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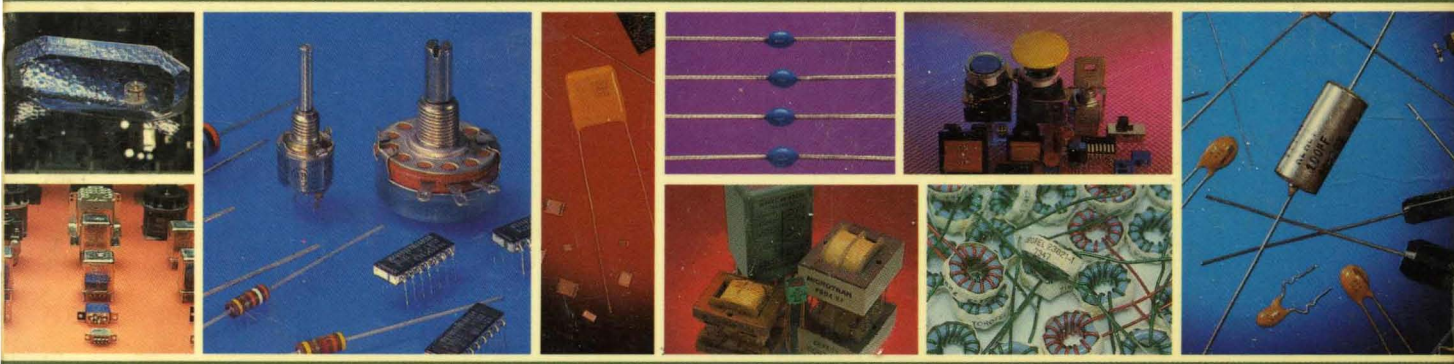
electronic engineers master catalog

VOLUME 1



circuit components and subassemblies

26th EDITION

1500	Capacitors
1800	Coils, Chokes, & Inductors
2300	Crystals, Oscillators, & Crystal Filters
2350	Delay Lines
2700	Filters (Excluding Crystal Filters)
3130	Integrated Circuits, Hybrid Circuits, & Function Modules
3450	Microwave Components
3470	Military Components & QPLs
3700	Electro-optical Equipment (Excluding Fiber Optics)
4300	Protective Components (Fuses, Circuit Breakers, etc.)
4500	Relays
4550	Solenoids
4700	Resistors
4750	Potentiometers, Trimmers, Controls, & Rheostats
4800	Discrete Semiconductors
5100	Switches
5150	Keyboards & Keypads
5300	Thermal Components
5500	Transducers & Encoders
5600	Transformers
5700	Electron Tubes (Including CRT)

volume 2 Interconnections, packaging, and hardware

volume 3 Power supplies, instrumentation, and equipment

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Electrostatic capacitors are typically described by the type of dielectric used in their construction. The conductors may be discrete as in "Film/Foil" capacitors or may be metalized, deposited or screened. One type of film capacitor has the plastic film deposited onto the aluminum foil conductor.

While most electrostatic capacitors are constructed in a "dry" method, some paper types employ an oil impregnant to improve performance characteristics.

A variety of special combination film and film/paper types are also available. Some are dry and others use an impregnant. Details of these types appear on the manufacturer's data pages.

Ceramic capacitors are available in two distinct styles. One employs a disc or rectangle of a specific ceramic material with the conductors screened on both sides. Some have multiple discs. Monolithic ceramic capacitors are often referred to as "Multilayer." As the name implies, they are made of multilayers of ceramic with appropriate conductors added and finally brought out to terminations with the assembly merged into a "monolithic" block. A variety of physical shapes are available in this type of capacitor as shown in the tables.

Here again the figures shown refer to the page number where product data on this capacitor may be found in EEM.

CAPACITORS, FIXED ELECTROSTATIC

CERAMIC (* MIL)

Manufacturer	General Purpose (25U)		Special Purpose (COG, X7R, Etc.)		Monolithic						
						Encapsulated					
	Disc	Axial	Disc	Axial	Chip	Dipped Radial	Molded Axial	Molded Radial	DIP	Feed Thru	High Power
American Tech. Ceramic					1•1007*, 1•1008*, 1•1009*						
AVX	1•1010	1•1011	1•1010	1•1011	1•1014*		1•1012		1•1013*		
Corning					1•1066*	1•1066	1•1066*	1•1066*	1•1066*		
International Components	1•1072		1•1072								
ISKRA	1•1076		1•1076							1•1076	
ISL	1•1185		1•1185							1•1185	
ITT Jennings											1•1086
Johanson					1•1088*						
Kemet					1•1118*	1•1119	1•1114*	1•1113*	1•1115		
Maida	1•1125				1•1125*	1•1125*			1•1125*	1•1125	
Metuchen	1•1155		1•1148*	1•1146*				1•1154		1•1150	
Multi-Products	1•1155				1•1155	1•1155					
Murata Erie	1•1156		1•1156						1•1156		
NIC Components	1•1161	1•1161	1•1161	1•1161							
Nichicon	1•1166		1•1166								
Republic	1•1183*	1•1183*			1•1183*	1•1183*	1•1183*				
TRW	1•1195		1•1195								
Tusonix	1•1196	1•1200*	1•1196	1•1200*						1•1196	
U.S. Capacitor					1•1201*	1•1201*	1•1201*	1•1201*			

CAPACITORS, FIXED, ELECTROSTATIC

FILM/FOIL (NONMETALIZED) * Indicates MIL Type

Manufacturer	Polyester (Mylar)		Polystyrene		Polysulfone		Polycarbonate		Polypropylene		Teflon		Combinations
	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	
Component Research			1•1050*		1•1056*				1•1062*		1•1046*		
CSI													1•1067
Electronic Concepts							1•1069*						
Illinois Capacitor		1•1071											
Intl. Components	1•1072	1•1072								1•1072			
Inter-Tech Grp/WIMA		1•1073						1•1073		1•1073			
ISL	1•1079	1•1079	1•1079	1•1079			1•1079	1•1079	1•1079	1•1079			
Kahgan		1•1091	1•1091						1•1091	1•1091			
KOA-Speer		1•1090		1•1090						1•1090			
Matsuo		1•1137								1•1141			
Mepco/Electra	1•1144	1•1144	1•1144	1•1144			1•1144	1•1144	1•1144	1•1144			1•1144
NIC Components	1•1161	1•1161	1•1161	1•1161			1•1161	1•1161	1•1161	1•1161			
Nichicon		1•1166											
Nytronics	1•1168		1•1170						1•1171				1•1175
PPD	1•1181	1•1181							1•1181	1•1181			
Seacor	1•1185	1•1185	1•1185	1•1185			1•1185	1•1185	1•1185	1•1185			
TRW	1•1189*	1•1189*	1•1194	1•1193					1•1193				
Wesco	1•1204*		1•1208						1•1210				

FILM METALIZED * Indicates MIL Type

Manufacturer	Polyester (Mylar)		Polystyrene		Polysulfone		Polycarbonate		Polypropylene		Teflon		Combinations
	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	Axial	Radial	
Component Research					1•1038* 1•1060*		1•1030*		1•1064*		1•1042*		
CSI								1•1068*					1•1067
Illinois Capacitor	1•1071	1•1071											
Intl. Components	1•1072	1•1072											
Inter-Tech Grp/WIMA		1•1073						1•1073		1•1073			
ISKRA	1•1077	1•1077											
ISL	1•1079	1•1079					1•1079	1•1079	1•1079	1•1079			
ITT	1•1080	1•1080											
Kahgan	1•1091	1•1091											
KOA-Speer		1•1090						1•1090		1•1090			
Kemet								1•1123*					
Mepco/Electra	1•1144	1•1144					1•1144	1•1144	1•1144	1•1144			1•1144
NIC Components	1•1161	1•1161											
Nichicon	1•1166	1•1166											
Nytronics	1•1172								1•1172				1•1175
PPD	1•1181	1•1181							1•1181	1•1181			
Seacor	1•1184	1•1184							1•1185	1•1185			
TRW		1•1187					1•1190*	1•1190*	1•1188*	1•1188*			1•1194
Wesco	1•1205	1•1207					1•1208		1•1209				

CAPACITORS, FIXED ELECTROSTATIC

GLASS, PORCELAIN, VACUUM, AIR, GAS-FILLED * Indicates MIL Type

Manufacturer	Glass			Porcelain			Air	Gas-Filled	Vacuum
	Axial	Radial	Flat	Axial	Radial	Flat			
American Tech. Ceramic						1•1007			
Corning	1•1066	1•1066	1•1066						
ITT Jennings	1•1084							1•1084	1•1084

MICA * Indicates MIL Type

Manufacturer	Stacked (Mica/Foil)					Reconstituted
	Dipped	Chip	Button	Molded	Transmitting	
CSI						1•1067
Kahgan	1•1091					
Murata Erie			1•1159			

PAPER * Indicates MIL Type

Manufacturer	Paper/Foil (Dry)			Metallized Paper			Paper/Foil (Oil Filled)	
	Axial	Single End	Herm. Sealed	Axial	Single End	Herm. Sealed	Energy Storage	Motor Run
CSI		1•1067			1•1067	1•1067	1•1067	
Nytronics	1•1177*	1•1177*	1•1177*				1•1287	

CAPACITORS, VARIABLE * Indicates MIL Type

Manufacturer	Ceramic					Mica	Air	Gas-Filled	Vacuum	Film	Sapphire	Glass
	Tubular		Disc									
	Piston	Other	Single	Multiple	Other							
ITT Jennings								1•1084	1•1085			
Johanson	1•1089	1•1089	1•1089	1•1089	1•1089		1•1089					
Maida	1•1125											
ISKRA	1•1076											
Mepco/Electra	1•1144									1•1144		
Murata Erie			1•1159	1•1159	1•1159		1•1159					
Sprague-Goodman	1•1186	1•1186	1•1186	1•1186	1•1186	1•1186	1•1186			1•1186	1•1186	1•1186
Tusonix			1•1199*	1•1199*								

This Capacitor Selection Guide has been prepared by EEM's editorial staff using the data pages which follow in Section 1500 as a base. Only those products which actually appear on the data pages are listed in this Guide.

If, for example, you are searching for an Aluminum Electrolytic Capacitor in a subminiature case with axial leads and polarized, you will find nine (9) manufacturers who can supply this type. The page numbers shown below indicate where data can be found.

The Guide is split into two basic categories: Electrolytic and Electrostatic. Electrolytic capacitors employ a liquid or solid electrolyte as the cathode. Electrostatic capacitors on the other hand have discrete conductors separated by a dielectric material and are generally designated by the specific type of dielectric material as in: Ceramic, Film, Mica, and so forth.

CAPACITORS, FIXED, ELECTROLYTIC

ALUMINUM * Indicates MIL Type

Manufacturer	Sub-miniature				Tubular				Small Can		Large Can Energy Storage Computer Grade	Plastic Case		
	Axial		Single End		Axial		Single End							
	Polar	Non-Pol.	Polar	Non-Pol.	Polar	Non-Pol.	Polar	Non-Pol.	Single Section	Multi-Section		Polar	Non-Pol.	AC Motor Start
Illinois Capacitor	1•1070	1•1070	1•1070	1•1070	1•1070	1•1070	1•1070	1•1070						
Intl. Components	1•1072	1•1072	1•1072	1•1072	1•1072		1•1072		1•1072					
ISL	1•1078*	1•1078	1•1078	1•1078	1•1078*	1•1078	1•1078	1•1078			1•1078			
ITT	1•1080		1•1080		1•1080									
Kahgan	1•1091		1•1091		1•1091									
Mepco/Electra	1•1143	1•1143	1•1143	1•1143	1•1143	1•1143	1•1143	1•1143	1•1143		1•1143			
NIC Components		1•1161		1•1161		1•1161								
Nichicon	1•1164	1•1164	1•1164	1•1164	1•1164	1•1164	1•1164	1•1164	1•1165					
United Chemi-con	1•1202	1•1202	1•1202	1•1202	1•1202	1•1202	1•1202	1•1202	1•1202	1•1202				

TANTALUM

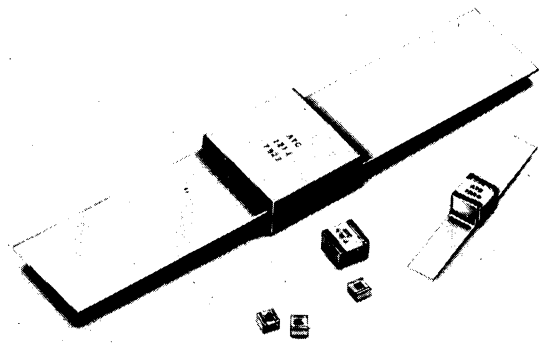
Manufacturer	Solid Electrolyte							Wet-Slug				Foil			
	Molded					Metal Case		Tubular Case		Large Case		Polar		Non Polar	
	Dipped	Axial	Radial	DIP	Chip	Comm.	MIL	Comm.	MIL	Comm.	MIL	Comm.	MIL	Comm.	MIL
Corning	1•1066	1•1066	1•1066		1•1066										
Intl. Components	1•1072														
ITT	1•1081	1•1082	1•1081			1•1092 1•1094 1•1098	1•1092 1•1094 1•1098								
Kemet	1•1103	1•1098	1•1100		1•1110	1•1096	1•1095								
Mallory	1•1126 1•1131	1•1130 1•1131	1•1127 1•1131												
Matsuo	1•1137		1•1140		1•1139										
Mepco/Electra	1•1142	1•1442	1•1142		1•1142	1•1142	1•1142	1•1142	1•1142	1•1142	1•1142	1•1142	1•1142	1•1142	1•1142
NIC Components	1•1161		1•1161												

american technical ceramics
division of phase industries inc.

ATC UHF/MICROWAVE CHIP CAPACITORS

American Technical Ceramics, the recognized leader in RF capacitor technology, offers a product line of outstanding quality and reliability to meet the most demanding requirements of the design engineer.

Unique features of construction, enforced by the highest quality control standards, are responsible for the consistent quality and high performance of ATC porcelain and ceramic capacitors. ATC capacitors are available in a wide variety of sizes and styles, and there is a capacitor to meet the requirements of almost any design application.



The severe thermal shock to which capacitors are subjected by direct soldering during circuit assembly can destroy the integrity of conventional capacitors, permitting flux and solvents to penetrate the dielectric. ATC porcelain capacitors have outstanding reliability and ultra-stable performance due to their hermetic, self-encapsulated porcelain construction. Rare metal internal electrodes are molecularly bonded and sealed in a monolith of non-porous porcelain, providing a rugged and hermetic structure that is not degraded by the circuit assembly process. ATC's design of the chip capacitor internal structure has resulted in the most reliable porcelain capacitors available proven by extensive testing programs of approximately 2 million component hours per month.

The ATC barrierCap® termination is now standard on all pellets (pre-tinned capacitors). The terminations remain intact under the most severe thermal shock, and are not dissolved away even by the most careless soldering. They easily withstand a 5 minute submersion in 260°C solder pot without leaching, while retaining complete solderability. Migration is virtually eliminated and a bond strength greater than 30 lbs. is typical for "B" Case capacitors (110 mils square) with nail head leads.

Laser Marking is available on ATC capacitors for quick and complete identification of capacity value and tolerance. This highly legible and permanent marking results in no degradation of performance or reliability and is impervious to all cleaning solvents.

The RF Capacitor Handbook presents over 190 pages of comprehensive detail design considerations and uses for miniature chip and leaded RF capacitors. You'll find theoretical and empirical high-frequency circuit design equations, especially at high RF power levels and frequencies, actual test data at frequencies from 100 MHz to 3 GHz, and practical design methods for increasing gain and power, DC to RF conversion efficiency, bandwidth, transistor lifetime, circuit MTBF, and low-noise performance. Request a copy from your representative or direct from ATC.

MILITARY PRODUCTS

American Technical Ceramics is QPL Listed for the latest established reliability Military Specification for Ceramic Capacitors (MIL-C-55681/4 and /5), and MIL-C-11272/16,/17, and /18, for UHF/Microwave Capacitors.

For MIL-C-55681/4 and /5, the QPL List includes BG (90 ±20 PPM/°C) characteristic (ATC 100 Series), and BP (0 ±30 PPM/°C) characteristic (ATC 700 Series) established reliability. CDR 11, 12, 13, 14, and 21 through 25 styles are available in both temperature characteristics.

For MIL-C-11272/16, /17 and /18, the QPL List includes CY81 through CY89 (ATC 100 Series).

ATC has complete Government approved Hi-Rel testing facilities as well as RF production testing capability through 2.5 GHz.

ONE NORDEN LANE, HUNTINGTON STATION, NY 11746 (516) 271-9600 • TWX 510-226-6993

american technical ceramics
division of phase industries inc.

ATC UHF/MICROWAVE CHIP CAPACITORS

ATC 100 HIGH Q SUPERCHIPS™

UHF/MICROWAVE PORCELAIN CAPACITORS

Ultra High Q even at high ambient temperatures and at extremely high currents. High power operation through microwave frequencies. Extremely low ESR and high dielectric strength.

High self-resonant frequencies.

Low noise figure in receiving systems due to low ESR.

Ultra stable performance assured by hermetic, self-encapsulating porcelain construction.

Capacitance Range:
Case A-0.1 pF to 100 pF to 50 WVDC, standard values per RETMA 5% Table
Case B-0.1 pF to 1000 pF to 500 WVDC, standard values per RETMA 5% Table

IR: 10^6 Megohms Min. @ 25°C, 10^5 Megohms Min. @ 125°C up to and including 470 pF;
10^5 Megohms Min. @ 25°C, 10^4 Megohms Min. @ 125°C, 510 to 1000 pF.

Available in Case A and B Chips, Pellets and Case B Leaded Styles.
QPL Approved, MIL-C-11272, MIL-C-55681.

ATC 175

ULTRA HIGH Q PORCELAIN CAPACITORS

Q is typically four times higher than ATC 100 at Microwave frequencies.

Capacitance Range:
1.0 pF to 100 pF to 500 WVDC, standard values per RETMA 5% Table.

IR: 10^6 Megohms Min. @ 25°C, 10^5 Megohms Min. @ 175°C at rated voltage.

Available in Case B Pellets and Microstrip (MS) leaded.
Military Operating Temperature Range for all Series is −55°C to +125°C.

ATC 200

HIGH CAPACITY CERAMIC CAPACITORS

High packaging density, stable high K chip capacitors for coupling and bypass applications.

Capacitance Range:
Case A, 510 pF to 0.01 MF, 50 WVDC, standard values per RETMA 10% Table.
Case B, 0.005 MF to 0.1 MF, 50 WVDC, standard values per RETMA 10% Table.

IR: 10^4 Megohms Min.

Available in Case A and B Chips, Pellets and Case B Leaded Styles.
DWV: 300% of working voltage.

ATC 700

TEMPERATURE STABLE CERAMIC CAPACITORS

Ultra-stable NPO's with RF characterization.

Capacitance Range:
Case A, 0.1 pF to 1000 pF, 50 WVDC, standard values per RETMA 5% Table.
Case B, 0.1 pF to 5100 pF to 500 WVDC, standard values per RETMA 5% Table.

IR: 10^6 Megohms Min. up to 470 pF;
10^5 Megohms Min. above 470 pF @ 25°C; one-tenth these values @ 125°C.

Available in Case A and B Chips, Pellets and Case B Leaded Styles.
QPL Approved, MIL-C-55681

ATC 111 Millimeter Wavelength Microcaps™

GENERAL SPECIFICATIONS FOR ALL STYLES

ELECTRICAL CHARACTERISTICS

OPERATING FREQUENCY: Up to 50 GHz.
CAPACITANCE VALUES: 0.1 to 1800 pF, 100 WVDC, standard values per RETMA 10% Table.
STANDARD MEASUREMENT FREQUENCY: 1 MHz.
IR: 10^{11} Ohms Min. at 25°C, 10^{10} Ohms Min. at 125°C.

MECHANICAL CHARACTERISTICS

HERMETICITY: The dielectric is virtually unaffected by moisture and commonly used cleaning solvents.

BODY DIMENSIONS

Case Size	S	T	U	X	Y	Z
W = L (Nom.)	.018 (.459)	.025 (.637)	.035 (.889)	.050 (1.27)	.070 (1.78)	.090 (2.29)

1. H is .005 (.127) to .011 (.279); H depends upon actual capacity value.
2. All dimensions are in inches except those in parentheses, which are in mm.

TERMINATION STYLES

	TERM. SUFFIX	MATERIAL
STANDARD	AP	Platinum Gold (Thick Film)
	AC	Gold Over Chromium (Thin Film)
SPECIAL	SP	Platinum Silver (Thick Film)
	AN	Gold Over Nickel (Thin Film)
	HT	Gold Over Base Metals (Thin Film)

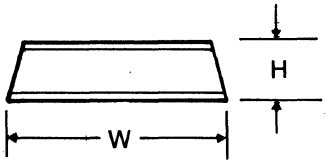
RUGGED CONSTRUCTION to minimize handling problems and circuit assembly problems. Impervious to static discharge failures.

BOND STRENGTH: Exceeds MIL-STD-883B Method 2011.2 for wire bondability of AC terminations.

ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE RANGE: −55°C to +125°C.

SHOCK, VIBRATION AND ALTITUDE: Meets or exceeds the requirements of MIL-C-55681.



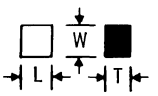
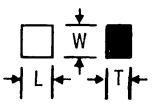
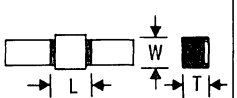
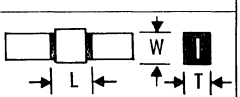
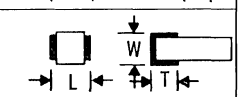
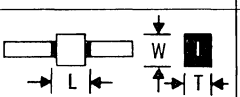
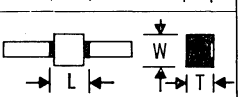
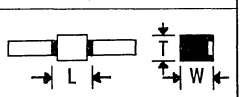
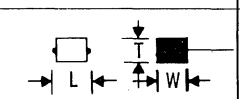
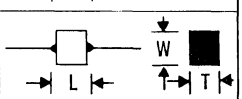
W = L (i.e., Width = Length)

RECOMMENDED BONDING TECHNIQUES

- Thermocompression, ultrasonic and thermosonic gold wire and aluminum silicon wire bonding are recommended for termination materials AC, AN and HT.
- Soldering is recommended for AP and SP, and is applicable with special processing for AC, AN and HT.
- Eutectic bonding is recommended for all termination materials except SP; preforms are preferable.
- Conductive epoxy can be used with all termination materials.
- HT is recommended for high temperature soldering.

DWV for all ATC Fixed Capacitors except 100E Capacitors and 200 A and B: 250% of working voltage

MECHANICAL CONFIGURATIONS: CASE SIZES A & B

Case Size & Type	ATC Term. Code	ATC Series	QPL MIL-C-11272C	QPL MIL-C-55681	Outlines	Body Dimensions Length (L)	Body Dimensions Width (W)	Body Dimensions Thickness (T)	Lead and Termination Dimensions and Materials Length (L)	Lead and Termination Dimensions and Materials Width (W)	Lead and Termination Dimensions and Materials Thickness (T)
A Chip	C	100	CY81	CDR11 BG	 W/T IS A TERMINATION SURFACE	.055 ±.010 (1.4 ±.25)		.055 (1.4) max.	Palladium Silver Terminations		
		700	—	CDR11 BP							
B Chip	C	100	CY83	CDR13 BG		.110 ±.015 (2.79 ±.38)		.100 (2.54) max.			
		700	—	CDR13 BP							
		175	—								
A Pellet	P	100	CY82	CDR12 BG	 W/T IS A TERMINATION SURFACE	Same as chip plus twice solder build-up: Solder build-up for size A is: .003 (.076) typ. Solder build-up for size B is: .005 (.127) typ.			barrierCap® Pellets are solder-coated chips with a nickel barrier over the termination. Solder melting temperature is 372°F, 179°C.		
		700	—	CDR12 BP							
B Pellet	P	100	CY84	CDR14 BG							
		700	—	CDR14 BP							
		175	—								
B Microstrip	MS	100	CY85	CDR21 BG		.120 (3.05) min. .150 (3.81) max.	.110 ±.015 (2.79 ±.38)	.100 (2.54) max.	.250 (6.35) min.	.093 ±.005 (2.36 ±.13)	.004 ±.001 (.102 ±.025)
		700	—	CDR21 BP							
		175	—								
B Axial Ribbon	AR	100	CY86	CDR22 BG							
		700	—	CDR22 BP							
B Radial Ribbon	RR	100	CY88	CDR24 BG							
		700	—	CDR24 BP							
B Narrow Axial Ribbon	NAR	100	—			.120 (3.05) min. .155 (3.94) max.	.110 ±.015 (2.79 ±.38)	.100 (2.54) max.	.250 (6.35) min.	.050 ±.005 (1.27 ±.13)	.006 ±.003 (.15 ±.08)
		700									
B Narrow Microstrip	NMS	100	—								
		700									
B Vertical Narrow MS	VNMS*	100	—								
B Radial Wire	RW	100	CY87	CDR23 BG		.120 (3.05) min. .165 (4.19) max.	.110 ±.015 (2.79 ±.38)	.100 (2.54) max.	.500 (12.7) min.	#26 AWG., .016 (.375) dia. nominal.	
		700	—	CDR23 BP							
B Axial Wire	AW	100	CY89	CDR25 BG							
		700	—	CDR25 BP							

Note: Mechanical configurations for the ATC200 Series are the same as those for ATC100 Series, except for VNMS which is not offered in the 200 Series.

All dimensions are in inches except those in parentheses which are in millimeters.

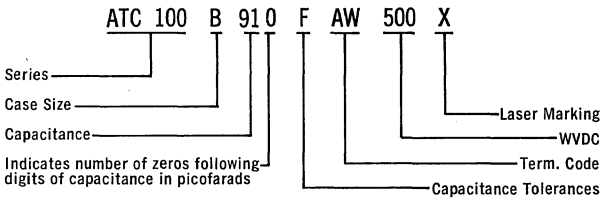
* VNMS improves the resonant frequency performance over that of the standard Microstrip. The first important parallel resonance is approximately twice as high in frequency as with "flat" mounting (NMS). Note that in this configuration, the marking is now on a vertical surface. For details, contact factory.

All leads are high purity silver and are attached with high temperature solder.

LASER MARKED CAPACITORS with manufacturer's indentification, capacity and tolerance code are available for any case size (including chips and pellets). To order, add suffix (X) to code.

ATC has made every effort to have this information as accurate as possible. However, no responsibility is assumed by ATC for its use, nor for any infringements of rights of third parties which may result from its use. ATC reserves the right to revise the content or modify its product line without prior notice.

ATC PART NUMBER CODE:



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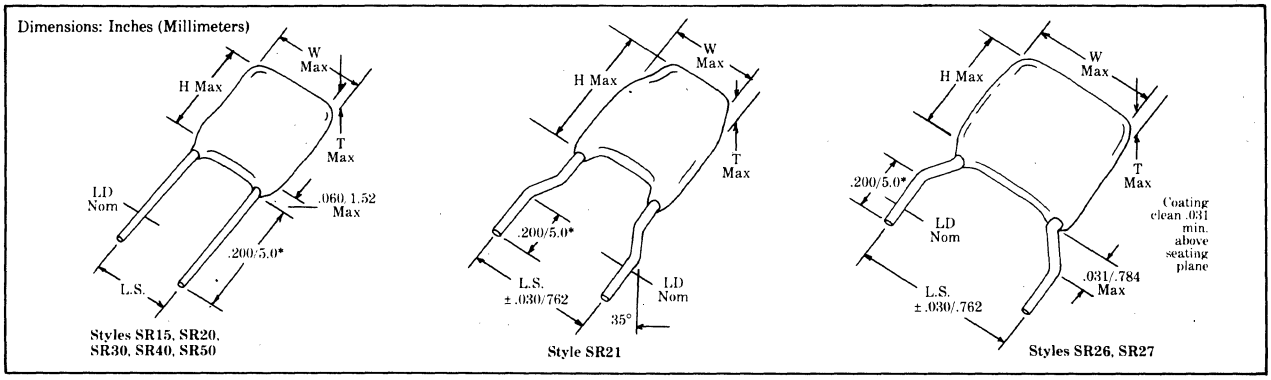
SkyCap®

AVX

GENERAL INFORMATION

AVX SR Series
Conformally Coated Radial Leaded MLC
Temperature Coefficients: NPO, X7R, Z5U
50, 100 Volts (200V available on request)
Case Material: Epoxy (Flame retardant to UL Bulletin 492, Pra. 280)
Lead Material: Solderable

Dimensions: Inches (Millimeters)



*Lead length tolerance = +.060 (1.5 mm) -0. Also available with lead length of 1.25" (31.75)minimum.

SIZE AND CAPACITANCE SPECIFICATIONS

EIA Characteristic

Dimensions: Inches (Millimeters)

AVX Style	SR15	SR20	SR21	SR26	SR27	SR30	SR40	SR50
Width (W)	.150 (3.81)	.200 (5.08)	.200 (5.08)	.260 (6.604)	.260 (6.604)	.300 (7.62)	.400 (10.16)	.500 (12.70)
Height (H)	.150 (3.81)	.200 (5.08)	.200 (5.08)	.200 (5.08)	.250 (6.35)	.300 (7.62)	.400 (10.16)	.500 (12.70)
Thickness (T)	.100 (2.54)	.125 (3.175)	.125 (3.175)	.150 (3.81)	.160 (4.06)	.150 (3.81)	.150 (3.81)	.200 (5.08)
Lead Spacing (L.S.)	.100 (2.54)	.100 (2.54)	.200 (5.08)	.250 (6.35)	.300 (7.62)	.200 (5.08)	.200 (5.08)	.400 (10.16)
Lead diameter (L.D.)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.025 (.635)

EIA/TC	WVDC	Capacitance Range (pf)							
NPO (COG)	100	10-330	390-2200	10-2200	1000-2200	1000-2200	3300-15,000	15,000-39,000	10,000-68,000
	50	10-470	470-4700	1000-4700	1000-4700	1000-4700	6800-22,000	33,000-68,000	10,000-100,000
X7R	100	470-4700	6800-47,000	1000-47,000	10,000-47,000	10,000-47,000	68,000-150,000	220,000-470,000	330,000-470,000
	50	470-15,000	22,000-100,000	1000-100,000	10,000-100,000	10,000-100,000	150,000-470,000	1.0mfd	1.0mfd-2.2mfd
Z5U	100	10,000	47,000-100,000	10,000-100,000	10,000-100,000	10,000-100,000	150,000-470,000	680,000-1.0mfd	1.0mfd-2.2mfd
	50	10,000	47,000-330,000	10,000-330,000	10,000-330,000	10,000-330,000	150,000-1.0mfd	1.0mfd-2.2mfd	1.0mfd-4.7mfd

HOW TO ORDER AVX Style: SR15, SR20, SR21, SR26, SR27, SR30, SR40, SR50

For values, tolerances, voltages, sizes and configurations, not shown, contact AVX facilities directly for information.

Part Number Example

SR20 5 E 10 4 M A T

- AVX Style
- Voltage
- Temperature Coefficient
- Sig. Figures of Capacitance
- Multiplier (Additional no. of zeros)
- Capacitance Tolerance
- Failure Rate Not Applicable
- Leads

Part Number Codes

Voltages: 50V=5, 100V=1, 200 V=6 (available on request)

Temp. Coefficient: NPO=A, X7R=C, Z5U=E

Sig. Fig. of Capacitance and Multiplier:
First two digits are the significant figures of capacitance. Third digit indicates the additional number of zeros. For example, order 560pf as 561.

Capacitance Tolerances:
NPO: F=±1.0%, J=±5%, K=±10%, M=±20%
X7R: J=±5%, K=±10%, M=±20%
Z5U: M=±20%, Z=+80% -20%
Tolerance Code F is not available in SR15.

Failure Rate: A = Not Applicable

Leads:
T = Trimmed Leads, .230" ±.060
A = Long Leads, 1.25" minimum

WHERE TO ORDER

AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

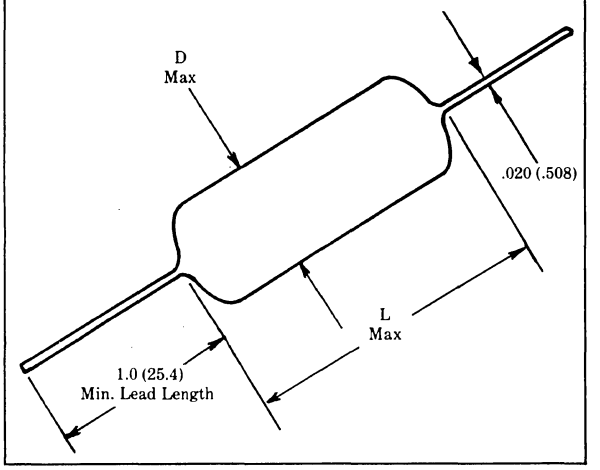
SpinGuard®

AVX

GENERAL INFORMATION

AVX SA Series
NPO (COG), X7R, Z5U Temperature Coefficients
50, 100 Volts
Lead Material: Solderable
Case Material: Epoxy
Packaging: Lead Taped and Reeled per EIA RS-296D
SA10, 20 - 5,000 parts per reel
SA30, 40 - 4,000 parts per reel

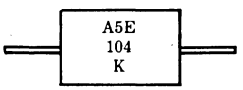
Dimensions: Inches (Millimeters)



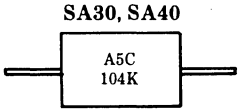
MARKING (Example)

Marking is as size permits in descending order: for code information see How to Order section.
A (AVX): Voltage Code, Temperature Coefficient Code
Capacitance Code
Tolerance Code

SA10, SA20

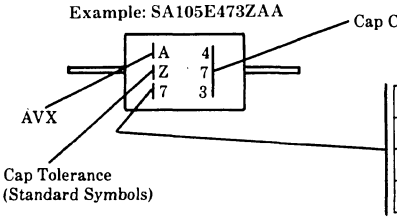


SA30, SA40



SA-10
ALTERNATE MARKING

Example: SA105E473ZAA



Dielectric/Voltage Rating Code

	50V	100V	200V
NPO	1	2	3
X7R	4	5	6
Z5U	7	8	9

SIZE AND CAPACITANCE SPECIFICATIONS

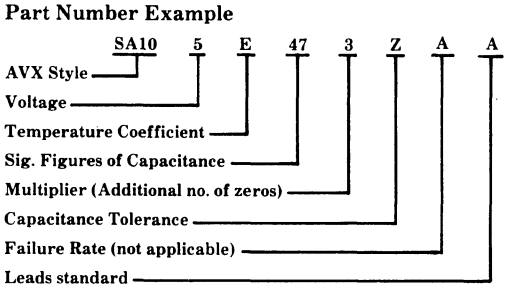
EIA Characteristic — Dimensions: Inches (Millimeters)

	AVX Style	SA10	SA20	SA30	SA40
	Length (L)	.170 (4.32)	.260 (6.60)	.290 (7.37)	.420 (10.66)
	Diameter (D)	.100 (2.54)	.100 (2.54)	.150 (3.81)	.150 (3.81)
EIA/TC	WVDC	Capacitance Range (pf)			
NPO (COG)	100	10-820	1000-1500	1800-3900	4700-8200
	50	1000	1800	4700	10,000
X7R	100	220-4700	5600-10,000	12,000-47,000	56,000-100,000
	50	5600-15,000	18,000-47,000	56,000-100,000	120,000-220,000
Z5U	100	10,000	15,000-22,000	33,000-100,000	100,000
	50	10,000-47,000	68,000-100,000	330,000	330,000-470,000

HOW TO ORDER

AVX Style: SA10, SA20, SA30, SA40

Part Number Example



Part Number Codes

Voltages: 50V=5, 100V=1, 200V=6

Temp. Coefficient: NPO=A, X7R=C, Z5U=E

Sig. Fig. of Capacitance and Multiplier:
First two digits are the significant figures of capacitance. Third digit indicates the additional number of zeros. For example, order 560pf as 561.

Capacitance Tolerances:
NPO: J=±5%, K=±10%
X7R: K=±10%, M=±20%
Z5U: M=±20%, Z=+80, -20%

Failure Rate: A=Not Applicable

Leads Standard: A=Standard Solderable

WHERE TO ORDER

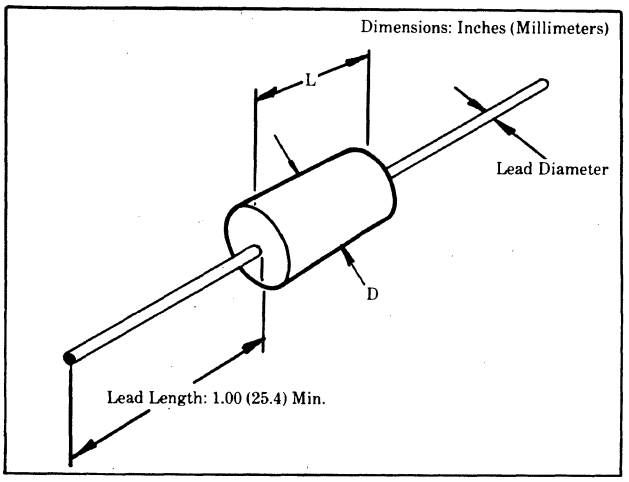
AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

Molded/Axial Lead

AVX

GENERAL INFORMATION

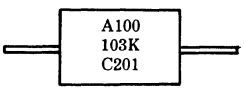
AVX MA Series
NPO (COG), X7R, Z5U Temperature Coefficients
50, 100 Volts
Case Material: Molded Epoxy
Lead Material: Solderable
Packaging: Lead Taped and Reeled per EIA RS-296D
MA-10, 20 - 4500 pcs/reel
MA-40 - 3000 pcs/reel
MA-50, 60 - 50 pcs/bag



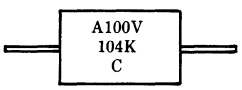
MARKING (Example)

Line 1, A=AVX, 100V=100 Volts (V is optional)
Line 2, 103=Capacitance and Tolerance
C=Voltage Code Rating
102=Temperature Coefficient
Date Code (optional)

MA10, MA20



MA40, MA50, MA60



SIZE AND CAPACITANCE SPECIFICATIONS

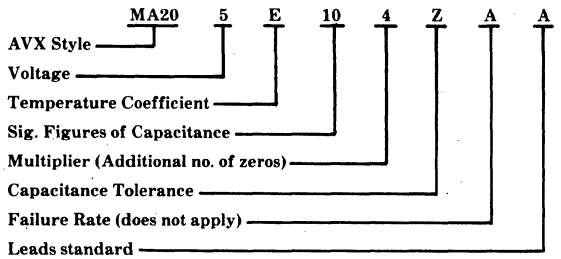
Dimensions: Inches (Millimeters)

AVX Style		MA10		MA20		MA40		MA50		MA60	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Length		.170 (4.32)	.150 (3.81)	.260 (6.60)	.240 (6.10)	.400 (10.2)	.380 (9.65)	.520 (13.2)	.480 (12.2)	.720 (18.3)	.660 (16.8)
Diameter		.100 (2.54)	.080 (2.03)	.100 (2.54)	.080 (2.03)	.150 (3.81)	.130 (3.30)	.265 (6.73)	.235 (5.97)	.370 (9.40)	.330 (8.39)
Lead Diameter		.019±.002 (.483±.05)		.019±.002 (.483±.05)		.025±.002 (.635±.051)		.025±.002 (.635±.051)		.025±.002 (.635±.051)	
EIA/TC	WVDC	Capacitance Range (pf)									
NPO (COG)	100	10-680		1000-1500		2200-6800		10,000-33,000		47,000-100,000	
	50	1000		1500		10,000		47,000		150,000	
X7R	100	470-4700		5600-10,000		15,000-100,000		150,000-330,000		330,000-1.0 mfd	
	50	5600-15,000		22,000-47,000		100,000-220,000		470,000-1.0 mfd		—	
Z5U	100	—		15,000-22,000		33,000-150,000		220,000-470,000		680,000-2.2 mfd	
	50	10,000-47,000		68,000-100,000		220,000-470,000		680,000-2.2 mfd		3.3 mfd-6.8 mfd	

HOW TO ORDER

AVX Styles: MA10, MA20, MA40, MA50, MA60

Part Number Example



Part Number Codes

Voltages: 50V=5, 100V=1

Temp. Coefficient: NPO=A, X7R=C, Z5U=E

Sig. Fig. of Capacitance and Multiplier:
First two digits are the significant figures of capacitance. Third digit indicates the additional number of zeros. For example, order 100,000pf as 104.

Capacitance Tolerances:
NPO: F=±1%, J=±5%, K=±10%
X7R: J=±5%, K=±10%, M=±20%
Z5U: M=±20%, Z=+80, -20%

Failure Rate: A=Not Applicable
Leads: A=Standard solderable

Note: Minimum tolerance for values 10pf to 220pf is ±5%.

WHERE TO ORDER

AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

DIPGuard®

AVX

GENERAL INFORMATION

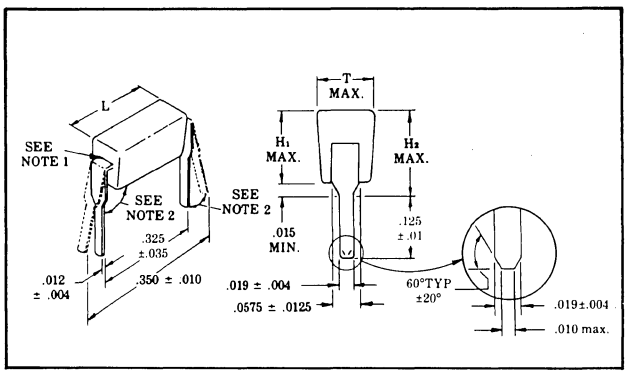
AVX MD Series
NPO (COG), X7R, Z5U Temperature Coefficients
50, 100 Volts

For established reliability DIPGuards see MIL-C-39014 section in the AVX Military Ceramic Capacitor Catalog.

Packaging: 200 pieces per slide pack

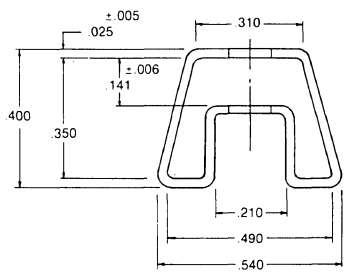
SIZE SPECIFICATIONS

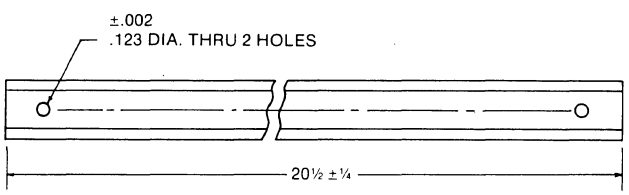
AVX Style		MD01	MD02
Length (L)		.260±.020 (6.60)	.260±.020 (6.60)
Height (H_1)		.135 max. (3.43)	.165 max. (4.19)
Height (H_2)		.165 max. (4.19)	.195 max. (5.08)
Thickness (T)		.098 max. (2.49)	.098 max. (2.49)
EIA/TC	WVDC	Capacitance Range (pf)	
NPO (COG)	100	10-150	—
	50	220-3300	4700-6800
X7R	100	220-10,000	—
	50	15,000-100,000	150,000-220,000
Z5U	100	—	—
	50	10,000-220,000	330,000-470,000



Note 1: Levels centered within ±.010
Note 2: The angle shall be 95°, +10°, −5°

SLIDE PACKAGE DIMENSIONS:

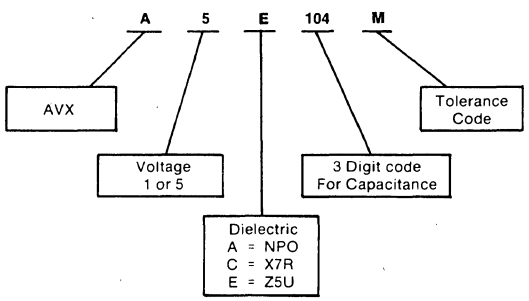




MARKING

PART NUMBER EXAMPLE
MD015E104MAA

TOP OF UNIT:

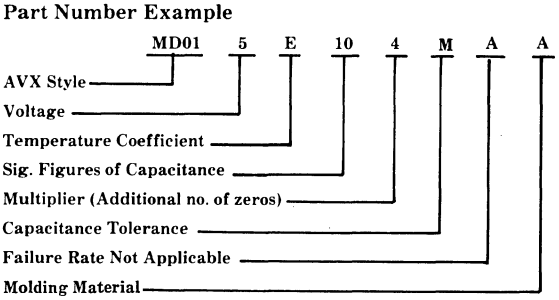


HOW TO ORDER

AVX Style: MD01, CKR22*, MD02

For values, tolerances, voltages, dielectrics and markings not shown, contact AVX facilities directly for information.

Part Number Example



Part Number Codes

Voltages: 50V=5, 100V=1**

Temp. Coefficient: NPO:=A, X7R=C, Z5U=E

Sig. Fig. of Capacitance and Multiplier:
First two digits are the significant figures of capacitance. Third digit indicates the additional number of zeros. For example, order 1000 pf as 102.

Capacitance Tolerances:
NPO: F=±1%, J=±5%, K=±10%
X7R: J=±5%, K=±10%, M=±20%
Z5U: M=±20%, Z=+80, -20%

Failure Rate: A = Not Applicable

Molding Material: A = Epoxy thermal set,
B = Ryton thermal plastic

*Reference AVX Military Multilayer Ceramic Capacitor Catalog
**For 200V requirements consult factory.

WHERE TO ORDER

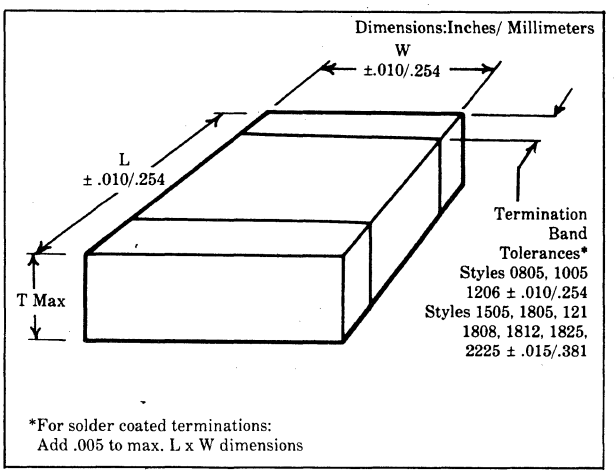
AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

MLC Chips

AVX

GENERAL INFORMATION

NPO (COG), X7R, Z5U Temperature Coefficients
25, 50, 100 Volts
MLC chips can be supplied with established reliability screening per MIL-C-55681, or high reliability screening upon request.



Packaging

5000 pcs per vial or can be taped and reeled per EIA Specification RS 1460.

Tape and Reel packaging quantities:
Standard Carrier Tape (8mm) = 4000 pcs
Embossed Carrier Tape (8mm) = 2600 pcs

SIZE AND CAPACITANCE SPECIFICATIONS

Dimensions: Inches (Millimeters)

AVX Style	0805	1005	1206	1505	1805	1210	1808	1812	1825	2225
Length (L)	.080 (2.00)	.095 (2.41)	.125 (3.20)	.150 (3.81)	.180 (4.57)	.125 (3.18)	.180 (4.57)	.175 (4.45)	.185 (4.70)	.225 (5.72)
Width (W)	.050 (1.27)	.050 (1.27)	.062 (1.60)	.050 (1.27)	.050 (1.27)	.100 (2.54)	.080 (2.00)	.125 (3.18)	.250 (6.35)	.250 (6.35)
Thickness (T)	.050 (1.27)	.060 (1.52)	.060 (1.27)	.060 (1.52)	.060 (1.52)	.060 (1.52)	.060 (1.52)	.060 (1.52)	.060 (1.52)	.060 (1.52)
Termination Band	.020 (.508)	.020 (.508)	.020 (.508)	.025 (.635)	.025 (.635)	.025 (.635)	.025 (.635)	.025 (.635)	.025 (.635)	.025 (.635)

EIA/TC	WVDC	Capacitance Range (pf)									
NPO (COG)	100	10-560	10-680	10-1200	180-1200	220-1500	330-2700	330-3300	1000-4700	1800-8200	3300-10,000
	50	100-1500	100-1800	100-3300	180-2700	220-3300	330-5600	330-6800	1000-10,000	1800-27,000	3300-39,000
X7R	100	120-3900	120-3300	390-15,000	1200-12,000	3300-15,000	2700-22,000	2700-27,000	10,000-47,000	33,000-100,000	33,000-150,000
	50	120-22,000	120-27,000	390-47,000	1200-56,000	3300-56,000	2700-100,000	2700-120,000	10,000-220,000	33,000-470,000	33,000-470,000
	25	120-47,000	120-47,000	120-100,000	1200-68,000	3300-100,000	2700-150,000	2700-180,000	1000-330,000	33,000-680,000	33,000-1.0mfd
Z5U	100	2700-6800	2700-8200	6800-18,000	5600-18,000	8200-18,000	18,000-39,000	1800-47,000	33,000-82,000	100,000-220,000	100,000-270,000
	50	2700-22,000	2700-27,000	6800-27,000	5600-68,000	8200-68,000	18,000-120,000	18,000-150,000	33,000-220,000	100,000-470,000	100,000-560,000
	25	2700-4700	2700-47,000	6800-120,000	5600-100,000	8200-100,000	18,000-220,000	18,000-220,000	33,000-470,000	100,000-1.0mfd	100,000-1.0mfd

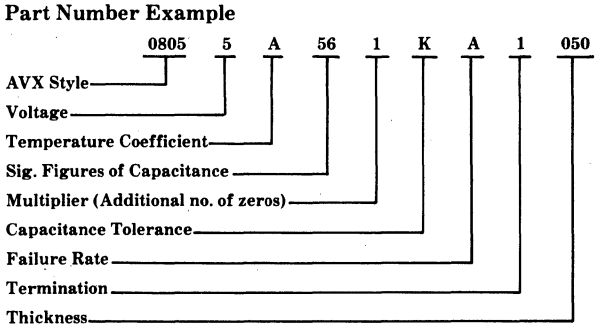
HOW TO ORDER

AVX Style: 0805, 1005, 1206, 1505, 1805, 1210, 1808, 1812, 1825, 2225

For values, tolerances, voltages, sizes, configurations and dielectrics not shown, contact AVX facilities directly for information.

Note: 0504 style available upon special request.

Part Number Example



Part Number Codes

Voltages: 25V = 2, 50V = 5, 100V = 1

Temp. Coefficient: NPO: = A, X7R = C, Z5U = E

Sig. Fig. of Capacitance and Multiplier:
First two digits are the significant figures of capacitance. Third digit indicates the additional number of zeros. For example, order 560pf as 561. (For values below 10pf, use "R" in place of decimal point, e.g., 5R6 = **5.6pf.**)

Capacitance Tolerances:
NPO: C = ±.25pf, D = ±.5pf, F = ±1%, G = ±2%, H = ±3%, J = ±5%, K = ±10%
X7R: J = ±5%, K = ±10%, M = ±20%
Z5U: M = ±20%, Z = +80, -20%, P = GMV

Failure Rate: A = Not applicable

Terminations: standard (non-standard terminations available upon request)
1 = Palladium Silver
2 = Palladium Silver Solder Alloy 62-36-2

Thickness: mils (inches/1000)

WHERE TO ORDER

AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

MINIGLOSSARY CAPACITORS

Anode: One of two plates or conductors. In polarized capacitors, the anode should be connected to the positive conductor in the circuit.

Capacitive Reactance: The measure of the opposition of a capacitor to accepting a charge and expressed in ohms. When direct current is applied under stated conditions capacitive reactance becomes a constant but, when alternating current is applied the capacitive reactance varies until an equilibrium is achieved and the capacitor appears to have only direct current present. This condition is commonly used in filter applications or in coupling circuits.

Cathode: One of two plates or conductors. In electrostatic capacitors the cathode is metallic. In electrolytic capacitors the cathode is a liquid, gel or other conductive material which is in intimate contact with a metallic cathodic connection.

Dielectric Constant: The measure of quality of the insulating materials in a capacitor. Dry air has a dielectric constant of one (1). Aluminum oxide used in aluminum electrolytic capacitors has a nominal dielectric constant of ten (10).

Electrolytic: A capacitor with one metallic conductor (generally the anode) and with a liquid or semiconductor cathode. Nonpolarized electrolytic capacitors generally have two equal anodes as well as the liquid cathode. These anodes operate alternately as anode and cathodic connection as alternating current is applied.

Electrostatic: One of two general classes of capacitors in which two or more discrete metallic conductors are present and separated by an insulating dielectric material. Examples include: mica, ceramic, film, and paper types.

Farad: The basic unit of measure in capacitors. A capacitor charged to one volt with a charge of one coulomb (one ampere flowing for one second) has a capacitance of one farad. Capacitors are generally rated at portions of a farad (microfarads or picofarads).

1 farad (F) = 1,000,000 microfarads (μF) 1 microfarad (μF) = 1,000,000 picofarads (pF)

Impedance: All capacitors exhibit impedance. It is a function of capacitor type and internal construction. This can be particularly important in certain applications such as filters for switching power supplies. Capacitors used in these applications often have special multiple tab construction to shorten current paths and to reduce internal resistance.

Leakage Current: Expressed as dcl for electrolytic capacitors, a measure of the intrinsic losses in a charged capacitor. Generally speaking, the lower the dcl, the higher quality the capacitor.

Power Factor: A measure of the overall efficiency of a capacitor. Power factor ratings take all internal losses into consideration in a complex formula. This parameter of certain capacitors is often very important in AC applications such as motor-start and/or motor-run capacitors.

Rated Voltage: The rated working voltage of a capacitor. Generally expressed in DC Volts (Vdcw). This is the voltage at which a capacitor may be safely operated at 25°C continuously within its overall parameters.

Ripple Current: The total amount of alternating and direct current that may be applied to an electrolytic capacitor under stated conditions. In general, the higher the ripple current applied, the shorter the operating life of the capacitor will be. Application of significantly higher than rated ripple currents can shorten the capacitor life dramatically and may even cause catastrophic failure (explosion).

Surge Voltage: The momentary surge voltage which may be applied for a stated length of time without doing permanent damage to the unit.

Temperature: Capacitors are generally rated at 25°C at sea level under specific humidity conditions. Operating temperature ranges are also given, along with derating (reliability) curves for operation at temperatures other than 25°C.

Temperature Coefficient: Expressed as TC in ppm (parts per million) or in percent (%) from the norm of 25°C. This is seldom a straight line and may vary widely for certain types. Most capacitors have positive TC in that the capacitance increases as temperature increases. Some types, however, have negative TC in that the capacitance decreases as temperature increases.

Ceramic Capacitor Codes
(Capacitance Given In pF)

Color	Digit	Multiplier	Tolerance			Temperature Coefficient ppm°C	Significant Figure	Multiplier
			Class 1		Class 2			
			10pF or less	Over 10pF				
Black	0	1	±2.0pF	±20%	±20%	0	0.0	−1
Brown	1	10	±0.1pF	±1%		−33		−10
Red	2	100		±2%		−75	1.0	−100
Orange	3	1000		±3%		−150	1.5	−1000
Yellow	4	10000			+100% −0%	−220	2.0	−10000
Green	5		±0.5pF	±5%	±5%	−330	3.3	+1
Blue	6					−470	4.7	+10
Violet	7					−750	7.5	+100
Gray	8	0.01	±0.25pF		+80% −20%	+150 to −1500		+1000
White	9	0.1	±1.0pF	±10%	±10%	+100 to −750		+10000
Silver								
Gold								

CRC COMPONENT RESEARCH CO.

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ESTABLISHED RELIABILITY CAPACITORS

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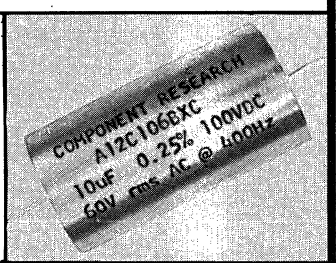
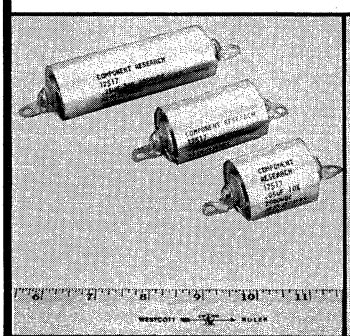
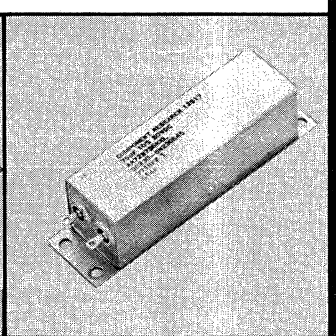
CRITICAL PROGRAMS QUALIFICATION



TRIDENT MARK 46
LANCE MISSILE MARK 48
F15 AIRCRAFT SPARROW
F18 AIRCRAFT NEARTIP
SPACE SHUTTLE NOMI I
ROLAND HARPOON
AND MANY OTHERS

CRC hermetically sealed plastic film capacitors are acknowledged world wide as the highest quality. Standard tubular metallized polycarbonate capacitor, AC rated to 40KHz and qualified to MIL-C-83421/01 is shown above.





Type 55 foil polypropylene capacitors are used in power resonating applications up to 160KHz and with fast switching, high peak current devices. A typical 10uF capacitor measuring 1.25″ diameter x 3.375″ length can handle up to 50A rms under continuous duty operation. Its ESR at 100KHz is approximately 0.0016 ohms which is typical of the low loss inherent in these capacitors.

This 75uF, 50VDC, metallized polycarbonate capacitor is 1″ square by 3¾″ long and is rated at 10A rms at 25KHz at 100°C. Each capacitor receives 168 hours of AC voltage at 25KHz to produce 10A rms in combination with 50VDC applied during burn-in at 100°C.

TYPE A12 & K12

DIELECTRIC: Metallized Polycarbonate

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 30-400 VDC

A.C. RATING: 22 to 240 VRMS @ 400Hz, AC ratings to 40KHz

OPERATING TEMPERATURE: −65°C to +125° (Derate 50% from 100°C to 125°C)

CAPACITANCE RANGE: .001 to 27uF, .1% to 10% tolerances

INSULATION RESISTANCE: 300,000 meg-uF (100,000 meg-uF for K12 @ 25°C)

DISSIPATION FACTOR: .15% max. @ 1KHz

DIELECTRIC ABSORPTION: .1% maximum

SCREENING: 100% Quality conformance inspection. Qualified to Failure Rate "S" of MIL-C-83421/01.

APPLICATIONS: Timing, filter and feed-back circuits, pulse-forming networks. A12 and K12 capacitors are used extensively in the Space Shuttle Program.

TYPE G12

DIELECTRIC: Miniaturized Metallized Polycarbonate

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 30-200VDC

A.C. RATING: 22 to 120 VRMS @ 400Hz, AC ratings to 40KHz

OPERATING TEMPERATURE: −65°C to +125°C (Derate 50% from 100°C to 125°C)

CAPACITANCE RANGE: .001 to 10uF, .1% to 10% tolerances

INSULATION RESISTANCE: 100,000 meg-uF @ 25°C

DISSIPATION FACTOR: .15% max. @ 1KHz

DIELECTRIC ABSORPTION: .1% maximum

SCREENING: 100% Quality conformance inspection per applicable paragraphs of MIL-C-83421.

APPLICATIONS: Timing, filter, feed-back circuits, and pulse-forming networks. Used where small size is critical. G12 capacitors are used in numerous Navy missile and torpedo projects.

TYPE P14

DIELECTRIC: Metallized Polysulfone

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 30-400VDC

A.C. RATING: 22 to 240 VRMS @ 400Hz, AC ratings to 40KHz

OPERATING TEMPERATURE: −65°C to +150°C (Derate 50% from 125°C to 150°C)

CAPACITANCE RANGE: .001 to 27uF, .25% to 10% tolerances

INSULATION RESISTANCE: 200,000 meg-uF @ 25°C

DISSIPATION FACTOR: .15% max. @ 1KHz

DIELECTRIC ABSORPTION: .1% maximum

SCREENING: 100% Quality conformance inspection with 96 hours AC burn-in @ 400Hz. Screening per applicable paragraphs of MIL-C-83421.

APPLICATIONS: Timing, filter, feed-back circuits, motor start and pulse-forming networks. Used in critical AC and DC applications where high temperature and small size is important. Used in numerous military and avionics applications.

CRC COMPONENT RESEARCH CO.

COMPARISON OF CAPACITOR TYPES

ESTABLISHED RELIABILITY CAPACITORS

TYPE J11 & K11

DIELECTRIC: Metallized Teflon

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 50-200VDC

OPERATING TEMPERATURE: −65°C to +125°C

CAPACITANCE RANGE: .001 to 2uF, .1% to 10% tolerances

INSULATION RESISTANCE: 1,000,000 meg-uF

DISSIPATION FACTOR: .05% max. @ 1KHz

DIELECTRIC ABSORPTION: .01% maximum

SCREENING: 100% Quality conformance inspection per applicable paragraphs of MIL-C-83421. Will meet all environmental requirements of MIL-C-83421 except vibration at 20 g's and shock at 50 g's.

APPLICATIONS: Timing, sample and hold, integrating and tuning circuits. J11 and K11 are used in critical space, military applications which require lowest dielectric absorption and highest insulation resistance and low dielectric loss.

TYPE A91

DIELECTRIC: Foil Teflon

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 50-400VDC

A.C. RATING: 36 to 240 VRMS @ 400Hz, AC ratings to 40KHz

OPERATING TEMPERATURE: −65°C to +150°C

CAPACITANCE RANGE: .001 to 1.2uF, 1% to 10% tolerances

INSULATION RESISTANCE: 1,000,000 meg-UF

DISSIPATION FACTOR: .02% max. @ 1KHz

DIELECTRIC ABSORPTION: .01% maximum

SCREENING: 100% Quality conformance inspection per applicable paragraphs of MIL-C-83421. Will meet all environmental requirements of MIL-C-83421 except vibration at 20 g's and shock at 60 g's.

APPLICATIONS: Pulse-forming networks, timing, sample and hold, integration and tuning circuits. A91 is used in hi-rel programs which require a rugged low loss capacitor with high insulation resistance and low dielectric absorption.

TYPE K93

DIELECTRIC: Polystyrene

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 50-400VDC

A.C. RATING: 36 to 240 VRMS @ 400Hz, AC ratings to 40KHz

OPERATING TEMPERATURE: −65°C to +85°C

CAPACITANCE RANGE: .001 to 2.7uF, .1% to 10% tolerances

INSULATION RESISTANCE: 1,000,000 meg-uF

DISSIPATION FACTOR: .02% max. @ 1KHz

DIELECTRIC ABSORPTION: .02% maximum

SCREENING: 100% Quality conformance inspection

APPLICATIONS: Qualified for the Trident Program. Used in critical space and military applications that require stability, high insulation resistance, low dielectric absorption and low dissipation factor.

TYPE A54

DIELECTRIC: Foil Polysulfone

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 100-400VDC

A.C. RATING: 60 to 240 VRMS @ 40KHz

OPERATING TEMPERATURE: −65°C to +150°C (Derate 50% from 125°C to 150°C)

CAPACITANCE RANGE: .001 to .47uF, 1% to 10% tolerances

INSULATION RESISTANCE: 100,000 meg-uF

DISSIPATION FACTOR: .1% max. @ 10KHz

DIELECTRIC ABSORPTION: .2% maximum

SCREENING: 100% Quality conformance inspection with 400Hz burn-in.

APPLICATIONS: Snubber, high current pulse applications. A54 capacitors are used in the F18 aircraft.

TYPE B54

DIELECTRIC: Foil Polysulfone

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 600 & 800VDC

A.C. RATING: 400 & 600 VRMS @ 400Hz, high current ratings to 40KHz, low E.S.R.

OPERATING TEMPERATURE: −55°C to +125°C

CAPACITANCE RANGE: .033 to .82uF

INSULATION RESISTANCE: 100,000 meg-uF

DISSIPATION FACTOR: .2% max. @ 10KHz

SCREENING: 100% Quality conformance inspection with 400Hz burn-in.

APPLICATIONS: Snubber circuits, switching power supplies and where high RMS and peak current ratings are required.

TYPE B14

DIELECTRIC: Metallized Polysulfone

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 600 & 800VDC

A.C. RATING: 400 & 600 VRMS @ 400 Hz, high current AC rating to 40KHz, low E.S.R.

OPERATING TEMPERATURE: −55°C to +125°C

CAPACITANCE RANGE: .01 to 1.2uF

INSULATION RESISTANCE: 100,000 meg-uF

DISSIPATION FACTOR: .5% max. @ 10KHz

SCREENING: 100% Quality conformance inspection with 400Hz burn-in.

APPLICATIONS: Snubber circuits, switching power supplies and where high RMS and peak current ratings are required.

TYPE B55

DIELECTRIC: Foil Polypropylene

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 600 & 800VDC

A.C. RATING: 400 & 600 VRMS @ 400Hz, high current ratings to 40KHz, low E.S.R.

OPERATING TEMPERATURE: −55°C to +85°C

CAPACITANCE RANGE: .033 to .82uF

INSULATION RESISTANCE: 100,000 meg-uF

DISSIPATION FACTOR: .05% @ 10KHz

SCREENING: 100% Quality conformance inspection with 400Hz burn-in.

APPLICATIONS: Snubber circuits, switching power supplies and where high RMS and peak current ratings are required.

TYPE B15

DIELECTRIC: Metallized Polypropylene

CONSTRUCTION: Metal case hermetically sealed

VOLTAGE RATING: 600 & 800 VDC

A.C. RATING: 400 & 600 VRMS @ 400Hz, high current ratings to 40KHz, low E.S.R.

OPERATING TEMPERATURE: −55°C to +85°C

CAPACITANCE RANGE: .01 to 1.2uF

INSULATION RESISTANCE: 100,000 meg-uF

DISSIPATION FACTOR: .05% max. @ 10KHz

SCREENING: 100% Quality conformance inspection with 400Hz burn-in.

APPLICATIONS: Snubber circuits, switching power supplies and where high RMS and peak current ratings are required.

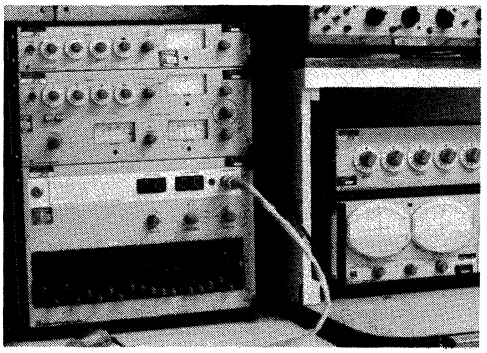
COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

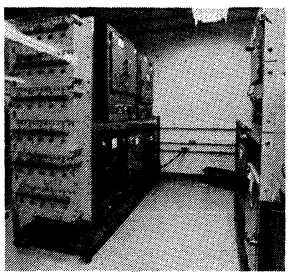
A VIEW OF CRC MANUFACTURING GENERAL PRODUCT INFORMATION

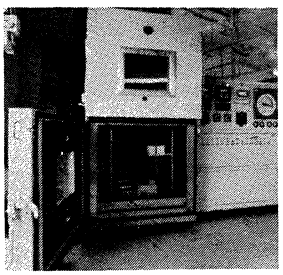
ESTABLISHED RELIABILITY CAPACITORS

CAPACITOR ASSEMBLY: Typical production area located within our award winning 50,000 sq. ft. manufacturing facility. Ideal assembly conditions enable CRC employees to produce high reliability precisely and efficiently.



CALIBRATION EQUIPMENT: Hundreds of precision instruments for parametric measurement are maintained under constant calibration. One out of approximately four employees is dedicated to quality control assurance, and inspection. CRC supplies capacitors for laboratory standards use throughout the world.

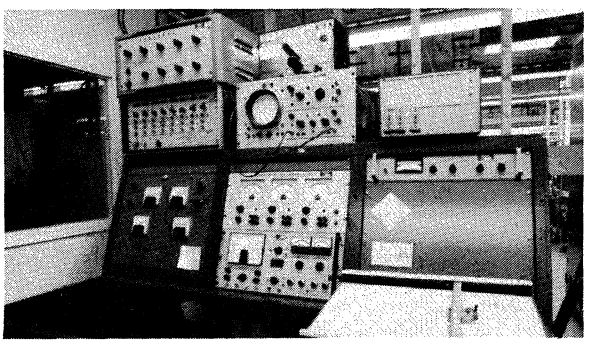




BURN-IN AND TEMPERATURE CYCLING: Before and after hermetic sealing, CRC capacitors receive 100% burn-in.

The 12 foot high shock chamber above right, was used in performing 500 thermal shock cycles (−55°C to +125°C) on CRC metallized polycarbonate capacitors being qualified for the space shuttle program.

Vibration, shock, salt spray, humidity, pressure, and various other stress tests are conducted in our modern laboratories. During these tests, capacitance parameters are accurately monitored in order to study how our products can be constantly improved. CRC has over 200 cubic feet of thermal shock and aging work space available.



ENVIRONMENTAL TESTING: Our qualified testing laboratory contains equipment necessary to perform random and sinusoidal vibration, shock, acceleration, moisture resistance, salt spray, solderability, resistance to solvents, barometric pressure, and many other tests. This laboratory is used daily to qualify standard and special designs as well as to prove out new designs. These capabilities ensure the consistent quality of our established reliability capacitors.

ORDERING INFORMATION — Terms: Our terms are net 30 days to customers approved by our credit department. All shipments are F.O.B., Santa Monica, Calif. **Minimum Order:** Minimum billing per order is $50.00. **Complete Part Number:** Please make certain that you have complete part number to avoid any errors or delays. Please check part number instructions on individual specification pages.

PART NUMBER OBSOLESCENCE — Due to changes in military specifications for which we are qualified, upgrading of our catalog specifications, or size reduction, part numbers formerly used may now be obsolete. We urge our customers to change their existing drawings to indicate the new part numbers for old and new design, wherever possible. If you are unable to make this change, CRC will continue to supply and mark parts indefinitely to the old specifications.

CONSTRUCTION INFORMATION — Unless otherwise specified all parts listed are metal cased, tubular, with both wire terminals isolated from the metal case.

INSTALLATION INSTRUCTIONS — To prevent damage to the hermetic seal joint, use a tweezer type heat sink between the soldering iron and solder beads when soldering within ¼" of beads. Prior to lead bending or twisting, protect glass seals and solder joints by gripping lead near solder bead with a small plier.

Contaminating films on the glass seal surfaces may appear during customer handling and installation of capacitors. To preserve the high insulation resistance inherent in CRC capacitors, clean the glass seal surfaces thoroughly with acetone or chlorinated hydrocarbon fluid.

CAPACITOR MEASUREMENT INFORMATION — The high quality of CRC capacitors may be difficult to evaluate unless sufficiently sensitive and accurate equipment is utilized in conjunction with proper measurement techniques.

Capacitance bridges equal to the General Radio 1620A are recommended for best accuracy of capacitance. This bridge is satisfactory for dissipation factor measurement of capacitors up to 1 uF. CRC has developed a special bridge capable of accurately measuring dissipation factor of capacitors up to 100 uF or more at frequencies up to 1 KHz. For inspection of DF of larger than 1 uF capacitors it is suggested that you use samples correlated by our measurement laboratory.

Insulation resistance measurement is performed by Component Research Co. using leakage current methods which are repeatable to 1 picoamp for capacitors less than 0.1 uF. Larger values require adequate charge time to minimize dielectric absorption effects. Guard boxes are used to perform leakage current and dielectric absorption measurements.

PATENT INFORMATION — CRC capacitors are exclusively manufactured under one or more of the following patents: 3,238,428; 3,260,906; 3,292,063; 3,506,895; 3,539,886; 3,603,849; 3,626,362. Additional patents pending.

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

OPTIONS AVAILABLE FOR STANDARD CAPACITORS

ESTABLISHED RELIABILITY CAPACITORS

Following is a list of some options and characteristics available when you are required to meet special design or operating conditions.

SPECIAL CAPACITOR VALUES

If your application requires odd values such as 0.10015uF ±0.1% or 0.9999uF ±0.25%, such requirements are readily met from our large stock of standard and non-standard values. Individual capacitors can be permanently marked or tagged with discrete values accurate to six places if required.

SPECIAL VOLTAGE RATINGS

Problems of size may occur when replacement of a poor quality capacitor is required. Under certain conditions such as restricting the operating temperature, or limiting DC hipot to 150% of rated volts, a substantial size reduction is possible. Check with our applications engineering department for our recommendations in such cases.

LINEAR TC SLOPE for RESISTOR MATCHING

CRC Series A93 Polystyrene Capacitors provide the closest approximation to a straight line plot for capacitance vs temperature over the range of −50°C to +85°C, with less than 150PPM/°C in negative slope. Larger capacitor values appear to have lower TC than smaller capacitor values. Typically, values ranging 0.01uF average −100PPM/°C and 1.0uF range −40PPM/°C. The normal worst case limits in non-linearity of TC slopes are ±50PPM/°C for all A93 polystyrene capacitors. Slopes are available as low as ±10PPM/°C for the full temperature range of −50°C to +85°C. This slope is a permanent characteristic and will remain constant with temperature cycling and time.

±10PPM/°C TRACKING MATCHED CAPACITORS

In some applications it is desirable to have several capacitors of the same value track together over a specified temperature range.

Frequently good linearity is not mandatory, provided all capacitors although non-linear, follow the same pattern of varying in capacitance with temperature. In other applications a set of different capacitors must track within a defined ratio limit of each other as temperature changes.

From its large stock of 100% screened and batch controlled high reliability capacitors, CRC can furnish many combinations of desired matched capacitors in a minimum of time.

MATCHED SETS TO ±0.05% ACCURACY

CRC can provide matched sets of two or more capacitors with readings of ±0.05% of each other although the purchase tolerance is as high as ±1%. This is more economical than purchasing individual capacitors to ±0.1% or ±0.25% tolerances.

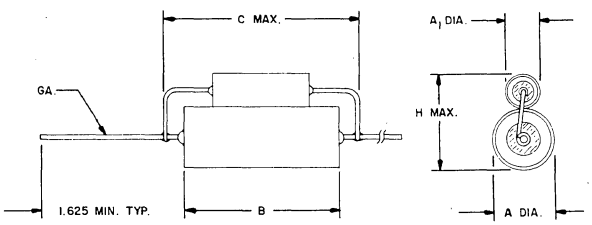
ZERO TEMPERATURE COEFFICIENT BY TC MATCHED PAIRS

It is difficult to obtain zero TC over a wide temperature range. But over a more limited range CRC can provide a TC as low as zero ±5PPM/°C by pairing two capacitors with opposing slopes. Typically an A93 polystyrene capacitor matched with the same value A12 polycarbonate capacitor will match to zero ±30PPM/°C from −10°C to +85°C, as off the shelf purchased items.

If lower TC than this is required, we can 100% measure and match for closer temperature coefficient.

"PIGGYBACK" PERMANENTLY CONNECTED MATCHED CAPACITORS

Customers sometimes prefer the matched capacitors connected together as one to prevent their separation prior to installation. CRC standards are made by "piggyback" connection of trimmers which can provide accuracies to ±0.05%. Shown below is a figure of a "piggyback" connected matched capacitor.



50,000,000 MEGOHMS INSULATION RESISTANCE

This may seem incredible but CRC is supplying special 1uF teflon capacitors which measure up to 5,000,000 megohms at 100°C, and up to 50,000,000 megohms at temperature from 25°C to −40°C.

CRC is developing new methods of measuring to higher levels of insulation resistance and believes it will be able to verify that specially selected smaller values such as 0.1uF can be supplied to meet a specification of 500,000,000 megohms. When you use capacitors in such sensitive applications certain errors and disturbances not normally observed become visible. Some of these are described below.

LOW "PIEZO ELECTRIC LIKE" VOLTAGE GENERATION CAPACITORS

When subjected to a temperature change, capacitors generate a voltage which may vary from one to another within the lot. Voltage up to ten millivolts per °C have been observed. While voltage outputs generally do not increase linearly with temperature, in some cases there has actually been voltage reversal during a temperature run in a given direction.

CRC supplies specially selected 0.5uF, 50VDC teflon capacitors similar to the J11B504 styles to meet requirement of 0.5 millivolts maximum/°C voltage generation, for a critical application.

CRC
COMPONENT RESEARCH CO.

HIGH PULSE CURRENT METALLIZED CAPACITORS

ESTABLISHED RELIABILITY CAPACITORS

CRC PLASTIC FILM CAPACITORS have low loss electrode terminations that are unsurpassed for current handling after exposure to the extremes of thermal shock and operational life.

CRC FOIL CAPACITORS utilizing low loss plastic films such as polypropylene, teflon, polystyrene, and polysulfone are recommended for use with fast switching rates at very high peak currents.

CRC METALLIZED FILM CAPACITORS with lower repetition rates and relatively high currents, can be used to conserve space and weight.

As an example a 10uF, 30VDC, metallized polycarbonate capacitor type G12A106 was charged at 30VDC and discharged into a 0.02 ohm vacuum switch at a 1 PPS rate for days to determine if it would open up. There was no noticeable effect on ESR or dissipation factor as a result of this test.

During this test the first ½ sine discharge current pulse was approximately 180 amperes and decayed to zero current after several 100 KHz resonant cycles.

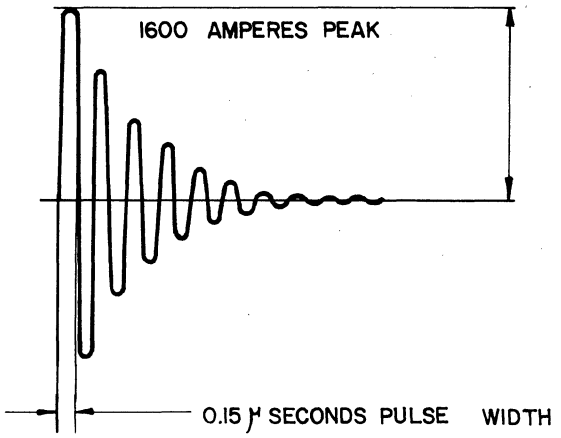
We attempted to open this miniature 10uF capacitor by charging it with 100VDC which resulted in a first ½ sine pulse current of 500 amperes peak at a 1 PPS rate for several hours. Despite the voltage overstress applied and the extremely high peak capacitor current developed, we could not degrade the termination quality of the G12A106 capacitor.

We can conclude that CRC miniature metallized polycarbonate capacitors are capable of handling enormous discharge current provided the repetition rate is slow.

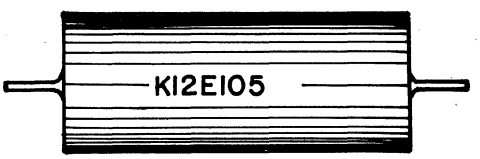
A study is now being conducted by CRC to determine the optimum AC operating conditions with maximum energy density under high current pulse conditions for metallized vs. metal foil capacitors.

These tests will determine what repetition rate conditions require a larger foil capacitor instead of a smaller metallized film capacitor for failure-free operation.

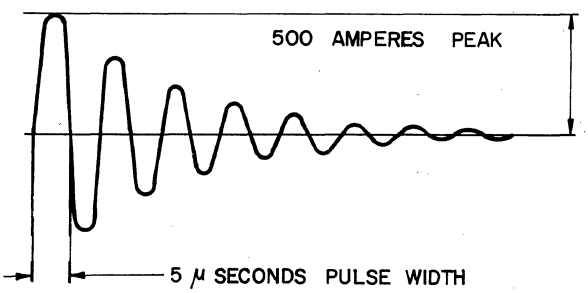
IF YOUR APPLICATION REQUIRES MAXIMUM RELIABILITY, SMALLEST SIZE, AND OPERATION IN CRITICAL AEROSPACE OR INDUSTRIAL ENVIRONMENTS, CRC APPLICATION ENGINEERS WILL BE PLEASED TO REVIEW YOUR SPECIFICATIONS FOR CORRECT CAPACITOR USAGE.



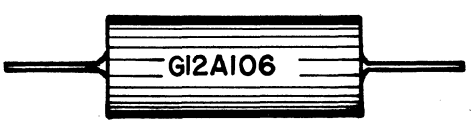
IN THIS TEST A 1 uF, 400VDC, METALLIZED POLYCARBONATE CAPACITOR, TYPE K12E105, IN A 0.750" X 1.875" CASE DEVELOPED 1600 AMPERES PULSE CURRENT WHEN DISCHARGED INTO A 0.02 OHM SWITCH LOAD AFTER CHARGE AT 800VDC. REPETITION RATE WAS 1 PPS AND NO DEGRADATION OF ESR OR DISSIPATION FACTOR OR CASE WARM-UP WAS MEASURABLE AFTER SEVERAL HOURS OF OPERATION.



Actual size of the 1uF, 400VDC capacitor tested at developed pulse currents up to 2600 amperes peak to peak at 1 PPS rate.



CAPACITOR DISCHARGE CURRENT SHOWN FOR TYPE G12A106 METALLIZED POLYCARBONATE CAPACITOR, 10 uF, 30VDC, AFTER CHARGE AT 100VDC AND DISCHARGE INTO A 0.02 OHM SWITCH LOAD. REPETITION RATE WAS ONE PULSE PER SECOND AND THE RESONANT FREQUENCY RESULTING FROM DISCHARGE INTO THE LOAD IS 100KHz.



Actual size of the 10uF, 30VDC capacitor tested at developed pulse currents up to 900 amperes peak to peak at 1 PPS rate.

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MIL-C-83421/1 - MIL-C-39022/9 MANUFACTURING & INSPECTION FLOW PLAN

ESTABLISHED RELIABILITY CAPACITORS

100% INSPECTION PER MIL-C-83421 & MIL-C-39022

The high reliability capacitor screening plans developed by Component Research Co. have been adopted by space and military contractors throughout the world for critical programs. The new general specification MIL-C-83421 incorporates much of the screening features shown below at an attempt to provide a "state of the art" capacitor specification for general industrial and aerospace use.

Our flow plan for manufacturing and inspection shown below covers the steps used to process and screen all of our polycarbonate, teflon, polystyrene and polysulfone film capacitors. The individual specifications shown in the catalog list the actual screening performed for each style. A choice of three quality levels provides different degrees of intensive screening to assure the highest possible quality at lowest cost. Special screening plans are available which include tests such as 100% corona inception inspection, 40KHz AC burn-in at 100°C, high impedance monitoring for intermittent conditions at low voltage during temperature cycling, ESR inspection at 100KHz, dielectric absorption effects with rapid switching rates and varying temperature, and many other sensitive measurement phenomena.

100% PROCESSED AND SCREENED

Steps 1-9 show the 100% processing (up to and including hermetic sealing), of MIL-C-39022/9 and MIL-C-83421/1 qualified polycarbonate and CRC standard capacitors — Polycarbonate, Teflon, Polystyrene and Polysulfone. The quality level selected will be determined by the individual capacitor specification.

PROCESSING STEPS

A. CAPACITOR MATERIAL INSPECTION
B. IDENTIFY PROCESS PAPERWORK WITH MATERIAL LOT NUMBERS
C. CAPACITOR SUB-ASSEMBLY INSPECTION
D. SPECIAL VACUUM PROCESSING
E. HERMETIC SEAL AFTER NITROGEN BACK-FILL
F. INITIAL INSPECTION OF COMPLETED CAPACITOR (7X POWER)

QUALITY LEVEL 1 MIL-C-83421/1 & MIL-C-39022/9

1. BURN-IN
2. TEMPERATURE CYCLING
3. HELIUM LEAK TEST AND GROSS LEAK TEST
4. AC-DIELECTRIC STRENGTH
5. DC-DIELECTRIC STRENGTH
6. INSULATION RESISTANCE
7. % CAPACITANCE TOLERANCE
8. % DISSIPATION FACTOR
9. SELECTION FOR PERFORMANCE GRADES
10. REPEAT ELECTRICAL MEASUREMENT AND RECORD DATA AS REQUIRED
11. CONDUCT SPECIAL MEASUREMENT WHEN REQUIRED BY CUSTOMER
12. FINAL VISUAL INSPECTION OF WORKMANSHIP, MARKING, PAPERWORK AND PACKAGING
13. SHIP CERTIFICATE OF COMPLIANCE WITH PARTS

Highest reliability capacitors with standard or special screening for Apollo, Viking, and other space programs. Also used in military and ultra high quality industrial applications.

Qualified for space, critical applications, F15 aircraft, Trident, space shuttle and other programs.

QUALITY LEVEL 2 MIL-C-39022/9

1. BURN-IN
2. TEMPERATURE CYCLING
3. HELIUM LEAK TEST AND GROSS LEAK TEST
4. AC-DIELECTRIC STRENGTH
5. DC-DIELECTRIC STRENGTH
6. INSULATION RESISTANCE
7. % CAPACITANCE TOLERANCE
8. % DISSIPATION FACTOR
9. FINAL VISUAL INSPECTION OF WORKMANSHIP, MARKING, PAPERWORK, AND PACKAGING
10. SHIP C OF C WITH PARTS

High reliability capacitors screened for space, missile and industrial applications. Qualified for many programs such as The Tow Missile, The Lance Missile and F15 aircraft.

QUALITY LEVEL 3 MIL-C-83421/1 & MIL-C-39022/9

1. TEMPERATURE CYCLING
2. HELIUM LEAK TEST AND GROSS LEAK TEST
3. AC-DIELECTRIC STRENGTH
4. DC-DIELECTRIC STRENGTH
5. INSULATION RESISTANCE
6. % CAPACITANCE TOLERANCE
7. %DISSIPATION FACTOR
8. FINAL VISUAL INSPECTION OF WORKMANSHIP, MARKING, PAPERWORK AND PACKAGING
9. SHIP C OF C WITH PARTS

High reliability capacitors with reduced screening and performance levels for lower cost high volume programs, such as missiles, aircraft and telephone equipment applications.

Random samples from completed production lots of all quality levels are periodically tested.

These tests may consist of Insulation Resistance at high temperature, Dielectric Absorption, Temperature Coefficient and AC stress analysis tests.

In addition, samples are life tested for retention of qualification.

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CRC COMPONENT RESEARCH CO.

RETENTION OF QPL - MIL-C-83421/1 FAILURE RATE "S"

ESTABLISHED RELIABILITY CAPACITORS

PERIODIC TESTING PROGRAM

GROUP "B" INSPECTION PER MIL-C-83421, TABLE IV

GROUP B, SUBGROUPS 1, 2 and 3: In order to maintain qualification, CRC performs periodic testing. Capacitors from current production lots of CRH01 through CRH00 which have successfully completed "Group A" Inspection (see "A12 and K12 Quality Conformance Inspection") are selected.

SUBGROUP 1 TESTS

10 Each CRH Style Monthly

- Barometric Pressure
- Insulation Resistance at Max. Rated Temperature
- Temperature Coefficient
- Life (2,000 Hours)

SUBGROUP 2 TESTS

CRH01 Parts Jan., July
CRH02 Parts Feb., Aug.
100 Volt Parts March, Sept.
200 Volt Parts April, Oct.
400 Volt Parts May, Nov.

- AC Conditioning 250 Hours
- Dissipation Factor
- Insulation Resistance
- △ Capacitance

SUBGROUP 3 TESTS

18 Parts Every 6 Months, Consisting of CRH01, CRH02, CRH03, CRH04 and CRH05

- Vibration
- Salt Spray
- Immersion
- Solderability
- Shock
- Moisture Resistance
- Terminal Strength
- Resistance to Solvents

DC LIFE TEST PERFORMED MONTHLY

GROUP B, SUBGROUP 1 FOR ALL CRH STYLES COVERING ALL FAILURE RATE LEVELS

Capacitors are DC-Life tested at 100°C and at 140% of the rated D.C. voltage for 2,000 hours. (This is an acceleration factor of 5:1, approximately).

EXAMINATION OR TEST	CONDITIONS	POST TEST LIMITS CRH01, CRH02, CRH03, CRH04, and CRH05	POST TEST LIMITS CRH06, CRH07, CRH08, CRH09, and CRH00
Barometric Pressure	Per MIL-C-83421	No breakdowns	No breakdowns
Insulation Resistance	@ Rated voltage @ 125°C	2,000 Megs-uF need not exceed 20,000 Megs	1,000 Megs-uF need not exceed 10,000 Megs
Temperature Coefficient	△ Cap. at −55°C Retrace at 25°C △ Cap. at +125°C	−1.5% to 0.5% max. ±0.1% max. +0.8% to −0.5% max.	−2.0% to −0.5% max. ±0.25% max. ±2.0% max.
POST LIFE TEST LIMITS AFTER 2,000 HOURS LIFE			
Insulation Resistance at Rated Voltage and 25°C	Insulation Sleeves	10,000 Megs min.	10,00 Megs min.
	Terminal to Terminal	100,000 Meg-uF need not exceed 1,000,000 Megs	33,333 Megs-uF need not exceed 333,333 Megs
	Terminals to Case	10,000 Megs min.	10,000 Megs min.
△ Capacitance % change with life	At 1KHz and 25°C	±2% max. of initial value	±4% max. of initial value
% Dissipation Factor	At 1KHz and 25°C	0.25% max.	0.35% max.

AC-SINUSOIDAL LIFE TEST PERFORMED MONTHLY

Capacitors are AC life tested for 250 hours at 100°C and at 140% of the rated RMS voltage at the applicable test frequency as shown in Table V. This test is performed monthly in order to verify the AC RMS voltage and current ratings.

POST AC TEST LIMITS	
Insulation Resistance at Rated Voltage and 25°C	100,000 Megs-uF, need not exceed 1,000,000 Megs
Capacitance % Change at 1KHz and 25°C	2% max. of initial value
% Dissipation Factor at 25°C	0.25% max.

TABLE V AC-LIFE TEST PARAMETERS PER MIL-C-83421/1

CRH Style	Equiv. CRC Type	DC Volts Rating	400 Hz AC RMS Volts Rating	250 Hours at 100°C Life Test Conditions AC RMS Volts	Frequency In Hertz
01	A12A	30	22	30	4,000
02	A12B	50	36	50	4,000
03	A12C	100	60	84	4,000
04	A12D	200	120	168	400
05	A12E	400	240	336	400

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CRC COMPONENT RESEARCH CO.

HIGHEST RELIABILITY SCREENING

ESTABLISHED RELIABILITY CAPACITORS

CRC SCREENS AND TESTS MANY ORDERS TO SPECIFIC CUSTOMER REQUIREMENTS FOR HIGHER RELIABILITY. IN ADDITION, CRC PERFORMS MANY IN-HOUSE TESTS THAT ARE NOT REQUIRED BY THE CUSTOMER, BUT WHICH CRC FEELS WILL IMPROVE QUALITY AND RELIABILITY. BELOW IS CRC'S MANUFACTURING AND INSPECTION FLOW PLAN FOR METALLIZED POLYCARBONATE CAPACITORS SUPPLIED TO TRIDENT SPECIFICATION 2864019.

MANUFACTURING AND INSPECTION FLOW PLAN

1. CAPACITOR MATERIAL INSPECTION
2. IDENTIFY PROCESS PAPERWORK WITH MATERIAL LOT NUMBERS
3. CAPACITOR SUB-ASSEMBLY
4. CAPACITOR SUB-ASSEMBLY INSPECTION
5. SPECIAL VACUUM PROCESSING
6. IN-PROCESS ELECTRICAL TESTING
7. VACUUM PROCESSING
8. NITROGEN BACKFILL
9. HERMETIC SEAL
10. INITIAL INSPECTION OF COMPLETED CAPACITOR AT 7X MAGNIFICATION

COMPONENT RESEARCH 100% PRE-SCREENING

1. 100% Screen and test per MIL-C-83421, table 4.
2. Select parts for Trident order.
3. Sample test capacitance, I.R. % D.F. & ESR at 25°C. Record readings on five samples.
4. Burn-in for 16 hours at 100°C at 40KHz at rated RMS voltage (100% test).
5. Thermal aging, 5 cycles −65°C to +125°C (100% test).
6. Seal test, fine leak (100% test).
7. I.R. at 125°C terminal to terminal (100% test, record samples).
8. I.R. at 25°C terminal to terminal (100% test, record samples).
9. Tolerance assort at 25°C at 10KHz (100% test).
10. Record capitance drift for 5 samples.
11. % dissipation factor at 25°C at 10KHz (100% test, record samples).
12. ESR at 25°C at 100KHz (record 5 samples only).
13. Select 2 random samples and dissect for product conformance.
14. Quality control manager review of data for lot acceptance.

QUALITY CONFORMANCE INSPECTION PER 2864019

TEST STEP	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	% CAPACITANCE TOLERANCE	At 25°C at 10KHz	4.7.8	±1%	100% TEST
2	BURN-IN	168 hrs. @ 100°C @ 40KHz @ maximum rated RMS voltage	4.7.2	There shall be no evidence of physical damage	100% TEST
3	THERMAL AGING	10 cycles from −65°C to +125°C	4.7.3	There shall be no evidence of physical damage	100% TEST
4	SEAL TEST (FINE LEAK)	Helium bomb and check for helium leak	4.7.5	$1x10^{-4}$atm/cm³/sec. max. leak rate	100% TEST
5	SEAL TEST (GROSS LEAK)	Per MIL-STD-202 Meth. 112B, Cond. D.	4.7.5	No bubble stream	100% TEST
6	AC SQUARE WAVE TERMINAL TO TERMINAL	Apply 100Hz square wave at a peak to peak voltage of 3 times DC rated voltage	4.7.6	No shorts	100% TEST
7	DC HI-POT	Apply 200% of rated DC voltage from terminal to terminal and terminals to case for 60 seconds minimum	4.7.6	No shorts	100% TEST
8	INSULATION RESISTANCE TERMINAL TO TERMINAL	At +125°C at rated DC voltage	4.7.7	1,000 meg's-uF, need not exceed 10,000 megohms	100% TEST
9	INSULATION RESISTANCE TERMINAL TO TERMINAL	At 25°C at rated DC voltage	4.7.7	100,000 meg's-uF, need not exceed 1,000,000 megohms	100% TEST
10	% CAPACITANCE TOLERANCE	At 25°C at 10KHz	4.7.8	±1%	100% TEST
11	% CAPACITANCE DRIFT FROM STEP 1 TO 10	At 25°C at 10KHz referenced to initial reading	4.7.8	±0.5%	100% TEST
12	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	0.5%	100% TEST
13	RADIOGRAPHIC INSPECTION	Two views at 90° per OD 48491	N/A	Per OD 48491	100% TEST
14	VISUAL MECHANICAL INSPECTION	Per 2864019	4.7.1	Per 2864019	1.0% AQL

NOTE: 5% PDA (percent defective allowable) or 1 device, whichever is greater for each test step 7, 8, 9, 11, 12 and 13.

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CRITICAL APPLICATIONS SCREENING

ESTABLISHED RELIABILITY CAPACITORS

Component Research capacitors are used in critical applications where their reliability and performance can affect the success of an entire program involving years of preparation and billions of dollars of program cost. For over a decade, aerospace programs from Apollo to Space Shuttle have used CRC capacitors for timing circuits and other control circuits, essential for controlling spacecraft millions of miles from earth, after years of space travel.

DC burn-in, thermal aging (temperature cycling), and Group "A" testing generally is sufficient to assure that the capacitors will be reliable for aerospace applications. The standard CRC capacitors listed in this catalog are offered with screening options most commonly required. Special screening can also be provided for critical requirements.

You can depend upon CRC to provide the most reliable capacitor and screening plan for your critical applications. Following are typical screening plans for standard and special applications.

AC BURN-IN AT 400Hz TO 40KHz

400Hz burn-in at 140Vrms at 125°C is generally a standard screen for metallized polysulfone capacitors supplied for aircraft programs. Typically low-loss filter, shunt, and feed-thru capacitors ranging from 1 μF to 240 μF in value receive from 16 hours to 96 hours of 400Hz burn-in at 125°C to provide high reliability performance in programs such as the F18 fighter aircraft, space shuttle, and commercial aircraft equipment.

40KHz burn-in is used in screening small valued metallized polycarbonate capacitors at 100°C for 168 hours for the Trident Program. CRC capacitors used for this program are the A12 Series which undergo rigorous burn-in and special screening for elimination of any possible defects or unusual behavior modes. With incorporation of such severe inspection and surveillance restraints, CRC production standards are maintained at a very high caliber of performance suited to the most critical programs.

AC AND DC COMBINED BURN-IN SCREENING

Several customers specify that the AC and DC voltages be simultaneously applied during burn-in to assure that the capacitor will operate reliably in this mode. Typically we have applied 100VDC together with approximately 2Vrms at 40KHz at 100°C to 22μF, 100VDC metallized polycarbonate capacitors for 168 hours of burn-in time as a Group "A" screen. In this application the 1" diameter x 1.875" long capacitor handles approximately 8 AMPS RMS during burn-in. Following 100% Group "A" screening, a lot sample is tested for 2000 hours as above without DC voltage applied.

CORONA INCEPTION INSPECTION PREVENTS OPERATIONAL FAILURES

In AC applications at 240Vrms levels and higher or where peak voltages exceed 320 volts approximately, capacitors may fail short or long term due to corona attack.

For such applications, CRC recommends capacitors which are uniformly free from corona inception for at least 20% higher than operational voltage conditions.

100% Group "A" corona inspection for no indication of inception is an excellent substitute for dielectric withstanding voltage tests and is a better monitor of possible shorting problems.

RECORDED READINGS BEFORE AND AFTER BURN-IN

Some programs must have recorded data for each capacitor taken prior to and after completion of burn-in and thermal aging. The capacitors are serialized and readings of capacitance, insulation resistance at 25°C and sometimes at elevated temperature are recorded. In addition, readings of capacitance vs. temperature for purposes of determining temperature coefficient and drift can be recorded.

On occasion dissipation factor is recorded at 1KHz and 10KHz and ESR at 100KHz for determination of reliable electrode connections.

40KHz BURN-IN AND CORONA SCREENING

Type BF51 teflon foil capacitors are being used in a high frequency switching application with a rise time of less than 1 microsecond, in a limited space. Typically a 0.025 μF, 400VDC rated teflon foil, oil impregnated capacitor operates with; 200 volt peak to peak, 10KHz square wave voltage conditions, a rise and fall time of 100 nanoseconds, in a 0.312 x 1.063 case. Under these conditions this teflon capacitor is relatively cool with peak current of 30 amps developed at a 20KHz repetition rate.

Following is the 100% screening used for this AC application.

1. **Burn-in** for 48 hours at 125°C. Apply 180Vrms at 40KHz ±5%.
2. **Thermal aging** temperature cycle 5 times −65°C to +125°C. Per MIL-C-83421.
3. **Seal Test** Bake for 4 hours at 125°C. Check for oil leakage or visual damage.
4. **Corona Test** Apply 400Vrms at 60Hz and check for evidence of corona inception.
5. **AC Stress Test** Apply 100Hz square wave voltage, terminal to terminal, for 1 minute, per MIL-C-83421/1, at 1000 volts peak to peak.
6. **DC Hipot** Apply 800VDC terminal to terminal and to case at 25°C for 1 minute, per MIL-C-83421.
7. **Insulation Resistance** when measured with 400VDC at 25°C, 1,000,000 megohms minimum.
8. **% Capacitance** at 1 KHz
9. **% Dissipation** factor at 10KHz, 0.01% maximum.
10. **Final visual** and mechanical inspection.

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CRC
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FAILURE ANTICIPATION
& IMPROVED RELIABILITY

ESTABLISHED
RELIABILITY
CAPACITORS

Plastic film dielectric type capacitors can provide remarkably good electrical characteristics and high reliability but it takes a combination of sound construction, suitable film quality, exacting process control, and 100% testing to achieve this.

Because we are concerned with a proliferation of marginal quality capacitors frequently used in high reliability level aerospace and industrial applications, we are listing below some pitfalls to avoid.

MIS-APPLICATION OF CAPACITORS IN AC CIRCUITS

The highest quality capacitor will fail if its ratings are exceeded by subjecting it to excessive voltage and current stresses. In sinusoidal applications metallized capacitors that warm up over 20°C after several hours of operation are considered a borderline case. You may be applying too high an RMS voltage or frequency.

If the capacitors you are using have higher than normal dissipation factor readings, this may be a sign of high series resistance caused by poor termination on the capacitor section. The square wave AC screening for one minute covered in MIL-C-83421/1 is a good way of eliminating capacitors with gross dissipation factor quality.

If dissipation factor limits are set too high as post test requirements, suspect capacitors will pass the square wave test. In fact terminations may have been damaged by this test, but are permitted to pass what we consider are abnormally high DF limits. A termination that is poor at room temperature generally should be worse at higher temperature and increased heating caused by power loss at the terminations may cause ultimate degeneration and possible failure. We consider 100% AC burn-in at elevated temperature an excellent method of checking for good terminations. Burn-in should be followed in 100% dissipation factor examination.

In SCR commutation and transistor switching type applications heat rise measurements by themselves are not a sufficient means of determining capacitor reliability. In these cases the capacitor is subjected to relatively high peak currents at a low duty cycle. A capacitor not designed for high peak current use while never exhibiting more than a few degrees of heat rise during operation, may open after hours or possibly months of operation.

We recommend that you forward copies of your oscilloscope current and voltage waveforms for analysis of your non-sinusoidal applications.

CAPACITOR OPENS & INTERMITTENTS AFTER ENVIRONMENTAL TESTING OR LONG TERM STORAGE

CRC is frequently requested to replace "Brand X" metallized capacitors (which may have cost 50% less) that fail after being qualified for the application and after passing initial breadboard and preproduction test.

Unfortunately many specifications and programs do not take the effects of temperature cycling into consideration. Capacitor termination may withstand DC burn-in, DC life and even AC life.

Dimensional changes between plastic and metal materials as a result of temperature cycling may result in microscopic ruptures of termination joints, possible electrode oxidation and generally unstable termination series resistance. This is the reason we recommend 100% temperature cycling or thermal aging followed by the screening as described above. Component Research Company patented stress-free termination designs and precise quality control eliminates the above problems.

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AC RATED CAPACITORS RELIABILITY QUESTIONS & ANSWERS

ESTABLISHED RELIABILITY CAPACITORS

What are the limiting factors restricting the use of metallized polycarbonate capacitors for AC applications?

A properly manufactured and screened capacitor can handle considerable RMS and peak currents from −55°C to +125°C without significant heat rise. The dissipation factor of capacitors to be used in AC applications must be uniformly low to limit watt loss.

We recommend a maximum dissipation factor of 0.15% at 1KHz as the acceptance test limit. All capacitors should be subjected to temperature cycling prior to final measurement of DF to insure that they remain less than 0.15%. This test eliminates failures which may occur after storage at extreme temperatures.

CRC specifications contain the maximum RMS current and voltage ratings for sinusoidal conditions, continuous duty cycle, at 400Hz and 40KHz. For conditions other than shown, send a sketch of the current and voltage waveforms under worst case and normal operating conditions to our sales office. Include all other information necessary for quotation purposes.

Is polycarbonate better than other dielectrics for AC applications?

If size, weight, cost, or operating temperatures were not important considerations, then other dielectric style capacitors would be superior to polycarbonate.

As an example, CRC can supply polystyrene, teflon, or polypropylene AC capacitors with approximately ten times lower loss than the series 12 polycarbonate capacitors.

Polysulfone is slightly better than polycarbonate for AC applications below 100° C, and can be used above 125°C (the limit for polycarbonate), to 150°C with proper voltage derating.

CRC considers mylar and paper dielectric styles too lossy for AC applications and therefore does not recommend this type for such requirements. Additional information on AC capacitors appears on other pages of this catalog.

What type of screening test will assure that the polycarbonate capacitors are reliable for AC applications?

Once it has been determined that your application requirements can be met by CRC standard polycarbonate series 12 capacitors, the screening test used by CRC and incorporated into MIL-C-83421/1 will be sufficient to provide the quality assurance needed.

As an example, 100% of the capacitors are temperature cycled then subjected to a square wave voltage at 100Hz at 300% of rated DC voltage for peak to peak amplitude.

During this test the capacitors must handle approximately 35 microsecond wide current pulses for one minute at a rate of 200 per second.

A routine examination of the current and voltage waveforms during square wave hipot of 10 uF, 50VDC type CRH capacitors, shows that with 150 volts peak to peak voltage at 100Hz applied, the peak current is 85 amps. This is equivalent to operation with a half sine wave peak current pulse of 8.5 amps/uF at a 200 PPS rate. SEE WAVEFORMS AT RIGHT.

Following the square wave voltage stress test the capacitors must meet 0.15% max. dissipation factor limits.

Life testing of CRC metallized polycarbonate capacitors at 400 Hz and 4000 Hz is performed continuously as retention of qualification to MIL-C-83421/1.

Why are CRC low dissipation factor polycarbonate capacitors replacing commonly manufactured capacitors in AC applications?

There is a risk that the dissipation factor of such capacitors will increase with use and result in hot spots at the terminations. Field failures of such capacitors have been reported where the capacitors have exploded and caused fire damage.

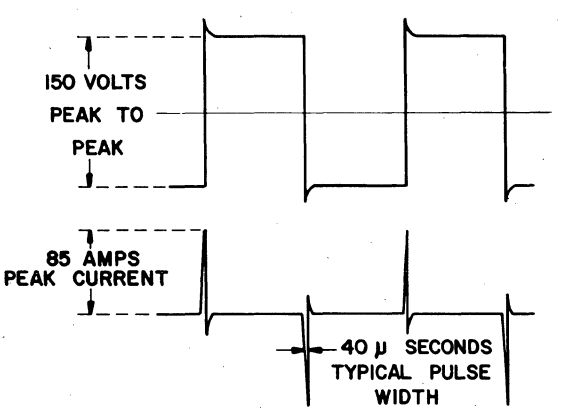
It may be possible to use ordinary higher DF capacitors without noticeable problems at 400Hz, provided that RMS voltage is sufficiently low such that the RMS current is limited. Heat sinking will also help prevent excess heat rise due to poor quality terminations.

Interestingly enough CRC polycarbonate capacitors have a lower dissipation factor at temperatures from 75°C to 125°C than at 25°C which lowers their effective heat rise at higher temperatures. Where the current source is limited, higher DF capacitors may not heat sufficiently to short, but may gradually suffer from increasing DF to the point where they are effectively open.

What is the maximum current that can be applied to MIL-C-83421/1 capacitors?

The 40 KHz current and voltage ratings listed in Table 1 of the Mil-Spec and CRC's specifications shown in this catalog, are based upon continuous operation under sinusoidal conditions. In order to eliminate failures it is essential that any use under conditions exceeding these limits be discussed further with our applications engineers. Under certain conditions, the capacitors can be used at higher frequencies and in square wave filtering applications. For good reliability it is best to study these special applications on an individual basis. CRC plans to provide data tables showing allowable working conditions during higher frequency sinusoidal, pulsed, and non-sinusoidal conditions.

TYPICAL VOLTAGE AND PEAK CURRENT WAVEFORMS SHOWN FOR A12B106, 10 uF, 50 V, METALLIZED POLYCARBONATE CAPACITOR DURING THE ONE MINUTE AC SQUARE WAVE SCREENING AT 100 Hz.



CRC COMPONENT RESEARCH CO.

VOLTAGE TEMPERATURE SCANNING FOR CAPACITOR FAULTS

ESTABLISHED RELIABILITY CAPACITORS

SCREENING FOR HIGH IMPEDANCE FAULTS

All types of capacitors whether metallized or foil, single or dual dielectric construction, can behave intermittently when operated under certain combined conditions of temperature, and high impedance or low power.

As a result of testing thousands of capacitors using computer scanning techniques and analysis of discrepant parts, the following has been concluded:

1) Low resistance faults such as clearings are not visible in CRC capacitors when they are operated under specified conditions. The CRC method of inspection, processing, and grading all film used in a capacitor prior to winding, assures that low resistance faults will not occur. A low resistance fault can arbitrarily be called a conductive path of less than 10,000 ohms.

2) Electro-chemical effects of contamination within the capacitor enclosure can cause spurious, random conduction when the capacitor is operated at elevated temperature in current limited applications such as in the feedback loop of an operational amplifier. Under some conditions the effect is polar resulting in low leakage current with voltage applied in one direction and increased leakage current in the other direction.

The resistance levels for faulty metallized polycarbonate capacitors at 125°C may vary from 10,000 megohms to as low as 1 megohm for capacitors 1 μF and less.

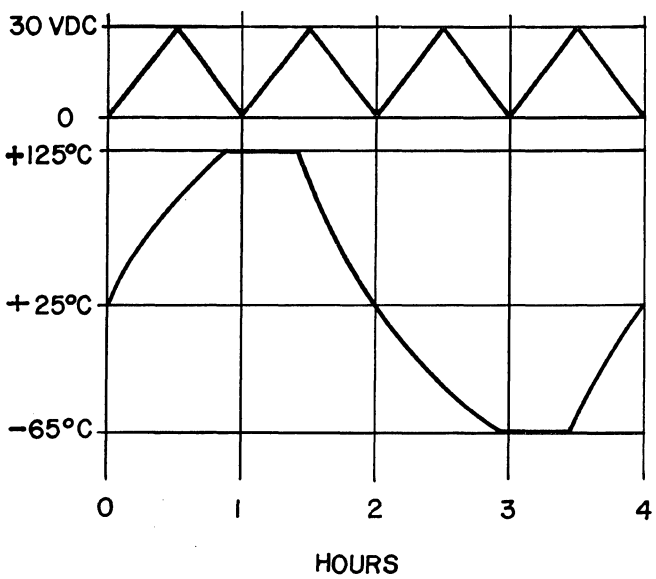
3) High resistance faults of this type are not readily detectable with conventional equipment and will not usually affect performance of most circuits particularly if kept in operation below 100°C.

4) Non-hermetically sealed capacitors or hermetically sealed types with fine or gross leak conditions which have ingested water or other contaminates tend to develop electro-chemical activity within the capacitor enclosure. This type of fault may be accelerated by condensation or pressure changes when the equipment sees temperature differences such as in aircraft or varying humidity conditions.

5) CRC eliminates contamination from its product before sealing and can screen for low or high resistance faults under worst case operating conditions.

Contact CRC for special fault screening if your requirement must have freedom from clearings, intermittent conduction at high temperature and if it must in every way be noise-free electrically.

TYPICAL VOLTAGE/ TEMPERATURE RAMP SCREENING CYCLE



This General Radio model 2230 Component Test System is used in conjunction with CRC specially designed ramp generators, cycling chambers, and interface equipment for voltage/ temperature capacitor fault-scanning.

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CRC COMPONENT RESEARCH CO.

THERMAL SHOCK TEST 500 CYCLES

ESTABLISHED RELIABILITY CAPACITORS

DATA COVERS A12A 30VDC METALLIZED POLYCARBONATE CAPACITORS

Applications such as the space shuttle require capacitors which can withstand many thermal shock cycles without deterioration of terminations.

In 1976 George C. Marshall Space Flight Center contracted Component Research to manufacture and test MIL-C-83421/1 style parts to withstand 500 thermal shock cycles, while maintaining electrical integrity without becoming intermittent.

One hundred and fifty capacitors incorporating design improvements (which have been implemented in all standard parts since completion of the test) were manufactured and subsequently underwent 500 thermal shock cycles.

One hundred and forty nine (149) capacitors survived the tests. Failure analysis of the failed part was due to a poor solder joint, initially detected during acceptance tests as having poor dissipation factor and equivalent series resistance measurements. Operator error precluded the capacitor being eliminated from the test program.

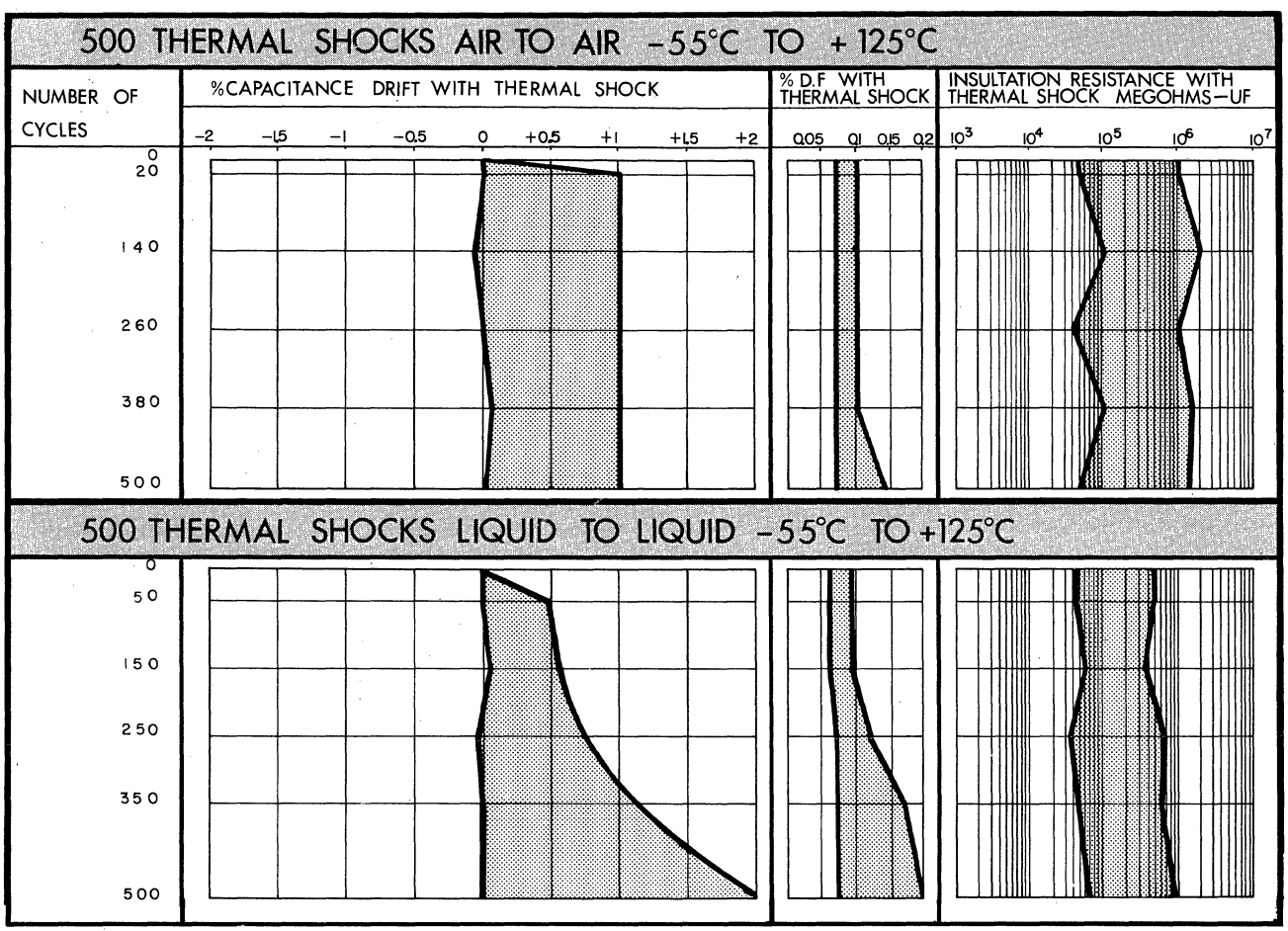
HIGHLIGHTS OF 500 THERMAL SHOCK CYCLE TEST

■ **60 capacitors were subjected to 500 thermal shock cycles** for accelerated test in liquid to liquid, at the rate of fifty (50) cycles per day. The capacitors were immersed into each liquid for sixty (60) seconds and transferred from one bath to another within fifteen (15) seconds. The temperature extremes were −55°C and 125°C.

TEST RESULTS: (60 CAPACITORS)
+0.84% MAXIMUM CAPACITANCE DRIFT
0.11% MAXIMUM DISSIPATION FACTOR @ 1KHz
0.22% MAXIMUM DISSIPATION FACTOR @ 10KHz
0.19 OHMS MAXIMUM EQUIVALENT SERIES RESISTANCE @ 100KHz
1.6×10^{7} MEG's-uF MINIMUM INSULATION RESISTANCE
■ ALL PARTS PASSED 1×10^{-6} ATM/CM³/SEC MAX LEAK RATE

■ **90 capacitors were subjected to 500 thermal shock cycles** in air to air, at the rate of one (1) cycle per hour. The dwell time at each temperature extreme was a minimum of thirty (30) minutes. The maximum transfer time from one chamber to another was sixty (60) seconds. The temperature extremes were −55°C to +125°C.

TEST RESULTS: (90 CAPACITORS)
+6.3% MAXIMUM CAPACITANCE DRIFT
0.095% MAXIMUM DISSIPATION FACTOR @ 1KHz
0.46% MAXIMUM DISSIPATION FACTOR @ 10KHz
0.53 OHMS MAXIMUM EQUIVALENT SERIES RESISTANCE @ 100KHz
9.7×10^{3} MEG'S-uF MINIMUM INSULATION RESISTANCE



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LIFE TEST - 40,000 HOURS

ESTABLISHED RELIABILITY CAPACITORS

PURPOSE OF 40,000 HOUR LIFE TEST

In 1972 CRC decided to conduct long term life tests on 50VDC metallized polycarbonate capacitors to study the effects of operation at 100°C and rated voltage on capacitance drift, insulation resistance, and dissipation factor.

After five years of test (including approximately 10 months of overstress at 125°C and 280% of rated DC), CRC is pleased to report that our capacitors are highly recommended for long life requirements.

In 1970 thousands of CRC metallized polycarbonate capacitors were used in an underwater cable application requiring a minimum of 20 years operation without failure. There have been no reported failures to date in this critical application or in others, such as long term space probes.

HIGHLIGHTS OF 40,000 HOUR LIFE TESTING

Test conditions were 50VDC at 100°C for 12,000 hours for 45 capacitors resulting in 0.27% max. capacitance drift, 0.17% max. dissipation factor, and 750,000 megs-uF minimum insulation resistance.

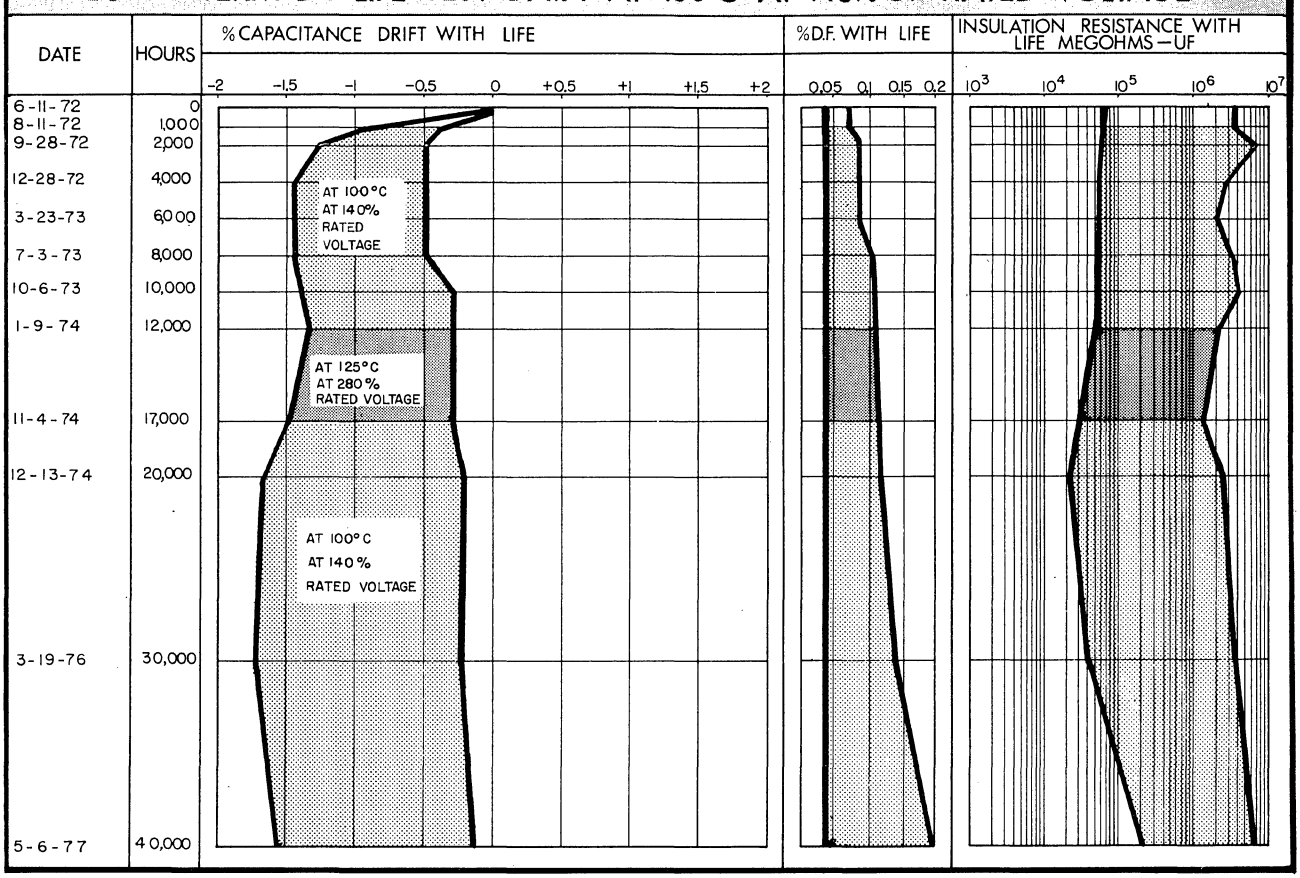
5000 additional hours (in error) were at 125°C and 70VDC which is actually at 280% of rated voltage considering that 50% derating is required from 100°C to 125°C.

As a result one capacitor shorted, capacitance drift was −1.5% worst case. Dissipation factor remained 0.17% max. and insulation resistance was 1,000,000 Megs-uF minimum.

Life testing was continued from 17,000 to 40,000 hours at 50VDC and 100°C with 1.25% max. capacitance drift, 0.19% max. dissipation factor, and 35,000 megs-uF minimum insulation resistance at end of test.

It is obvious that considerably reduced drift and parametric change would have resulted if the 5000 hr. overstress period had not occurred.

LONG TERM DC LIFE TEST DATA AT 100°C AT 140% OF RATED VOLTAGE



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CRC
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METALLIZED POLYCARBONATE
A12 & K12

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

1.0 μF 30VDC ACTUAL SIZE CAPACITOR

QUALIFIED TO MIL-C-83421/01 FAILURE RATE S.

HERMETICALLY SEALED, HIGH RELIABILITY SCREENED FOR CRITICAL AEROSPACE APPLICATIONS.

AC RATED FROM 22VRMS TO 240VRMS AT FREQUENCIES FROM 0 TO 400Hz. RATINGS TO 40KHz AT LOWER VOLTAGE RATINGS, −65°C TO +100°C WITH DERATED OPERATION AT 125°C, DC RATED 30VDC TO 400VDC.

100% RELIABILITY SCREENING, INCLUDES BURN-IN, TEMPERATURE CYCLING, FINE LEAK TESTS, AND AC SQUARE WAVE TESTS.

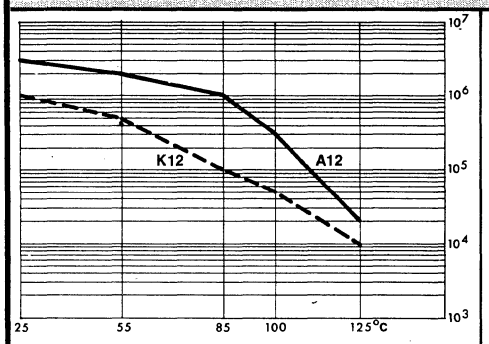
LOW LOSS, RUGGED INTERNAL TERMINATIONS QUALIFIED FOR ALL HI-REL PROGRAMS (CRC PATENTED CONSTRUCTION).

CAPACITORS HAVE BEEN THERMAL SHOCK TESTED FOR 1000 CYCLES FROM −65°C to +125°C, AIR TO AIR AND LIQUID TO LIQUID, SEE THERMAL SHOCK TEST PAGE.

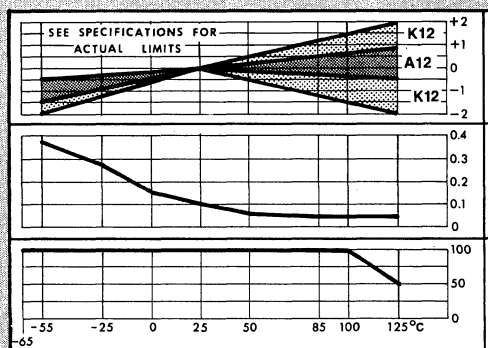
CAPACITORS OF SAME DESIGN AND CONSTRUCTION HAVE BEEN LIFE TESTED TO 40,000 HOURS, SEE 40,000 HOUR LIFE TEST DATA PAGE.

AVAILABLE IN STANDARD TOLERANCES: 0.25%, 0.5%, 1%, 2%, 5%, 10%. OTHER TOLERANCES AVAILABLE ON REQUEST.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



% CAPACITANCE CHANGE WITH TEMPERATURE

% DISSIPATION FACTOR WITH TEMPERATURE

% VOLTAGE RATING WITH TEMPERATURE

TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- FILTERING
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- POWER SUPPLY FILTERING
- GYRO CIRCUITS
- PULSE FORMING NETWORKS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #77TR116

TEST RESULTS FOR SERIES A12 CAPACITORS LIFE TESTED FOR 2000 HOURS AT 100°C AT 140% OF RATED DC VOLTAGE.

THERE WERE NO FAILURES FOR THIS TEST.

LIST OF CAPACITORS SUBMITTED TO LIFE TEST			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
A12A	.1	20	$1x10^6$	$3x10^6$	$4x10^6$	±2.0	0.00	+.40	.25	.07	.08
A12A	.001	20	$1x10^6$	$1x10^7$	$30x10^6$	±2.0	−.38	+.06	.25	.05	.05
A12B	1.0	20	$1x10^5$	$8x10^5$	$1x10^6$	±2.0	−.03	+.18	.25	.04	.05
A12B	.018	20	$1x10^6$	$1.2x10^7$	$2.5x10^7$	±2.0	−.33	−.16	.25	.07	.08
A12C	4.7	20	$2x10^4$	$1.1x10^5$	$5x10^5$	±2.0	−.13	−.06	.25	.04	.05
A12C	.039	20	$1x10^6$	$1.4x10^7$	$2x10^7$	±2.0	−.07	+.05	.25	.08	.08
A12D	.56	30	$1.8x10^5$	$1.6x10^6$	$1.8x10^6$	±2.0	−.03*	+.05	.25	.05	.06
A12E	.01	30	$1x10^6$	$4x10^7$	$6.6x10^7$	±2.0	+.02	−.16	.25	.07	.07

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METALLIZED POLYCARBONATE A12 & K12

ESTABLISHED RELIABILITY CAPACITORS

A12 AND K12 SPECIFICATIONS

CONSTRUCTION	Metallized polycarbonate dielectric, hermetically sealed, extended metal film electrodes, axial leads isolated from case.		
ENVIRONMENTAL	Capacitors meet all environmental requirements and are qualified to MIL-C-83421/1.		
OPERATING TEMPERATURE	−65°C to +100°C		At full rated voltage, derate linearly to 50% of rated voltage at 125°C.
DIELECTRIC ABSORPTION	0.1% maximum		At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.15% maximum		At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum		At 25°C at a peak to peak voltage of 3 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	200% rated DC voltage		At 25°C from terminal to terminal and terminal to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT (IN % CAPACITANCE)	A12	−0.5% to +0.8%	From +25°C to +125°C
	K12	±2%	
	A12	−0.5% to −1.5%	From −55°C to 25°C
	K12	−0.5% to −2.0%	
CAPACITANCE STABILITY (IN % CAPACITANCE)	A12	±0.2%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
	K12	±0.25%	
HERMETIC SEAL	1×10^{-6} atm/cm³/sec.		Maximum leak rate.
INSULATION RESISTANCE	See Insulation Resistance Table		Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R.
EXAMPLE: A 0.5uF, SERIES A12 CAPACITOR AT 25°C IS 300,000 ÷ 0.5 = 600,000 MEGOHMS.

RANGE	STYLE	25°C	55°C	85°C	100°C	125°C
.001 TO 0.1uF	A12	3,000,000 Megohms	2,000,000 Megohms	1,000,000 Megohms	300,000 Megohms	20,000 Megohms
	K12	1,000,000 Megohms	500,000 Megohms	100,000 Megohms	50,000 Megohms	10,000 Megohms
GREATER THAN 0.1uF	A12	300,000 Megohms-uF	200,000 Megohms-uF	100,000 Megohms-uF	30,000 Megohms-uF	2,000 Megohms-uF
	K12	100,000 Megohms-uF	50,000 Megohms-uF	10,000 Megohms-uF	5,000 Megohms-uF	1,000 Megohms-uF

A12 AND K12 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL A12	QUALITY LEVEL K12
1	BURN-IN	48 hrs. minimum at 125°C, at 140% rated DC voltage	4.7.2	No physical damage	100% Test	Not Req'd
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C (5 cycles min. for K12)	4.7.3	No physical damage	100% Test	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1×10^{-6} atm/cm³/sec. max.	100% Test	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test	100% Test
5	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 3 times DC rated voltage for 60 seconds minimum	4.7.6	No shorts	100% Test	100% Test
6	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum. Do not exceed 800 volts peak to peak.	4.7.6	No shorts	100% Test	100% Test
7	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	Per I.R. Table	100% Test	100% Test
8	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8.	Per part number	100% Test	100% Test
9	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.15% max.	100% Test	100% Test
10	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. 2. Traceability to production and test records by permanent marking of parts with date code lot. 3. Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

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METALLIZED POLYCARBONATE A12 & K12 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE 12A 30VDC			TYPE 12B 50VDC			TYPE 12C 100VDC			TYPE 12D 200VDC			TYPE 12E 400VDC		
	Diam. A	Length B	Length C	Diam. A	Length B	Length C	Diam. A	Length B	Length C	Diam. A	Length B	Length C	Diam. A	Length B	Length C
.001	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0012	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0015	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0018	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.002	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0022	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0027	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.0033	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.0039	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.0047	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.005	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.0056	.170	.500	.600	.170	.500	.600	.170	.500	.600	.170	.562	.662	.235	.562	.662
.0068	.170	.500	.600	.170	.500	.600	.170	.562	.662	.170	.562	.662	.235	.687	.787
.0075	.170	.500	.600	.170	.562	.662	.170	.562	.662	.193	.562	.662	.235	.687	.787
.0082	.170	.500	.600	.170	.562	.662	.170	.562	.662	.193	.562	.662	.235	.687	.787
.01	.170	.500	.600	.170	.562	.662	.170	.687	.787	.193	.562	.662	.235	.687	.787
.012	.170	.500	.600	.170	.562	.662	.170	.687	.787	.193	.562	.662	.235	.687	.787
.015	.170	.500	.600	.170	.562	.662	.170	.687	.787	.235	.562	.662	.235	.813	.913
.018	.170	.500	.600	.193	.562	.662	.193	.687	.787	.235	.687	.787	.312	.813	.913
.02	.170	.500	.600	.193	.562	.662	.193	.687	.787	.235	.687	.787	.312	.813	.913
.022	.170	.500	.600	.193	.562	.662	.193	.687	.787	.235	.687	.787	.312	.813	.913
.027	.170	.562	.662	.193	.562	.662	.193	.687	.787	.312	.687	.787	.312	.813	.913
.033	.170	.562	.662	.193	.562	.662	.193	.687	.787	.312	.687	.787	.312	.813	.913
.039	.170	.562	.662	.170	.687	.787	.235	.687	.787	.312	.687	.787	.312	.813	.913
.047	.170	.562	.662	.170	.687	.787	.235	.687	.787	.312	.687	.787	.400	.813	.913
.05	.170	.562	.662	.170	.687	.787	.235	.687	.787	.312	.687	.787	.400	.813	.913
.056	.170	.562	.662	.193	.687	.787	.235	.687	.787	.312	.813	.913	.400	.813	.913
.068	.170	.687	.787	.193	.687	.787	.235	.813	.913	.312	.813	.913	.400	.813	.913
.075	.170	.687	.787	.193	.813	.913	.312	.687	.787	.312	.813	.913	.400	1.063	1.163
.082	.170	.687	.787	.193	.813	.913	.312	.687	.787	.312	.813	.913	.400	1.063	1.163
.1	.193	.687	.787	.193	.813	.913	.312	.687	.787	.312	.813	.913	.400	1.063	1.163
.12	.193	.687	.787	.235	.687	.787	.312	.687	.787	.312	.813	.913	.400	1.063	1.163
.15	.235	.562	.662	.235	.687	.787	.312	.813	.913	.400	1.063	1.163	.400	1.375	1.475
.18	.235	.687	.787	.235	.813	.913	.312	.813	.913	.400	1.375	1.475	.500	1.375	1.475
.2	.235	.687	.787	.235	.813	.913	.312	.813	.913	.400	1.375	1.475	.500	1.375	1.475
.22	.235	.687	.787	.235	.813	.913	.312	.813	.913	.400	1.375	1.475	.500	1.375	1.475
.27	.235	.687	.787	.312	.687	.787	.312	1.063	1.163	.500	1.375	1.475	.562	1.375	1.475
.33	.235	.687	.787	.312	.687	.787	.312	1.063	1.163	.500	1.375	1.475	.562	1.375	1.475
.39	.235	.687	.787	.312	.813	.913	.400	1.063	1.163	.500	1.375	1.475	.562	1.875	1.975
.47	.312	.687	.787	.312	.813	.913	.400	1.063	1.163	.500	1.375	1.475	.562	1.875	1.975
.5	.312	.687	.787	.312	.813	.913	.400	1.063	1.163	.500	1.375	1.475	.562	1.875	1.975
.56	.312	.687	.787	.400	.813	.913	.400	1.063	1.163	.500	1.375	1.475	.562	1.875	1.975
.68	.312	.687	.787	.400	.813	.913	.500	1.125	1.225	.562	1.375	1.475	.750	1.875	1.975
.75	.312	.813	.913	.400	1.063	1.163	.500	1.125	1.225	.562	1.875	1.975	.750	1.875	1.975
.82	.312	.813	.913	.400	1.063	1.163	.500	1.125	1.225	.562	1.875	1.975	.750	1.875	1.975
1.0	.312	.813	.913	.400	1.063	1.163	.562	1.125	1.225	.562	1.875	1.975	.750	1.875	1.975
1.2	.312	.813	.913	.400	1.063	1.163	.562	1.125	1.225	.562	1.875	1.975	1.000	1.875	1.975
1.5	.400	.813	.913	.400	1.063	1.163	.562	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475
1.8	.400	.813	.913	.400	1.063	1.163	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
2.0	.400	.813	.913	.500	1.125	1.225	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
2.2	.400	.813	.913	.500	1.125	1.225	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
2.5	.400	1.063	1.163	.500	1.375	1.475	.670	1.875	1.975	.750	1.875	1.975			
2.7	.400	1.063	1.163	.500	1.375	1.475	.670	1.875	1.975	.750	1.875	1.975			
3.0	.400	1.063	1.163	.500	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975			
3.3	.400	1.063	1.163	.500	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975			
3.9	.400	1.375	1.475	.562	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475			
4.7	.500	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475			
5.0	.500	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475			
5.6	.500	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475			
6.8	.562	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475						
7.5	.562	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475						
8.2	.562	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475						
10.0	.562	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475						
12.0	.562	1.875	1.975	.750	1.875	1.975									
15.0	.562	1.875	1.975	.750	1.875	1.975									
18.0	.670	1.875	1.975	1.000	1.875	1.975									
20.0	.670	1.875	1.975	1.000	1.875	1.975									
22.0	.670	1.875	1.975	1.000	1.875	1.975									
25.0	.750	1.875	1.975	1.000	2.375	2.475									
27.0	.750	1.875	1.975	1.000	2.375	2.475									

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads. CRC "C" dimensions for A12 and K12 capacitors is 0.1" less than MIL-C-83421/1 requires.

A12 | A | 104 | J | S | W

STYLE

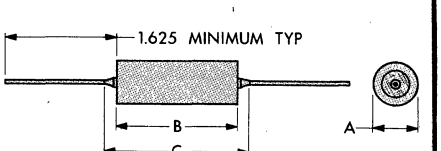
VOLTAGE
A=30VDC
B=50VDC
C=100VDC
D=200VDC
E=400VDC

SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025") for .312" case dia & smaller; #20 (.032") for .400" & .500" case dia.
C=Tinned oxygen-free copper: #18 (.040") for .562" case dia. & larger.

CAPACITANCE TOLERANCE
K=10% J=5% G=2% F=1% D=½% B=¼% A=.1%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.



COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

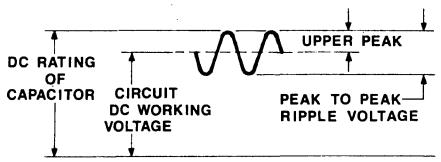
CRC COMPONENT RESEARCH CO.

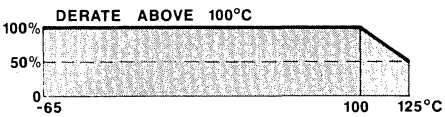
METALLIZED POLYCARBONATE A12 & K12 AC RATINGS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE 12A 30VDC AC RATINGS			TYPE 12B 50VDC AC RATINGS			TYPE 12C 100VDC AC RATINGS			TYPE 12D 200VDC AC RATINGS			TYPE 12E 400VDC AC RATINGS		
	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps
.001	22.0	22.0	.0055	36.0	36.0	.0090	60.0	60.0	.015	120.0	120.0	.030	240.0	240.0	.060
.0012	22.0	22.0	.0066	36.0	36.0	.0108	60.0	60.0	.018	120.0	120.0	.036	240.0	240.0	.072
.0015	22.0	22.0	.0083	36.0	36.0	.0135	60.0	60.0	.0225	120.0	120.0	.045	240.0	240.0	.090
.0018	22.0	22.0	.0099	36.0	36.0	.0162	60.0	60.0	.027	120.0	120.0	.054	240.0	240.0	.108
.002	22.0	22.0	.0110	36.0	36.0	.0180	60.0	60.0	.030	120.0	120.0	.060	240.0	240.0	.120
.0022	22.0	22.0	.0121	36.0	36.0	.0198	60.0	60.0	.033	120.0	120.0	.066	240.0	240.0	.132
.0027	22.0	22.0	.0149	36.0	36.0	.0243	60.0	60.0	.0405	120.0	120.0	.081	240.0	240.0	.162
.0033	22.0	22.0	.0182	36.0	36.0	.0297	60.0	60.0	.0495	120.0	120.0	.099	240.0	240.0	.198
.0039	22.0	22.0	.0215	36.0	36.0	.0351	60.0	60.0	.0585	120.0	120.0	.117	240.0	240.0	.234
.0047	22.0	22.0	.0259	36.0	36.0	.0423	60.0	60.0	.0705	120.0	120.0	.141	240.0	240.0	.282
.005	22.0	22.0	.0275	36.0	36.0	.0450	60.0	60.0	.075	120.0	120.0	.150	240.0	240.0	.300
.0056	22.0	22.0	.0308	36.0	36.0	.0504	60.0	60.0	.084	120.0	120.0	.168	240.0	240.0	.336
.0068	22.0	22.0	.0374	36.0	36.0	.0612	60.0	60.0	.102	120.0	120.0	.204	240.0	240.0	.408
.0075	22.0	22.0	.0413	36.0	36.0	.0675	60.0	60.0	.1125	120.0	120.0	.225	240.0	240.0	.450
.0082	22.0	22.0	.0451	36.0	36.0	.0738	60.0	60.0	.123	120.0	120.0	.246	240.0	240.0	.492
.01	22.0	22.0	.0550	36.0	36.0	.090	60.0	60.0	.150	120.0	120.0	.30	240.0	240.0	.60
.012	22.0	22.0	.0660	36.0	36.0	.108	60.0	60.0	.180	120.0	120.0	.36	240.0	240.0	.72
.015	22.0	22.0	.0825	36.0	36.0	.135	60.0	60.0	.225	120.0	120.0	.45	240.0	240.0	.90
.018	22.0	22.0	.0990	36.0	36.0	.162	60.0	60.0	.270	120.0	120.0	.54	240.0	240.0	1.08
.02	22.0	22.0	.1100	36.0	36.0	.180	60.0	60.0	.300	120.0	120.0	.60	240.0	240.0	1.20
.022	22.0	22.0	.1210	36.0	36.0	.198	60.0	60.0	.330	120.0	120.0	.66	240.0	240.0	1.32
.027	22.0	22.0	.1485	36.0	36.0	.243	60.0	60.0	.405	120.0	120.0	.81	240.0	240.0	1.62
.033	22.0	22.0	.1815	36.0	36.0	.297	60.0	60.0	.495	120.0	120.0	.99	240.0	240.0	1.98
.039	22.0	22.0	.2145	36.0	36.0	.351	60.0	60.0	.585	120.0	120.0	1.17	240.0	220.51	2.15
.047	22.0	22.0	.2585	36.0	36.0	.423	60.0	60.0	.705	120.0	120.0	1.41	240.0	212.76	2.50
.05	22.0	22.0	.2750	36.0	36.0	.450	60.0	60.0	.750	120.0	120.0	1.50	240.0	200.00	2.50
.056	22.0	22.0	.3080	36.0	36.0	.504	60.0	60.0	.840	120.0	120.0	1.68	240.0	178.57	2.50
.068	22.0	22.0	.3740	36.0	36.0	.612	60.0	60.0	1.020	120.0	120.0	2.04	240.0	147.05	2.50
.075	22.0	22.0	.4125	36.0	36.0	.675	60.0	60.0	1.125	120.0	114.66	2.15	240.0	160.00	3.00
.082	22.0	21.95	.450	36.0	36.0	.738	60.0	60.0	1.23	120.0	104.87	2.15	240.0	146.34	3.00
.1	22.0	22.0	.550	36.0	36.0	.85	60.0	60.0	1.50	120.0	86.00	2.15	240.0	120.00	3.00
.12	22.0	22.0	.660	36.0	36.0	1.08	60.0	60.0	1.80	120.0	71.66	2.15	240.0	99.99	3.00
.15	22.0	22.0	.825	36.0	36.0	1.35	60.0	57.33	2.15	120.0	80.00	3.00	240.0	88.00	3.30
.18	22.0	22.0	.990	36.0	36.0	1.62	60.0	47.77	2.15	120.0	73.33	3.30	240.0	77.77	3.50
.2	22.0	22.0	1.100	36.0	34.4	1.72	60.0	43.00	2.15	120.0	66.00	3.30	240.0	70.00	3.50
.22	22.0	22.0	1.210	36.0	31.27	1.72	60.0	39.09	2.15	120.0	60.00	3.30	240.0	63.63	3.50
.27	22.0	22.0	1.485	36.0	30.37	2.05	60.0	33.33	2.25	120.0	51.85	3.50	240.0	63.70	4.30
.33	22.0	18.18	1.50	36.0	24.84	2.05	60.0	27.27	2.25	120.0	42.42	3.50	240.0	52.12	4.30
.39	22.0	15.38	1.50	36.0	22.05	2.15	60.0	30.76	3.00	120.0	35.89	2.50	240.0	46.15	4.50
.47	22.0	17.44	2.05	36.0	18.29	2.15	60.0	25.53	3.00	120.0	29.78	3.50	240.0	38.29	4.50
.5	22.0	16.4	2.05	36.0	17.20	2.15	60.0	24.00	3.00	120.0	28.00	3.50	240.0	36.00	4.50
.56	22.0	14.64	2.05	36.0	17.85	2.50	60.0	21.42	3.00	120.0	25.00	3.50	240.0	32.14	4.50
.68	22.0	12.05	2.05	36.0	14.70	2.50	60.0	19.41	3.30	120.0	25.29	4.30	240.0	35.29	6.00
.75	22.0	11.46	2.15	36.0	16.00	3.00	60.0	17.60	3.30	120.0	24.00	4.50	240.0	32.00	6.00
.82	22.0	10.48	2.15	36.0	14.63	3.00	60.0	16.09	3.30	120.0	21.95	4.50	240.0	29.26	6.00
1.0	22.0	8.6	2.15	36.0	12.00	3.00	60.0	16.00	4.00	120.0	18.00	4.50	240.0	24.00	6.00
1.2	22.0	7.16	2.15	36.0	9.99	3.00	60.0	13.33	4.00	120.0	15.00	4.50	240.0	21.33	6.40
1.5	22.0	6.66	2.50	36.0	8.00	3.00	60.0	11.46	4.30	120.0	14.13	5.30	240.0	18.66	7.00
1.8	22.0	5.55	2.50	36.0	6.66	3.00	60.0	11.11	5.00	120.0	13.33	6.00	240.0	15.55	7.00
2.0	22.0	5.0	2.50	36.0	6.60	3.30	60.0	10.00	5.00	120.0	12.00	6.00	240.0	14.00	7.00
2.2	22.0	4.54	2.50	36.0	6.00	3.30	60.0	9.09	5.00	120.0	10.09	6.00	240.0	12.72	7.00
2.5	22.0	4.8	3.00	36.0	5.60	3.50	60.0	8.48	5.30	120.0	9.60	6.00			
2.7	22.0	4.44	3.00	36.0	5.18	3.50	60.0	7.85	5.30	120.0	8.88	6.00			
3.0	22.0	3.99	3.00	36.0	4.66	3.50	60.0	7.06	5.30	120.0	8.53	6.40			
3.3	22.0	3.63	3.00	36.0	4.24	3.50	60.0	6.42	5.30	120.0	7.75	6.40			
3.9	22.0	3.38	3.30	36.0	4.41	4.30	60.0	6.15	6.00	120.0	7.17	7.00			
4.7	22.0	2.97	3.50	36.0	4.25	5.00	60.0	5.10	6.00	120.0	5.95	7.00			
5.0	22.0	2.8	3.50	36.0	4.00	5.00	60.0	4.80	6.00	120.0	5.60	7.00			
5.6	22.0	2.5	3.50	36.0	3.57	5.00	60.0	4.28	6.00	120.0	5.00	7.00			
6.8	22.0	2.52	4.30	36.0	3.11	5.30	60.0	4.11	7.00						
7.5	22.0	2.29	4.30	36.0	2.82	5.30	60.0	3.73	7.00						
8.2	22.0	2.09	4.30	36.0	2.58	5.30	60.0	3.41	7.00						
10.0	22.0	1.72	4.30	36.0	2.12	5.30	60.0	2.80	7.00						
12.0	22.0	1.50	4.50	36.0	2.00	6.00	60.0	2.33	7.00						
15.0	22.0	1.2	4.50	36.0	1.60	6.00									
18.0	22.0	1.17	5.30	36.0	1.42	6.40									
20.0	22.0	1.06	5.30	36.0	1.28	6.40									
22.0	22.0	0.96	5.30	36.0	1.16	6.40									
25.0	22.0	0.96	6.00	36.0	1.12	7.00									
27.0	22.0	0.88	6.00	36.0	1.03	7.00									

1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. CAPACITORS CAN HANDLE PULSE CURRENTS UP TO 100 TIMES GREATER THAN THE PEAK CURRENTS CALCULATED FROM THE RATED RMS RATING (PROVIDED SLOW REPETITION RATES ARE USED). IF THERE IS ANY DOUBT, A SKETCH OF THE VOLTAGE AND CURRENT WAVE FORMS WITH TIME BASE SHOULD BE SENT TO CRC FOR ANALYSIS.





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CRC
COMPONENT RESEARCH CO.

METALLIZED POLYCARBONATE
G12

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

2.5 μF 30VDC ACTUAL SIZE CAPACITOR

MINIATURE SIZE TO REPLACE NON-HERMETIC WRAP AND FILL, AND MOLDED CAPACITORS.

HERMETICALLY SEALED, HIGH RELIABILITY SCREENED FOR CRITICAL AEROSPACE APPLICATIONS.

AC RATED FROM 22VRMS TO 120VRMS AT FREQUENCIES UP TO 20KHz, −65°C to 100°C, WITH DERATED OPERATION AT 125°C. DC RATED 30VDC TO 200VDC.

100% RELIABILITY SCREENING, INCLUDES BURN-IN, TEMPERATURE CYCLING, FINE LEAK TESTS, AC SQUARE WAVE TESTS.

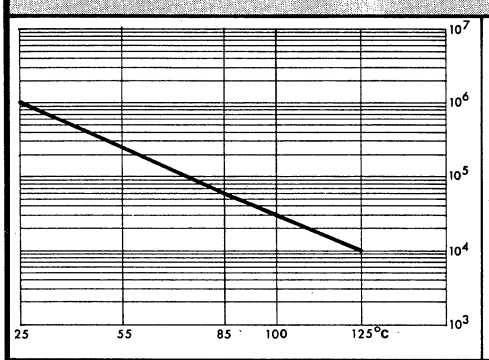
G12 CAPACITORS ARE PRESENTLY DESIGNED INTO MANY NAVY AND AIRFORCE PROGRAMS.

LOW LOSS, RUGGED INTERNAL TERMINATIONS QUALIFIED FOR ALL HI-REL PROGRAMS (CRC PATENTED CONSTRUCTION).

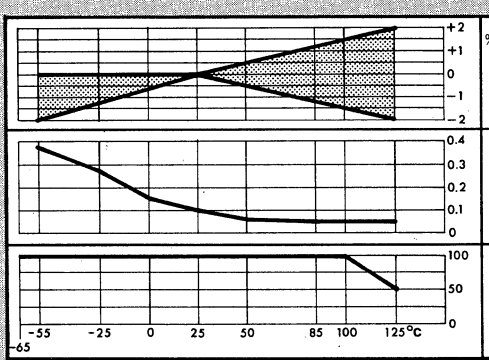
LOWEST PRICED, HIGH RELIABILITY, METALLIZED FILM CAPACITORS FOR HIGH VOLUME PROGRAM USE.

AVAILABLE IN STANDARD CAPACITANCE TOLERANCES, ±1%, ±2%, ±5%, ±10%. OTHER TOLERANCES AVAILABLE ON REQUEST.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



% CAPACITANCE CHANGE WITH TEMPERATURE

% DISSIPATION FACTOR WITH TEMPERATURE

% VOLTAGE RATING WITH TEMPERATURE

TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- FILTERING
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- POWER SUPPLY FILTERING
- GYRO CIRCUITS
- PULSE FORMING NETWORKS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #78TR129

TEST RESULTS FOR 180 SERIES G12 CAPACITORS LIFE TESTED FOR 2000 HOURS AT 100°C AT 140% OF RATED DC VOLTAGE. THERE WERE NO FAILURES FOR THIS TEST.

LIST OF CAPACITORS LIFE TESTED			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
G12A102	.001	20	$3.3x10^5$	$1.5x10^7$	$3x10^7$	±2	0.000	−.245	.25	.035	.055
G12A153	.015	20	$3.3x10^5$	$1.5x10^7$	$3x10^7$	±2	−.055	−.215	.25	.06	.08
G12B102	.001	20	$3.3x10^5$	$2x10^7$	$5x10^7$	±2	+.005	+.15	.25	.045	.055
G12B684	.68	20	$4.9x10^4$	$1.9x10^6$	$5x10^6$	±2	−.035	−.13	.25	.045	.055
G12C222	.0022	20	$3.3x10^5$	$5x10^7$	$1x10^8$	±2	+.01	−.225	.25	.055	.065
G12C305	3.0	20	$1.1x10^4$	$2.7x10^5$	$8.3x10^5$	±2	0.00	+.07	.25	.04	.045
G12D333	.033	20	$3.3x10^5$	$2x10^7$	$2.8x10^7$	±2	−.005	−.22	.25	.07	.075
G12D564	.56	20	$5.9x10^4$	$1.7x10^6$	$3.4x10^6$	±2	−.06	−.15	.25	.045	.055

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

METALLIZED POLYCARBONATE G12

ESTABLISHED RELIABILITY CAPACITORS

G12 SPECIFICATIONS

CONSTRUCTION	Metallized polycarbonate dielectric, hermetically sealed, extended metal film electrodes, axial leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmental requirements of MIL-C-83421.	
OPERATING TEMPERATURE	−65°C to +100°C	At full rated voltage, derate linearly to 50% of rated voltage at 125°C.
DIELECTRIC ABSORPTION	0.1% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.15% maximum	At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum	At 25°C at a peak to peak voltage of 2 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	200% DC volts	At 25°C from terminal to terminal and terminal to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	±2% 0% to −2%	From 25°C to +125°C. From 25°C to −55°C.
CAPACITANCE STABILITY	±0.25%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6}atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.18uF CAPACITOR AT 25°C IS 100,000 ÷ 0.18 = 555,555 MEGOHMS.

RANGE	25°C	85°C	100°C	125°C
.001 TO 0.1uF	1,000,000 Megohms	60,000 Megohms	30,000 Megohms	10,000 Megohms
GREATER THAN 0.1uF	100,000 Megohms-uF	6,000 Megohms-uF	3,000 Megohms-uF	1,000 Megohms-uF

G12 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	48 hrs. minimum at 125°C, at 140% rated DC voltage	4.7.2	No physical damage	100% Test
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1×10^{-6}atm/cm³/sec. max.	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
5	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 2 times DC rated voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
7	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	100,000 megohm-uF, need not exceed 1,000,000 megohms	100% Test
8	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
9	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.15% max.	100% Test
10	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. **2.** Traceability to production and test records by permanent marking of parts with date code lot. **3.** Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

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CRC COMPONENT RESEARCH CO.

METALLIZED POLYCARBONATE G12 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE G12A 30VDC				TYPE G12B 50VDC				TYPE G12C 100VDC				TYPE G12D 200VDC			
	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C
.001	G12A102	.170	.500	.600	G12B102	.170	.500	.600	G12C102	.170	.500	.600	G12D102	.170	.500	.600
.0012	G12A122	.170	.500	.600	G12B122	.170	.500	.600	G12C122	.170	.500	.600	G12D122	.170	.500	.600
.0015	G12A152	.170	.500	.600	G12B152	.170	.500	.600	G12C152	.170	.500	.600	G12D152	.170	.500	.600
.0018	G12A182	.170	.500	.600	G12B182	.170	.500	.600	G12C182	.170	.500	.600	G12D182	.170	.500	.600
.002	G12A202	.170	.500	.600	G12B202	.170	.500	.600	G12C202	.170	.500	.600	G12D202	.170	.500	.600
.0022	G12A222	.170	.500	.600	G12B222	.170	.500	.600	G12C222	.170	.500	.600	G12D222	.170	.500	.600
.0027	G12A272	.170	.500	.600	G12B272	.170	.500	.600	G12C272	.170	.500	.600	G12D272	.170	.500	.600
.0033	G12A332	.170	.500	.600	G12B332	.170	.500	.600	G12C332	.170	.500	.600	G12D332	.170	.500	.600
.0039	G12A392	.170	.500	.600	G12B392	.170	.500	.600	G12C392	.170	.500	.600	G12D392	.170	.500	.600
.0047	G12A472	.170	.500	.600	G12B472	.170	.500	.600	G12C472	.170	.500	.600	G12D472	.170	.500	.600
.005	G12A502	.170	.500	.600	G12B502	.170	.500	.600	G12C502	.170	.500	.600	G12D502	.170	.500	.600
.0056	G12A562	.170	.500	.600	G12B562	.170	.500	.600	G12C562	.170	.500	.600	G12D562	.170	.500	.600
.0068	G12A682	.170	.500	.600	G12B682	.170	.500	.600	G12C682	.170	.500	.600	G12D682	.170	.500	.600
.0075	G12A752	.170	.500	.600	G12B752	.170	.500	.600	G12C752	.170	.500	.600	G12D752	.170	.562	.662
.0082	G12A822	.170	.500	.600	G12B822	.170	.500	.600	G12C822	.170	.500	.600	G12D822	.170	.562	.662
.01	G12A103	.170	.500	.600	G12B103	.170	.500	.600	G12C103	.170	.500	.600	G12D103	.170	.687	.787
.012	G12A123	.170	.500	.600	G12B123	.170	.500	.600	G12C123	.170	.500	.600	G12D123	.170	.687	.787
.015	G12A153	.170	.500	.600	G12B153	.170	.500	.600	G12C153	.170	.500	.600	G12D153	.170	.687	.787
.018	G12A183	.170	.500	.600	G12B183	.170	.500	.600	G12C183	.170	.562	.662	G12D183	.193	.687	.787
.02	G12A203	.170	.500	.600	G12B203	.170	.500	.600	G12C203	.170	.562	.662	G12D203	.193	.687	.787
.022	G12A223	.170	.500	.600	G12B223	.170	.500	.600	G12C223	.170	.562	.662	G12D223	.193	.687	.787
.027	G12A273	.170	.500	.600	G12B273	.170	.500	.600	G12C273	.170	.562	.662	G12D273	.193	.687	.787
.033	G12A333	.170	.500	.600	G12B333	.170	.500	.600	G12C333	.170	.562	.662	G12D333	.193	.687	.787
.039	G12A393	.170	.500	.600	G12B393	.170	.500	.600	G12C393	.170	.562	.662	G12D393	.235	.687	.787
.047	G12A473	.170	.500	.600	G12B473	.170	.500	.600	G12C473	.193	.562	.662	G12D473	.235	.687	.787
.05	G12A503	.170	.500	.600	G12B503	.170	.500	.600	G12C503	.193	.562	.662	G12D503	.235	.687	.787
.056	G12A563	.170	.500	.600	G12B563	.170	.500	.600	G12C563	.193	.562	.662	G12D563	.235	.687	.787
.068	G12A683	.170	.500	.600	G12B683	.170	.562	.662	G12C683	.235	.562	.662	G12D683	.312	.687	.787
.075	G12A753	.170	.500	.600	G12B753	.170	.562	.662	G12C753	.235	.562	.662	G12D753	.312	.687	.787
.082	G12A823	.170	.562	.662	G12B823	.170	.562	.662	G12C823	.235	.562	.662	G12D823	.312	.687	.787
.1	G12A104	.170	.562	.662	G12B104	.193	.562	.662	G12C104	.235	.687	.787	G12D104	.312	.687	.787
.12	G12A124	.170	.562	.662	G12B124	.193	.562	.662	G12C124	.235	.687	.787	G12D124	.312	.687	.787
.15	G12A154	.170	.562	.662	G12B154	.193	.562	.662	G12C154	.235	.687	.787	G12D154	.312	.813	.913
.18	G12A184	.193	.562	.662	G12B184	.235	.562	.662	G12C184	.235	.687	.787	G12D184	.312	.813	.913
.2	G12A204	.193	.562	.662	G12B204	.235	.562	.662	G12C204	.235	.687	.787	G12D204	.312	.813	.913
.22	G12A224	.193	.562	.662	G12B224	.235	.562	.662	G12C224	.235	.687	.787	G12D224	.312	.813	.913
.27	G12A274	.235	.562	.662	G12B274	.235	.687	.787	G12C274	.312	.687	.787	G12D274	.312	1.063	1.163
.33	G12A334	.235	.562	.662	G12B334	.235	.687	.787	G12C334	.312	.813	.913	G12D334	.312	1.063	1.163
.39	G12A394	.235	.687	.787	G12B394	.235	.687	.787	G12C394	.312	.813	.913	G12D394	.400	1.063	1.163
.47	G12A474	.235	.687	.787	G12B474	.312	.687	.787	G12C474	.400	.687	.787	G12D474	.400	1.063	1.163
.5	G12A504	.235	.687	.787	G12B504	.312	.687	.787	G12C504	.400	.687	.787	G12D504	.400	1.063	1.163
.56	G12A564	.235	.687	.787	G12B564	.312	.687	.787	G12C564	.400	.687	.787	G12D564	.400	1.063	1.163
.68	G12A684	.235	.813	.913	G12B684	.312	.687	.787	G12C684	.400	.813	.913	G12D684	.500	1.125	1.225
.75	G12A754	.235	.813	.913	G12B754	.312	.687	.787	G12C754	.400	.813	.913	G12D754	.500	1.125	1.225
.82	G12A824	.235	.813	.913	G12B824	.312	.687	.787	G12C824	.400	.813	.913	G12D824	.500	1.375	1.475
1.0	G12A105	.235	.813	.913	G12B105	.312	.813	.913	G12C105	.400	1.063	1.163	G12D105	.500	1.375	1.475
1.2	G12A125	.312	.813	.913	G12B125	.312	.813	.913	G12C125	.400	1.063	1.163	G12D125	.500	1.375	1.475
1.5	G12A155	.312	.813	.913	G12B155	.400	.813	.913	G12C155	.400	1.375	1.475				
1.8	G12A185	.312	.813	.913	G12B185	.400	.813	.913	G12C185	.400	1.375	1.475				
2.0	G12A205	.312	.813	.913	G12B205	.400	.813	.913	G12C205	.500	1.375	1.475				
2.2	G12A225	.312	.813	.913	G12B225	.400	.813	.913	G12C225	.500	1.375	1.475				
2.5	G12A255	.312	1.063	1.163	G12B255	.400	.813	.913	G12C255	.500	1.375	1.475				
2.7	G12A275	.312	1.063	1.163	G12B275	.400	1.063	1.163	G12C275	.500	1.375	1.475				
3.0	G12A305	.312	1.063	1.163	G12B305	.400	1.063	1.163	G12C305	.500	1.375	1.475				
3.3	G12A335	.312	1.063	1.163	G12B335	.400	1.063	1.163	G12C335	.500	1.375	1.475				
3.9	G12A395	.400	1.063	1.163	G12B395	.400	1.375	1.475								
4.7	G12A475	.400	1.063	1.163	G12B475	.500	1.375	1.475								
5.0	G12A505	.400	1.063	1.163	G12B505	.500	1.375	1.475								
5.6	G12A565	.400	1.063	1.163	G12B565	.500	1.375	1.475								
6.8	G12A685	.400	1.375	1.475	G12B685	.500	1.375	1.475								
7.5	G12A755	.400	1.375	1.475	G12B755	.500	1.375	1.475								
8.2	G12A825	.500	1.375	1.475	G12B825	.500	1.375	1.475								
10.0	G12A106	.500	1.375	1.475												

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±0.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads

G12 | A | 104 | J | S | W

STYLE

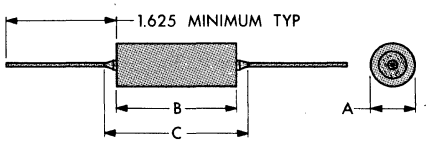
SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025″) for .312″ case dia. & smaller; #20 (.032″) for .400″ & .500″ case dia.

VOLTAGE
A=30VDC
B=50VDC
C=100VDC
D=200VDC

CAPACITANCE TOLERANCE
K=10% F=1% B=¼%
J=5% D=½% A=.1%
G=2%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.



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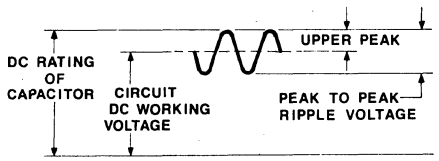
CRC COMPONENT RESEARCH CO.

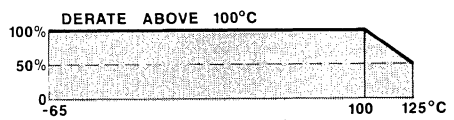
METALLIZED POLYCARBONATE G12 AC RATINGS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE G12A 30VDC MAXIMUM RATING			TYPE G12B 50VDC MAXIMUM RATING			TYPE G12C 100VDC MAXIMUM RATING			TYPE G12D 200VDC MAXIMUM RATING		
	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps
.0010	22.0	22.0	.0055	36.0	36.0	.0090	60.0	60.0	.0150	120.0	120.0	.030
.0012	22.0	22.0	.0066	36.0	36.0	.0108	60.0	60.0	.0180	120.0	120.0	.036
.0015	22.0	22.0	.0083	36.0	36.0	.0135	60.0	60.0	.0225	120.0	120.0	.045
.0018	22.0	22.0	.0099	36.0	36.0	.0162	60.0	60.0	.0270	120.0	120.0	.054
.0020	22.0	22.0	.0110	36.0	36.0	.0180	60.0	60.0	.0300	120.0	120.0	.060
.0022	22.0	22.0	.0121	36.0	36.0	.0198	60.0	60.0	.0330	120.0	120.0	.066
.0027	22.0	22.0	.0149	36.0	36.0	.0243	60.0	60.0	.0405	120.0	120.0	.081
.0033	22.0	22.0	.0182	36.0	36.0	.0297	60.0	60.0	.0495	120.0	120.0	.099
.0039	22.0	22.0	.0215	36.0	36.0	.0351	60.0	60.0	.0585	120.0	120.0	.117
.0047	22.0	22.0	.0259	36.0	36.0	.0423	60.0	60.0	.0705	120.0	120.0	.141
.0050	22.0	22.0	.0275	36.0	36.0	.0450	60.0	60.0	.0750	120.0	120.0	.150
.0056	22.0	22.0	.0308	36.0	36.0	.0504	60.0	60.0	.0840	120.0	120.0	.168
.0068	22.0	22.0	.0374	36.0	36.0	.0612	60.0	60.0	.1020	120.0	120.0	.204
.0075	22.0	22.0	.0413	36.0	36.0	.0675	60.0	60.0	1125	120.0	120.0	.225
.0082	22.0	22.0	.0451	36.0	36.0	.0738	60.0	60.0	.123	120.0	120.0	.246
.010	22.0	22.0	.0550	36.0	36.0	.090	60.0	60.0	.150	120.0	120.0	.30
.012	22.0	22.0	.0660	36.0	36.0	.108	60.0	60.0	.180	120.0	120.0	.36
.015	22.0	22.0	.0825	36.0	36.0	.135	60.0	60.0	.225	120.0	120.0	.45
.018	22.0	22.0	.0990	36.0	36.0	.162	60.0	60.0	.27	120.0	120.0	.54
.020	22.0	22.0	.1100	36.0	26.0	.180	60.0	60.0	.30	120.0	120.0	.60
.022	22.0	22.0	.1210	36.0	36.0	.198	60.0	60.0	.33	120.0	120.0	.66
.027	22.0	22.0	.1485	36.0	36.0	.243	60.0	60.0	.405	120.0	120.0	.81
.033	22.0	22.0	.1815	36.0	36.0	.297	60.0	54.54	.45	120.0	103.03	.85
.039	22.0	22.0	.2145	36.0	31.79	.31	60.0	46.15	.45	120.0	120.0	1.17
.047	22.0	22.0	.2585	36.0	26.38	.31	60.0	60.00	.705	120.0	120.0	1.41
.050	22.0	22.0	.275	36.0	24.80	.31	60.0	60.00	.75	120.0	120.0	1.50
.056	22.0	22.0	.308	36.0	22.14	.31	60.0	60.00	.84	120.0	107.14	1.50
.068	22.0	18.23	.31	36.0	26.47	.45	60.0	60.00	1.02	120.0	120.00	2.04
.075	22.0	16.53	.31	36.0	24.00	.45	60.0	58.66	1.10	120.0	109.33	2.05
.082	22.0	21.95	.45	36.0	21.95	.45	60.0	53.65	1.10	120.0	100.00	2.05
.100	22.0	18.00	.45	36.0	34.00	.85	60.0	60.00	1.50	120.0	82.00	2.05
.12	22.0	15.00	.45	36.0	28.33	.85	60.0	50.00	1.50	120.0	68.33	2.05
.15	22.0	12.00	.45	36.0	22.66	.85	60.0	40.00	1.50	120.0	57.33	2.15
.18	22.0	18.88	.85	36.0	24.44	1.10	60.0	33.33	1.50	120.0	47.77	2.15
.20	22.0	17.00	.85	36.0	22.00	1.10	60.0	30.00	1.50	120.0	43.00	2.15
.22	22.0	15.45	.85	36.0	20.00	1.10	60.0	27.27	1.50	120.0	39.09	2.15
.27	22.0	16.29	1.10	36.0	22.22	1.50	60.0	30.37	2.05	120.0	33.33	2.25
.33	22.0	13.33	1.10	36.0	18.18	1.50	60.0	26.06	2.15	120.0	27.27	2.25
.39	22.0	15.38	1.50	36.0	15.38	1.50	60.0	22.05	2.15	120.0	30.76	3.00
.47	22.0	12.76	1.50	36.0	17.44	2.05	60.0	19.14	2.25	120.0	25.53	3.00
.50	22.0	12.00	1.50	36.0	16.40	2.05	60.0	18.00	2.25	120.0	24.00	3.00
.56	22.0	10.71	1.50	36.0	14.64	2.05	60.0	16.07	2.25	120.0	21.42	3.00
.68	22.0	10.11	1.72	36.0	12.05	2.05	60.0	14.70	2.50	120.0	19.41	3.30
.75	22.0	9.17	1.72	36.0	10.93	2.05	60.0	13.33	2.50	120.0	17.60	3.30
.82	22.0	8.39	1.72	36.0	10.00	2.05	60.0	12.19	2.50	120.0	17.07	3.50
1.0	22.0	6.88	1.72	36.0	8.60	2.15	60.0	12.00	3.00	120.0	14.00	3.50
1.2	22.0	7.16	2.15	36.0	7.16	2.15	60.0	9.99	3.00	120.0	11.66	3.50
1.5	22.0	5.73	2.15	36.0	6.66	2.50	60.0	8.80	3.30			
1.8	22.0	4.77	2.15	36.0	5.55	2.50	60.0	7.33	3.30			
2.0	22.0	4.30	2.15	36.0	5.00	2.50	60.0	7.00	3.50			
2.2	22.0	3.90	2.15	36.0	4.54	2.50	60.0	6.36	3.50			
2.5	22.0	3.60	2.25	36.0	4.00	2.50	60.0	5.60	3.50			
2.7	22.0	3.33	2.25	36.0	4.44	3.00	60.0	5.18	3.50			
3.0	22.0	2.99	2.25	36.0	3.99	3.00	60.0	4.66	3.50			
3.3	22.0	2.72	2.25	36.0	3.63	3.00	60.0	4.24	3.50			
3.9	22.0	3.09	3.00	36.0	3.38	3.30						
4.7	22.0	2.55	3.00	36.0	2.97	3.50						
5.0	22.0	2.40	3.00	36.0	2.80	3.50						
5.6	22.0	2.14	3.00	36.0	2.50	3.50						
6.8	22.0	1.94	3.30	36.0	2.05	3.50						
7.5	22.0	1.76	3.30	36.0	1.86	3.50						
8.2	22.0	1.71	3.50	36.0	1.70	3.50						
10.0	22.0	1.40	3.50									

1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. CAPACITORS CAN HANDLE PULSE CURRENTS UP TO 100 TIMES GREATER THAN THE PEAK CURRENTS CALCULATED FROM THE RATED RMS RATING (PROVIDED SLOW REPETITION RATES ARE USED). IF THERE IS ANY DOUBT, A SKETCH OF THE VOLTAGE AND CURRENT WAVE FORMS WITH TIME BASE SHOULD BE SENT TO CRC FOR ANALYSIS.





COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SA.. A MONICA. CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

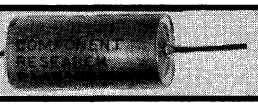
CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE P14

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

1.0 μF 50VDC ACTUAL SIZE CAPACITOR



MINIATURE SIZE - RATED TO 150°C OPERATION.

HERMETICALLY SEALED, HIGH RELIABILITY AC SCREENED FOR AEROSPACE APPLICATIONS.

AC RATED FROM 36VRMS TO 240VRMS AT FREQUENCIES UP TO 20KHz, −65°C TO 125°C WITH 50% DERATED OPERATION AT 150°C.

DC RATED FROM 50VDC TO 400VDC, −65°C TO 125°C WITH 50% DERATED OPERATION AT 150°C.

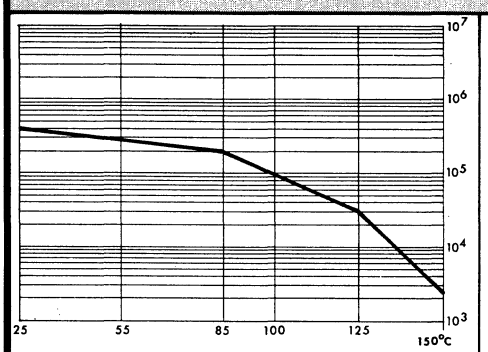
P14 CAPACITORS ARE SCREENED PER MIL-C-83421, AND ARE PRESENTLY DESIGNED INTO MANY MILITARY PROGRAMS.

LOW LOSS, RUGGED INTERNAL TERMINATIONS, QUALIFIED FOR ALL HIGH RELIABILITY PROGRAMS (CRC PATENTED CONSTRUCTION).

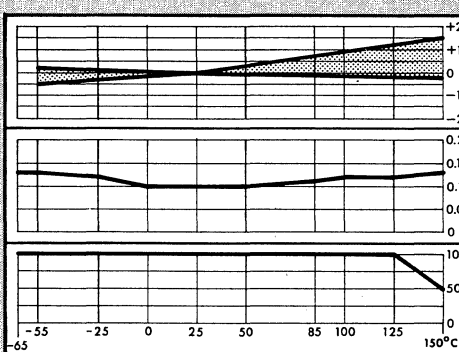
LOW CAPACITANCE DRIFT AND TC, HIGH INSULATION RESISTANCE.

AVAILABLE IN STANDARD CAPACITANCE TOLERANCES ±1%, ±2%, ±5%, ±10%. OTHER TOLERANCES AVAILABLE ON REQUEST.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



% CAPACITANCE CHANGE WITH TEMPERATURE

% DISSIPATION FACTOR WITH TEMPERATURE

% VOLTAGE RATING WITH TEMPERATURE

TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- FILTERING
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- POWER SUPPLY FILTERING
- GYRO CIRCUITS
- PULSE FORMING NETWORKS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #78TR129

TEST RESULTS FOR 180 SERIES H14 CAPACITORS LIFE TESTED FOR 2000 HOURS AT 125°C AT 140% OF RATED DC VOLTAGE. THERE WERE NO FAILURES FOR THIS TEST. H14 CAPACITORS ARE THE SAME CONSTRUCTION AND DESIGN AS P14.

LIST OF CAPACITORS SUBMITTED TO LIFE TEST			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
H14B	.047	15	$1.3x10^5$	$8x10^6$	$1.6x10^7$	±2	−.2	−.25	.25	.07	.08
H14B	.015	15	$1.3x10^5$	$1.6x10^7$	$5x10^7$	±2	+.02	+.14	.25	.06	.07
H14B	.0022	20	$1.3x10^5$	$1.2x10^7$	$5x10^7$	±2	−.01	−1.3	.25	.04	.07
H14A	.02	20	$1.3x10^5$	$1x10^7$	$1.5x10^7$	±2	0.00	−.26	.25	.04	.06
H14A	.005	20	$1.3x10^5$	$6x10^6$	$3x10^7$	±2	0.00	−1.5	.25	.05	.09

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE P14

ESTABLISHED RELIABILITY CAPACITORS

P14 SPECIFICATIONS

CONSTRUCTION	Metallized polysulfone dielectric, hermetically sealed, extended metal film electrodes, axial leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmental requirements of MIL-C-83421.	
OPERATING TEMPERATURE	−65°C to +125°C	At full rated voltage, derated linearly to 50% of rated voltage at 150°C.
DIELECTRIC ABSORPTION	0.1% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.15% maximum	At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum	At 25°C at a peak to peak voltage of 2 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	150% rated DC voltage	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	+1.5% to −1.0% +0.5% to −0.5%	From 25°C to +150°C. From 25°C to −55°C.
CAPACITANCE STABILITY	±0.25%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +150°C.
HERMETIC SEAL	1 × 10^{-6}atm/cm^3/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.5uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.68uF CAPACITOR AT 25°C IS 200,000 ÷ 0.68 = 294,117 MEGOHMS.

RANGE	25°C	85°C	125°C	150°C
.001 TO 0.5uF	400,000 Megohms	200,000 Megohms	30,000 Megohms	2,500 Megohms
GREATER THAN 0.5uF	200,000 Megohms-uF	100,000 Megohms-uF	15,000 Megohms-uF	1,250 Megohms-uF

P14 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	48 hrs. minimum at 125°C, at 120% rated AC voltage at 400Hz	4.7.2	No physical damage	100% Test
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1x10^{-6}atm/cm^3/sec. max.	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
5	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 2 times DC rated voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 150% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
7	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	200,000 megohm-uF, need not exceed 400,000 megohms	100% Test
8	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
9	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.15% max.	100% Test
10	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. 2. Traceability to production and test records by permanent marking of parts with date code lot. 3. Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

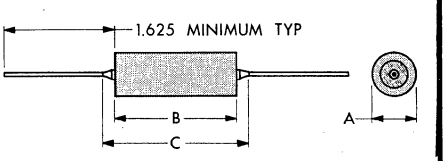
CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE P14 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE P14B 50VDC (36Vrms AC)			TYPE P14C 100VDC (60Vrms AC)			TYPE P14D 200VDC (120Vrms AC)			TYPE P14E 400VDC (240Vrms AC)		
	Diam. A	Length B	Length C	Diam. A	Length B	Length C	Diam. A	Length B	Length C	Diam. A	Length B	Length C
.001	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0012	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0015	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0018	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.002	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0022	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.562	.662
.0027	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.0033	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.0039	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.0047	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.005	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.0056	.170	.500	.600	.170	.500	.600	.170	.562	.662	.193	.687	.787
.0068	.170	.500	.600	.170	.500	.600	.193	.562	.662	.235	.687	.787
.0075	.170	.500	.600	.170	.500	.600	.193	.562	.662	.235	.687	.787
.0082	.170	.500	.600	.170	.500	.600	.193	.562	.662	.235	.687	.787
.01	.170	.500	.600	.170	.562	.662	.193	.687	.787	.312	.687	.787
.012	.170	.500	.600	.170	.562	.662	.193	.687	.787	.312	.687	.787
.015	.170	.500	.600	.170	.562	.662	.193	.687	.787	.312	.687	.787
.018	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.02	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.022	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.027	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.033	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.039	.170	.562	.662	.193	.562	.662	.235	.687	.787	.312	.813	.913
.047	.193	.562	.662	.193	.687	.787	.312	.687	.787	.400	.813	.913
.05	.193	.562	.662	.193	.687	.787	.312	.687	.787	.400	.813	.913
.056	.193	.562	.662	.193	.687	.787	.312	.687	.787	.400	.813	.913
.068	.193	.562	.662	.193	.687	.787	.312	.687	.787	.400	.813	.913
.075	.193	.687	.787	.235	.687	.787	.312	.813	.913	.400	1.063	1.163
.082	.193	.687	.787	.235	.687	.787	.312	.813	.913	.400	1.063	1.163
.1	.193	.687	.787	.235	.687	.787	.312	.813	.913	.400	1.063	1.163
.12	.193	.687	.787	.235	.687	.787	.312	.813	.913	.400	1.063	1.163
.15	.235	.687	.787	.312	.687	.787	.312	.813	.913	.500	1.125	1.225
.18	.235	.687	.787	.312	.687	.787	.400	.813	.913	.500	1.125	1.225
.20	.235	.687	.787	.312	.687	.787	.400	.813	.913	.500	1.125	1.225
.22	.235	.687	.787	.312	.687	.787	.400	.813	.913	.500	1.125	1.225
.27	.312	.687	.787	.312	.813	.913	.400	1.063	1.163	.562	1.375	1.475
.33	.312	.687	.787	.312	.813	.913	.400	1.063	1.163	.562	1.375	1.475
.39	.312	.687	.787	.312	.813	.913	.400	1.063	1.163	.562	1.375	1.475
.47	.312	.813	.913	.400	.813	.913	.500	1.125	1.225	.670	1.375	1.475
.50	.312	.813	.913	.400	.813	.913	.500	1.125	1.225	.670	1.375	1.475
.56	.312	.813	.913	.400	.813	.913	.500	1.125	1.225	.670	1.375	1.475
.68	.400	.813	.913	.400	1.063	1.163	.562	1.375	1.475	.670	1.375	1.475
.75	.400	.813	.913	.400	1.063	1.163	.562	1.375	1.475	.670	1.375	1.475
.82	.400	.813	.913	.400	1.063	1.163	.562	1.375	1.475	.670	1.875	1.975
1.0	.400	.813	.913	.400	1.063	1.163	.562	1.375	1.475	.750	1.875	1.975
1.2	.400	1.063	1.163	.500	1.125	1.225	.670	1.375	1.475	.750	1.875	1.975
1.5	.400	1.063	1.163	.500	1.125	1.225	.670	1.375	1.475	.750	1.875	1.975
1.8	.500	1.125	1.225	.500	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975
2.0	.500	1.125	1.225	.500	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975
2.2	.500	1.125	1.225	.500	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975
2.5	.562	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
2.7	.562	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
3.0	.562	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
3.3	.562	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975	1.000	2.375	2.475
3.9	.562	1.375	1.475	.670	1.375	1.475	.750	1.875	1.975			
4.7	.670	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975			
5.0	.670	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975			
5.6	.670	1.375	1.475	.670	1.875	1.975	1.000	1.875	1.975			
6.8	.670	1.375	1.475	.670	1.875	1.975	1.000	2.375	2.475			
7.5	.670	1.875	1.975	.750	1.875	1.975	1.000	2.375	2.475			
8.2	.670	1.875	1.975	.750	1.875	1.975	1.000	2.375	2.475			
10.0	.670	1.875	1.975	.750	1.875	1.975	1.000	2.375	2.475			
12.0	.750	1.875	1.975	1.000	1.875	1.975						
15.0	.750	1.875	1.975	1.000	1.875	1.975						
18.0	1.000	1.875	1.975	1.000	2.375	2.475						
20.0	1.000	1.875	1.975	1.000	2.375	2.475						
22.0	1.000	1.875	1.975	1.000	2.375	2.475						
25.0	1.000	2.375	2.475									
27.0	1.000	2.375	2.475									

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.



CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±0.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads

P14	B	104	J	S	W

STYLE

VOLTAGE
B=50VDC
C=100VDC
Y=150VDC
D=200VDC
V=300VDC
E=400VDC

SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025") for .312" case dia. & smaller; #20 (.032") for .400" & .500" case dia.
C=Tinned oxygen-free copper: #18 (.040") for .562" case dia. & larger.

CAPACITANCE TOLERANCE
K=10% G=2% D=½%
J=5% F=1% B=¼%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.

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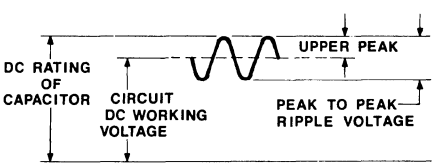
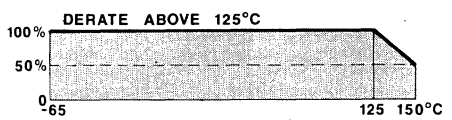
CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE P14 AC RATINGS

ESTABLISHED RELIABILITY CAPACITORS

CAP. uF	TYPE P14B 50VDC MAXIMUM RATING			TYPE P14C 100VDC MAXIMUM RATING			TYPE P14D 200VDC MAXIMUM RATING			TYPE P14E 400VDC MAXIMUM RATING		
	Volts RMS	In KHz Freq.	Amps RMS	Volts RMS	In KHz Freq.	Amps RMS	Volts RMS	In KHz Freq.	Amps RMS	Volts RMS	In KHz Freq.	Amps RMS
.001	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.0012	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.0015	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.0018	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.002	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.0022	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.4
.0027	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.0033	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.0039	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.0047	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.005	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.0056	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.25	240.0	40.0	.6
.0068	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.40	240.0	40.0	1.0
.0075	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.40	240.0	40.0	1.0
.0082	36.0	40.00	.14	60.0	40.00	.14	120.0	40.00	.40	240.0	40.0	1.0
.01	36.0	40.00	.14	60.0	40.00	.25	120.0	40.00	.60	240.0	40.0	1.4
.012	36.0	40.00	.14	60.0	40.00	.25	120.0	40.00	.60	240.0	40.0	1.4
.015	36.0	40.00	.14	60.0	40.00	.25	120.0	40.00	.60	240.0	40.0	1.4
.018	36.0	40.00	.25	60.0	40.00	.40	120.0	40.00	1.00	240.0	40.0	1.6
.02	36.0	40.00	.25	60.0	40.00	.40	120.0	40.00	1.00	240.0	40.0	1.6
.022	36.0	40.00	.25	60.0	40.00	.40	120.0	40.00	1.00	240.0	40.0	1.6
.027	36.0	40.00	.25	60.0	40.00	.40	120.0	40.00	1.00	240.0	40.0	1.6
.033	36.0	34.00	.25	60.0	32.00	.40	120.0	40.00	1.00	240.0	32.3	1.6
.039	36.0	32.00	.28	60.0	29.00	.42	120.0	40.00	1.20	240.0	27.4	1.6
.047	36.0	32.00	.34	60.0	28.00	.50	120.0	39.70	1.40	240.0	25.5	1.8
.05	36.0	32.00	.36	60.0	28.00	.53	120.0	37.30	1.40	240.0	24.0	1.8
.056	36.0	31.70	.40	60.0	27.50	.58	120.0	33.30	1.40	240.0	21.4	1.8
.068	36.0	29.00	.45	60.0	27.40	.70	120.0	27.40	1.40	240.0	17.0	1.8
.075	36.0	29.00	.50	60.0	25.00	.70	120.0	27.00	1.50	240.0	17.0	2.0
.082	36.0	28.00	.53	60.0	25.00	.78	120.0	26.00	1.60	240.0	16.3	2.0
.1	36.0	26.60	.60	60.0	25.00	.94	120.0	21.30	1.60	240.0	13.3	2.0
.12	36.0	26.00	.70	60.0	25.00	1.10	120.0	17.80	1.60	240.0	11.1	2.0
.15	36.0	25.00	.85	60.0	24.80	1.40	120.0	16.00	1.80	240.0	11.0	2.4
.18	36.0	24.60	1.00	60.0	20.70	1.40	120.0	13.30	1.80	240.0	11.0	3.0
.20	36.0	22.20	1.00	60.0	18.70	1.40	120.0	12.00	1.80	240.0	10.0	3.0
.22	36.0	20.00	1.00	60.0	16.90	1.40	120.0	11.00	1.80	240.0	10.0	3.0
.27	36.0	20.00	1.20	60.0	15.80	1.60	120.0	10.00	2.00	240.0	10.0	4.2
.33	36.0	16.00	1.20	60.0	13.00	1.60	120.0	8.80	2.20	240.0	8.7	4.3
.39	36.0	14.00	1.20	60.0	11.00	1.60	120.0	8.20	2.40	240.0	7.3	4.3
.47	36.0	14.00	1.50	60.0	10.20	1.80	120.0	8.00	2.80	240.0	6.4	4.5
.50	36.0	13.30	1.50	60.0	9.60	1.80	120.0	8.00	3.00	240.0	6.0	4.5
.56	36.0	11.90	1.50	60.0	8.60	1.80	120.0	7.60	3.20	240.0	5.4	4.5
.68	36.0	11.90	1.80	60.0	7.80	2.00	120.0	7.40	3.80	240.0	5.0	5.0
.75	36.0	10.60	1.80	60.0	7.10	2.00	120.0	7.40	4.20	240.0	4.4	5.0
.82	36.0	9.75	1.80	60.0	6.50	2.00	120.0	7.00	4.30	240.0	4.1	5.0
1.0	36.0	8.00	1.80	60.0	5.80	2.20	120.0	5.70	4.30	240.0	3.3	5.0
1.2	36.0	7.40	2.00	60.0	5.70	2.60	120.0	5.00	4.50	240.0	3.3	6.0
1.5	36.0	5.90	2.00	60.0	5.30	3.00	120.0	4.00	4.50	240.0	2.7	6.0
1.8	36.0	5.70	2.30	60.0	5.10	3.50	120.0	3.70	5.00	240.0	2.4	6.4
2.0	36.0	5.10	2.30	60.0	4.70	3.50	120.0	3.30	5.00	240.0	2.1	6.4
2.2	36.0	4.60	2.30	60.0	4.20	3.50	120.0	3.00	5.00	240.0	2.0	6.4
2.5	36.0	4.60	2.60	60.0	4.80	4.50	120.0	3.20	6.00	240.0	1.9	7.0
2.7	36.0	4.30	2.60	60.0	4.40	4.50	120.0	3.00	6.00	240.0	1.7	7.0
3.0	36.0	3.90	2.60	60.0	4.00	4.50	120.0	2.70	6.00	240.0	1.6	7.0
3.3	36.0	3.50	2.60	60.0	3.60	4.50	120.0	2.40	6.00	240.0	1.4	7.0
3.9	36.0	3.00	2.60	60.0	3.10	4.50	120.0	2.10	6.00			
4.7	36.0	2.80	3.00	60.0	2.80	5.00	120.0	1.80	6.40			
5.0	36.0	2.60	3.00	60.0	2.70	5.00	120.0	1.70	6.40			
5.6	36.0	2.40	3.00	60.0	2.40	5.00	120.0	1.50	6.40			
6.8	36.0	2.00	3.00	60.0	2.00	5.00	120.0	1.30	6.40			
7.5	36.0	2.00	3.50	60.0	2.00	6.00	120.0	1.20	7.00			
8.2	36.0	1.90	3.50	60.0	1.95	6.00	120.0	1.14	7.00			
10.0	36.0	1.60	3.50	60.0	1.60	6.00	120.0	.93	7.00			
12.0	36.0	1.50	4.00	60.0	1.42	6.40						
15.0	36.0	1.20	4.00	60.0	1.14	6.40						
18.0	36.0	1.18	4.80	60.0	.98	6.60						
20.0	36.0	1.10	4.80	60.0	.88	6.60						
22.0	36.0	.97	4.80	60.0	.80	6.60						
25.0	36.0	.96	5.40									
27.0	36.0	.88	5.40									





1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. CAPACITORS CAN HANDLE PULSE CURRENTS UP TO 100 TIMES GREATER THAN THE PEAK CURRENTS CALCULATED FROM THE RATED RMS RATING (PROVIDED SLOW REPETITION RATES ARE USED). IF THERE IS ANY DOUBT, A SKETCH OF THE VOLTAGE AND CURRENT WAVE FORMS WITH TIME BASE SHOULD BE SENT TO CRC FOR ANALYSIS.

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

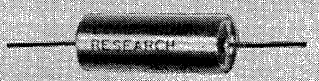
CRC
COMPONENT RESEARCH CO.

METALLIZED TEFLON J11 & K11

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

.068 μF 50VDC ACTUAL SIZE CAPACITOR



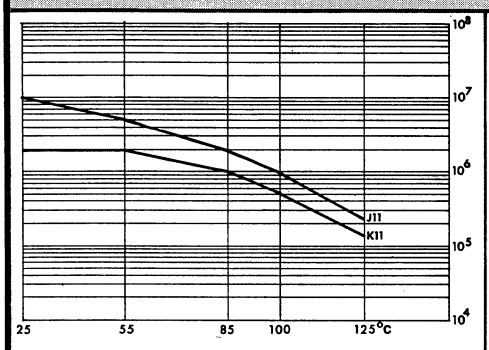
HIGH INSULATION RESISTANCE: 10,000,000 MEGOHMS MINIMUM. (FOR J11 SERIES, ALL VALUES UP TO 0.1uF).

LOW DIELECTRIC ABSORPTION: 0.01% MAXIMUM VOLTAGE RECOVERY.

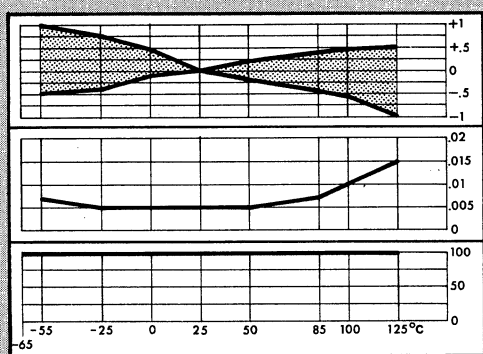
LONG TERM STABILITY: LESS THAN 0.5% CAPACITANCE DRIFT AFTER 2000 HRS. AT 125°C AT RATED VOLTS.

SERIES 11 CAPACITORS HAVE BEEN QUALIFIED FOR USE IN SPACE AND MISSILE SYSTEMS WHERE MAXIMUM RELIABILITY AND LOW DIELECTRIC LOSS ARE ESSENTIAL.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- GYRO CIRCUITS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #XT1303

TEST RESULTS FOR 80 SERIES D11B CAPACITORS LIFE TESTED FOR 2000 HOURS AT 125°C AT 140% OF RATED DC VOLTAGE. THERE WERE NO FAILURES FOR THIS TEST. D11B CAPACITORS ARE THE SAME CONSTRUCTION AND DESIGN AS J11-K11 SERIES.

LIST OF CAPACITORS LIFE TESTED			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
D11B	0.1	12	$5x10^5$	$3.9x10^6$	$5x10^7$	±1	−.035	−.35	.2	.01	.065
D11B	0.22	32	$5x10^5$	$2x10^6$	$2.5x10^7$	±1	−.01	+.85	.2	.005	.075
D11B	0.47	11	$5x10^5$	$1x10^6$	$1x10^6$	±1	−.005	+.58	.2	.01	.10
D11B	1.0	6	$2.5x10^5$	$5.2x10^5$	$3.8x10^6$	±1	−.005	+.24	.2	.01	.12
D11B	0.5	20	$5x10^5$	$3.8x10^6$	$5x10^7$	±1	+.02	+.48	.2	.01	.02

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CRC COMPONENT RESEARCH CO.

METALLIZED TEFLON J11

ESTABLISHED RELIABILITY CAPACITORS

J11 SPECIFICATIONS

CONSTRUCTION	Metallized teflon dielectric, hermetically sealed, extended metal film electrodes, axial leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmetal requirements of MIL-C-83421, except vibration at 20g and shock at 50g.	
OPERATING TEMPERATURE	−65°C to +125°C	At full rated voltage.
DIELECTRIC ABSORPTION	0.01% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.05% maximum	At 25°C when measured per MIL-C-83421.
DIELECTRIC STRENGTH	200% rated voltage	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	Referenced to 25°C −55°C −25°C 0°C 50°C 85°C 100°C 125°C	 From −0.5% to +1.0% From −0.35% to +0.75% From −0.1% to +0.45% From −0.2% to +0.2% From −0.45% to +0.4% From −0.65% to +0.45% From −1.0% to +0.5%
CAPACITANCE STABILITY	±0.10%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6}atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.68uF CAPACITOR AT 25°C IS 1,000,000 ÷ 0.68 = 1,475,000 MEGOHMS.

RANGE	25°	55°C	85°C	100°C	125°C
.001 TO 0.1uF	10,000,000 Megohms	5,000,000 Megohms	2,000,000 Megohms	1,000,000 Megohms	250,000 Megohms
GREATER THAN 0.1uF	1,000,000 Megohms-uF	500,000 Megohms-uF	200,000 Megohms-uF	100,000 Megohms-uF	25,000 Megohms-uF

J11 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	48 hrs. minimum at 125°C, at 140% rated DC voltage	4.7.2	No physical damage	100% Test
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1×10^{-6}atm/cm³/sec. max.	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
5	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	Per I.R. Table	100% Test
7	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
8	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.05% max.	100% Test
9	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. **2.** Traceability to production and test records by permanent marking of parts with date code lot. **3.** Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

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CRC COMPONENT RESEARCH CO.

METALLIZED TEFLON K11

ESTABLISHED RELIABILITY CAPACITORS

K11 SPECIFICATIONS

CONSTRUCTION	Metallized teflon dielectric, hermetically sealed, extended metal film electrodes, leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmental requirements of MIL-C-83421, except vibration at 20g and shock at 50g.	
OPERATING TEMPERATURE	−65°C to +125°C	At full rated voltage.
DIELECTRIC ABSORPTION	0.01% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.1% maximum	At 25°C when measured per MIL-C-83421.
DIELECTRIC STRENGTH	200% rated voltage	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	Referenced to 25°C −55°C −25°C 0°C 50°C 85°C 100°C 125°C	 From −0.5% to +1.0% From −0.35% to +0.75% From −0.1% to +0.45% From −0.2% to +0.2% From −0.45% to +0.4% From −0.65% to +0.45% From −1.0% to +0.5%
CAPACITANCE STABILITY	±0.10%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6}atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.18uF CAPACITOR AT 25°C IS 200,000 ÷ 0.18 = 1,111,000 MEGOHMS.

RANGE	25°C	55°C	85°C	100°C	125°C
.001 TO 0.1uF	2,000,000 Megohms	2,000,000 Megohms	1,000,000 Megohms	500,000 Megohms	150,000 Megohms
GREATER THAN 0.1uF	200,000 Megohms-uF	200,000 Megohms-uF	100,000 Megohms-uF	50,000 Megohms-uF	15,000 Megohms-uF

K11 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	THERMAL AGING	5 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
2	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1x10⁻⁶atm/cm³/sec. max.	100% Test
3	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
4	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
5	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	Per I.R. Table	100% Test
6	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
7	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.1% max.	100% Test
8	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. 2. Traceability to production and test records by permanent marking of parts with date code lot. 3. Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

METALLIZED TEFLON J11 & K11 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

	50VDC					100VDC					200VDC				
uF	J11	K11	Diam. A	Length B	Length C	J11	K11	Diam. A	Length B	Length C	J11	K11	Diam. A	Length B	Length C
.001	J11B102	K11B102	.235	.687	.887	J11C102	K11C102	.235	.687	.887	J11D102	K11D102	.235	.687	.887
.0012	J11B122	K11B122	.235	.687	.887	J11C122	K11C122	.235	.687	.887	J11D122	K11D122	.235	.687	.887
.0015	J11B152	K11B152	.235	.687	.887	J11C152	K11C152	.235	.687	.887	J11D152	K11D152	.235	.687	.887
.0018	J11B182	K11B182	.235	.687	.887	J11C182	K11C182	.235	.687	.887	J11D182	K11D182	.235	.687	.887
.002	J11B202	K11B202	.235	.687	.887	J11C202	K11C202	.235	.687	.887	J11D202	K11D202	.235	.687	.887
.0022	J11B222	K11B222	.235	.687	.887	J11C222	K11C222	.235	.687	.887	J11D222	K11D222	.235	.687	.887
.0027	J11B272	K11B272	.235	.687	.887	J11C272	K11C272	.235	.687	.887	J11D272	K11D272	.235	.687	.887
.0033	J11B332	K11B332	.235	.687	.887	J11C332	K11C332	.235	.687	.887	J11D332	K11D332	.235	.687	.887
.0039	J11B392	K11B392	.235	.687	.887	J11C392	K11C392	.235	.687	.887	J11D392	K11D392	.235	.687	.887
.0047	J11B472	K11B472	.235	.687	.887	J11C472	K11C472	.235	.687	.887	J11D472	K11D472	.235	.687	.887
.005	J11B502	K11B502	.235	.687	.887	J11C502	K11C502	.235	.687	.887	J11D502	K11D502	.235	.687	.887
.0056	J11B562	K11B562	.235	.687	.887	J11C562	K11C562	.235	.687	.887	J11D562	K11D562	.235	.687	.887
.0068	J11B682	K11B682	.235	.687	.887	J11C682	K11C682	.235	.687	.887	J11D682	K11D682	.235	.687	.887
.0082	J11B822	K11B822	.235	.687	.887	J11C822	K11C822	.235	.687	.887	J11D822	K11D822	.235	.687	.887
.01	J11B103	K11B103	.235	.687	.887	J11C103	K11C103	.235	.687	.887	J11D103	K11D103	.235	.687	.887
.012	J11B123	K11B123	.235	.687	.887	J11C123	K11C123	.235	.687	.887	J11D123	K11D123	.235	.687	.887
.015	J11B153	K11B153	.312	.687	.887	J11C153	K11C153	.312	.687	.887	J11D153	K11D153	.312	.687	.887
.018	J11B183	K11B183	.312	.687	.887	J11C183	K11C183	.312	.687	.887	J11D183	K11D183	.312	.813	1.013
.02	J11B203	K11B203	.312	.687	.887	J11C203	K11C203	.312	.687	.887	J11D203	K11D203	.312	.813	1.013
.022	J11B223	K11B223	.312	.687	.887	J11C223	K11C223	.312	.687	.887	J11D223	K11D223	.312	.813	1.013
.027	J11B273	K11B273	.312	.687	.887	J11C273	K11C273	.312	.813	1.013	J11D273	K11D273	.312	.813	1.013
.033	J11B333	K11B333	.312	.687	.887	J11C333	K11C333	.312	.813	1.013	J11D333	K11D333	.400	.813	1.013
.039	J11B393	K11B393	.312	.687	.887	J11C393	K11C393	.400	.813	1.013	J11D393	K11D393	.400	1.063	1.263
.047	J11B473	K11B473	.312	.687	.887	J11C473	K11C473	.400	.813	1.013	J11D473	K11D473	.400	1.063	1.263
.05	J11B503	K11B503	.312	.687	.887	J11C503	K11C503	.400	.813	1.013	J11D503	K11D503	.400	1.063	1.263
.056	J11B563	K11B563	.312	.813	1.013	J11C563	K11C563	.400	.813	1.013	J11D563	K11D563	.400	1.063	1.263
.068	J11B683	K11B683	.312	.813	1.013	J11C683	K11C683	.400	.813	1.013	J11D683	K11D683	.400	1.063	1.263
.082	J11B823	K11B823	.312	.937	1.137	J11C823	K11C823	.400	1.063	1.263	J11D823	K11D823	.500	1.125	1.325
.1	J11B104	K11B104	.312	.937	1.137	J11C104	K11C104	.400	1.063	1.263	J11D104	K11D104	.500	1.125	1.325
.12	J11B124	K11B124	.312	1.063	1.263	J11C124	K11C124	.500	1.125	1.325	J11D124	K11D124	.500	1.375	1.575
.15	J11B154	K11B154	.312	1.063	1.263	J11C154	K11C154	.500	1.125	1.325	J11D154	K11D154	.562	1.375	1.575
.18	J11B184	K11B184	.400	1.063	1.263	J11C184	K11C184	.500	1.125	1.325	J11D184	K11D184	.562	1.375	1.575
.20	J11B204	K11B204	.400	1.063	1.263	J11C204	K11C204	.562	1.125	1.325	J11D204	K11D204	.562	1.375	1.575
.22	J11B224	K11B224	.400	1.063	1.263	J11C224	K11C224	.562	1.125	1.325	J11D224	K11D224	.562	1.375	1.575
.27	J11B274	K11B274	.400	1.063	1.263	J11C274	K11C274	.562	1.125	1.325	J11D274	K11D274	.670	1.375	1.575
.33	J11B334	K11B334	.500	1.125	1.325	J11C334	K11C334	.562	1.125	1.325	J11D334	K11D334	.670	1.375	1.575
.39	J11B394	K11B394	.500	1.125	1.325	J11C394	K11C394	.562	1.375	1.575	J11D394	K11D394	.562	1.875	2.075
.47	J11B474	K11B474	.562	1.125	1.325	J11C474	K11C474	.670	1.375	1.575	J11D474	K11D474	.670	1.875	2.075
.50	J11B504	K11B504	.562	1.125	1.325	J11C504	K11C504	.670	1.375	1.575	J11D504	K11D504	.670	1.875	2.075
.56	J11B564	K11B564	.562	1.125	1.325	J11C564	K11C564	.670	1.375	1.575	J11D564	K11D564	.670	1.875	2.075
.68	J11B684	K11B684	.562	1.125	1.325	J11C684	K11C684	.670	1.875	2.075	J11D684	K11D684	.750	1.875	2.075
.82	J11B824	K11B824	.562	1.375	1.575	J11C824	K11C824	.670	1.875	2.075	J11D824	K11D824	.750	1.875	2.075
1.0	J11B105	K11B105	.670	1.375	1.575	J11C105	K11C105	.670	1.875	2.075	J11D105	K11D105	.750	1.875	2.075
1.5	J11B155	K11B155	.670	1.875	2.075	J11C155	K11C155	.750	1.875	2.075	J11D155	K11D155	1.00	1.875	2.075
2.0	J11B205	K11B205	.670	1.875	2.075	J11C205	K11C205	1.00	1.875	2.075	J11D205	K11D205	1.00	2.375	2.575

J11 | B | 104 | J | S | A

STYLE

SLEEVING CODE
S = Mylar sleeve
X = No sleeve

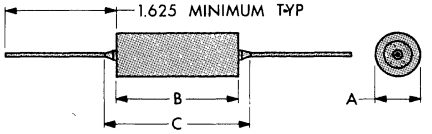
LEAD CODE
A = Solderable leads: #22 (.025") for .312" case dia. & smaller; #20 (.032") for .400" case dia. & smaller.

CAPACITANCE TOLERANCE
K = 10% J = 5% G = 2% F = 1% D = ½% B = ¼% A = .1%

VOLTAGE
B = 50VDC
C = 100VDC
D = 200VDC

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±0.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads



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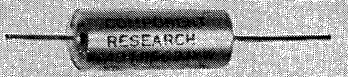
CRC
COMPONENT RESEARCH CO.

FOIL TEFLON
A91

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

.056 μF 50VDC ACTUAL SIZE CAPACITOR



AC AND DC RATED TO 150°C AT FULL RATED VOLTAGE.

HERMETICALLY SEALED, HIGH RELIABILITY SCREENED FOR CRITICAL AEROSPACE APPLICATIONS.

AC RATED FROM 36VRMS TO 240VRMS AT FREQUENCIES FROM 0 TO 400 Hz. RATINGS AT 40KHz AT LOWER VOLTAGE RATINGS.

HIGH INSULATION RESISTANCE, 10,000,000 MEGOHMS MINIMUM. ALL VALUES UP TO 0.1uF.

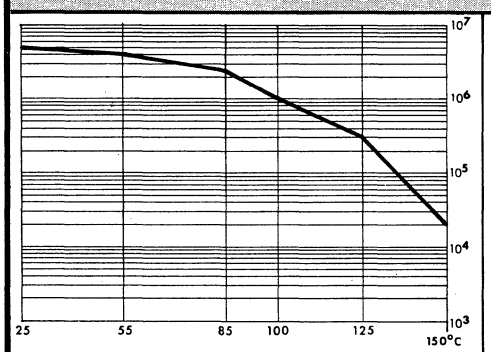
LOW DIELECTRIC ABSORPTION, 0.01% MAXIMUM VOLTAGE RECOVERY.

LOW LOSS, RUGGED INTERNAL TERMINATIONS FOR ALL HI-REL PROGRAMS (CRC PATENTED CONSTRUCTION).

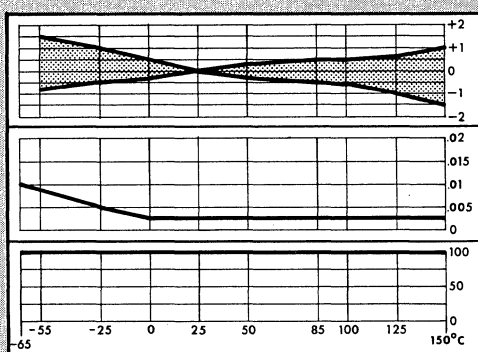
0.1% MAXIMUM SHELF DRIFT FOR 10 YEARS (OR IN NORMAL USE).

AVAILABLE IN 1%, 2%, 5% AND 10%, CAPACITANCE TOLERANCE FROM 50VDC TO 400VDC. OTHER TOLERANCES AVAILABLE ON REQUEST.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- FILTERING
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- POWER SUPPLY FILTERING
- GYRO CIRCUITS
- PULSE FORMING NETWORKS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #XT-1306

TEST RESULTS FOR D51 SERIES CAPACITORS LIFE TESTED FOR 2000 HOURS AT 125°C AT 140% OF RATED DC VOLTAGE. THERE WERE NO FAILURES FOR THIS TEST. D51 CAPACITORS ARE THE SAME CONSTRUCTION AND DESIGN AS A91.

LIST OF CAPACITORS SUBMITTED TO LIFE TEST			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
D51C	.01	48	3.3×10^6	2.5×10^7	5×10^7	±2	−.01	−.56	.05	−.01	.02
D51C	.002	6	3.3×10^6	2.5×10^7	5×10^7	±2	−.15	−.64	.05	−.01	−.01
D51C	.0039	5	3.3×10^6	2×10^7	1×10^8	±2	−.075	−.64	.05	−.01	−.01
D51C	.02	10	3.3×10^6	2×10^7	1×10^8	±2	−.01	−.33	.05	−.01	−.01

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CRC COMPONENT RESEARCH CO.

FOIL TEFLON A91

ESTABLISHED RELIABILITY CAPACITORS

A91 SPECIFICATIONS

CONSTRUCTION	Foil teflon, hermetically sealed, extended metallized film electrodes, foil axial leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmetal requirements of MIL-C-83421, except vibration at 20g and shock at 50g.	
OPERATING TEMPERATURE	−65°C to +150°C	At full rated voltage.
DIELECTRIC ABSORPTION	0.01% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.02% maximum	At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum	At 25°C at a peak to peak voltage of 3 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	200% rated DC voltage	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	Referenced to 25°C −55°C −25°C 0°C 50°C 85°C 100°C 125°C 150°C	 +1.5% to −0.8% +1.0% to −0.5% +0.5% to −0.3% +0.3% to −0.3% +0.5% to −0.5% +0.5% to −0.8% +0.6% to −1.0% +1.0% to −1.5%
CAPACITANCE STABILITY	±0.25%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6}atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

RANGE	25°C	85°C	100°C	125°C	150°C
.001 TO 0.2uF	10,000,000 Megohms	2,000,000 Megohms	1,000,000 Megohms	250,000 Megohms	20.000 Megohms
GREATER THAN 0.2uF	1,000,000 Megohms	200,000 Megohms	100,000 Megohms	25,000 Megohms	2,000 Megohms

A91 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	16 hrs. minimum at 125°C at 140% AC rated voltage, at 400Hz or 240VRMS, whichever is less	4.7.2	No physical damage	100% Test
2	THERMAL AGING	5 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb for 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1x10⁻⁶atm/cm³/sec. max.	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
5	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 3 times DC rated voltage for 60 seconds minimum. Do not exceed 800 volts peak to peak.	4.7.6	No shorts	100% Test
6	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
7	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	Per I.R. Table	100% Test
8	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
9	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.02% max.	100% Test
10	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. 2. Traceability to production and test records by permanent marking of parts with date code lot. 3. Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

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CRC COMPONENT RESEARCH CO.

FOIL TEFLON
A91 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE A91B 50VDC RATED				TYPE A91C 100VDC RATED				TYPE A91D 200VDC RATED				TYPE A91E 400VDC RATED			
	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C
.001	A91B102	.193	.562	.662	A91C102	.235	.562	.662	A91D102	.235	.687	.787	A91E102	.235	.687	.787
.0012	A91B122	.193	.562	.662	A91C122	.235	.562	.662	A91D122	.235	.687	.787	A91E122	.235	.687	.787
.0015	A91B152	.193	.562	.662	A91C152	.235	.562	.662	A91D152	.235	.687	.787	A91E152	.235	.687	.787
.0018	A91B182	.193	.562	.662	A91C182	.235	.562	.662	A91D182	.235	.687	.787	A91E182	.235	.687	.787
.002	A91B202	.193	.562	.662	A91C202	.235	.562	.662	A91D202	.235	.687	.787	A91E202	.235	.687	.787
.0022	A91B222	.193	.562	.662	A91C222	.235	.562	.662	A91D222	.235	.687	.787	A91E222	.235	.687	.787
.0027	A91B272	.193	.562	.662	A91C272	.235	.562	.662	A91D272	.235	.687	.787	A91E272	.312	.687	.787
.0033	A91B332	.193	.562	.662	A91C332	.235	.562	.662	A91D332	.235	.687	.787	A91E332	.312	.687	.787
.0039	A91B392	.193	.562	.662	A91C392	.235	.562	.662	A91D392	.235	.687	.787	A91E392	.312	.687	.787
.0047	A91B472	.193	.562	.662	A91C472	.235	.562	.662	A91D472	.235	.687	.787	A91E472	.312	.687	.787
.005	A91B502	.193	.562	.662	A91C502	.235	.562	.662	A91D502	.235	.687	.787	A91E502	.312	.687	.787
.0056	A91B562	.193	.562	.662	A91C562	.235	.562	.662	A91D562	.235	.687	.787	A91E562	.312	.687	.787
.0068	A91B682	.235	.562	.662	A91C682	.235	.687	.787	A91D682	.312	.687	.787	A91E582	.312	.813	.913
.0075	A91B752	.235	.562	.662	A91C752	.235	.687	.787	A91D752	.312	.687	.787	A91E752	.312	.813	.913
.0082	A91B822	.235	.562	.662	A91C822	.235	.687	.787	A91D822	.312	.687	.787	A91E822	.312	.813	.913
.01	A91B103	.235	.562	.662	A91C103	.235	.687	.787	A91D103	.312	.687	.787	A91E103	.312	.813	.913
.012	A91B123	.235	.562	.662	A91C123	.235	.687	.787	A91D123	.312	.687	.787	A91E123	.312	.813	.913
.015	A91B153	.235	.687	.787	A91C153	.312	.687	.787	A91D153	.312	.813	.913	A91E153	.400	.813	.913
.018	A91B183	.235	.687	.787	A91C183	.312	.687	.787	A91D183	.312	.813	.913	A91E183	.400	.813	.913
.02	A91B203	.312	.687	.787	A91C203	.312	.813	.913	A91D203	.400	.813	.913	A91E203	.400	1.063	1.163
.022	A91B223	.312	.687	.787	A91C223	.312	.813	.913	A91D223	.400	.813	.913	A91E223	.400	1.063	1.163
.027	A91B273	.312	.687	.787	A91C273	.312	.813	.913	A91D273	.400	.813	.913	A91E273	.400	1.063	1.163
.033	A91B333	.312	.687	.787	A91C333	.312	.813	.913	A91D333	.400	.813	.913	A91E333	.400	1.063	1.163
.039	A91B393	.312	.813	.913	A91C393	.400	.813	.913	A91D393	.400	1.063	1.163	A91E393	.500	1.125	1.225
.047	A91B473	.312	.813	.913	A91C473	.400	.813	.913	A91D473	.400	1.063	1.163	A91E473	.500	1.125	1.225
.05	A91B503	.312	.813	.913	A91C503	.400	.813	.913	A91D503	.400	1.063	1.163	A91E503	.500	1.125	1.225
.056	A91B563	.312	.813	.913	A91C563	.400	.813	.913	A91D563	.400	1.063	1.163	A91E563	.500	1.125	1.225
.068	A91B683	.400	.813	.913	A91C683	.400	1.063	1.163	A91D683	.500	1.125	1.225	A91E683	.500	1.375	1.475
.075	A91B753	.400	.813	.913	A91C753	.400	1.063	1.163	A91D753	.500	1.125	1.225	A91E753	.500	1.375	1.475
.082	A91B823	.400	.813	.913	A91C823	.400	1.063	1.163	A91D823	.500	1.125	1.225	A91E823	.562	1.375	1.475
.1	A19B104	.400	.813	.913	A91C104	.400	1.063	1.163	A91D104	.500	1.375	1.475	A91E104	.670	1.375	1.475
.12	A91B124	.400	.813	.913	A91C124	.400	1.063	1.163	A91D124	.500	1.375	1.475	A91E124	.670	1.375	1.475
.15	A91B154	.400	.813	.913	A91C154	.500	1.125	1.225	A91D154	.500	1.375	1.475	A91E154	.670	1.375	1.475
.18	A91B184	.400	1.063	1.163	A91C184	.500	1.125	1.225	A91D184	.562	1.375	1.475	A91E184	.670	1.875	1.975
.20	A91B204	.400	1.063	1.163	A91C204	.500	1.125	1.225	A91D204	.670	1.375	1.475	A91E204	.670	1.875	1.975
.22	A91B224	.400	1.063	1.163	A91C224	.500	1.125	1.225	A91D224	.670	1.375	1.475	A91E224	.670	1.875	1.975
.27	A91B274	.500	1.125	1.225	A91C274	.562	1.375	1.475	A91D274	.670	1.375	1.475				
.33	A91B334	.500	1.125	1.225	A91C334	.562	1.375	1.475	A91D334	.670	1.875	1.975				
.39	A91B394	.500	1.125	1.225	A91C394	.562	1.375	1.475	A91D394	.670	1.875	1.975				
.47	A91B474	.562	1.125	1.225	A91C474	.670	1.375	1.475	A91D474	.750	1.875	1.975				
.50	A91B504	.562	1.125	1.225	A91C504	.670	1.375	1.475	A91D504	.750	1.875	1.975				
.56	A91B564	.562	1.375	1.475	A91C564	.670	1.375	1.475								
.68	A91B684	.562	1.375	1.475	A91C684	.670	1.875	1.975								
.75	A91B754	.670	1.375	1.475	A91C754	.750	1.875	1.975								
.82	A91B824	.670	1.375	1.475	A91C824	.750	1.875	1.975								
1.0	A91B105	.670	1.375	1.475	A91C105	.750	1.875	1.975								
1.2	A91B125	.670	1.375	1.475												

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±0.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads

A91 | B | 104 | J | S | W

STYLE

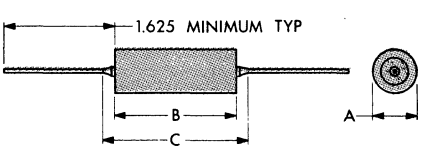
VOLTAGE
B=50VDC
C=100VDC
D=200VDC
E=400VDC

SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025″) for .312″ case dia. & smaller; #20 (.032″) for .400″ & .500″ case dia.
C=Tinned oxygen-free copper: #18 (.040″) for .562″ case dia. & larger.

CAPACITANCE TOLERANCE
K=10% J=5% G=2% F=1% D=½% B=¼%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.



COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

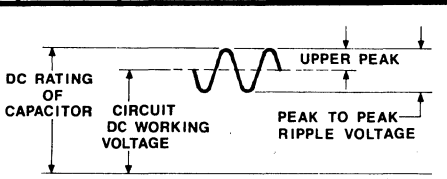
CRC COMPONENT RESEARCH CO.

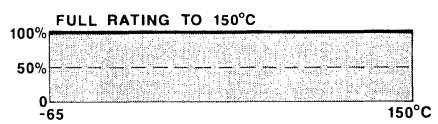
FOIL TEFLON A91 AC RATINGS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE A91B 50VDC AC RATINGS			TYPE A91C 100VDC AC RATINGS			TYPE A91D 200VDC AC RATINGS			TYPE A91E 400VDC AC RATINGS		
	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps	RMS Volts 400Hz	RMS Volts 40KHz	Max. RMS Amps
.001	36.0	36.0	.009	60.0	60.0	.015	120.0	80.0	.020	240.0	100.0	.025
.0012	36.0	36.0	.011	60.0	60.0	.018	120.0	80.0	.024	240.0	100.0	.030
.0015	36.0	36.0	.013	60.0	60.0	.022	120.0	80.0	.030	240.0	100.0	.037
.0018	36.0	36.0	.016	60.0	60.0	.027	120.0	80.0	.036	240.0	100.0	.045
.002	36.0	36.0	.018	60.0	60.0	.030	120.0	80.0	.040	240.0	100.0	.050
.0022	36.0	36.0	.020	60.0	60.0	.033	120.0	80.0	.044	240.0	100.0	.055
.0027	36.0	36.0	.024	60.0	60.0	.041	120.0	80.0	.054	240.0	100.0	.068
.0033	36.0	36.0	.030	60.0	60.0	.050	120.0	80.0	.066	240.0	100.0	.083
.0039	36.0	36.0	.035	60.0	60.0	.058	120.0	80.0	.078	240.0	100.0	.097
.0047	36.0	36.0	.042	60.0	60.0	.071	120.0	80.0	.094	240.0	100.0	.12
.005	36.0	36.0	.045	60.0	60.0	.075	120.0	80.0	.10	240.0	100.0	.13
.0056	36.0	36.0	.050	60.0	60.0	.084	120.0	80.0	.11	240.0	100.0	.14
.0068	36.0	36.0	.061	60.0	60.0	.10	120.0	80.0	.14	240.0	100.0	.17
.0075	36.0	36.0	.067	60.0	60.0	.11	120.0	80.0	.15	240.0	100.0	.19
.0082	36.0	36.0	.074	60.0	60.0	.12	120.0	80.0	.16	240.0	100.0	.21
.01	36.0	36.0	.090	60.0	60.0	.15	120.0	80.0	.20	240.0	100.0	.25
.012	36.0	36.0	.11	60.0	59.0	.18	120.0	78.0	.23	240.0	100.0	.30
.015	36.0	36.0	.14	60.0	58.0	.22	120.0	76.0	.29	240.0	94.0	.35
.018	36.0	36.0	.16	60.0	57.0	.26	120.0	74.0	.33	240.0	90.0	.41
.02	36.0	36.0	.18	60.0	55.0	.28	120.0	71.0	.36	240.0	88.0	.44
.022	36.0	36.0	.20	60.0	53.0	.29	120.0	68.0	.37	240.0	85.0	.47
.027	36.0	36.0	.24	60.0	51.0	.34	120.0	65.0	.44	240.0	81.0	.55
.033	36.0	36.0	.30	60.0	50.0	.41	120.0	62.0	.51	240.0	78.0	.65
.039	36.0	36.0	.35	60.0	48.0	.47	120.0	60.0	.59	240.0	75.0	.73
.047	36.0	36.0	.42	60.0	47.0	.55	120.0	57.0	.67	240.0	71.0	.83
.05	36.0	36.0	.45	60.0	46.0	.58	120.0	56.0	.70	240.0	70.0	.88
.056	36.0	36.0	.50	60.0	46.0	.64	120.0	56.0	.78	240.0	67.0	.95
.068	36.0	34.0	.58	60.0	42.0	.71	120.0	50.0	.85	240.0	60.0	1.02
.075	36.0	33.0	.61	60.0	40.0	.75	120.0	47.0	.88	240.0	55.0	1.03
.082	36.0	32.0	.66	60.0	38.0	.78	120.0	44.0	.90	240.0	50.0	1.03
.1	36.0	30.0	.75	60.0	36.0	.90	120.0	42.0	1.10	240.0	46.0	1.20
.12	36.0	30.0	.90	60.0	35.0	1.05	120.0	40.0	1.20	240.0	44.5	1.34
.15	36.0	26.0	.98	60.0	33.0	1.24	120.0	36.0	1.34	240.0	40.0	1.50
.18	36.0	25.0	1.13	60.0	31.0	1.40	120.0	34.0	1.54	240.0	38.0	1.70
.20	36.0	24.0	1.20	60.0	30.0	1.50	120.0	33.0	1.65	240.0	37.0	1.85
.22	36.0	23.0	1.27	60.0	27.0	1.50	120.0	32.0	1.76	240.0	35.0	1.93
.27	36.0	19.0	1.28	60.0	24.0	1.62	120.0	29.0	1.96			
.33	36.0	18.0	1.48	60.0	23.0	1.90	120.0	28.0	2.31			
.39	36.0	17.0	1.66	60.0	22.0	2.15	120.0	27.0	2.63			
.47	36.0	15.7	1.85	60.0	21.0	2.47	120.0	26.0	3.06			
.50	36.0	15.2	1.90	60.0	20.0	2.50	120.0	25.0	3.13			
.56	36.0	14.4	2.01	60.0	19.0	2.64	120.0	23.0	3.17			
.68	36.0	14.0	2.38	60.0	16.0	2.72						
.75	36.0	13.0	2.44	60.0	15.0	2.81						
.82	36.0	12.0	2.46	60.0	14.0	2.87						
1.0	36.0	10.0	2.50	60.0	12.0	3.00						
1.2	36.0	9.1	2.73									

1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. CAPACITORS CAN HANDLE PULSE CURRENTS UP TO 100 TIMES GREATER THAN THE PEAK CURRENTS CALCULATED FROM THE RATED RMS RATING (PROVIDED SLOW REPETITION RATES ARE USED). IF THERE IS ANY DOUBT, A SKETCH OF THE VOLTAGE AND CURRENT WAVE FORMS WITH TIME BASE SHOULD BE SENT TO CRC FOR ANALYSIS.





COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

POLYSTYRENE K93

ESTABLISHED RELIABILITY CAPACITORS

PRODUCT FEATURES

.056 μF 50VDC ACTUAL SIZE CAPACITOR

5,000,000 MEGOHMS MIN. INSULATION RESISTANCE FOR VALUES 0.2uF AND LESS.

0.02% MAXIMUM DIELECTRIC ABSORPTION.

0.1% MAXIMUM SHELF DRIFT FOR 10 YEARS (OR IN NORMAL USE).

UTILIZES CRC UNIQUE PATENTED, RUGGED, LOW LOSS LEAD TERMINATIONS, QUALIFIED FOR ALL HI-REL PROGRAMS.

HERMETICALLY SEALED, HIGH RELIABILITY SCREENED FOR CRITICAL AEROSPACE PROGRAMS.

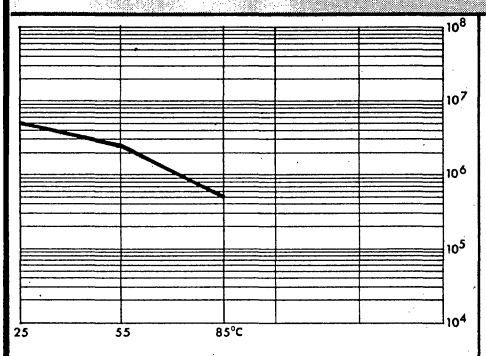
100% RELIABILITY SCREENING, INCLUDES TEMPERATURE CYCLING, FINE LEAK TEST, AC SQUARE WAVE TEST.

SIMILAR GENERIC PARTS HAVE BEEN QUALIFIED FOR TRIDENT PROGRAM.

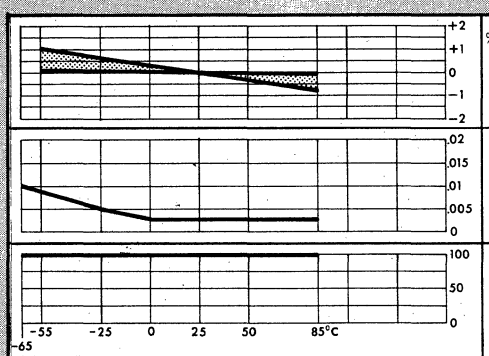
AVAILABLE IN ±0.1% TO ±10% CAPACITANCE TOLERANCE FROM 50VDC TO 400VDC.

AC AND DC RATED.

TYPICAL CURVES



INSULATION RESISTANCE WITH TEMPERATURE IN MEGOHMS (0.1 μF OR LESS)



% CAPACITANCE CHANGE WITH TEMPERATURE

% DISSIPATION FACTOR WITH TEMPERATURE

% VOLTAGE RATING WITH TEMPERATURE

TYPICAL APPLICATIONS

- CRITICAL TIMING CIRCUITS
- FIXED TUNING CIRCUITS
- FILTERING
- TEMPERATURE COMPENSATION
- COUPLING AND DECOUPLING
- FEEDBACK CIRCUITS
- POWER SUPPLY FILTERING
- GYRO CIRCUITS
- PULSE FORMING NETWORKS
- INTEGRATING CIRCUITS

LIFE TEST DATA CRC TEST REPORT #XT1304

TEST RESULTS FOR 75 SERIES N53 CAPACITORS LIFE TESTED FOR 2000 HOURS AT +85°C AT 140% OF RATED DC VOLTAGE. THERE WERE NO FAILURES FOR THIS TEST. N53 CAPACITORS ARE THE SAME CONSTRUCTION AND DESIGN AS K93 SERIES CAPACITORS.

LIST OF CAPACITORS LIFE TESTED			INSULATION RESISTANCE IN MEGOHMS AT 25°C			% CAPACITANCE CHANGE WITH LIFE			% DISSIPATION FACTOR AT 25°C WITH LIFE		
CRC TYPE	uF VALUE	Q'TY TESTED	POST TEST LIMITS (MIN. I.R.)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. △C)	TEST RESULTS LOW	TEST RESULTS HIGH	POST TEST LIMITS (MAX. D.F.)	TEST RESULTS LOW	TEST RESULTS HIGH
N53B	.012	20	$5x10^5$	$2x10^7$	$5x10^7$	0.5	0.00	+.26	.05	.01	.01
N53B	.1	20	$5x10^5$	$1x10^7$	$5x10^7$	0.5	−.03	+.29	.05	.01	.01
N53B	.82	15	$5x10^5$	$5x10^6$	$4x10^7$	0.5	−.02	+.18	.05	.01	.01
N53C	.02	5	$5x10^5$	$3.3x10^7$	$5x10^7$	0.5	−.025	+.245	.05	.01	.01
N53C	.039	5	$5x10^5$	$5.5x10^6$	$1x10^8$	0.5	−.01	+.30	.05	.01	.01
N53C	.068	20	$5x10^5$	$1x10^7$	$2x10^7$	0.5	+.06	+.22	.05	.01	.01

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CRC COMPONENT RESEARCH CO.

POLYSTYRENE K93

ESTABLISHED RELIABILITY CAPACITORS

K93 SPECIFICATIONS

OPERATING TEMPERATURE	−65°C to 85°C	At full rated voltage.
DIELECTRIC ABSORPTION	0.02% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.02% maximum	At 25°C when measured per MIL-C-83421.
DIELECTRIC STRENGTH	200% rated voltage	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	−80 ±50 PPM/°C −60 ±50 PPM/°C	For values 0.001uF to 0.0082uF For values 0.01uF to 2.7uF Special polystyrene capacitors can be supplied with a temperature coefficient of −20 to −100 PPM/°C that is linear to ±30 PPM/°C and ±10 PPM/°C. A wide selection is available of large uF values in bathtub and custom cases.
CAPACITANCE STABILITY	0.03% maximum Drift	With five cycles from −25°C to +85°C
HERMETIC SEAL	1×10^{-6}atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 1.0uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 2.0uF CAPACITOR AT 25°C IS 1,000,000 ÷ 2 = 500,000 MEGOHMS.

RANGE	25°C	55°C	85°C
0.001 TO 0.1uF	10,000,000 Megohms	5,000,000 Megohms	1,000,000 Megohms
GREATER THAN 0.1uF	1,000,000 Megohms-uF	500,000 Megohms-uF	100,000 Megohms-uF

K93 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	THERMAL AGING	From −65°C to +85°C, 5 cycles min.	4.7.3	There shall be no physical damage	100% Test
2	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1x10⁻⁶atm/cm³/sec. max.	100% Test
3	SEAL TEST (GROSS LEAK)	Place in 85°C hot water for 60 seconds minimum and observe for bubbles	4.7.5	No continuous bubble stream	100% Test
4	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz square wave at a peak to peak voltage of 3 times DC rated voltage for 60 seconds minimum. Do not exceed 800 volts peak to peak.	4.7.6	No shorts	100% Test
5	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	Per I.R. Table	100% Test
7	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
8	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measured at 0.1KHz	4.7.9	0.02% max.	100% Test
9	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship as required.	4.7.1	Per specification	1.0% AQL

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CRC COMPONENT RESEARCH CO.

POLYSTYRENE
K93 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE K93B 50VDC RATED				TYPE K93C 100VDC RATED				TYPE K93D 200VDC RATED				TYPE K93E 400VDC RATED			
	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C
.001	93B102	.193	.562	.662	93C102	.193	.687	.787	93D102	.235	.687	.787	93E102	.312	.687	.787
.0012	93B122	.193	.562	.662	93C122	.193	.687	.787	93D122	.235	.687	.787	93E122	.312	.687	.787
.0015	93B152	.193	.562	.662	93C152	.193	.687	.787	93D152	.235	.687	.787	93E152	.312	.687	.787
.0018	93B182	.193	.562	.662	93C182	.193	.687	.787	93D182	.235	.687	.787	93E182	.312	.687	.787
.002	93B202	.193	.562	.662	93C202	.193	.687	.787	93D202	.235	.687	.787	93E202	.312	.687	.787
.0022	93B222	.193	.562	.662	93C222	.193	.687	.787	93D222	.235	.687	.787	93E222	.312	.687	.787
.0027	93B272	.193	.562	.662	93C272	.193	.687	.787	93D272	.235	.687	.787	93E272	.312	.687	.787
.0033	93B332	.193	.562	.662	93C332	.193	.687	.787	93D332	.235	.687	.787	93E332	.312	.687	.787
.0039	93B392	.193	.562	.662	93C392	.193	.687	.787	93D392	.235	.687	.787	93E392	.312	.687	.787
.0047	93B472	.193	.562	.662	93C472	.193	.687	.787	93D472	.235	.687	.787	93E472	.312	.687	.787
.005	93B502	.193	.562	.662	93C502	.193	.687	.787	93D502	.235	.687	.787	93E502	.312	.687	.787
.0056	93B562	.193	.562	.662	93C562	.193	.687	.787	93D562	.235	.687	.787	93E562	.312	.687	.787
.0068	93B682	.193	.562	.662	93C682	.193	.687	.787	93D682	.235	.687	.787	93E682	.312	.687	.787
.0075	93B752	.193	.687	.787	93C752	.193	.813	.913	93D752	.235	.813	.913	93E752	.312	.813	.913
.0082	93B822	.193	.687	.787	93C822	.193	.813	.913	93D822	.235	.813	.913	93E812	.312	.813	.913
.01	93B103	.193	.687	.787	93C103	.193	.813	.913	93D103	.235	.813	.913	93E103	.312	.813	.913
.012	93B123	.193	.687	.787	93C123	.193	.813	.913	93D123	.235	.813	.913	93E123	.312	.813	.913
.015	93B153	.235	.687	.787	93C153	.235	.813	.913	93D153	.312	.813	.913	93E153	.400	.813	.913
.018	93B183	.235	.813	.913	93C183	.312	.813	.913	93D183	.400	.813	.913	93E183	.400	1.063	1.163
.02	93B203	.235	.813	.913	93C203	.312	.813	.913	93D203	.400	.813	.913	93E203	.400	1.063	1.163
.022	93B223	.235	.813	.913	93C223	.312	.813	.913	93D223	.400	.813	.913	93E223	.400	1.063	1.163
.027	93B273	.235	.813	.913	93C273	.312	.813	.913	93D273	.400	.813	.913	93E273	.400	1.063	1.163
.033	93B333	.235	.813	.913	93C333	.312	.813	.913	93D333	.400	.813	.913	93E333	.400	1.063	1.163
.039	93B393	.312	.813	.913	93C393	.400	.813	.913	93D393	.400	1.063	1.163	93E393	.500	1.125	1.225
.047	93B473	.312	.813	.913	93C473	.400	.813	.913	93D473	.400	1.063	1.163	93E473	.500	1.125	1.225
.05	93B503	.312	.813	.913	93C503	.400	.813	.913	93D503	.400	1.063	1.163	93E503	.500	1.125	1.225
.056	93B563	.312	.813	.913	93C563	.400	.813	.913	93D563	.400	1.063	1.163	93E563	.500	1.125	1.225
.068	93B683	.400	.813	.913	93C683	.400	1.063	1.163	93D683	.500	1.125	1.225	93E583	.500	1.375	1.475
.075	93B753	.400	.813	.913	93C753	.400	1.063	1.163	93D753	.500	1.125	1.225	93E753	.500	1.375	1.475
.082	93B823	.400	.813	.913	93C823	.400	1.063	1.163	93D823	.500	1.125	1.225	93E823	.500	1.375	1.475
.1	93B104	.400	.813	.913	93C104	.400	1.063	1.163	93D104	.500	1.125	1.225	93E104	.500	1.375	1.475
.12	93B124	.400	.813	.913	93C124	.400	1.063	1.163	93D124	.500	1.125	1.225	93E124	.500	1.375	1.475
.15	93B154	.400	1.063	1.163	93C154	.500	1.125	1.225	93D154	.500	1.375	1.475	93E154	.562	1.375	1.475
.18	93B184	.400	1.063	1.163	93C184	.500	1.125	1.225	93D184	.500	1.375	1.475	93E184	.562	1.375	1.475
.20	93B204	.400	1.063	1.163	93C204	.500	1.125	1.225	93D204	.500	1.375	1.475	93E204	.562	1.375	1.475
.22	93B224	.400	1.063	1.163	93C224	.500	1.125	1.225	93D224	.500	1.375	1.475	93E224	.562	1.375	1.475
.27	93B274	.500	1.125	1.225	93C274	.500	1.375	1.475	93D274	.562	1.375	1.475	93E274	.670	1.375	1.475
.33	93B334	.500	1.125	1.225	93C334	.500	1.375	1.475	93D334	.562	1.375	1.475	93E334	.670	1.375	1.475
.39	93B394	.500	1.375	1.475	93C394	.562	1.375	1.475	93D394	.670	1.375	1.475	93E394	.670	1.875	1.975
.47	93B474	.562	1.375	1.475	93C474	.670	1.375	1.475	93D474	.670	1.875	1.975	93E474	.750	1.875	1.975
.50	93B504	.562	1.375	1.475	93C504	.670	1.375	1.475	93D504	.670	1.875	1.975	93E504	.750	1.875	1.975
.56	93B564	.562	1.375	1.475	93C564	.670	1.375	1.475	93D564	.670	1.875	1.975	93E564	.750	1.875	1.975
.68	93B684	.670	1.375	1.475	93C684	.670	1.875	1.975	93D684	.750	1.875	1.975	93E684	1.000	1.875	1.975
.75	93B754	.670	1.875	1.975	93C754	.750	1.875	1.975	93D754	1.000	1.875	1.975	93E754	1.000	2.375	2.475
.82	93B824	.670	1.875	1.975	93C824	.750	1.875	1.975	93D824	1.000	1.875	1.975	93E824	1.000	2.375	2.475
1.0	93B105	.670	1.875	1.975	93C105	.750	1.875	1.975	93D105	1.000	1.875	1.975	93E105	1.000	2.375	2.475
1.2	93B125	.750	1.875	1.975	93C125	1.000	1.875	1.975								
1.5	93B155	.750	1.875	1.975	93C155	1.000	1.875	1.975								
1.8	93B185	1.000	1.875	1.975	93C185	1.000	2.375	2.475								
2.0	93B205	1.000	1.875	1.975	93C205	1.000	2.375	2.475								
2.2	93B225	1.000	1.875	1.975												
2.5	93B255	1.000	2.375	2.225												
2.7	93B275	1.000	2.375	2.225												

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.

K93 | B | 104 | J | S | W

STYLE

VOLTAGE
B=50VDC
C=100VDC
D=200VDC
E=400VDC

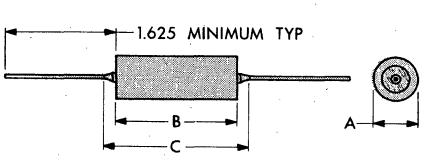
SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025") for .312" case dia. & smaller; #20 (.032") for .400" & .500" case dia.
C=Tinned oxygen-free copper: #18 (.040") for .562" case dia. & larger.

CAPACITANCE TOLERANCE
K=10% J=5% G=2% F=1% D=½% B=¼% A=.1%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±0.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads



COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

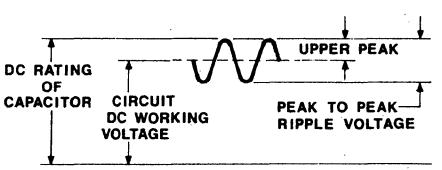
CRC
COMPONENT RESEARCH CO.

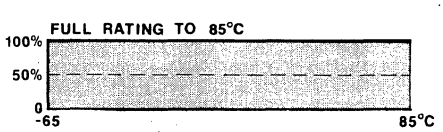
POLYSTYRENE K93 AC RATINGS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE K93 50VDC			TYPE K93 100VDC			TYPE K93 200VDC			TYPE K93 400VDC		
	MAXIMUM AC RATINGS			MAXIMUM AC RATINGS			MAXIMUM AC RATINGS			MAXIMUM AC RATINGS		
	RMS Volts	Freq. In KHz	RMS Amps	RMS Volts	Freq. In KHz	RMS Amps	RMS Volts	Freq. In KHz	RMS Amps	RMS Volts	Freq. In KHz	RMS Amps
.001	36.0	40.0	.009	60.0	40.0	.015	120.0	40.0	.03	240.0	40.0	.06
.0012	36.0	40.0	.011	60.0	40.0	.018	120.0	40.0	.036	240.0	40.0	.072
.0015	36.0	40.0	.013	60.0	40.0	.022	120.0	40.0	.044	240.0	40.0	.088
.0018	36.0	40.0	.016	60.0	40.0	.027	120.0	40.0	.054	240.0	40.0	.108
.002	36.0	40.0	.018	60.0	40.0	.03	120.0	40.0	.06	240.0	40.0	.12
.0022	36.0	40.0	.020	60.0	40.0	.033	120.0	40.0	.066	240.0	40.0	.132
.0027	36.0	40.0	.024	60.0	40.0	.041	120.0	40.0	.082	240.0	40.0	.16
.0033	36.0	40.0	.030	60.0	40.0	.045	120.0	40.0	.09	240.0	40.0	.18
.0039	36.0	40.0	.035	60.0	40.0	.059	120.0	40.0	.12	240.0	40.0	.24
.0047	36.0	40.0	.042	60.0	40.0	.071	120.0	40.0	.14	240.0	40.0	.28
.005	36.0	40.0	.045	60.0	40.0	.075	120.0	40.0	.15	240.0	40.0	.30
.0056	36.0	40.0	.050	60.0	40.0	.084	120.0	40.0	.17	240.0	40.0	.34
.0068	36.0	40.0	.061	60.0	40.0	.102	120.0	40.0	.2	240.0	40.0	.4
.0075	36.0	40.0	.067	60.0	40.0	.11	120.0	40.0	.22	240.0	40.0	.44
.0082	36.0	40.0	.074	60.0	40.0	.12	120.0	40.0	.24	240.0	40.0	.48
.01	36.0	40.0	.090	60.0	40.0	.15	120.0	40.0	.30	240.0	40.0	.60
.012	36.0	40.0	.11	60.0	40.0	.18	120.0	40.0	.36	240.0	40.0	.72
.015	36.0	40.0	.14	60.0	40.0	.22	120.0	40.0	.44	240.0	40.0	.88
.018	36.0	40.0	.16	60.0	40.0	.27	120.0	40.0	.54	240.0	40.0	1.1
.02	36.0	40.0	.18	60.0	40.0	.3	120.0	40.0	.6	240.0	40.0	1.2
.022	36.0	40.0	.20	60.0	40.0	.33	120.0	40.0	.66	240.0	40.0	1.3
.027	36.0	40.0	.24	60.0	40.0	.41	120.0	40.0	.82	240.0	40.0	1.6
.033	36.0	40.0	.30	60.0	40.0	.45	120.0	40.0	.9	240.0	40.0	1.8
.039	36.0	40.0	.35	60.0	40.0	.59	120.0	40.0	1.2	240.0	40.0	2.4
.047	36.0	40.0	.42	60.0	40.0	.71	120.0	40.0	1.4	240.0	40.0	2.9
.05	36.0	40.0	.45	60.0	40.0	.75	120.0	40.0	1.5	240.0	40.0	3.0
.056	36.0	40.0	.50	60.0	40.0	.84	120.0	40.0	1.7	240.0	35.5	3.0
.068	36.0	40.0	.61	60.0	40.0	1.0	120.0	40.0	2.0	240.0	34.1	3.5
.075	36.0	40.0	.67	60.0	40.0	1.1	120.0	40.0	2.2	240.0	30.9	3.5
.082	36.0	40.0	.74	60.0	40.0	1.2	120.0	40.0	2.4	240.0	28.3	3.5
.1	36.0	40.0	.90	60.0	40.0	1.5	120.0	40.0	3.0	240.0	23.2	3.5
.12	36.0	36.9	1.0	60.0	40.0	1.8	120.0	33.1	3.0	240.0	19.3	3.5
.15	36.0	40.0	1.4	60.0	40.0	2.2	120.0	30.9	3.5	240.0	17.7	4.0
.18	36.0	40.0	1.6	60.0	40.0	2.7	120.0	25.8	3.5	240.0	14.7	4.0
.20	36.0	40.0	1.8	60.0	40.0	3.0	120.0	23.2	3.5	240.0	13.2	4.0
.22	36.0	40.0	2.0	60.0	36.2	3.0	120.0	21.1	3.5	240.0	12.0	4.0
.27	36.0	40.0	2.4	60.0	34.4	3.5	120.0	19.6	4.0	240.0	11.0	4.5
.33	36.0	40.0	3.0	60.0	28.1	3.5	120.0	16.1	4.0	240.0	9.0	4.5
.39	36.0	40.0	3.5	60.0	32.6	4.0	120.0	15.3	4.5	240.0	8.5	5.0
.47	36.0	37.6	4.0	60.0	25.4	4.5	120.0	14.1	5.0	240.0	7.0	5.0
.50	36.0	35.4	4.0	60.0	23.8	4.5	120.0	13.2	5.0	240.0	6.6	5.0
.56	36.0	31.6	4.0	60.0	21.3	4.5	120.0	11.8	5.0	240.0	5.9	5.0
.68	36.0	28.6	4.5	60.0	19.5	5.0	120.0	10.7	5.5	240.0	5.8	6.0
.75	36.0	29.5	5.0	60.0	19.4	5.5	120.0	10.6	6.0	240.0	6.2	7.0
.82	36.0	27.0	5.0	60.0	17.8	5.5	120.0	9.7	6.0	240.0	5.6	7.0
1.0	36.0	22.1	5.0	60.0	14.6	5.5	120.0	7.9	6.0	240.0	4.6	7.0
1.2	36.0	20.4	5.5	60.0	13.2	6.0						
1.5	36.0	16.2	5.5	60.0	10.6	6.0						
1.8	36.0	14.7	6.0	60.0	10.3	7.0						
2.0	36.0	13.2	6.0	60.0	9.28	7.0						
2.2	36.0	12.06	6.0									
2.5	36.0	11.5	6.5									
2.7	36.0	10.66	6.5									

1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. CAPACITORS CAN HANDLE PULSE CURRENTS UP TO 100 TIMES GREATER THAN THE PEAK CURRENTS CALCULATED FROM THE RATED RMS RATING (PROVIDED SLOW REPETITION RATES ARE USED). IF THERE IS ANY DOUBT, A SKETCH OF THE VOLTAGE AND CURRENT WAVE FORMS WITH TIME BASE SHOULD BE SENT TO CRC FOR ANALYSIS.





COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

DOUBLE LAYER A10

ESTABLISHED RELIABILITY CAPACITORS

A10 SPECIFICATIONS

CONSTRUCTION	Type A10 capacitors utilize a dual layer construction as extra assurance clearings that low resistance faults will not occur. See Index for Capacitor Fault Scanning.	
OPERATING TEMPERATURE	−65°C to +100°C	At full rated voltage, derate linearly to 50% of rated voltage at 125°C.
DIELECTRIC ABSORPTION	0.1% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.15% maximum	At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum	At 25°C at a peak to peak voltage of 3 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	200% DC volts	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	±1% 0% to −2%	From 25°C to +125°C. From 25°C to −55°C.
CAPACITANCE STABILITY	±0.2%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6} atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.18uF CAPACITOR AT 25°C IS 300,000 ÷ 0.18 = 1,666,666 MEGOHMS.

RANGE	25°C	85°C	100°C	125°C
.001 TO 0.1uF	3,000,000 Megohms	500,000 Megohms	200,000 Megohms	20,000 Megohms
GREATER THAN 0.1uF	300,000 Megohms-uF	50,000 Megohms-uF	20,000 Megohms-uF	2,000 Megohms-uF

A10 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	48 hrs. minimum at 125°C, at 140% rated DC voltage	4.7.2	No physical damage	100% Test
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (FINE LEAK)	Helium bomb 45 PSI for 1 hr. minimum, check for helium leak	4.7.5	1x10 ⁶atm/cm³/sec. max.	100% Test
4	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
5	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 3 times DC rated voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	DC HI-POT (TERMINAL TO TERMINAL AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
7	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	300,000 megohm-uF need not exceed 3,000,000 megohms	100% Test
8	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
9	% DISSIPATION FACTOR	At 25°C at 1KHz, values above 1uF measure at 0.1KHz	4.7.9	0.15% max.	100% Test
10	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship	4.7.1	Per specification	1.0% AQL

1. Capacitors are packaged and shipped with Certification of Conformance. 2. Traceability to production and test records by permanent marking of parts with date code lot. 3. Process and inspection data is maintained on file per NHB 5300.4 (1C), MIL-Q-9858 and MIL-STD-790.

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

DOUBLE LAYER A10 CASE DIMENSIONS

ESTABLISHED RELIABILITY CAPACITORS

uF	TYPE A10B 50VDC RATED				TYPE A10C 100VDC RATED				TYPE A10D 200VDC RATED				TYPE A10E 400VDC RATED			
	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C	Basic P/N	Diam. A	Length B	Length C
.001	A10B102	.170	.500	.600	A10C102	.170	.500	.600	A10D102	.170	.562	.662	A10E102	.193	.562	.662
.0012	A10B122	.170	.500	.600	A10C122	.170	.500	.600	A10D122	.170	.562	.662	A10E122	.193	.562	.662
.0015	A10B152	.170	.500	.600	A10C152	.170	.500	.600	A10D152	.170	.562	.662	A10E152	.193	.562	.662
.0018	A10B182	.170	.500	.600	A10C182	.170	.500	.600	A10D182	.170	.562	.662	A10E182	.193	.562	.662
.002	A10B202	.170	.500	.600	A10C202	.170	.500	.600	A10D202	.170	.562	.662	A10E202	.193	.562	.662
.0022	A10B222	.170	.500	.600	A10C222	.170	.500	.600	A10D222	.170	.562	.662	A10E222	.193	.562	.662
.0027	A10B272	.170	.500	.600	A10C272	.170	.500	.600	A10D272	.170	.562	.662	A10E272	.235	.562	.662
.0033	A10B332	.170	.500	.600	A10C332	.170	.500	.600	A10D332	.170	.562	.662	A10E332	.235	.562	.662
.0039	A10B392	.170	.500	.600	A10C392	.170	.500	.600	A10D392	.170	.562	.662	A10E392	.235	.562	.662
.0047	A10B472	.170	.500	.600	A10C472	.170	.500	.600	A10D472	.170	.562	.662	A10E472	.235	.562	.662
.005	A10B502	.170	.500	.600	A10C502	.170	.500	.600	A10D502	.170	.562	.662	A10E502	.235	.562	.662
.0056	A10B562	.170	.500	.600	A10C562	.170	.500	.600	A10D562	.170	.562	.662	A10E562	.235	.562	.662
.0068	A10B682	.170	.500	.600	A10C682	.170	.562	.662	A10D682	.170	.562	.662	A10E582	.235	.687	.787
.0075	A10B752	.170	.562	.662	A10C752	.170	.562	.662	A10D752	.193	.562	.662	A10E752	.235	.687	.787
.0082	A10B822	.170	.562	.662	A10C822	.170	.562	.662	A10D822	.193	.562	.662	A10E822	.235	.687	.787
.01	A10B103	.170	.562	.662	A10C103	.170	.687	.787	A10D103	.193	.562	.662	A10E103	.235	.687	.787
.012	A10B123	.170	.562	.662	A10C123	.170	.687	.787	A10D123	.193	.562	.662	A10E123	.235	.687	.787
.015	A10B153	.170	.562	.662	A10C153	.170	.687	.787	A10D153	.235	.562	.662	A10E153	.235	.813	.913
.018	A10B183	.193	.562	.662	A10C183	.193	.687	.787	A10D183	.235	.687	.787	A10E183	.312	.813	.913
.02	A10B203	.193	.562	.662	A10C203	.193	.687	.787	A10D203	.235	.687	.787	A10E203	.312	.813	.913
.022	A10B223	.193	.562	.662	A10C223	.193	.687	.787	A10D223	.235	.687	.787	A10E223	.312	.813	.913
.027	A10B273	.193	.562	.662	A10C273	.193	.687	.787	A10D273	.312	.687	.787	A10E273	.312	.813	.913
.033	A10B333	.193	.562	.662	A10C333	.193	.687	.787	A10D333	.312	.687	.787	A10E333	.312	.813	.913
.039	A10B393	.170	.687	.787	A10C393	.235	.687	.787	A10D393	.312	.687	.787	A10E393	.312	.813	.913
.047	A10B473	.170	.687	.787	A10C473	.235	.687	.787	A10D473	.312	.687	.787	A10E473	.400	.813	.913
.05	A10B503	.170	.687	.787	A10C503	.235	.687	.787	A10D503	.312	.687	.787	A10E503	.400	.813	.913
.056	A10B563	.193	.687	.787	A10C563	.235	.687	.787	A10D563	.312	.813	.913	A10E563	.400	.813	.913
.068	A10B683	.193	.687	.787	A10C683	.235	.813	.917	A10D683	.312	.813	.913	A10E683	.400	.813	.913
.075	A10B753	.193	.813	.913	A10C753	.312	.687	.787	A10D753	.312	.813	.913	A10E753	.400	1.063	1.163
.082	A10B823	.193	.813	.913	A10C823	.312	.687	.787	A10D823	.312	.813	.913	A10E823	.400	1.063	1.163
.1	A10B104	.193	.813	.913	A10C104	.312	.687	.787	A10D104	.312	.813	.913	A10E104	.400	1.063	1.163
.12	A10B124	.235	.687	.787	A10C124	.312	.687	.787	A10D124	.312	.813	.913	A10E124	.400	1.063	1.163
.15	A10B154	.235	.687	.787	A10C154	.312	.813	.913	A10D154	.400	1.063	1.163	A10E154	.400	1.375	1.475
.18	A10B184	.235	.813	.913	A10C184	.312	.813	.913	A10D184	.400	1.375	1.475	A10E184	.500	1.375	1.475
.20	A10B204	.235	.813	.913	A10C204	.312	.813	.913	A10D204	.400	1.375	1.475	A10E204	.500	1.375	1.475
.22	A10B224	.312	.687	.787	A10C224	.312	.813	.913	A10D224	.400	1.375	1.475	A10E224	.500	1.375	1.475
.27	A10B274	.312	.687	.787	A10C274	.312	1.063	1.163	A10D274	.500	1.375	1.475	A10E274	.562	1.375	1.475
.33	A10B334	.312	.813	.913	A10C334	.312	1.063	1.163	A10D334	.500	1.375	1.475	A10E334	.562	1.375	1.475
.39	A10B394	.312	.813	.913	A10C394	.400	1.063	1.163	A10D394	.500	1.375	1.475	A10E394	.562	1.875	1.975
.47	A10B474	.400	.813	.913	A10C474	.400	1.063	1.163	A10D474	.500	1.375	1.475	A10E474	.562	1.875	1.975
.50	A10B504	.400	.813	.913	A10C504	.400	1.063	1.163	A10D504	.500	1.375	1.475	A10E504	.562	1.875	1.975
.56	A10B564	.400	.813	.913	A10C564	.400	1.063	1.163	A10D564	.500	1.375	1.475	A10E564	.562	1.875	1.975
.68	A10B684	.400	.813	.913	A10C684	.500	1.125	1.225	A10D684	.562	1.375	1.475	A10E684	.750	1.875	1.975
.75	A10B754	.400	1.063	1.163	A10C754	.500	1.125	1.225	A10D754	.562	1.875	1.975	A10E754	.750	1.875	1.975
.82	A10B824	.400	1.063	1.163	A10C824	.500	1.125	1.225	A10D824	.562	1.875	1.975	A10E824	.750	1.875	1.975
1.0	A10B105	.400	1.063	1.163	A10C105	.562	1.125	1.225	A10D105	.562	1.875	1.975	A10E105	.750	1.875	1.975
1.2	A10B125	.500	1.125	1.225	A10C125	.562	1.125	1.225	A10D125	.562	1.875	1.975	A10E125	1.000	1.875	1.975
1.5	A10B155	.500	1.125	1.225	A10C155	.562	1.375	1.475	A10D155	.670	1.875	1.975	A10E155	1.000	2.375	2.475
1.8	A10B185	.500	1.375	1.475	A10C185	.670	1.375	1.475	A10D185	.750	1.875	1.975	A10E185	1.000	2.375	2.475
2.0	A10B205	.500	1.375	1.475	A10C205	.670	1.375	1.475	A10D205	.750	1.875	1.975	A10E205	1.000	2.375	2.475
2.2	A10B225	.500	1.375	1.475	A10C225	.670	1.375	1.475	A10D225	.750	1.875	1.975				
2.5	A10B255	.500	1.375	1.475	A10C255	.670	1.875	1.975	A10D255	.750	1.875	1.975				
3.0	A10B305	.562	1.375	1.475	A10C305	.670	1.875	1.975	A10D305	1.000	1.875	1.975				
3.3	A10B335	.562	1.375	1.475	A10C335	.670	1.875	1.975	A10D335	1.000	1.875	1.975				
4.0	A10B405	.670	1.375	1.475	A10C405	.750	1.875	1.975	A10D405	1.000	2.375	2.475				
4.7	A10B475	.670	1.375	1.475	A10C475	.750	1.875	1.975								
5.0	A10B505	.670	1.375	1.475	A10C505	.750	1.875	1.975								
6.8	A10B685	.670	1.875	1.975	A10C685	1.000	2.375	2.475								
8.0	A10B805	.670	1.875	1.975	A10C805	1.000	2.375	2.475								
10.0	A10B106	.750	1.875	1.975	A10C106	1.000	2.375	2.475								

FOR SPECIAL VALUES AND TOLERANCES, PLEASE CONTACT OUR APPLICATION DEPARTMENT.

A10 | B | 104 | J | S | W

STYLE

VOLTAGE
B=50VDC
C=100VDC
D=200VDC
E=400VDC

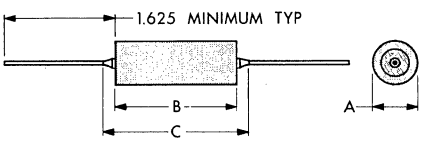
CAPACITANCE TOLERANCE
K=10% G=2%
J=5% F=1%

SLEEVING CODE
S=Mylar sleeve
X=No sleeve

LEAD CODE
W=Tinned copper clad steel: #22 (.025″) for .312″ case dia. & smaller; #20 (.032″) for .400″ & .500″ case dia.
C=Tinned oxygen-free copper: #18 (.040″) for .562″ case dia. & larger.

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±.010 Without Sleeving
	+0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	The lengths shown in table are maximum and include solder beads.



COMPONENT RESEARCH CO., INC. ■ 1655 26TH STREET ■ SANTA MONICA, CALIF. 90404 ■ (213) 829-3615. TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

FOIL POLYSULFONE A54

ESTABLISHED RELIABILITY CAPACITORS

A54 SPECIFICATIONS

CONSTRUCTION	Polysulfone dielectric, extended foil electrodes, hermetically sealed, leads isolated from case.	
ENVIRONMENTAL	Capacitors meet all environmental requirements of MIL-C-83421 except vibration and shock. Vibration is at 20g's and shock at 50g's.	
OPERATING TEMPERATURE	−65°C to +125°C	At full rated voltage, derate linearly to 50% of rated voltage at 150°C.
DIELECTRIC ABSORPTION	0.1% maximum	At 25°C when measured per MIL-C-83421.
DISSIPATION FACTOR	0.1% maximum	At 25°C when measured per MIL-C-83421.
AC SQUARE WAVE	100Hz, 60 seconds minimum	At 25°C at a peak to peak voltage of 3 times rated DC voltage, terminal to terminal per MIL-C-83421.
DIELECTRIC STRENGTH	200% DC volts	At 25°C from terminal to terminal and terminals to case for 60 seconds minimum.
TEMPERATURE COEFFICIENT	±2% maximum capacitance change	From −55°C to +150°C.
CAPACITANCE STABILITY	±0.25%	When measured at any two corresponding temperature points taken in five successive temperature cycles from −65°C to +125°C.
HERMETIC SEAL	1×10^{-6} atm/cm³/sec.	Maximum leak rate.
INSULATION RESISTANCE	See I.R. Table	Measured from terminal to terminal at rated DC voltage and 5 minutes charge time. Values greater than 1uF, allow an additional minute/uF charge time.

MINIMUM INSULATION RESISTANCE AT RATED DC VOLTAGE

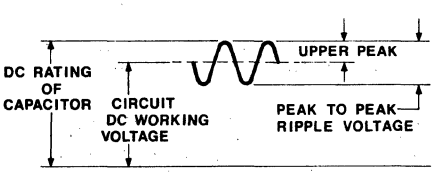
FOR VALUES OVER 0.1uF DIVIDE LIMIT SHOWN BY uF TO OBTAIN MINIMUM I.R. EXAMPLE: A 0.18uF CAPACITOR AT 25°C is 100,000 ÷ 0.18 = 555,000 MEGOHMS.

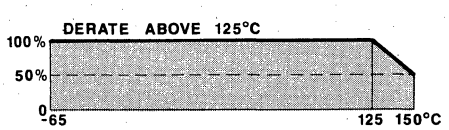
RANGE	25°C	85°C	125°C	150°C
.001 TO 0.1uF	1,000,000 Megohms	500,000 Megohms	30,000 Megohms	2,500 Megohms
GREATER THAN 0.1uF	100,000 Megohms-uF	50,000 Megohms-uF	3,000 Megohms-uF	250 Megohms-uF

A54 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METH. MIL-C-83421	TEST LIMIT	QUALITY LEVEL
1	BURN-IN	48 hours minimum at 125°C, at 120% rated AC voltage at 400Hz not to exceed 240VRMS	4.7.2	No physical damage	100% Test
2	THERMAL AGING	10 cycles minimum from −65°C to +125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST (GROSS LEAK)	Per MIL-C-83421	4.7.5	No continuous bubble stream	100% Test
4	AC SQUARE WAVE (TERMINAL TO TERMINAL)	Apply 100Hz at a peak to peak voltage of 3 times DC rated voltage for 60 sec. min. Do not exceed 800 volts peak to peak.	4.7.6	No shorts	100% Test
5	DC HI-POT (TERMINAL TO TERMINAL) AND TERMINALS TO CASE)	Apply 200% of rated DC voltage for 60 seconds minimum	4.7.6	No shorts	100% Test
6	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage	4.7.7	100,000 megohms-uF, need not exceed 1,000,000 megohms	100% Test
7	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
8	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	.15 maximum	100% Test
9	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions, and workmanship as required.	4.7.1	Per specification	1.0% AQL

1. THE COMBINED DC AND AC VOLTAGES SHOULD NOT EXCEED THE DC RATINGS, SEE FIGURE.
2. CAPACITORS MAY BE OPERATED AT HIGHER FREQUENCIES, AT REDUCED RMS VOLTAGE SUCH THAT MAX. AC CURRENT RATINGS ARE NOT EXCEEDED.
3. TYPE A54 CAPACITORS CAN HANDLE MUCH HIGHER PULSE REPETITION RATES THAN METALLIZED CAPACITORS.





COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615. TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

FOIL POLYSULFONE A54

ESTABLISHED RELIABILITY CAPACITORS

CASE DIMENSIONS • AC RATINGS

	TYPE A54C 100VDC					TYPE A54D 200VDC					TYPE A54V 300VDC					TYPE A54E 300VDC				
			AC RATINGS					AC RATINGS					AC RATINGS					AC RATINGS		
uF	Dia. A	Length B	Max. RMS Volts 20 KHz	Max. RMS Volts 100 KHz	Max. RMS Amps	Dia. A	Length B	Max. RMS Volts 20 KHz	Max. RMS Volts 100 KHz	Max. RMS Amps	Dia. A	Length B	Max. RMS Volts 20 KHz	Max. RMS Volts 100 KHz	Max. RMS Amps	Dia. A	Length B	Max. RMS Volts 20 KHz	Max. RMS Volts 100 KHz	Max. RMS Amps
.001	.193	.562	60	60	.038	.193	.562	120	120	.075	.193	.562	180	180	.113	.193	.687	240	240	.15
.0012	.193	.562	60	60	.045	.193	.562	120	120	.090	.193	.562	180	180	.135	.193	.687	240	240	.18
.0015	.193	.562	60	60	.056	.193	.562	120	120	.112	.193	.562	180	180	.169	.193	.687	240	240	.22
.0018	.193	.562	60	60	.067	.193	.562	120	120	.135	.193	.562	180	180	.202	.193	.687	240	240	.27
.002	.193	.562	60	60	.075	.193	.562	120	120	.150	.193	.562	180	180	.225	.193	.687	240	240	.30
.0022	.193	.562	60	60	.083	.193	.562	120	120	.165	.193	.562	180	180	.248	.193	.687	240	240	.33
.0027	.193	.562	60	60	.101	.193	.562	120	120	.202	.193	.687	180	180	.304	.193	.687	240	240	.4
.0033	.193	.562	60	60	.124	.193	.562	120	120	.247	.193	.687	180	180	.371	.193	.687	240	240	.5
.0039	.193	.562	60	60	.146	.193	.562	120	120	.293	.193	.687	180	180	.439	.193	.687	240	240	.6
.0047	.193	.562	60	60	.176	.193	.687	120	120	.353	.193	.687	180	180	.529	.235	.687	240	240	.7
.005	.193	.562	60	60	.188	.193	.687	120	120	.375	.193	.687	180	180	.562	.235	.687	240	240	.75
.0056	.193	.562	60	60	.210	.193	.687	120	120	.420	.193	.687	180	180	.623	.235	.687	240	240	.85
.0068	.193	.687	60	60	.255	.193	.687	120	120	.511	.235	.687	180	180	.766	.312	.687	240	240	1.0
.0075	.193	.687	60	60	.282	.235	.687	120	120	.563	.235	.687	180	180	.845	.312	.687	240	240	1.13
.0082	.193	.687	60	60	.308	.235	.687	120	120	.615	.235	.687	180	180	.923	.312	.687	240	240	1.23
.01	.235	.687	60	60	.375	.235	.687	120	120	.750	.312	.687	180	180	1.13	.312	.687	240	224	1.4
.012	.235	.687	60	60	.451	.235	.687	120	120	.902	.312	.687	180	172	1.3	.312	.687	240	200	1.5
.015	.235	.687	60	60	.561	.312	.687	120	120	1.12	.312	.687	180	150	1.4	.312	.813	240	190	1.8
.018	.312	.687	60	60	.674	.312	.687	120	120	1.35	.312	.687	180	134	1.5	.312	.813	240	178	2.0
.02	.312	.687	60	60	.750	.312	.687	120	112	1.4	.312	.813	180	132	1.65	.400	.813	240	168	2.1
.022	.312	.687	60	60	.822	.312	.687	120	110	1.5	.312	.813	180	130	1.8	.400	.813	240	158	2.2
.027	.312	.687	60	60	1.02	.312	.813	120	106	1.8	.312	.813	180	118	2.0	.400	.813	240	148	2.5
.033	.312	.687	60	60	1.22	.312	.813	120	98	2.0	.400	.813	180	108	2.2	.400	1.063	240	130	2.7
.039	.312	.813	60	60	1.46	.400	.813	120	90	2.2	.400	.813	180	98	2.4	.400	1.063	240	117	2.9
.047	.312	.813	60	60	1.76	.400	.813	120	82	2.4	.400	.813	180	85	2.5	.400	1.063	240	102	3.0
.05	.400	.813	60	60	1.88	.400	.813	120	80	2.5	.400	1.063	180	83.2	2.6	.500	1.125	240	102	3.2
.056	.400	.813	60	60	2.07	.400	.813	120	73	2.5	.400	1.063	180	78	2.7	.500	1.125	240	100	3.5
.068	.400	.813	60	53	2.2	.400	1.063	120	65	2.7	.400	1.063	180	67	2.8	.500	1.125	240	96	4.0
.075	.400	.813	60	50	2.4	.400	1.063	120	61	2.9	.400	1.063	180	63	3.0	.500	1.375	240	97	4.6
.082	.400	.813	60	49	2.5	.400	1.063	120	59	3.0	.500	1.125	180	61	3.15	.500	1.375	240	98	5.0
.1	.400	1.063	60	44	2.7	.500	1.125	120	55	3.4	.500	1.125	180	56	3.50	.562	1.375	240	85	5.3
.12	.400	1.063	60	37	2.8	.500	1.125	120	48	3.6	.500	1.125	180	53	4.00	.562	1.375	240	75	5.6
.15	.400	1.063	60	37	2.9	.500	1.125	120	43	4.00	.500	1.375	180	48	4.50	.562	1.375	240	53	6.0
.18	.400	1.063	60	27	3.0	.500	1.375	120	40	4.50	.500	1.375	180	45	5.00					
.2	.500	1.125	60	26	3.3	.500	1.375	120	38	4.75	.562	1.375	180	45	5.63					
.22	.500	1.125	60	25	3.4	.500	1.375	120	37	5.00	.562	1.375	180	45	6.00					
.27	.500	1.125	60	22	3.8	.562	1.375	120	33	5.50										
.33	.500	1.125	60	20	4.13	.562	1.375	120	29	6.00										
.39	.500	1.375	60	20	5.00															
.47	.562	1.375	60	20	6.00															

A54 | C | 104 | J | S | W

STYLE

VOLTAGE
C=100VDC
D=200VDC
V=300VDC
E=400VDC

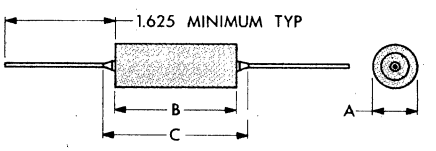
SLEEVING CODE
S=Mylar sleeve
X=No sleeve

CAPACITANCE TOLERANCE K=10% G=2% J=5% F=1%

PICOFARAD CODE: First two digits represent significant figures. Last digit represents number of zeros to follow. Example: 104 = 100,000 picofarads.

LEAD CODE
W=Tinned copper clad steel: #22 (.025") for .312" case dia. & smaller; #20 (.032") for .400" & .500" case dia.
C=Tinned oxygen-free copper: #18 (.040") for .562" case dia. & larger.

CASE DIMENSIONS	TOLERANCE LIMITS (INCHES)
"A" Diameter	±.010 Without Sleeving +0.02 −0.00 With Mylar Sleeving
"B" Case Length	±0.03 With or Without Sleeving
"C" Bead to Bead Max. Length	"C" Dimension is 0.2" maximum more than "B" dimension in table



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CRC COMPONENT RESEARCH CO.

FOIL POLYSULFONE B54

ESTABLISHED RELIABILITY CAPACITORS

SPECIFICATIONS & QUALITY CONFORMANCE

400VRMS, 600VRMS, RATED FROM −65°C TO +125°C

Series B54 capacitors are designed for continuous duty operation over the full temperature range from −65°C to +125°C at rated voltage, current and frequency.

The maximum RMS current or peak current can be exceeded with reduced duty cycle or tone burst operation, provided the peak rated voltages are not exceeded, and provided the heat rise measured at the terminals and within ¼" of the hermetic seals does not exceed 20°C.

Heat rise is measured with the capacitor located in a room temperature environment allowing for non-cooled normal convection. Lead size and distance to the power source must be adequate to prevent undue heat sinking or heat generation during measurement.

HIGH CURRENT HANDLING WITH LOW LOSS

Series B54 capacitors have very low series resistance terminations, measuring in the range of several milliohms at 100KHz, and can handle very high peak current discharge currents. Typically it is estimated that a 1uF capacitor can handle over 3000 amperes of peak current at repetition rates up to 10 pulses per second. Testing is now in process to develop meaningful pulse current limits to be added to future specifications for B54 capacitors.

FREEDOM FROM CORONA INCEPTION AND INTERNAL HOT SPOTS

CRC capacitors use a patented low loss termination which remains reliable after years of operation under severe environmental conditions. Whereas commercial type AC rated capacitors may be adequate for 60Hz and possibly 400Hz long term life, the use of CRC terminations enables these capacitors to operate up to 40KHz without abnormal hot spot conditions or corona inception.

40KHz RATED FOR HIGH CURRENT HANDLING UP TO 125°C

CRC capacitors will operate efficiently up to approximately 400KHz at their maximum current rated conditions. Typically a capacitor that is 1uF and is rated at 10 amps at 40KHz will be handling 40VRMS at 40KHz. This capacitor when operated at 400KHz at 4VRMS will handle approximately 10ARMS current.

CRC has higher frequency, lower loss, higher power capacitors in the planning stage for future applications that seek for higher frequency power sources.

HERMETICALLY SEALED, RUGGED AEROSPACE, MILITARY CONSTRUCTION

CRC true hermetic sealing preserves the high quality performance of Series B54 foil polysulfone capacitors and protects the dielectric materials from chemical attack. Merely potting non-hermetic type capacitors is poor insurance against long term loss of dielectric strength and life. It has been found that attack by vapor ingestion of chemicals of non-hermetic polysulfone capacitors has resulted in failure in life or long term operation.

AVAILABLE WITH 400Hz OR 40KHz BURN-IN OPTIONS

AC burn-in options at additional cost are available for critical applications. The most economical AC burn-in is at rated RMS voltage @ 400Hz at 125°C. Burn-in @ 400KHz at maximum rated current is also available for those applications where long term use at high current is anticipated. Group "A" testing is performed 100%. This testing consists of vital capacitor parameters performed after burn-in to tight specification limits. This ensures the high reliability required to assure our customers of fault free operation under harsh operating conditions.

TYPE B54 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METHOD	TEST LIMIT	INSPECTION LEVEL
1	BURN-IN	16 hrs. minimum at 120% rated AC voltage at 400Hz at 125°C	4.7.2 MIL-C-83421	No physical damage	100% Test
2	THERMAL AGING	5 cycles minimum −65°C to 125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST	Gross leak Meth. 112 MIL-STD-202 Cond. B		No continuous bubble stream or oil leaks as required	100% Test
4	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage, or at 600VDC, whichever is less	4.7.7	100,000 megohm-uF, need not exceed 1,000,000 megohms	100% Test
5	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
6	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	0.15% maximum	100% Test
7	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions and workmanship	4.7.1	Per specification	1.0% AQL

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CRC COMPONENT RESEARCH CO.

FOIL POLYSULFONE B54

ESTABLISHED RELIABILITY CAPACITORS

DIMENSIONS & AC RATINGS

TYPE B54F 400VRMS RATED

uF	600VDC RATED OR 600 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −65°C TO 125°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
.033	B54F333KXD	BH	.400	1.083	400	400	360	3.0
.039	B54F393KXD	BH	.400	1.083	400	400	308	3.0
.047	B54F473KXD	BJ	.500	1.145	400	400	306	3.6
.056	B54F563KXD	BJ	.500	1.145	400	400	255	3.6
.068	B54F683KXD	BJ	.500	1.145	400	400	235	4.0
.075	B54F753KXD	BK	.500	1.395	400	400	235	4.4
.082	B54F823KXD	BK	.500	1.395	400	400	235	4.8
.092	B54F923KXD	BL	.562	1.395	400	400	230	5.3
.1	B54F104KXD	BL	.562	1.395	400	400	220	5.5
.12	B54F124KXD	BL	.562	1.395	400	400	200	6.0
.15	B54F154KXD	BL	.562	1.395	400	400	160	6.0
.18	B54F184KXD	BM	.670	1.395	400	400	155	7.0
.22	B54F224KXD	BM	.670	1.395	400	400	127	7.0
.27	B54F274KXD	BN	.670	1.895	400	400	118	8.0
.33	B54F334KXD	BN	.670	1.895	400	400	97	8.0
.39	B54F394KXD	BN	.670	1.895	400	400	82	8.0
.47	B54F474KXD	BP	.750	1.895	400	400	77	9.0
.56	B54F564KXD	BP	.750	1.895	400	400	64	9.0
.68	B54F684KXD	BQ	.750	2.480	400	400	53	9.0
.75	B54F754KXD	BQ	.750	2.480	400	400	53	10.0
.82	B54F824KXD	BQ	.750	2.480	400	400	49	10.0

TYPE B54P 600 VRMS RATED

800VDC RATED OR 840 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −65°C TO 125°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
B54P333KXD	BK	.500	1.395	600	600	600	5.0
B54P393KXD	BK	.500	1.395	600	600	513	5.0
B54P473KXD	BK	.500	1.395	600	600	426	5.0
B54P563KXD	BK	.500	1.395	600	600	357	5.0
B54P683KXD	BL	.562	1.395	600	600	353	6.0
B54P753KXD	BL	.562	1.395	600	600	320	6.0
B54P823KXD	BL	.562	1.395	600	600	293	6.0
B54P923KXD	BM	.670	1.395	600	600	305	7.0
B54P104KXD	BM	.670	1.395	600	600	280	7.0
B54P124KXD	BM	.670	1.395	600	600	233	7.0
B54P154KXD	BN	.670	1.895	600	600	214	8.0
B54P184KXD	BN	.670	1.895	600	600	178	8.0
B54P224KXD	BN	.670	1.895	600	600	146	8.0
B54P274KXD	BP	.750	1.980	600	600	133	9.0
B54P334KXD	BP	.750	1.980	600	600	109	9.0
B54P394KXD	BQ	.750	2.480	600	600	103	10.0
B54P474KXD	BQ	.750	2.480	600	600	85.1	10.0

ORDERING INFORMATION: All part numbers listed in tables have a capacitance tolerance of ±10% and are supplied with bare metal (unsleeved) cases.

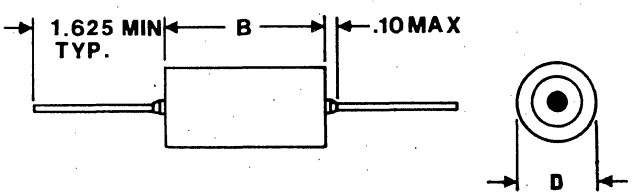
TECHNICAL INFORMATION: These capacitors can be damaged when you solder to the lead wires due to possible overheating that can occur. Place a suitable heat sink on the lead wire between the solder beads on the hermetic seal and the area of wire lead to be soldered.

For initial design, when operating the capacitors at high current levels it is suggested that you monitor the capacitor heat rise on the leads adjacent to the solder beads to verify that it does not exceed 20°C above ambient.

All maximum current ratings shown should result in less than 20°C heat rise with continuous duty operation under normal convection conditions.

Avoid tearing of solder beads when bending wire leads by using a suitable clamping fixture for lead bending.

PART DIMENSIONS AND TOLERANCES



Case Figure	D Case Diameter	B Maximum Case Length	Leads Diam. ±.003	Leads AWG	D Max.	Approx. Wt. Grams
BH	.400	1.187	.041	18	.420	7
BJ	.500	1.250	.041	18	.530	11
BK	.500	1.500	.041	18	.530	12
BL	.562	1.500	.041	18	.592	14
BM	.670	1.500	.051	16	.700	16
BN	.670	2.000	.051	16	.700	24
BP	.750	2.000	.051	16	.780	29
BQ	.750	2.500	.051	16	.780	35

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CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE B14

ESTABLISHED RELIABILITY CAPACITORS

SPECIFICATIONS & QUALITY CONFORMANCE

400VRMS, 600VRMS, RATED FROM −65°C TO +125°C

Series B14 capacitors are designed for continuous duty operation over the full temperature range from −65°C to +125°C at the ratings for voltage, current and frequency listed in the specifications.

The maximum RMS current or peak current can be exceeded with reduced duty cycle or tone burst operation, provided the peak rated voltages are not exceeded, and provided the heat rise measured at the terminals and within ¼″ of the hermetic seals does not exceed 20°C.

Heat rise is measured with the capacitor located in a room temperature environment allowing for non-cooled normal convection. Lead size and distance to the power source must be adequate to prevent undue heat sinking or heat generation during measurement.

HIGH CURRENT HANDLING WITH LOW LOSS

Series B14 capacitors have terminations slightly higher in resistance than Series B54 capacitors and can be used in pulse applications where the peak currents generally do not exceed 100 times B14 RMS current ratings and where the repetition rate is less than 10 pulses per second.

Testing is now in process to develop pulse current limits to be added to future specifications for B14 capacitors. Series B14 capacitors are smaller in size and lighter in weight than Series B54 foil polysulfone capacitors.

FREEDOM FROM CORONA INCEPTION AND INTERNAL HOT SPOTS

CRC capacitors use a patented low loss termination which remains reliable after years of operation under severe environmental conditions. Whereas commercial type AC rated capacitors may be adequate for 60Hz and possibly 400Hz long term life, the use of CRC terminations enables these capacitors to operate up to 40KHz without abnormal hot spot conditions or corona inception.

40KHz RATED FOR HIGH CURRENT HANDLING UP TO 125°C

CRC capacitors will operate efficiently up to approximately 400KHz at their maximum current rated conditions. Typically a capacitor that is 1uF and is rated at 10 amps at 40KHz will be handling 40VRMS at 40KHz. This capacitor when operated at 400KHz at 4VRMS will handle approximately 10ARMS current.

CRC has higher frequency, lower loss, higher power capacitors in the planning stage for future applications that seek for higher frequency power sources.

HERMETICALLY SEALED, RUGGED AEROSPACE, MILITARY CONSTRUCTION

CRC true hermetic sealing preserves the high quality performance of Series B14 foil polysulfone capacitors and protects the dielectric materials from chemical attack. Merely potting non-hermetic type capacitors is poor insurance against long term loss of dielectric strength and life. It has been found that attack by vapor ingestion of chemicals of non-hermetic polysulfone capacitors has resulted in failure in life or long term operation.

AVAILABLE WITH 400Hz OR 40KHz BURN-IN OPTIONS

AC burn-in options at additional cost are available for critical applications. The most economical AC burn-in is at rated RMS voltage @ 400Hz at 125°C. Burn-in @ 400KHz at maximum rated current is also available for those applications where long term use at high current is anticipated. Group "A" testing is performed 100%. This testing consists of vital capacitor parameters performed after burn-in to tight specification limits. This ensures the high reliability required to assure our customers of fault free operation under harsh operating conditions.

TYPE B14 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METHOD	TEST LIMIT	INSPECTION LEVEL
1	BURN-IN	16 hrs. minimum at 120% rated AC voltage at 400Hz at 125°C	4.7.2 MIL-C-83421	No physical damage	100% Test
2	THERMAL AGING	5 cycles minimum −65°C to 125°C	4.7.3	No physical damage	100% Test
3	SEAL TEST	Gross leak Meth. 112 MIL-STD-202 Cond. B		No continuous bubble stream or oil leaks as required	100% Test
	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage, or at 600VDC, whichever is less	4.7.7	100,000 megohm-uF, need not exceed 1,000,000 megohms	100% Test
5	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
6	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	0.5% maximum	100% Test
7	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions and workmanship	4.7.1	Per specification	1.0% AQL

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CRC COMPONENT RESEARCH CO.

METALLIZED POLYSULFONE B14

ESTABLISHED RELIABILITY CAPACITORS

DIMENSIONS & AC RATINGS

TYPE B14F 400VRMS RATED

TYPE B14P 600VRMS RATED

uF	600VDC RATED OR 600 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −65°C TO 125°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps	800VDC RATED OR 840 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −65°C TO 125°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
.01	B14F103KXD	BF	.312	.833	400	400	400	1.0	B14P103KXD	BH	.400	1.083	600	600	600	1.5
.012	B14F123KXD	BF	.312	.833	400	400	400	1.2	B14P123KXD	BH	.400	1.083	600	600	600	1.8
.015	B14F153KXD	BF	.312	.833	400	400	400	1.5	B14P153KXD	BH	.400	1.083	600	600	600	2.3
.018	B14F183KXD	BF	.312	.833	400	400	355	1.6	B14P183KXD	BH	.400	1.083	600	600	600	2.7
.022	B14F223KXD	BG	.400	.833	400	400	309	1.7	B14P223KXD	BH	.400	1.083	600	600	509	2.8
.027	B14F273KXD	BG	.400	.833	400	400	252	1.7	B14P273KXD	BH	.400	1.083	600	600	414	2.8
.033	B14F333KXD	BG	.400	.833	400	400	218	1.8	B14P333KXD	BH	.400	1.083	600	600	339	2.8
.039	B14F393KXD	BG	.400	.833	400	400	205	2.0	B14P393KXD	BH	.400	1.083	600	600	287	2.8
.047	B14F473KXD	BH	.400	1.083	400	400	187	2.2	B14P473KXD	BJ	.500	1.145	600	600	272	3.2
.056	B14F563KXD	BH	.400	1.083	400	400	164	2.3	B14P563KXD	BJ	.500	1.145	600	600	236	3.3
.068	B14F683KXD	BH	.400	1.083	400	400	159	2.7	B14P683KXD	BJ	.500	1.145	600	600	200	3.4
.075	B14F753KXD	BH	.400	1.083	400	400	149	2.8	B14P753KXD	BK	.500	1.395	600	600	200	3.75
.082	B14F823KXD	BJ	.500	1.145	400	400	146	3.0	B14P823KXD	BK	.500	1.395	600	600	195	4.0
.092	B14F923KXD	BJ	.500	1.145	400	400	140	3.2	B14P923KXD	BL	.562	1.395	600	600	191	4.4
.1	B14F104KXD	BJ	.500	1.145	400	400	128	3.2	B14P104KXD	BL	.562	1.395	600	600	180	4.5
.12	B14F124KXD	BK	.500	1.395	400	400	110	3.3	B14P124KXD	BL	.562	1.395	600	600	160	4.8
.15	B14F154KXD	BK	.500	1.395	400	400	110	4.1	B14P154KXD	BL	.562	1.395	600	600	134	5.0
.18	B14F184KXD	BL	.562	1.395	400	400	95	4.3	B14P184KXD	BM	.670	1.395	600	600	120	5.4
.22	B14F224KXD	BL	.562	1.395	400	400	91	5.0	B14P224KXD	BM	.670	1.395	600	600	102	5.6
.27	B14F274KXD	BL	.562	1.395	400	400	74	5.0	B14P274KXD	BN	.670	1.895	600	600	101	6.8
.33	B14F334KXD	BM	.670	1.395	400	400	67	5.5	B14P334KXD	BN	.670	1.895	600	600	82	6.8
.39	B14F394KXD	BM	.670	1.395	400	400	57	5.5	B14P394KXD	BN	.670	1.895	600	600	70	6.8
.47	B14F474KXD	BN	.670	1.895	400	400	47	5.5	B14P474KXD	BP	.750	1.980	600	600	61	7.2
.56	B14F564KXD	BN	.670	1.895	400	400	42	5.9	B14P564KXD	BP	.750	1.980	600	535	53.5	7.5
.68	B14F684KXD	BN	.670	1.895	400	400	40	6.8	B14P684KXD	BP	.750	1.980	600	470	47	8
.75	B14F754KXD	BP	.750	1.980	400	400	40	7.5	B14P754KXD	BQ	.750	2.480	600	533	53.3	10
.82	B14F824KXD	BP	.750	1.980	400	366	36	7.5	B14P824KXD	BS	.750	2.480	600	488	48.8	11
.92	B14F924KXD	BQ	.750	2.480	400	370	37	8.5								
1.0	B14F105KXD	BQ	.750	2.480	400	340	34	8.5								
1.2	B14F125KXD	BQ	.750	2.480	400	333	33.3	10								

ORDERING INFORMATION: All part numbers listed in tables have a capacitance tolerance of ±10% and are supplied with bare metal (unsleeved) cases.

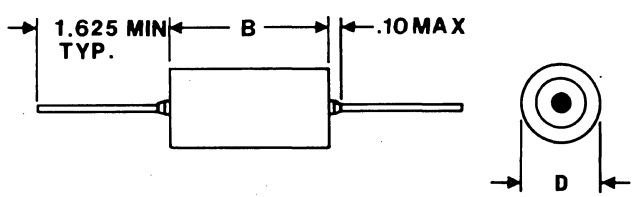
TECHNICAL INFORMATION: These capacitors can be damaged when you solder to the lead wires due to possible overheating that can occur. Place a suitable heat sink on the lead wire between the solder beads on the hermetic seal and the area of wire lead to be soldered.

For initial design, when operating the capacitors at high current levels it is suggested that you monitor the capacitor heat rise on the leads adjacent to the solder beads to verify that it does not exceed 20°C above ambient.

All maximum current ratings shown should result in less than 20°C heat rise with continuous duty operation under normal convection conditions.

Avoid tearing of solder beads when bending wire leads by using a suitable clamping fixture for lead bending.

PART DIMENSIONS AND TOLERANCES



Case Figure	D Case Diameter	B Maximum Case Length	Leads Diam. ±.003	Leads AWG	D Max.	Approx. Wt. Grams
BF	.312	.937	.032	20	.332	2.5
BG	.400	.937	.041	18	.420	4
BH	.400	1.187	.041	18	.420	6
BJ	.500	1.250	.041	18	.530	10
BK	.500	1.500	.041	18	.530	11
BL	.562	1.500	.041	18	.592	13
BM	.670	1.500	.051	16	.700	14
BN	.670	2.000	.051	16	.700	22
BP	.750	2.000	.051	16	.780	27
BQ	.750	2.500	.051	16	.780	31

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CRC
COMPONENT RESEARCH CO.

FOIL POLYPROPYLENE B55

ESTABLISHED RELIABILITY CAPACITORS

SPECIFICATIONS & QUALITY CONFORMANCE

400VRMS, 600VRMS, RATED FROM −55°C TO +85°C (HIGHER RATINGS AVAILABLE)

Series B55 capacitors are designed for continuous duty operation over the full temperature range from −55°C to +85°C at the rating for voltage, current and frequency listed in the specifications.

The maximum RMS current or peak current can be exceeded with reduced duty cycle or tone burst operation, provided that peak rated voltages are not exceeded, and provided the heat rise measured at the terminals and within ¼" of the hermetic seals does not exceed 20°C.

Heat rise is generally measured with the capacitor located in a room temperature environment allowing for non-cooled normal convection. Lead size and distance to the power source must be adequate to prevent undue heat sinking or generation during measurement.

HIGH CURRENT HANDLING WITH LOW LOSS

Series B55 capacitors have very low series resistance terminations, in the range of several milliohms at 100KHz, and can handle very high peak current discharge currents. Typically it is estimated that a 1uF capacitor can handle over 3000 amperes of peak current at repetition rates up to 10 pulses per second. Testing is now in process to develop meaningful pulse current limits to be added to future specifications for B55 capacitors.

FREEDOM FROM CORONA INCEPTION AND INTERNAL HOT SPOTS

Commercial type AC rated capacitors may be adequate for 60Hz and possibly 400Hz long term life. CRC capacitors are designed to operate up to 40KHz without abnormal hot spot conditions, without corona inception, with constant controlled low loss terminations which remain reliable after years of use, after operation during severe environmental conditions.

40KHz RATED FOR HIGH CURRENT HANDLING UP TO 85°C

CRC capacitors use a patented low loss termination which remains reliable after years of operation under severe environmental conditions. Whereas commercial type AC rated capacitors may be adequate for 60Hz and possibly 400Hz long term life, the use of CRC terminations enables these capacitors to operate up to 40KHz without abnormal hot spot conditions or corona inception.

HERMETICALLY SEALED, RUGGED AEROSPACE, MILITARY CONSTRUCTION

CRC true hermetic sealing preserves the high quality performance of Series B55 foil polypropylene capacitors and protects the dielectric materials from chemical attack. Merely potting non-hermetic type capacitors is poor insurance against long term loss of dielectric strength and life. It has been found that attack by vapor ingestion of chemicals of non-hermetic polypropylene capacitors has resulted in failure in life or long term operation.

AVAILABLE WITH 400Hz OR 40KHz BURN-IN OPTIONS

AC burn-in options at additional cost are available for critical applications. The most economical AC burn-in is at rated RMS voltage @ 400Hz at 85°C. Burn-in @ 40KHz at maximum rated current is also available for those applications where long term use at high current is anticipated. Group "A" testing is performed 100%. This testing consists of vital capacitor parameters performed after burn-in to tight specification limits. This ensures the high reliability required to assure our customers of fault free operation under harsh operating conditions.

TYPE B55 QUALITY CONFORMANCE INSPECTION

TEST NO.	TEST	TEST CONDITIONS	TEST METHOD	TEST LIMIT	INSPECTION LEVEL
1	BURN-IN	16 hrs. minimum at 120% rated AC voltage at 400Hz at 85°C	4.7.2 MIL-C-83421	No physical damage	100% Test
2	THERMAL AGING	5 cycles minimum −55°C to 85°C	4.7.3	No physical damage	100% Test
3	SEAL TEST	Gross leak Meth. 112 MIL-STD-202 Cond. B		No continuous bubble stream or oil leaks as required	100% Test
4	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage, or at 600VDC. whichever is less	4.7.7	100,000 megohm-uF, need not exceed 1,000,000 megohms	100% Test
5	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
6	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	.05% maximum	100% Test
7	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions and workmanship	4.7.1	Per specification	1.0% AQL

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CRC COMPONENT RESEARCH CO.

FOIL POLYPROPYLENE B55

ESTABLISHED RELIABILITY CAPACITORS

DIMENSIONS & AC RATINGS

TYPE B55F 400VRMS RATED

TYPE B55P 600VRMS RATED

uF	600VDC RATED OR 600 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −55°C TO 85°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps	800VDC RATED OR 840 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −55°C TO 85°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
.033	B55F333KXD	BH	.400	1.083	400	400	400	4	B55P333KXD	BK	.500	1.395	600	600	600	6
.039	B55F393KXD	BH	.400	1.083	400	400	400	4	B55P393KXD	BK	.500	1.395	600	600	600	6
.047	B55F473KXD	BJ	.500	1.145	400	400	400	5	B55P473KXD	BK	.500	1.395	600	600	511	6
.056	B55F563KXD	BJ	.500	1.145	400	400	357	5	B55P563KXD	BK	.500	1.395	600	600	428	6
.068	B55F683KXD	BJ	.500	1.145	400	400	294	5	B55P683KXD	BL	.562	1.395	600	600	412	7
.075	B55F753KXD	BK	.500	1.395	400	400	320	6	B55P753KXD	BL	.562	1.395	600	600	373	7
.082	B55F823KXD	BK	.500	1.395	400	400	293	6	B55P823KXD	BL	.562	1.395	600	600	342	7
.092	B55F923KXD	BL	.562	1.395	400	400	305	7	B55P923KXD	BM	.670	1.395	600	600	348	8
.1	B55F104KXD	BL	.562	1.395	400	400	280	7	B55P104KXD	BM	.670	1.395	600	600	360	8
.12	B55F124KXD	BL	.562	1.395	400	400	233	7	B55P124KXD	BM	.670	1.395	600	600	266	8
.15	B55F154KXD	BL	.562	1.395	400	400	187	7	B55P154KXD	BN	.670	1.895	600	600	214	8
.18	B55F184KXD	BM	.670	1.395	400	400	178	8	B55P184KXD	BN	.670	1.895	600	600	200	9
.22	B55F224KXD	BM	.670	1.395	400	400	146	8	B55P224KXD	BN	.670	1.895	600	600	164	9
.27	B55F274KXD	BN	.670	1.895	400	400	133	9	B55P274KXD	BP	.750	1.980	600	600	178	12
.33	B55F334KXD	BN	.670	1.895	400	400	109	9	B55P334KXD	BP	.750	1.980	600	600	145	12
.39	B55F394KXD	BN	.670	1.895	400	400	92.7	9	B55P394KXD	BQ	.750	2.480	600	600	144	14
.47	B55F474KXD	BP	.750	1.895	400	400	102	12	B55P474KXD	BQ	.750	2.480	600	600	119	14
.56	B55F564KXD	BP	.750	1.895	400	400	85.7	12								
.68	B55F684KXD	BP	.750	2.480	400	400	70.6	12								
.75	B55F754KXD	BQ	.750	2.480	400	400	74.6	14								
.82	B55F824KXD	BQ	.750	2.480	400	400	68.3	14								

ORDERING INFORMATION: All part numbers listed in tables have a capacitance tolerance of ±10% and are supplied with bare metal (unsleeved) cases.

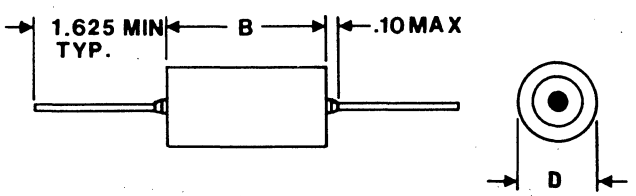
TECHNICAL INFORMATION: These capacitors can be damaged when you solder to the lead wires due to possible overheating that can occur. Place a suitable heat sink on the lead wire between the solder beads on the hermetic seal and the area of wire lead to be soldered.

For initial design, when operating the capacitors at high current levels it is suggested that you monitor the capacitor heat rise on the leads adjacent to the solder beads to verify that it does not exceed 20°C above ambient.

All maximum current ratings shown should result in less than 20°C heat rise with continuous duty operation under normal convection conditions.

Avoid tearing of solder beads when bending wire leads by using a suitable clamping fixture for lead bending.

PART DIMENSIONS AND TOLERANCES



Case Figure	D Case Diameter	B Maximum Case Length	Leads Diam. ±.003	Leads AWG	D Max.	Approx. Wt. Grams
BH	.400	1.187	.041	18	.420	6
BJ	.500	1.250	.041	18	.530	10
BK	.500	1.500	.041	18	.530	11
BL	.562	1.500	.041	18	.592	13
BM	.670	1.500	.051	16	.700	14
BN	.670	2.000	.051	16	.700	22
BP	.750	2.000	.051	16	.780	27
BQ	.750	2.500	.051	16	.780	32

COMPONENT RESEARCH CO., INC. ▪ 1655 26TH STREET ▪ SANTA MONICA, CALIF. 90404 ▪ (213) 829-3615, TWX: (910) 343-6864

CRC COMPONENT RESEARCH CO.

METALLIZED POLYPROPYLENE B15

ESTABLISHED RELIABILITY CAPACITORS

SPECIFICATIONS & QUALITY CONFORMANCE

400VRMS, 600VRMS, RATED −55°C TO +85°C

Series B15 metallized polypropylene capacitors have lower loss than Series B14 metallized polysulfone capacitors and therefore are superior for power resonating applications requiring minimum loss. The B15 capacitors are however limited for use in 85°C or lower temperature applications. CRC can supply special high temperature low loss teflon capacitors for 200°C power resonating applications if required.

When Series B15 specifications are completed, RMS ratings above 600VRMS will be available together with information covering this product line.

LOW LOSS, HIGH Q, LIGHT WEIGHT, HIGH POWER RATED, HERMETICALLY SEALED

The B15 capacitors are lighter in weight than any other hermetically sealed capacitor with equivalent current and voltage ratings at 40KHz. Typically a 5.6uF, 400VRMS, capacitor in a 1.25″ x 3.440″ case weighs approximately 110 grams and is rated to handle 35 amps at 40KHz.

Polypropylene film like many other dielectrics is affected by chemical attack of solvents, epoxies and contamination. True hermetic sealing of CRC's capacitors protects them from outside chemical attack and assures that long term high quality performance can be maintained.

RUGGED LOW LOSS TERMINATIONS FOR 100% DUTY CYCLE OPERATING LIFE

The large amount of power that B15 capacitors can handle is a result of years of development searching for all possible means of reducing capacitor losses and preserving the integrity of CRC's rugged capacitor terminations. When CRC's metallized polypropylene capacitors are subjected to temperature extremes, they surpass commercial type products in their ability to maintain a constant low loss equivalent series resistance and can maintain their low power factor for critical aerospace applications. Where extremely high pulse currents may be encountered Series B55 should be considered.

AC RATED TO 40KHz UP TO 85°C

Series B15 capacitors are rated up to 40KHz and are ideal for power resonating circuits. Due to a negative temperature coefficient of approximately 200 PPM/°C a 10°C temperature increase due to applied power or applied temperature will cause the capacitance to decrease approximately 0.2%.

CRC's polysulfone capacitors increase a maximum of only 0.05% in capacitance for 10°C increase when operated above 25°C.

AVAILABLE WITH AC BURN-IN AND OTHER SCREENING OPTIONS

CRC manufactures larger capacitors of similar construction to the B15 series in rectangular cases for power inverter applications requiring low loss filtering of several hundreds of amperes of ripple at frequencies 20KHz and higher.

Further developments in lowering capacitor losses are currently being completed at CRC and will result in further improved ratings for B15 and other new model capacitors.

TYPE B15 QUALITY CONFORMANCE INSPECTION

NO. TEST	TEST	TEST CONDITIONS	TEST METHOD	TEST LIMIT	INSPECTION LEVEL
1	BURN-IN	16 hrs. minimum at 120% rated AC voltage at 400Hz at 85°C	4.7.2 MIL-C-83421	No physical damage	100% Test
2	THERMAL AGING	5 cycles minimum −55°C to 85°C	4.7.3	No physical damage	100% Test
3	SEAL TEST	Gross leak Meth. 112 MIL-STD-202 Cond. B		No continuous bubble stream or oil leaks as required	100% Test
4	INSULATION RESISTANCE (TERMINAL TO TERMINAL)	At 25°C at rated DC voltage, or at 600VDC, whichever is less	4.7.7	100,000 megohm-uF, need not exceed 1,000,000 megohms	100% Test
5	% CAPACITANCE TOLERANCE	At 25°C at 1KHz	4.7.8	Per part number	100% Test
6	% DISSIPATION FACTOR	At 25°C at 10KHz	4.7.9	0.05% maximum	100% Test
7	VISUAL AND MECHANICAL INSPECTION	For marking, dimensions and workmanship	4.7.1	Per specification	1.0% AQL

NOW AVAILABLE: TYPE A15 METALLIZED POLYPROPYLENE LOW LOSS CAPACITORS. 100 VDC RATED .1 TO 22 μF. A.C. RATED TO 40 kHZ. CONTACT OUR APPLICATIONS DEPARTMENT FOR MORE INFORMATION.

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CRC COMPONENT RESEARCH CO.

METALLIZED POLYPROPYLENE B15

ESTABLISHED RELIABILITY CAPACITORS

DIMENSIONS & AC RATINGS

TYPE B15F 400VRMS RATED

uF	600VDC RATED OR 600 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −55°C TO 85°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
.01	B15F103KXD	BF	.312	.833	400	400	400	2.5
.012	B15F123KXD	BF	.312	.833	400	400	400	2.5
.015	B15F153KXD	BF	.312	.833	400	400	400	2.5
.018	B15F183KXD	BF	.312	.833	400	400	400	2.5
.022	B15F223KXD	BG	.400	.833	400	400	400	3.0
.027	B15F273KXD	BG	.400	.833	400	400	400	3.0
.033	B15F333KXD	BG	.400	.833	400	400	364	3.0
.039	B15F393KXD	BG	.400	.833	400	400	308	3.0
.047	B15F473KXD	BH	.400	1.083	400	400	298	3.5
.056	B15F563KXD	BH	.400	1.083	400	400	250	3.5
.068	B15F683KXD	BH	.400	1.083	400	400	206	3.5
.075	B15F753KXD	BH	.400	1.083	400	400	187	3.5
.082	B15F823KXD	BJ	.500	1.145	400	400	195	4
.092	B15F923KXD	BJ	.500	1.145	400	400	174	4
.1	B15F104KXD	BJ	.500	1.145	400	400	160	4
.12	B15F124KXD	BK	.500	1.395	400	400	167	5
.15	B15F154KXD	BK	.500	1.395	400	400	134	5
.18	B15F184KXD	BL	.562	1.395	400	400	133	6
.22	B15F224KXD	BL	.562	1.395	400	400	109	6
.27	B15F274KXD	BL	.562	1.395	400	400	88.8	6
.33	B15F334KXD	BM	.670	1.395	400	400	84.7	7
.39	B15F394KXD	BM	.670	1.395	400	400	72.1	7
.47	B15F474KXD	BN	.670	1.895	400	400	68.1	8
.56	B15F564KXD	BN	.670	1.895	400	400	57	8
.68	B15F684KXD	BN	.670	1.895	400	400	47	8
.75	B15F754KXD	BP	.750	1.980	400	400	58.6	11
.82	B15F824KXD	BP	.750	1.980	400	400	53.7	11
.92	B15F924KXD	BQ	.750	2.480	400	400	56.6	13
1.0	B15F105KXD	BQ	.750	2.480	400	400	52	13
1.2	B15F125KXD	BQ	.750	2.480	400	400	43.3	13

TYPE B15P 600VRMS RATED

800VDC RATED OR 840 VOLTS PEAK (AC PLUS DC VOLTS) Part No.	Fig.	Dia.	Leng.	MAX. AC RATING −55°C TO 85°C RMS Volts at 400Hz	RMS Volts at 4KHz	RMS Volts at 40KHz	Max. RMS Amps
B15P103KXD	BH	.400	1.083	600	600	600	3.5
B15P123KXD	BH	.400	1.083	600	600	600	3.5
B15P153KXD	BH	.400	1.083	600	600	600	3.5
B15P183KXD	BH	.400	1.083	600	600	600	3.5
B15P223KXD	BH	.400	1.083	600	600	600	3.5
B15P273KXD	BH	.400	1.083	600	600	518	3.5
B15P333KXD	BH	.400	1.083	600	600	424	3.5
B15P393KXD	BH	.400	1.083	600	600	369	3.5
B15P473KXD	BJ	.500	1.145	600	600	340	4
B15P563KXD	BJ	.500	1.145	600	600	286	4
B15P683KXD	BJ	.500	1.145	600	600	227	4
B15P753KXD	BK	.500	1.395	600	600	267	5
B15P823KXD	BK	.500	1.395	600	600	244	5
B15P923KXD	BL	.562	1.395	600	600	261	6
B15P104KXD	BL	.562	1.395	600	600	240	6
B15P124KXD	BL	.562	1.395	600	600	200	6
B15P154KXD	BL	.562	1.395	600	600	160	6
B15P184KXD	BM	.670	1.395	600	600	155	7
B15P224KXD	BM	.670	1.395	600	600	127	7
B15P274KXD	BN	.670	1.895	600	600	118	8
B15P334KXD	BN	.670	1.895	600	600	96.8	8
B15P394KXD	BN	.670	1.895	600	600	82.4	8
B15P474KXD	BP	.750	1.980	600	600	93.6	11
B15P564KXD	BP	.750	1.980	600	600	78.5	11
B15P684KXD	BP	.750	1.980	600	600	64.7	11
B15P754KXD	BQ	.750	2.480	600	600	69.3	13
B15P824KXD	BS	1.0	2.480	600	600	63.4	15

ORDERING INFORMATION: All part numbers listed in tables have a capacitance tolerance of ±10% and are supplied with bare metal (unsleeved) cases.

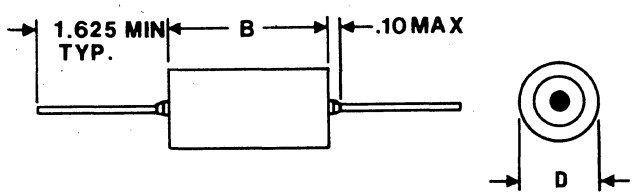
TECHNICAL INFORMATION: These capacitors can be damaged when you solder to the lead wires due to possible overheating that can occur. Place a suitable heat sink on the lead wire between the solder beads on the hermetic seal and the area of wire lead to be soldered.

For initial design, when operating the capacitors at high current levels it is suggested that you monitor the capacitor heat rise on the leads adjacent to the solder beads to verify that it does not exceed 20°C above ambient.

All maximum current ratings shown should result in less than 20°C heat rise with continuous duty operation under normal convection conditions.

Avoid tearing of solder beads when bending wire leads by using a suitable clamping fixture for lead bending.

PART DIMENSIONS AND TOLERANCES



Case Figure	D Case Diameter	B Maximum Case Length	Leads Diam. ±.003	Leads AWG	D Max.	Approx. Wt. Grams
BF	.312	.937	.032	20	.332	2.5
BG	.400	.937	.041	18	.420	3.5
BH	.400	1.187	.041	18	.420	5
BJ	.500	1.250	.041	18	.530	8
BK	.500	1.500	.041	18	.530	9
BL	.562	1.500	.041	18	.592	12
BM	.670	1.500	.051	16	.700	13
BN	.670	2.000	.051	16	.700	21
BP	.750	2.000	.051	16	.780	25
BQ	.750	2.500	.051	16	.780	30
BS	1.0	2.500	.051	16		50

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CAPACITORS

Ceramic Capacitors

CK12, CK13, CK14 . . . . . MIL-C-11015/20
CKR11, CKR12, CKR14 . . . . . MIL-C-39014/15
CK31, CK32 . . . . . MIL-C-11015/25
CKR31, CKR32 . . . . . MIL-C-39014/21
CAC02, CAC03, CAC04, CAC05 . . . Spinseal™ Z5U, X7R, C0G

Glass Capacitors

CY10, 15, 20, 30 . . . . . MIL-C-11272
CY06, 07, 08 . . . . . MIL-C-11272
CYFR10, 15, 20, 30 . . . . . Corning Hi-Rel
CYR10, 15, 20, 30, 51, 52, 53 . . . . . MIL-C-23269

Tantalum Capacitors

Minitan® Modular . . . Microminiature, rectangular case
Minitan Cordwood . . . Microminiature, cylindrical case
Minitan Nonpolar . . . . Microminiature, nonpolar series
Minidip . . . . . Microminiature, dipped radials
Minichip MK . . . . . Microminiature, tantalum chips

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NJ	Marlton, Milgray Electronics, Inc.	609-983-5010
NJ	Fairfield, Schweber Electronics	201-227-7880
NJ	Hanover, State Electronics Corp.	201-887-2550
NJ	Perth Amboy, Sterling Electronics	201-442-8000
NM	Albuquerque, Arrow Electronics, Inc.	505-243-4566
NM	Albuquerque, Bell Industries	505-292-2700
NY	Hauppauge, Arrow Electronics, Inc.	516-231-1030
NY	Farmingdale, Arrow Electronics	516-694-6800
NY	Liverpool, Arrow Electronics, Inc.	315-652-1000
NY	Rochester, Arrow Electronics, Inc.	716-275-0300
NY	Freeport, Milgray Electronics, Inc.	516-546-6000
NY	Rochester, Schweber Electronics	716-424-2222
NY	Westbury, Schweber Electronics	516-334-7474
NC	Raleigh, Arrow Electronics, Inc.	919-876-3132
NC	Winston Salem, Arrow Electronics	919-725-8711
NC	Greensboro, Hammond Electronics	919-275-6391
NC	Raleigh, RESCO	919-781-5700
NC	Raleigh, Schweber Electronics	919-976-0000
OH	Centerville, Arrow Electronics, Inc.	513-435-5563
OH	Columbus, Arrow Electronics, Inc.	614-885-8362
OH	Solon, Arrow Electronics, Inc.	216-248-3990
OH	Dayton, Bell Industries, Inc.	513-434-8231
OH	Cincinnati, Hughes-Peters, Inc.	513-351-2000
OH	Columbus, Hughes-Peters, Inc.	614-294-5351
OH	Cleveland, Milgray Electronics, Inc.	216-447-1520
OH	Cleveland, Pioneer Standard Electr.	216-587-3600
OH	Dayton, Pioneer Standard Electronics	513-236-9900
OH	Beachwood, Schweber Electronics	216-464-2970
OH	Dayton, Schweber Electronics	513-439-1800
OK	Tulsa, Schweber Electronics	918-622-8000
OR	Lake Oswego, Bell Industries	503-241-4115
OR	Hillsboro, Wyle Distribution Group	503-640-6000
PA	Enola, Almo Electronics Corporation	717-732-3681
PA	Philadelphia, Almo Electronics Corp.	215-698-4000
PA	Pittsburgh, Almo Electronics Corp.	412-931-5990
PA	Monroeville, Arrow Electronics, Inc.	412-856-7000
PA	Philadelphia, Phila. Electronics, Inc.	215-568-7400
PA	Pittsburgh, Pioneer Standard Electr.	412-782-2300
PA	Horsham, Schweber Electronics	215-441-0600
PA	Pittsburgh, Schweber Electronics	412-782-1600
TX	Austin, Arrow Electronics, Inc.	512-835-4180
TX	Dallas, Arrow Electronics, Inc.	214-386-7500
TX	Stafford, Arrow Electronics, Inc.	713-491-4100
TX	Houston, Hamilton/Avnet Electronics	713-780-1771
TX	Austin, Pioneer Standard Electronics	512-835-4000
TX	Dallas, Pioneer Standard Electronics	214-386-7300
TX	Houston, Pioneer Standard Electr.	713-988-5555
TX	Austin, Schweber Electronics	512-458-8253
TX	Dallas, Schweber Electronics	214-661-5010
TX	Houston, Schweber Electronics	713-784-3600
TX	Dallas, Solid State Electronics	214-438-5700
TX	Houston, Solid State Electronics	713-881-6289
TX	Houston, Sterling Electronics	713-623-6600
UT	Salt Lake City, Arrow Electronics	801-539-1135
UT	Salt Lake City, Bell Industries	801-972-6969
UT	Salt Lake City, Wyle Distribution	801-974-9953
VA	Richmond, Sterling Electronics	804-226-2190
VA	Charlottesville, Virginia Radio Supply	804-296-4184
WA	Bellevue, Arrow Electronics, Inc.	206-643-4800
WA	Tukwila, Arrow Electronics, Inc.	206-575-0907
WA	Bellevue, Bell Industries	206-747-1515
WA	Bellevue, Wyle Distribution Group	206-453-8300
WI	Madison, Arrow Electronics, Inc.	608-273-4977
WI	Oak Creek, Arrow Electronics, Inc.	414-764-6600
WI	Waukesha, Bell Industries	414-784-0235
WI	Brookfield, Schweber Electronics	414-784-9020

Corning Electronics...All Systems "Go"!

capacitors

A DIVISION OF CSI TECHNOLOGIES, INC.

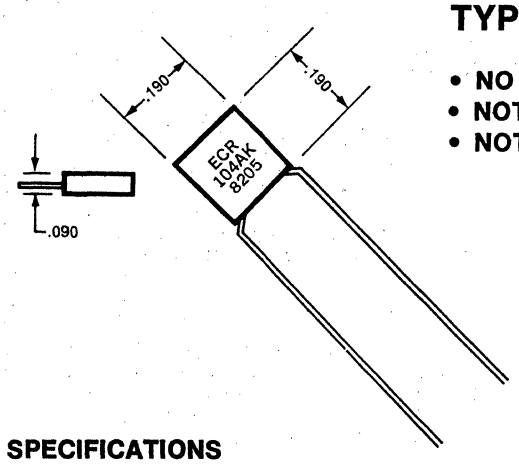
SERIES	TYPE	FEATURE	1nF 10nF 100nF 1uF 10uF 100uF	PAGE NO.
NT	FILTER	DC/AC to 50KHZ	5 kV; 10 kV; 15 kV; 20 kV	4
FT	FILTER	TUBULAR XHV	50 - 250 kV	5
FM	FILTER	LONG LIFE XMITTER	0.6 - 6 kV; 7.5 - 15 kV; 20 - 30 kV; 35 - 50 kV	6
CP	FILTER	MIL SPEC	0.6 - 2.5 kV; 3.0 - 5.0 kV; 6.0 - 12.5 kV	18
AE	PULSE	RAILS X LOW L	5 - 40 kV	23
MED	DEFIB	SMALLEST	2.8 - 8kV	24
FC	INDUCTOR	LIGHT WEIGHT	.3 mH - 200 mH	25
WM	PULSE	GENERAL PURPOSE FLASHLAMP	2 - 5 kV; 7.5 kV; 15 kV; 25 kV	26
WPC	PULSE	RAILS LOW L HIGH E	35 - 100 kV	27
ES	ENERGY STORAGE	HIGH R.R. WIDE ΔT LOW ESR NON-FLAM.	3300 JOULES 3 - 50 kV; 5500 JOULES 4 - 125 kV; 8800 JOULES 4 - 125 kV	28
NB	AC	LOW D.F. BALLAST	1.3 - 4.0 kVAC	32
ME	RF	XMITTER	1-35 kV	33
MR	AC	MOTOR RUN BALLAST	165-800 VAC	36
CUSTOM & SCR	ANY WOUND DIELECTRIC	150° C 5 n H 4000 KW 10 KJ	0.6 kVDC - 250 kVDC 100VAC - 180 KVAC	37

capacitors
A DIVISION OF CSI TECHNOLOGIES, INC.
POST OFFICE BOX 2052, ESCONDIDO, CALIFORNIA 92025 / TLX 697832 / (619) 747-4000

AVIONICAPS® *The smallest film capacitor in the world*

METALLIZED POLYCARBONATE

TYPE ECR



- **NO PIEZOELECTRIC EFFECT**
- **NOT FREQUENCY SENSITIVE**
- **NOT VOLTAGE SENSITIVE**

A new innovation pioneered by Electronic Concepts leads the way to a new era of smaller metallized film capacitors. Now a combination of excellent electrical characteristics and compactness is offered the equipment designer in a size equal to a ceramic CK05 capacitor.

Besides the superior electrical characteristics Type ECR are self-healing, as is the case with all metallized capacitors.

Additionally, these capacitors do not exhibit any of the drawbacks inherent in all ceramic capacitors.

SPECIFICATIONS

Operating Temperature Range: −55°C to +125°C without derating.

Dissipation Factor: When measured at the frequency specified for capacitance measurements, the dissipation factor shall not exceed 0.3%.

Insulation Resistance: When measured at the applicable test temperature, and rated voltage, the insulation resistance shall equal or exceed the following values:

	25°C	85°C	125°C
Megohm x Microfarads	100,000	7,000	700
Except the insulation resistance in megohms need not exceed	200,000	70,000	7,000

Capacitance Change: The Capacitance change vs. temperature for these capacitors shall not exceed the following:

Temperature Degrees C.	−55	+25	+85	+125
Percent Change	±1.5	0	±0.3	±0.8

The measurement at each temperature shall be recorded when two successive readings taken at 5-minute intervals indicate no change in capacitance.

Capacitance Tolerance: Standard Tolerance is ±10%. Tolerances of ±20%, ±5%, ±2% and ±1% are available.

Note: Capacitance shall be measured at 25°C, and at or referred to a frequency of 1KHz.

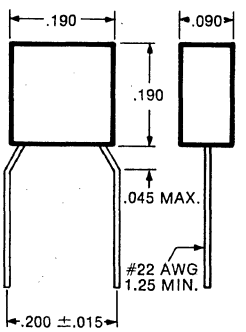
Capacitance Range

30V	50V	75V	100V	150V	200V	250V
.0010	.0010	.0010	.0010	.0012	.0012	.0012
.0012	.0012	.0012	.0012	.0010	.0010	.0010
.0018	.0018	.0018	.0018	.0018	.0018	.0018
.0022	.0022	.0022	.0022	.0022	.0022	.0022
.0027	.0027	.0027	.0027	.0027	.0027	.0027
.0033	.0033	.0033	.0033	.0033	.0033	.0033
.0039	.0039	.0039	.0039	.0039	.0039	
.0047	.0047	.0047	.0047	.0047	.0047	
.0056	.0056	.0056	.0056	.0056	.0056	
.0068	.0068	.0068	.0068	.0068		
.0082	.0082	.0082	.0082	.0082		
.010	.010	.010	.010			
.012	.012	.012	.012			
.015	.015	.015	.015			
.018	.018	.018	.018			
.022	.022	.022				
.027	.027	.027				
.033	.033					
.039	.039					
.047	.047					
.056	.056					
.068						
.082						
.10						

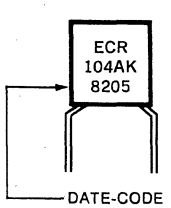
Also available hermetically sealed (D = .195 L = .25) and in other dielectrics on request.

DIMENSIONAL DATA

Type ECR

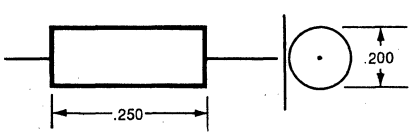


Part Marking

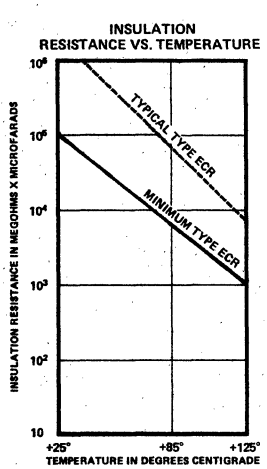


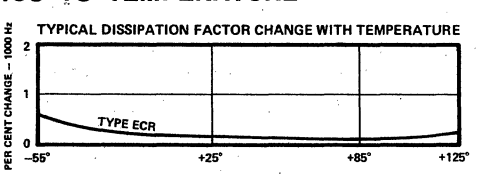
The first two digits represent the year, the second two digits represent the week. ie: 7952 is the 52nd week of 1979, 8012 is the 12th week of 1980.

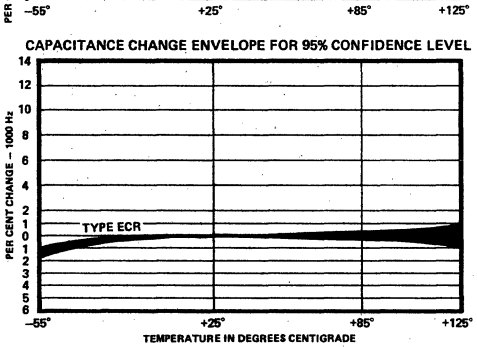
Type AECR



ELECTRICAL CHARACTERISTICS VS TEMPERATURE







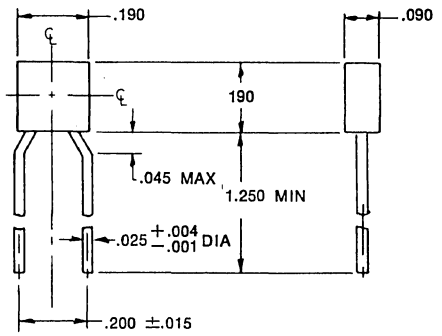
ELECTRONIC CONCEPTS INC.

P.O. BOX 627E EATONTOWN, NEW JERSEY 07724 • (201) 542-7880

ESTABLISHED RELIABILITY CAPACITORS

FIXED, PLASTIC DIELECTRIC, DC, IN NON-METAL CASES PER MIL-C-55514

STYLE CFR12



World's smallest film capacitor (CKO size) now available as CFR12.

Dielectric: metallized polycarbonate film.

Construction: molded rectangular case, radial leaded. See previous page **AVIONICAPS®**

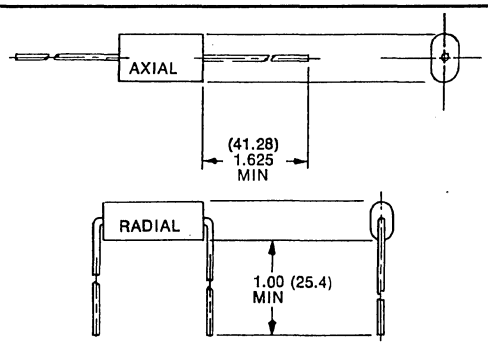
Capacitance values in MFD:

.0010 thru .10 30V	.0012 thru .0082 150V
.0010 thru .056 50V	.0012 thru .0056 200V
.0010 thru .027 75V	.0012 thru .0033 250V
.0010 thru .018 100V	

Capacitance tolerance: ±1%, ±2%, ±5%, ±10%

Refer to MIL-C-55514 for additional specifics or call Electronic Concepts, Inc.

STYLE CFR06



Dielectric: metallized plastic film

Characteristic R: metallized polycarbonate
N: metallized polyester

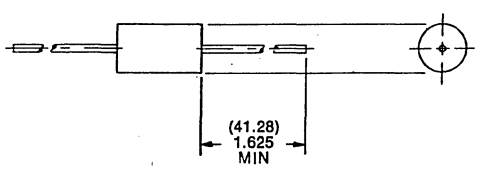
Construction: oval configuration, axial or radial leaded

Capacitance values in MFD:

Characteristic "R"	Characteristic "N"
.0010 thru 50.0 50V	.010 thru 10.0 200V
.0010 thru 20.0 100V	.010 thru 3.3 400V

Capacitance tolerance:
"R" ±1%, ±2%, ±5%, ±10%
"N" ±2%, ±5%, ±10%

STYLE CFR05



Dielectric: metallized polycarbonate plastic film. Characteristic R.

Construction: round configuration, axial leaded.

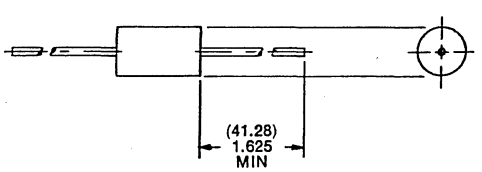
Capacitance values in MFD:

.0010 thru 50.0 50V	.010 thru 10.0 200V
.0010 thru 20.0 100V	.010 thru 5.0 400V

Capacitance tolerance: ±1%, ±2%, ±5%, ±10%

Refer to MIL-C-55514 for additional specifics or call Electronic Concepts, Inc.

STYLE CFR02



Dielectric: plastic film

Characteristic M: polyester film and foil
Q: polycarbonate film and foil

Construction: Round configuration, axial leaded

Capacitance values in MFD:

Characteristic "M"	Characteristic "Q"
.0068 thru 1.0 100V	.0010 thru 1.0 100V
.0010 thru 1.0 200V	.0010 thru 1.0 200V
.0018 thru 1.0 400V	
.0010 thru 0.1 600V	

Capacitance tolerance:
"M" ±2%, ±5%, ±10%
"Q" ±1%, ±2%, ±5%, ±10%

Refer to MIL-C-55514 for additional specifics or call Electronic Concepts, Inc.

ELECTRONIC CONCEPTS INC. ®

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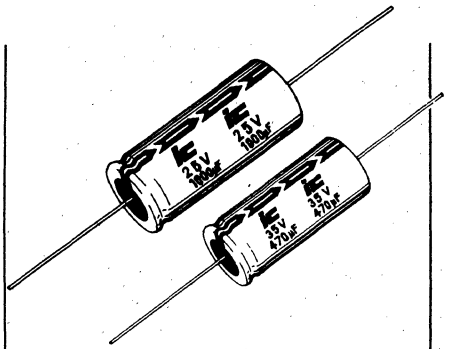
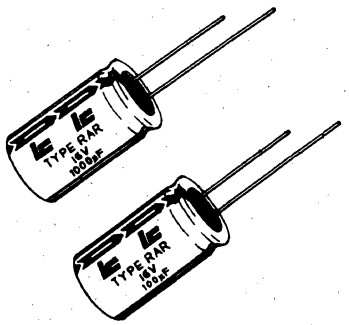
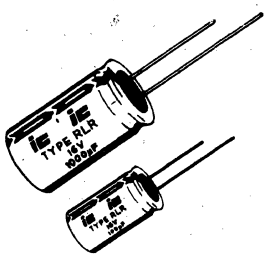
DEPENDABILITY



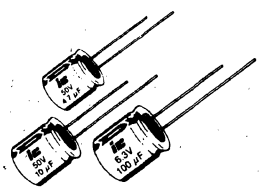
TYPE TTA COMMERCIAL/INDUSTRIAL ELECTROLYTIC CAPACITORS
0.47 Mfd. To 33,000 Mfd.
6.3 WVDC To 500 WVDC
−40°C To +85°C Min.
2000 HOUR +85°C Rating
EPOXY END SEAL Optional (TTA-PX)
TAPE & REEL Avail.



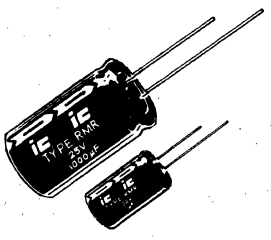
TYPE RAR COMMERCIAL/INDUSTRIAL ELECTROLYTIC CAPACITORS
0.47 Mfd. To 4,700 Mfd.
6.3 WVDC To 450 WVDC
−40°C To +85°C Min.
2000 HOUR, +85°C Rating
EPOXY END SEAL Optional (RAR-PX)
TAPE & REEL Avail.



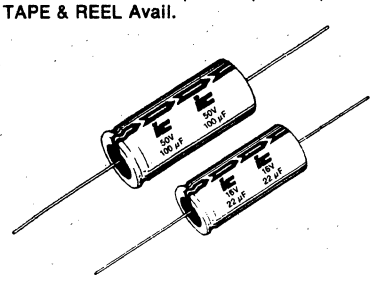
TYPE RLR LOW-LEAKAGE ELECTROLYTIC CAPACITORS
0.1 Mfd. To 2,200 Mfd.
6.3 WVDC To 50 WVDC
−40°C To +85°C Min.
Leakage Current: ≤0.002CV or 0.4 uA min.
EPOXY END SEAL Optional (RLR-PX)
TAPE & REEL Avail.



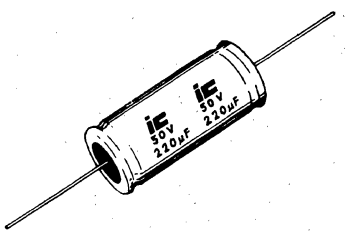
TYPE RSS SUB-SUBMINIATURE ELECTROLYTIC CAPACITORS
0.1 Mfd. To 100 Mfd.
6.3 WVDC To 50 WVDC
Min. Dia. 0.15 in./4.0mm
Max. Length .28 in./7.0mm
−40° C To +85° C Min.
TAPE & REEL Avail.



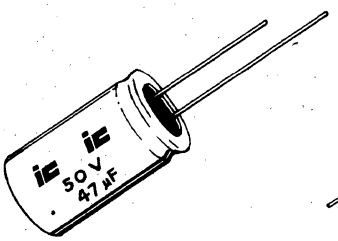
TYPE RMR SUBMINIATURE, +105°C ELECTROLYTIC CAPACITORS
0.47 Mfd. To 10,000 Mfd.
6.3 WVDC To 250 WVDC
−40°C To +105°C Min.
2000 HOUR +105°C Rating
EPOXY END SEAL Optional (RMR-PX)
TAPE & REEL Avail.



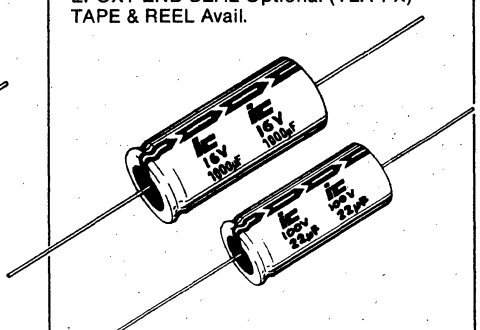
TYPE TLA LOW LEAKAGE ELECTROLYTIC CAPACITORS
0.1 Mfd. To 100 Mfd.
6.3 WVDC To 50 WVDC
−40° C To +85° C Min.
Leakage Current: ≤0.002 CV or 0.4 µA min.
EPOXY END SEAL Optional (TLA-PX)
TAPE & REEL Avail.



TYPE BPA NON-POLARIZED ELECTROLYTIC CAPACITORS
0.47 Mfd. To 1,000 Mfd.
10 WVDC To 200 WVDC
−40°C To +85°C Min.
1000 HOUR +85° Rating
EPOXY END SEAL Optional (BPA-PX)



TYPE BPR NON-POLARIZED ELECTROLYTIC CAPACITORS
0.47 Mfd. To 1,000 Mfd.
10 WVDC To 50 WVDC
−40 °C To +85°C Min.
1000 HOUR +85°C Rating
EPOXY END SEAL Optional (BPR-PX)



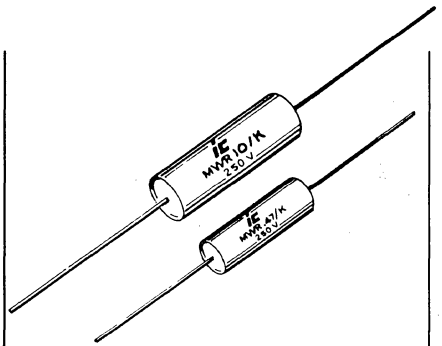
TYPE THA +125°C OPERATION ELECTROLYTIC CAPACITORS
0.47 Mfd. To 1,000 Mfd.
10 WVDC To 100 WVDC
−40°C To +125°C Min.
EPOXY END SEAL Optional (THA-PX)

The source for Quality, Performance and Delivery

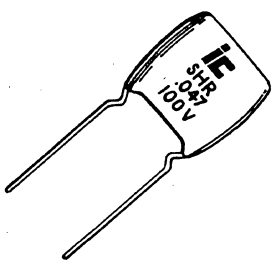
ILLINOIS CAPACITOR, INC.®

3757 West Touhy Avenue, Lincolnwood, IL 60645
(312) 675-1760 / Telex: 72-4361 / Cable: Illcon Lcwd

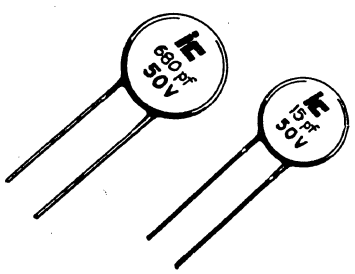
AVAILABILITY



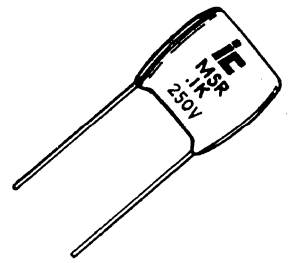
TYPE MWR METALLIZED MYLAR® POLYESTER FILM CAPACITORS
WRAP & FILLED CONSTRUCTION
NON-INDUCTIVE WINDING, + 125°C
100 WVDC To 1,000 WVDC
0.01 Mfd. To 22 Mfd.
TOLERANCE: ±10% (±5% Opt.)



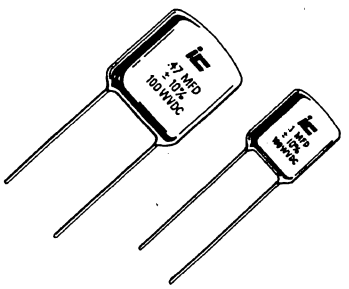
TYPE SHR POLYESTER FILM CAPACITORS
NON-INDUCTIVE WINDING, + 125°C
100 WVDC
0.001 Mfd. To .47 Mfd.
TOLERANCE: ±10% (±5% Opt.)



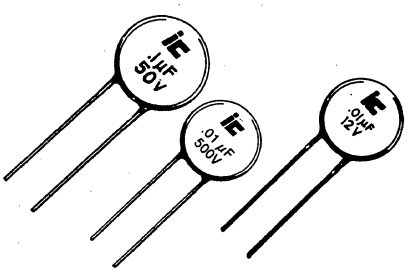
TYPE BCR TEMPERATURE STABLE CERAMIC DISC CAPACITORS
50 WVDC
1 pf to 680 pf
TEMP. CHAR.: Y5F
TOLERANCE: ±10%



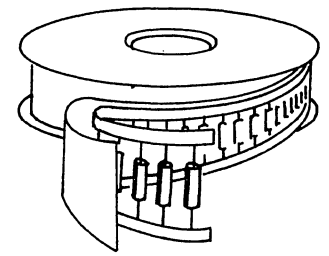
TYPE MSR METALLIZED MYLAR® POLYESTER FILM CAPACITORS
NON-INDUCTIVE WINDING, + 125°C
250 WVDC To 1,000 WVDC
0.01 Mfd. To 10 Mfd.
TOLERANCE: ±10% (±5%, Opt.)



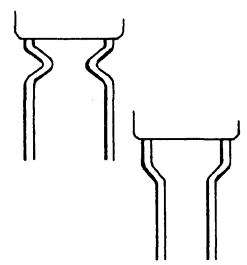
TYPE UMR POLYESTER FILM CAPACITORS
INDUCTIVE WINDING
100 WVDC
.001 Mfd. To .47 Mfd.
TOLERANCE: ±10% (±5%, Opt.)



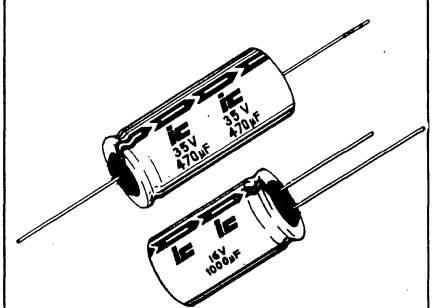
GENERAL PURPOSE CERAMIC DISC
Tolerances: −20% +80%, ±20%
TYPE GCR: 50 WVDC
0.001 Mfd. To 0.1 Mfd. (Y5V, Y5S)
TYPE GMR: 12 WVDC
0.047 Mfd. To .47 Mfd. (Y5S)
TYPE GQR: 500 WVDC
.001 Mfd. To .01 Mfd. (Z5V)



TAPE & REEL CONFIGURATIONS
FOR AUTOMATIC INSERTION OF AXIAL AND RADIAL LEAD PARTS
AVAILABLE ON SPECIAL ORDER



CUT & FORMED LEADS
AVAILABLE ON SPECIAL ORDER



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COMMERCIAL & INDUSTRIAL ALUMINUM ELECTROLYTIC CAPACITORS — AXIAL & RADIAL LEADS

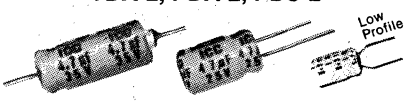
General Purpose
TDA & PDA, PDS

Temp. Range	−40°C to +85°C
Cap. Range	0.47μF−22,000μF Axial 0.47μF−10,000μF Radial
Cap. Tol.	−10% +75%, −10% +50%, ±20%
Volt. Range	6.3VDC−450VDC
Leakage (Max.)	6.3V−80V .02CxV +4μA 100V−450V .02CxV +100μA

Extended Temperature
TDB & PDB (Close Tolerance)

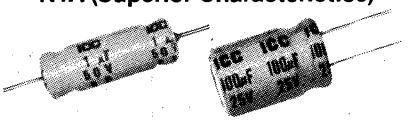
Temp. Range	−40°C to +105°C
Cap. Range	0.47μF−10,000μF
Cap. Tol.	±20%
Volt. Range	6.3VDC−250VDC
Leakage (Max.)	.01CxV +3μA
Life Test	2,000 hrs. @ 105°C

Low Leakage
TDA-L, PDA-L, PDS-L



Temp. Range	−40°C to +85°C
Cap. Range	0.1μF−2200μF
Cap. Tol.	±20%, ±10%
Volt. Range	6.3VDC−63VDC
Leakage (Max.)	0.002CxV or 0.4μA whichever is greater

Non-Polar
NTD (General Purpose)
NTA (Superior Characteristics)

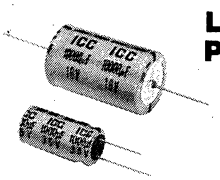


Temp. Range	−25°C to +85°C
Cap. Range	0.47μF−470μF
Cap. Tol.	−10% +50%, ±30%, ±20%, ±10%
Volt. Range	16WV−50WV
Leakage (Max.)	0.06CxV +10μA, 0.1CxV +10μA

Radial Lead — Mechanical Support Third Lead
PDA-T

Temp. Range	−40°C to +85°C	**Volt. Range**	6.3VDC−250VDC
Cap. Range	100μF−33000μF	**Leakage (Max.)**	−0.02CxV
Cap. Tol.	±20%		

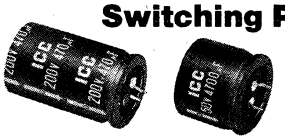
Low Impedance Radial Lead for Switching Power Supply Output & Regulator Circuits
PZL



Temp. Range	−55°C to +105°C	**Volt. Range**	7.5VDC−100VDC
Cap. Range	2.2μF−8200μF	**Leakage (Max.)**	≤40V = $0.5\sqrt{CxV}\,\mu A$
Cap. Tol.	−10% +75%		>40V = $\sqrt{CxV}\,\mu A$

Series Features Low Impedance, High E.S.R. & Ripple Current Specifications

Snap-In Capacitors — Switching Power Supply Input Circuit



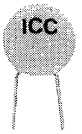
PST — Standard Height
PSL — Low Profile Construction
PXT — Extra High Ripple — Standard Height
PXL — High Ripple Low Profile

Specifications	PST	PSL	PXT	PXL
Temp. Range	−40°C to +85°C			
Cap. Range	220μF−22000μF	220μF−22000μF	100μF−820μF	100μF−390μF
Cap. Tol.	±20%	±20%	±20%	±20%
Volt. Range	10VDC−250VDC	10VDC−250VDC	200VDC−250VDC	200VDC−250VDC
Leakage (Max.)	.02CxV or 2000μA whichever is smaller		.02CxV or 3000μA whichever is smaller	

Dipped Tantalum
DP (Straight & Snap-In Leads)

Temp. Range	−55°C to +85°C
Cap. Range	0.1μF−330μF
Cap. Tol.	±20%, ±10%
Volt. Range	3.15VDC−50VDC
Leakage (Max.)	.007CxV or .05μA whichever is greater

Ceramic Disc
CD



Various lead forms are available in both bulk and tape & reel packaging.

Temperature Compensating
NPO−N750
100V−1000V
General Purpose
100pF−100,000pF
50V−1000V
Semiconductor
10,000pF−100,000pF
12V−50V

FILM CAPACITORS

Polyester Film
EM (Radial Leads, Welded Construction)

Temp. Range	−55°C to +85°C
Cap. Range	.001μF−0.47μF
Cap. Tol.	±5%, ±10%, ±20%
Volt. Range	100V, 200V, 400V

Metalized Polyester Film
PMG

Polyester Film/Foil
FM
(Radial Leads, Welded Construction)

	PMG	FM
Temp. Range	−55°C to +155°C	−40°C to +85°C
Cap. Range	.01μF−4.7μF	.001μF−0.47μF
Cap. Tol	±10% STD	±10% STD
Volt. Range	250V−630V	100V

Metalized Polyester Film
YM

Polyester Film/Foil
YFT
(Axial Leads, Welded Construction)

	YM	YFT
Temp. Range	−40°C to +85°C	−40°C to +85°C
Cap. Range	.01μF−10μF	.001μF−1.0μF
Cap. Tol.	±10%, ±20%	±10%, ±20%
Volt. Range	250V−630V	100V−1000V

Polypropylene Film
PP (Radial Leads, Welded Construction)

Temp. Range	−40°C to +85°C
Cap. Range	.001μF−0.47μF
Cap. Tol.	±5%, ±10%, ±20%
Volt. Range	250V−630V

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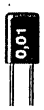
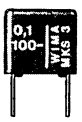
5 mm
PCM/available taped and reeled

	Sub-miniature PCM 2.5 mm							Semi-miniature PCM 7.5 mm
								
	WIMA MKS 02	**WIMA MKS 2**	**WIMA MKS 20**	**WIMA MKC 2**	**WIMA FKS 2**	**WIMA FKC 2**	**WIMA FKP 2**	**WIMA MKS 3**
Dielectric	Polyester film	Polyester film	Polyester film	Polycarbonate film	Polyester film	Polycarbonate film	Polypropylene film	Polyester film
Capacitor electrodes	Vacuum deposited aluminium	Vacuum deposited aluminium	Double sided metallization	Vacuum deposited aluminium	Metal foil	Metal foil	Metal foil	Vacuum deposited aluminium
Temperature ranges	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +85°C	−55°C to +100°C
Insulation resistance at +20°C	1 x 10^4 MΩ	1 x 10^4 MΩ >0.33:3,300 sec.	1 x 10^4 MΩ	1 x 10^4 MΩ	5 x 10^5 MΩ	5 x 10^5 MΩ	5 x 10^5 MΩ	1 x 10^4 MΩ >0.33:3,300 sec.
Power factor tan δ at 1 kHz and +20°C	5 to 8 x 10^{-3}	5 to 8 x 10^{-3}	5 to 7 x 10^{-3}	3 x 10^{-3}	5 to 8 x 10^{-3}	1 to 3 x 10^{-3}	2 to 4 x 10^{-4}	5 to 8 x 10^{-3}
Voltage ranges	50 VDC	50 VDC, 63 VDC, 100 VDC	63 VDC	63 VDC, 100 VDC	100 VDC	100 VDC	63 VDC	63 VDC, 100 VDC
Capacitance tolerances	±20% ±10% ±5%	±20% ±10%	±20% ±10%	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%	±10% ±5% ±2.5%	±20% ±10%
100 pF 220 pF								
↓ 680 pF								
1000 pF 1500 pF								
2200 pF 3300 pF								
4700 pF 6800 pF								
0.01 µF 0.015 µF	2.5							
0.022 µF 0.033 µF			5	5	5	5	5	
0.047 µF 0.068 µF		5						7.5
0.1 µF 0.15 µF		5		5				
0.22 µF 0.33 µF		5						7.5
0.47 µF 0.68 µF								
1.0 µF 1.5 µF								

Encapsulation Plastic Cases — All Types

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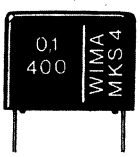
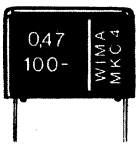
CECC approved

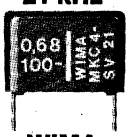


WIMA MKS 4



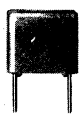
WIMA MKC 4

Frequency limit 21 kHz

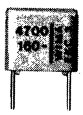


WIMA MKC 4 SV 21

Film capacitors with metal foil electrodes

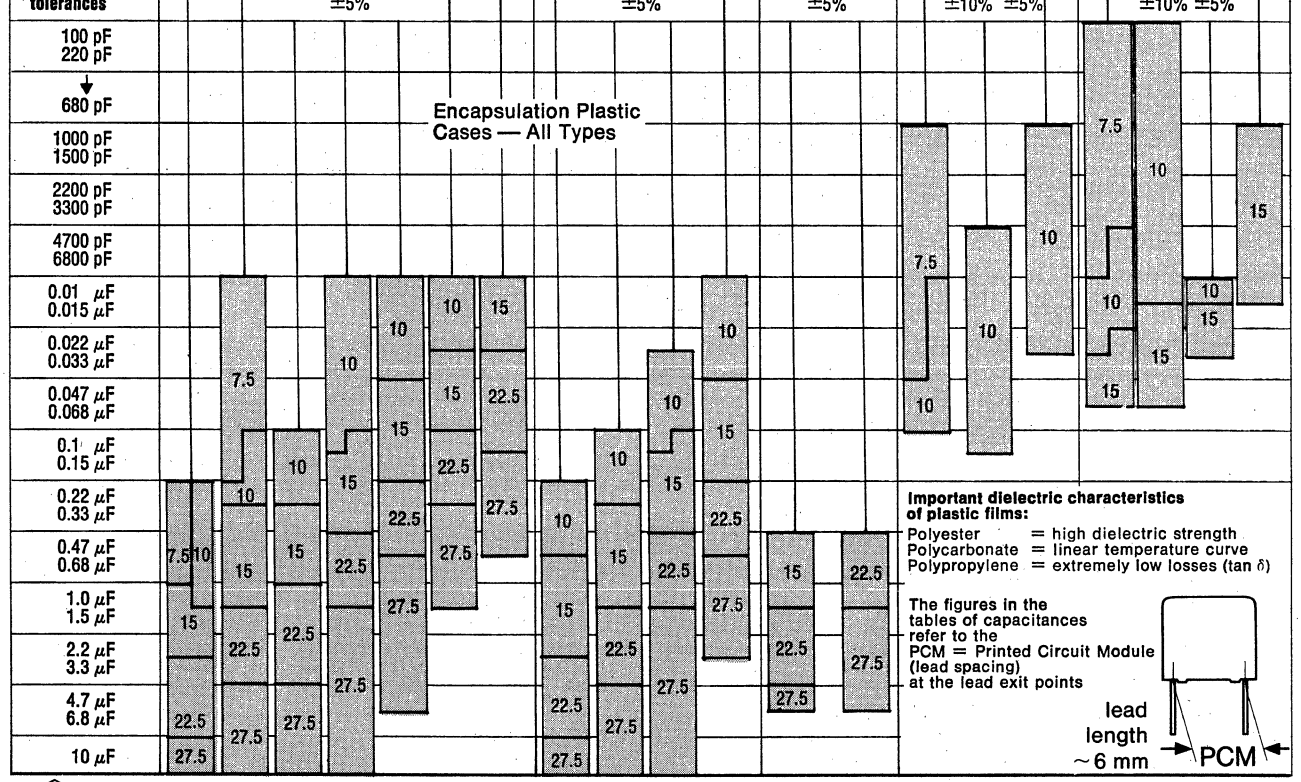


WIMA FKS 3



WIMA FKC 3

	WIMA MKS 4	WIMA MKC 4	WIMA MKC 4 SV 21	WIMA FKS 3	WIMA FKC 3
Dielectric	Polyester film	Polycarbonate film	Polycarbonate film flame-retardent	Polyester film	Polycarbonate film
Capacitor electrodes	Vacuum deposited aluminium	Vacuum deposited aluminium	Vacuum deposited aluminium	Metal foil	Metal foil
Temperature ranges	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Insulation resistance at +20°C	1.5 to 3 • 10^4 MΩ >0.33:5,000 to 10,000 sec.	1.5 to 3 x 10^4 MΩ >0.33:5,000 to 10,000 sec.	5,000 to 10,000 sec.	5 x 10^5 MΩ >0.02:10,000 sec.	5 x 10^5 MΩ >0.02:10,000 sec.
Power factor tan δ at 1 kHz and +20°C	5 to 8 x 10^{-3}	1 to 3 x 10^{-3}	1 to 3 • 10^{-3}	5 to 8 x 10^{-3}	1 to 2 x 10^{-3}
Voltage ranges	63 VDC, 100 VDC, 160 VDC, 250 VDC, 400 VDC, 630 VDC, 1000 VDC	63 VDC, 100 VDC, 250 VDC, 400 VDC	100 VDC, 250 VDC	100 VDC, 160 VDC, 400 VDC	160 VDC, 400 VDC, 630 VDC, 1000 VDC
Capacitance tolerances	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%



Important dielectric characteristics of plastic films:

Polyester = high dielectric strength
Polycarbonate = linear temperature curve
Polypropylene = extremely low losses (tan δ)

The figures in the tables of capacitances refer to the PCM = Printed Circuit Module (lead spacing) at the lead exit points

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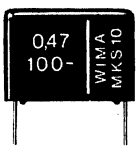
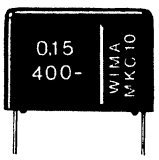
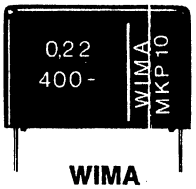
with double metallized film electrodes



WIMA MKS 10

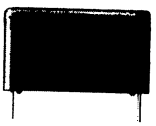


WIMA MKC 10



WIMA MKP 10

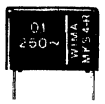
with two metal foil electrodes and a floating electrode of plastic film metallized on both sides (internal series connection)



WIMA FKP 1

Radio interference suppression capacitors

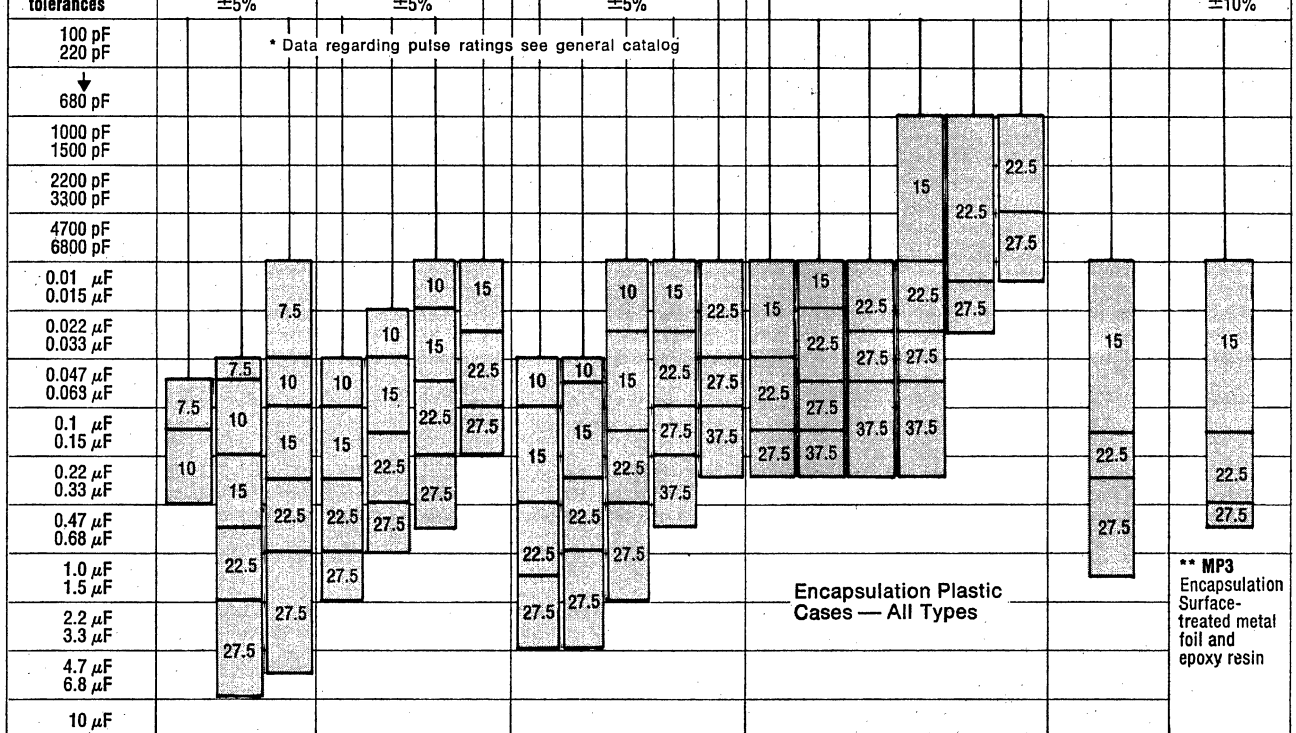
in accordance with VDE 0565-1 class X 2



WIMA MKS 4-R

WIMA MP 3**

	WIMA MKS 10	WIMA MKC 10	WIMA MKP 10	WIMA FKP 1	WIMA MKS 4-R	WIMA MP 3**
Dielectric	Polyester film	Polycarbonate film	Polypropylene film	Polypropylene film	Polyester film	Paper, epoxy resin impregnated
Capacitor electrodes	Carrier film metallized on both sides, self-healing			Metal foil and carrier film metallized on both sides, self-healing	Vacuum deposited aluminium, self-healing	Metallized self-healing
Temperature ranges	−55°C to +100°C	−55°C to +100°C	−55°C to +85°C	−55°C to +85°C	−40°C to +85°C	−40°C to +85°C
Insulation resistance at +20°C	3 x 10^4 MΩ >0.33:10,000 sec.	3 x 10^4 MΩ >0.33:10,000 sec.	3 x 10^4 MΩ >0.33:10,000 sec.	1 x 10^5 MΩ >0.1:10,000 sec.	1.5 x 10^4 MΩ >0.33:5,000 sec.	6 x 10^3 MΩ >0.33:2,000 sec.
Power factor tan δ at 1 kHz and +20°C	5 to 6 x 10^{-3}	1 to 4 x 10^{-3}	1 to 3 x 10^{-4}	1 to 3 x 10^{-4}	5 to 8 x 10^{-3}	6 to 10 x 10^{-3}
Voltage ranges	63 VDC, 100 VDC, 250 VDC	250 VDC, 400 VDC, 630 VDC, 1000 VDC	160 VDC / 100 VAC, 250 VDC / 180 VAC, 400 VDC / 220 VAC, 630 VDC / 400 VAC, 1000 VDC / 400 VAC	400 VDC / 250 VAC, 630 VDC / 300 VAC, 1000 VDC / 350 VAC, 1000 VDC / 400 VAC, 1500 VDC / 500 VAC, 2000 VDC / 600 VAC	250 VAC	250/275 VAC
Capacitance tolerances	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10% ±5%	±20% ±10%	±20% ±10%



** MP3 Encapsulation Surface-treated metal foil and epoxy resin

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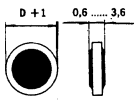
From 1 kV to 8 kV — EIA Types (Y5P/25P) (Y5U/25U)

BUTTON DISC CAPACITORS 500V / K2P
EIA Types (Y5P/Z5P) (Y5U/Z5U)



WAFER CAPACITORS 50V / P1
Range 4700 to 4700 pF

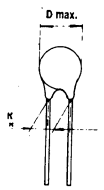
TUBULAR CAPACITORS, HIGH VOLTAGE PULSE TYPE / CIM
1.5 kV to 4 kV

TUBULAR CAPACITORS 500V / C1
0,1 pF to 30,000 pF

SAFETY TYPE DISC CAPACITORS / KZ
For AC Applications

REDUCED TITANATE DISC/KR1
.001 mFd to .18 mFd 50 V for bypass application

SUBMINIATURE DISC CAPACITORS 500V / K1



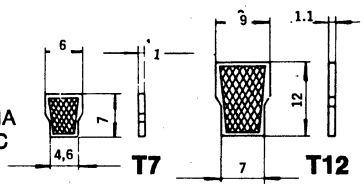
Tolerances Available: ±1% to −20 and +80%

△ Engineering Note: Type No.'s (I.E. D10) also specifies nominal diameter of the part.

			C (pF)		
D (mm)	**5,5**	**7**	**10**	**14**	**18**
P 100	0,5 3	>3 4,7	>4,7 9,1	>9,1 18	
NP 0	1,0 7,5	>55 15	>15 27	>27 51	
N 150	1,0 8,2	>75 16	>16 33	>33 62	
N 750	2,2 22	>22 33	>33 62	>62 120	>120 160
N 1500	4,7 24	>24 56	>56 100	>100 220	>220 300
M 2000	47 330	>330 510	>510 1200	>1200 2200	
M 3000	150 360	>360 510	>820 1800	>1800 3600	
M 6000	270 680	>680 1200	>1200 3300	>3300 7500	>7500 10000
R (mm)	**2,5**	**5**	**5**	**7,5**	**7,5**

NICKEL PLATED TRAPEZOIDAL CAPACITORS 500V / T7 / T12

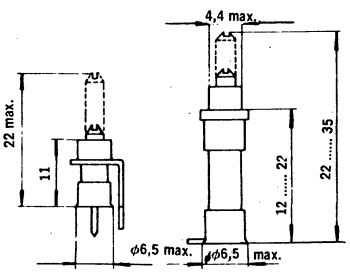
1 ..... 56 pF
P 100 ..... N 1500
150 ..... 3600 pF
M 2000 ..... M 6000
(Y5P/Z5P) (Y5U/Z5U) EIA
(2B4/2A5) (2E4/2D5) IEC
4,7 ..... 91 pF
330 ..... 560 pF



△ All dimensions given in millimeters — tolerances ±0.5.

TUBULAR TRIMMERS / CT

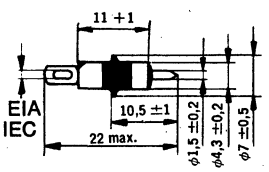
2,0 ..... 62 pF
8 16
470 ..... 1200 pF
0,7/3,7 pF ..... 4/13 pF
0,4/2 pF ..... 1/9 pF



FEED-THROUGH CAPACITORS 500V

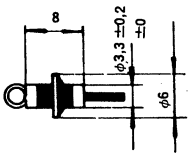
S1

1 ..... 68 pF
P 100 ..... N 1500
180 ..... 2400 pF
M 2000 ..... M 3000 ..... M 6000
(Y5P/Z5P) (Y5T/Z5T) (Y5U/Z5U) EIA
(2B4/2A5) (2D4/2C5) (2E4/2D5) IEC



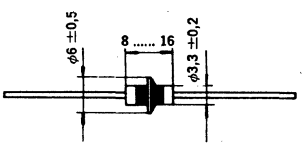
S2

1,5 ..... 270 pF
220 ..... 8200 pF
P 100 ..... N 1500
M 2000 ..... M 6000
(Y5P/Z5P) (Y5U/Z5U) EIA
(2B4/2A5) (2E4/2D5) IEC



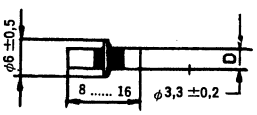
S5

1,5 ..... 100 pF
220 ..... 2700 pF
P 100 ..... N 1500
M 2000 ..... M 6000
(Y5P/Z5P) (Y5U/Z5U) EIA
(2B4/2A5) (2E4/2D5) IEC



S21

P 100 ..... N 1500
M 2000 ..... M 6000
(Y5P/Z5P) (Y5U/Z5U) EIA
(2B4/2A5) (2E4/2D5) IEC



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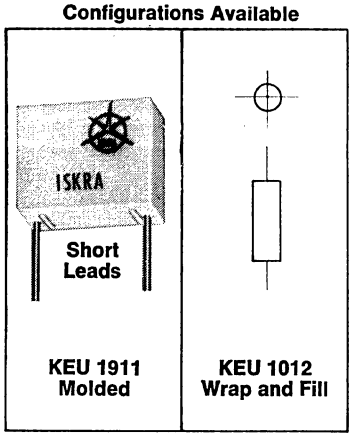
METALLIZED POLYESTER FILM CAPACITORS

Configurations Available



FEATURES

△ High insulation resistance
△ Low dielectric loss
△ Wide temperature range
△ High humidity resistance
△ Very small dimensions
△ Self-healing properties

CONSTRUCTION

△ Metallized polyester foil with excellent electrical characteristics.
△ Plastic coating permits operation under exceptionally humid climatic conditions.
△ Contact surface applied by high pressure spraying and connecting wires are soldered reducing possibility of failures or unsatisfactory contact during operation.
△ Self-healing properties guarantee greater than usual operating efficiency.
△ Flammability per UL 492.
△ Self-extinguishing plastic case and sealed with self-extinguishing epoxy resin.

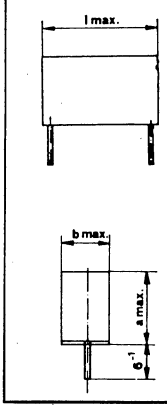
TECHNICAL DATA

Temperature Range: −40°C to +85°C.
Humidity test: Per EIA specifications RS 376
Capacitance tolerance: ±5%, ±10%, ±20%.
Rated voltage Vn: 100V-, 250V-, 400V-, 630V-, 1000V-.
Allowable a.c. voltage to 60 Hz: 63V~, 160V~, 200V~, 220V~, 250V~.
Dielectric loss tg at 20°C: $\leqslant 80\times10^{-4}$ at 1 kHz
$\leqslant 200\times10^{-4}$ at 10 kHz.
Inductance: <20nH measured at terminal length of 6mm.
Test voltage (2s): 1.6×Vn.

Insulation resistance at 20°C and 100V-:

C $\leqslant$0.33μF	C >0.33μF
Vn $\leqslant$100V-	Vn $\leqslant$100V-
R = 15×10^3 MΩ	R×C = 5×10^3s
Vn >100V-	Vn >100V-
R = 30×10^3 MΩ	RR×C = 10^4s

The capacitors can be used to a temperature of 100°C, by which the working voltage at a temperature above 85°C is less than the rated voltage by 1.25% for every °C.



CAPACITANCE VALUES	AVAILABLE HOUSING SIZES				
	100V	250V	400V	630V	1000V
0.01	1	1	1	2	4
0.015	1	1	1	3	5
0.022	1	1	1	3	5
0.033	1	1	2	4	7
0.047	1	1	3	5	7
0.068	1	2	4	6	9
0.1	1	3	5	8	10
0.15	2	4	5	9	11
0.22	3	5	7	9	12
0.33	4	6	8	11	
0.47	4	7	10	12	
0.68	5	8	11		
1	6	10	12		
1.5	8	11			
2.2	9	12			
3.3	10				
4.7	11				
6.8	12				

SIZE OF HOUSING	l (LENGTH)		a (HEIGHT)		b (WIDTH)		Lead Spacing ±0.5 ±0.02		Lead Dia. ±0.5 ±0.002	
	INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM
1	0.512	13	0.413	10.5	0.177	4.5	0.40	10	0.024	0.6
2	0.512	13	0.453	11.5	0.217	5.5	0.40	10	0.024	0.6
3	0.512	13	0.492	12.5	0.256	6.5	0.40	10	0.024	0.6
4	0.709	18	0.472	12	0.236	6	0.60	15	0.031	0.8
5	0.709	18	0.531	13.5	0.295	7.5	0.60	15	0.031	0.8
6	0.709	18	0.610	15.5	0.374	9.5	0.60	15	0.031	0.8
7	1.063	27	0.630	16	0.276	7	0.90	22.5	0.031	0.8
8	1.063	27	0.650	16.5	0.295	7.5	0.90	22.5	0.031	0.8
9	1.063	27	0.728	18.5	0.354	9.0	0.90	22.5	0.031	0.8
10	1.063	27	0.787	20	0.433	11	0.90	22.5	0.031	0.8
11	1.260	32	0.827	21	0.472	12	1.10	27.5	0.031	0.8
12	1.260	32	0.925	23.5	0.551	14	1.10	27.5	0.031	0.8

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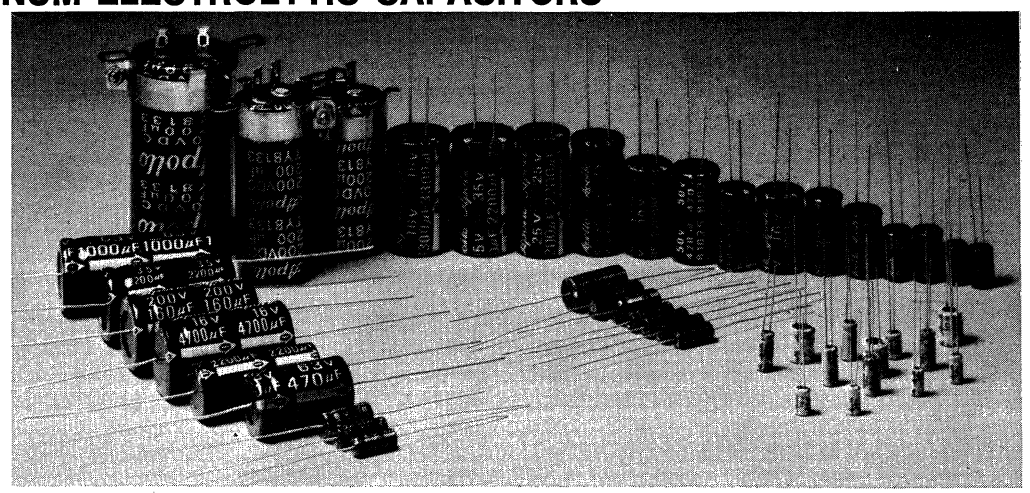
ALUMINUM ELECTROLYTIC CAPACITORS



Application	Type R-Radial T-Axial	Operating Temperature Range	Rated Voltage Range	Leakage Current @ 25°C i_L μa, C mf, V volts (Rated)	Standard Tolerances
General Uses • Filter • By Pass • Radio • TV • Industrial	RS TS	Under 100V: −40°C +85°C Over 100V: −25°C +85°C	6.3V − 500V	$i_L <$ .03 CV or 4 μa whichever is greater	−10 +75% <4.7 mf < −10 +50%
Sub Miniature Size Low Leakage • Timing Circuits • Pulse Circuits • Substitutes for Tantalums	SMR SMT	−40°C +85°C	6.3V − 50V	$i_L <$ .002 CV or .3 μa whichever is greater	±20%
Epoxy Sealed • Same applications as SM Series, but impervious to chlorinated solvents	LMR LMT	−40°C +85°C	16V − 50V	$i_L <$ .002 CV or .3 μa whichever is greater	±20%
Non Polar •General Use • Small Size	NPR NPT	−40°C +85°C	6.3V − 100V	$i_L <$ .01 CV +3 μa	±30% − 20% & 10% available
Non Polar • Cross Over Networks • High Circulating Currents	BPR BTT	−25°C +85°C	16V − 63V	$i_L <$ .03 CV +4 μa	±20%
Computer Grade • Low ESR values to 550,000 mf • ESR .009 Ω @ 6V & 2500 mf @ 350V ESR .091 Ω	CXR CXT	−40°C +85°C	3.5V − 450V	$i_L < .005\sqrt{CV}$ i_L in ma	−10 +100% <50V < −10 +75% −10 +75% <50V < −10 +50%
Computer Grade • Very Low ESR with high ripple current typically: .009 Ω, 22 Amps, 6V; 550,000 mf • Extended shelf life • 35,000 mf at 6V axial in less than 3 cu. in.	CXR CXT	−40°C +85°C	3.5V − 450V 6V − 450V	$i_L < .005\sqrt{CV}$ i_L in ma	−10 +100% <50V < −10 +75% −10 +75% <75V < −10 +50%
Military and Telecommunication • Hi Reliability	MTT	−55°C +125°C	3.5 − 250 VDC	$i_L < .01\,V\sqrt{C} + 2$ μa	−10 +75% <75V < −10 +50%
Horizontal Deflection • For "S" Correction in Transistor Circuits • Low Cost Substitutes for Film Capacitors	HD	−25°C +85°C	25 VAC	30 μa max	±20%

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SEE OUR PAGES ON DIODES & BRIDGES SECTION 4800 PAGE 1•2197 & RESISTORS SECTION 4700 PAGE 1•1988

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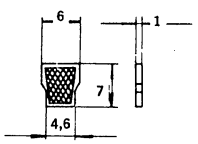
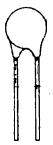
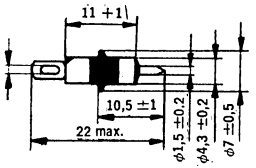
CERAMIC CAPACITORS AND MONOLYTHICS



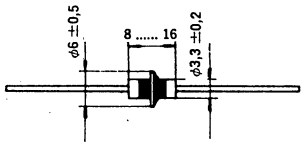
T7



K1



S1



S5 — WITH PIN
S21 — WITHOUT PIN

1 .... 56 pF, P 100 .... N 1500, 150 .... 3600 pF, M 2000 .... M 6000, (Y5P/Z5P) (Y5U/Z5U) EIA, (2B4/2A5) (2E4/2D5) IEC, 4,7 .... 91 .... pF, 330 .... 560 pF.

1 .... 68 pF, P 100 .... N 1500, 180 .... 2400 pF, M 2000 .... M 3000 .... M 6000, (Y5P/Z5P) (Y5T/Z5T) (Y5U/Z5U) EIA, (2B4/2A5) (2D4/2C5) (2E4/2D5) IEC.

1.5 .... 100 pF, 220 .... 2700 pF, P 100 .... N 1500, M 2000 .... M 6000, (Y5P/Z5P) (Y5U/Z5U) EIA, (2B4/2A5) (2E4/2D5) IEC.

△ All dimensions given in millimeters — tolerances ±0.5.

DISC CAPACITORS HIGH VOLTAGE TYPES/KV1
From 1 kV to 8 kV—EIA Types (Y5P/25P) (Y5U/25U)

BUTTON DISC CAPACITORS 500V/K2P
EIA Types (Y5P/Z5P) (Y5U/Z5U)

SAFETY TYPE DISC CAPACITORS/KZ
For AC Applications

TRAPEZOIDAL CAPACITORS 500V/T7/T12
REDUCED TITANATE DISC/KR1
.001 mFd to .18 mFd 50V for bypass application

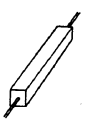
SUBMINIATURE DISC CAPACITORS 500V/K1
All TC's starting at 4mm
P100 ..... N56000
HIK Y5P Z5V

FEED-THROUGH CAPACITORS 500V

FOIL CAPACITORS

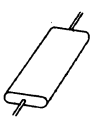
1511 Molded Radial

2710 Molded Axial

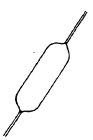


1012 Wrap and Fill Round

1011 Oval



1010 Axial



MPE104 Epoxy DIP Radial

Capacitor Type	KSC Polystyrene	KFU Polyester	KKU Polycarbonate	KLI-1511 Polypropylene	KEU Metallized Polyester	KCU Metallized Polycarbonate	KNU Metallized Polypropylene
Cap Range	33 pf to .82 μf	.001 to 1 μf	470 pf to .1 μf	.0022 to .1 μf	.01 μf to 10 μf	.01 to 10 μf	.002 to 1.8 μf
Avail. Tol. ±%	10, 5, 2.5	20, 10, 5	20, 10, 5	20, 10, 5	20, 10, 5	20, 10,5	20, 10, 5
VDC	63V to 1000V	100 to 1000	160, 400	630, 1000, 1500	100 to 1000	100 to 630	400 to 1500
AC Vrms	.4 × Rated DC	63 to 250	100, 200	300, 350, 400	63 to 250	63 to 220	≈ .4 VDC
Pdn Test Voltage	3 × Rated	2 × Rated	2 × Rated	2 × Rated	1.6 × Rated	1.6 × Rated	1.6V Rated
Dielectric Loss @ 1 kHz, 20°C	≤2 × 10^{-4} ≤5 × 10^{-4} Cn <10 μf <Cn	Tan δ ≤60 × 10^{-4}	Tan δ ≤10^{-4}	Tan δ @ 10 kHz ≤5 × 10^{-4}	Tan δ ≤10^{-5}	Tan δ 50 × 10^{-4} Cn <1 μf Tan δ 80 × 10^{-4} Cn ≥1 μf	≤25 × 10^{-4} C >/μf
Insulation Res.	Ri ≥10^{5} Meg Cn ≤.1 μf Ri Cn ≥10^{4} Sec Cn >.1 μf	Ri ≤30,000 Meg Cn ≤.33 μf Ri Cn=10,000 Sec Cn >.33 μf	Ri ≥30,000 Meg	Ri ≥30,000 Meg	Ri ≤3750 Meg Cn≤ .33 μf Ri Cn >1250 Cn ≥.33 μf	Ri ≤3750 Meg Cn .≤33 μf Ri Cn >1250 Cn ≥.33 μf	≥20,000 Meg C ≤.33 μf Ri × Cn >6000 Sec C >.33
Operating °C Temp. Range	−40 to +70	−40 to +100	−40 to +100	−40 to +85	−40 to +85	−40 to +85	−25 to +85
Temp. Coefficient	−(125 ±60) × 10^{-6}/°C	≈ 10^{-4}/°C	Less than 5 × 10^{-5}/°C	−200 × 10^{-6}/°C	≈10^{-4}/°C	Less than 5 × 10^{-5}/°C	−200 × 10^{-6}/°C
Pulse Loading	1000V/μsec	1000 v/μsec	1000V/μsec	750V/μsec	1.5 to 24V/μsec*	1.5 to 24V/μsec*	4 to 125V/μsec†
Inductance at Term Length 6 MM	10 nH/Cm Length of cap	20 nH	15 nH	10 nH	20 nH	20 nH	20 nH

* Varies with Case Size and Voltage Rating. † Depending on Value and Voltage Rating.

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SEE OUR PAGES ON DIODES & BRIDGES SECTION 4800 PAGE 1•2197 & RESISTORS SECTION 4700 PAGE 1•1988

ITT Components
A Unit of International Telephone and Telegraph Corporation

Aluminum Electrolytic Capacitors

Miniature Radial
Miniature Axial

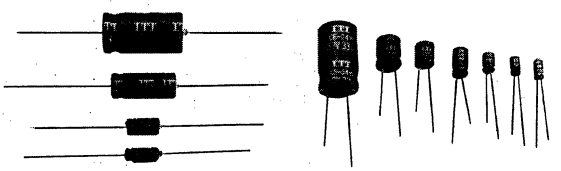
ORDERING INFORMATION:

SM 3.3 M 50 S

- Series Designation (SM-Subminiature Radial)
- Nominal Capacitance (Micro Farads)
- Tolerance Designation (as specified)
- Rated Voltage (DC)
- Lead Style Designation

(AX-Miniature Axial) (CE04-W-Miniature Radial)
(SSM-Super Subminiature)

NOTE: For tape and reel packaging, use a T for the lead style designation. Available for case diameters through .315 (8.00).
For epoxy end sealing, use an E next to the lead style designation. Available for case diameters through .709 (18.00)

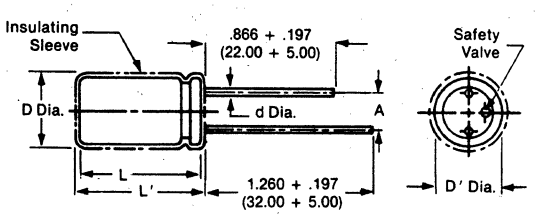


Standard Capacitance Range
(Case Diameters and Lengths in mm)

WV / μf	6.3	10	16	25	35	50	63	100
0.1								5x11
0.22								5x11
0.33								5x11
0.47								5x11
1								5x11
2.2								5x11
3.3								5x11
4.7							5x11	6.3x11
10						5x11	6.3x11	8x11.5
22				5x11	6.3x11	6.3x11	8x11.5	10x12.5
33			5x11	6.3x11	6.3x11	8x11.5	8x11.5	10x16
47		5x11	6.3x11	6.3x11	8x11.5	8x11.5	10x12.5	10x20
100		6.3x11	8x11.5	8x11.5	10x12.5	10x16	10x20	13x20
220		8x11.5	10x12.5	10x16	10x20	13x20	13x20	16x25
330		10x12.5	10x16	10x20	13x20	13x20	13x25	16x31.5
470	10x12.5	10x16	10x20	13x20	13x25	16x25	16x25	18x35.5
1000	10x20	13x20	13x20	13x25	16x25	16x31.5	18x35.5	
2200	13x25	16x20	16x25	16x35.5	18x35.5			
3300	16x25	16x31.5	16x35.5	18x40				
4700	16x31.5	16x35.5	18x35.5					
10000	18x40							

Case Sizes and Dimensions: All dimensions shown in inches (millimeters)

SM Series



D	.197(5.00)	.248(6.30)	.315(8.00)	.394(10.00)	.512(13.00)	.630(16.00)	.709(18.00)
A	.079(2.00)	.099(2.50)	.140(3.50)	.197(5.00)		.295(7.50)	
d	.020(0.50)			.024(0.60)		.026(0.65)	.032(0.80)

D' = [D +.020(0.50)] Max.
L' = [L +.039(1.00)] Max. at D ≤ .315(8.00)
L' = [L +.079(2.00)] Max. at D ≥ .394(10.00)

PERFORMANCE SPECIFICATIONS:

Operating Temperature Range: −40°C to +85°C (−40°F to +185°F)

Leakage Current: Less than 3μa +.01 CV (measured after 3 minutes of applied voltage).
C = Nominal capacitance (μf)
V = Rated voltage

Capacitance Tolerance: ±20% (M) or 10% (K)
(measured at 20°C (68°F), 120Hz)

Dissipation Factor: (measured at 20°C (68°F), 120Hz)

Rated Voltage	6.3	10	16	25	35	50 to 100
0.1μf to 1000μf	0.24	0.20	0.17	0.15	0.12	0.10
1000μf to 10,000μf	Values above plus 0.02 for each 1000μf					

Impedance Ratio at Low Temperature: 120Hz

Rated Voltage	6.3	10	16	25	35	50 to 100
Z −25°C (−13°F)/Z @ 20°C (68°F)	4	3	2	2	2	2
Z −40°C (−40°F)/Z @ 20°C (68°F)	8	6	4	4	4	4

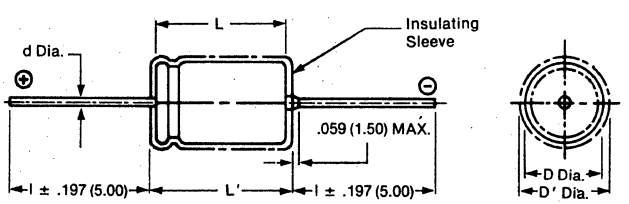
Surge Voltage:

DC Rated Voltage	6.3	10	16	25	35	50	63	100
Surge Voltage	8	13	20	32	44	63	79	125

Load Life: 1000 ±12 hrs @ +85°C (+185°F) and rated voltage.
Leakage Current: Within values specified above
Dissipation Factor: With ±150% of specified value

Shelf Life: 1000 hrs. @ +85°C (+185°F), No voltage applied
Leakage Current: Within ±200% of values specified above
Dissipation Factor: Within ±150% of specified value
Capacitance Change Max.: ±20% from initial value

AX Series



D	d	f
.248 ~ .315 (6.30 ~ 8.00)	.024 (0.60)	1.500 (38.00)
.394 ~ .512 (10.00 ~ 13.00)	.024 (0.60)	1.500 (38.00)
.630 ~ .870 (16.00 ~ 22.00)	.032 (0.80)	1.500 (38.00)
.984 (25.00)	.039 (1.00)	1.500 (38.00)

D' = [D +.020(0.50)] Max.
L' = [L +.039(1.00)] Max. at D ≤ .315(8.00)
L' = [L +.079(2.00)] Max. at D ≥ .394(10.00)

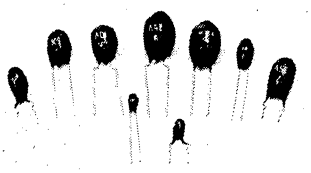
ITT Components

A Unit of International Telephone and Telegraph Corporation

Epoxy Dipped Solid Tantalum Capacitors

TAP

- Extremely Low Leakage Current
- High Surge Capability
- Small Size
- High Component Density
- Rugged Construction
- Reliability-Long Term Stability
- Outstanding Performance Over Wide Frequency Range
- Wide Temperature Range



Catalog Ordering Information

TAP F 2.2 M 15 — General Specifications

- 15 — Voltage
- M — Tolerance: M ±20%, K ±10%
- 2.2 — Capacity in μF
- F — Lead Execution
  - S = 0.100″ Lead Spacing
  - C = 0.200″ with Shoulder
  - D = 0.125″ Lead Spacing
  - B = 0.250″ Lead Spacing
  - F = Lock-In Leads 0.200″ Spacing
  - Y = Special
  - E = Tape and Reel

Packed in the following quantities:

Case Size	Quantity (units per bag)
1—8	500
9—12	100
13—15	50
1—5	1500 pcs/reel
6—8	1000 pcs/reel

Ratings

Capacitance: 0.1 to 330 μF (values up to 680 μF available on request)
Tolerance Range: ±20% (±10%)
Voltage: 3 to 50 volts
Temperature Range: Continuous operation between −55°C to +85°C

Standard Ratings

*Insert Lead Execution Letter & Tolerance Letter in the 2nd and 4th space to complete Ordering Code.

Code*	Cap μF	Case Size	Max Leak μA @ 25°C	Impedance Ω @ 25°C Nom	Impedance Ω @ 25°C Max	Max Diss Fac %
3 Volts — DC; 3.9 Volts — DC Surge @ 85°C						
TAP_10_3	10	1	1	3	9.5	
TAP_15_3	15	2	2	2	8.5	
TAP_22_3	22	3	2	1.5	5	8
TAP_33_3	33	4	3	0.8	3.5	
TAP_47_3	47	5	4	0.6	2	
TAP_68_3	68	6	5	0.5	2	8
TAP_100_3	100	7	10	0.5	1.5	10
TAP_150_3	150	9	10	0.4	0.9	10
TAP_220_3	220	9	15	0.4	0.9	10
TAP_330_3	330	11	20	0.3	0.7	10
6.3 Volts — DC; 8 Volts — DC Surge @ 85°C						
TAP_4.7_6.3	4.7	1	1	5.6	19	6
TAP_6.8_6.3	6.8	2	1	4	10	6
TAP_10_6.3	10	3	2	3	9.5	8
TAP_15_6.3	15	4	2	2.3	6.8	8
TAP_22_6.3	22	5	2	1.5	4	8
TAP_33_6.3	33	6	3	0.8	3.5	8
TAP_47_6.3	47	7	4	0.6	2	8
TAP_68_6.3	68	8	5	0.5	2	8
TAP_100_6.3	100	9	10	0.5	1.5	10
TAP_150_6.3	150	11	10	0.4	0.9	10
TAP_220_6.3	220	12	15	0.4	0.9	10
TAP_330_6.3	330	14	20	0.3	0.7	10
10 Volts — DC; 13 Volts — DC Surge @ 85°C						
TAP_3.3_10	3.3	1	1	8	22	6
TAP_4.7_10	4.7	2	1	5	12	6
TAP_6.8_10	6.8	3	2	3	9.5	6
TAP_10_10	10	4	2	2.4	7	8
TAP_15_10	15	5	2	1.8	4.5	8
TAP_22_10	22	6	3	1	3.5	8
TAP_33_10	33	7	5	0.8	2.2	8
TAP_47_10	47	8	5	0.6	2.2	8
TAP_68_10	68	9	10	0.5	1.8	8
TAP_100_10	100	11	15	0.4	1	10
TAP_150_10	150	13	20	0.4	0.9	10
TAP_220_10	220	14	20	0.3	0.8	10
15(16)† Volts — DC; 20 Volts — DC Surge @ 85°C						
TAP_2.2_15	2.2	1	1	10	25	6
TAP_3.3_16	3.3	2	1	6.5	13.5	6
TAP_4.7_16	4.7	3	2	5.8	12.8	6
TAP_6.8_16	6.8	4	2	5	12	6
TAP_10_16	10	5	2	2.5	5	8
TAP_15_16	15	6	3	1.5	4	
TAP_22_16	22	7	5	1	2.5	
TAP_33_16	33	8	5	0.8	2.2	8
TAP_47_16	47	10	10	0.6	1.5	
TAP_68_16	68	11	10	0.5	1.1	
TAP_100_16	100	13	15	0.4	0.9	10
TAP_150_16	150	15	20	0.3	0.8	10
20 Volts — DC; 26 Volts — DC Surge @ 85°C						
TAP_15_20	15	7	4	1.7	3.5	
TAP_22_20	22	7	5	1.2	2.5	
TAP_33_20	33	9	10	0.8	2	8
TAP_47_20	47	11	15	0.7	1.4	
TAP_68_20	68	12	15	0.6	1.1	
TAP_100_20	100	14	20	0.5	1.1	10
25 Volts — DC; 32 Volts — DC Surge @ 85°C						
TAP_1.5_25	1.5	1	1	12	25	4
TAP_2.2_25	2.2	2	1	9	15	6
TAP_3.3_25	3.3	3	1	6.5	14.5	6
TAP_4.7_25	4.7	4	2	4.5	7.5	6
TAP_6.8_25	6.8	5	3	3	5.5	6
TAP_10_25	10	6	4	2.4	4.2	
TAP_15_25	15	7	5	1.7	2.8	
TAP_22_25	22	9	10	1.2	2.5	8
TAP_33_25	33	10	10	0.8	1.8	
TAP_47_25	47	12	15	0.7	1.4	
TAP_68_25	68	13	15	0.6	1	8
35 Volts — DC; 46 Volts — DC Surge @ 85°C						
TAP_0.1_35	0.1			165	270	
TAP_0.15_35	0.15			110	160	
TAP_0.22_35	0.22	1	1	75	130	4
TAP_0.33_35	0.33			51	85	
TAP_0.47_35	0.47			37	58	
TAP_0.68_35	0.68	1	1	27	40	4
TAP_1.0_35	1.0	1	1	18	28	4
TAP_1.5_35	1.5	2	1	13	20	4
TAP_2.2_35	2.2	3	1	9	13	6
TAP_3.3_35	3.3	4	2	6	10	6
TAP_4.7_35	4.7	5	2	4	7	6
TAP_6.8_35	6.8	6	3	3	4.5	6
TAP_10_35	10	7	5	2.5	3.2	8
TAP_15_35	15	9	5	1.2	2.5	8
TAP_22_35	22	11	10	1	2	8
TAP_33_35	33	12	10	0.8	1.6	8
TAP_47_35	47	14	10	0.6	1.2	8
50 Volts — DC; 65 Volts — DC Surge @ 85°C						
TAP_0.1_50	0.1	1	1	170	270	
TAP_0.15_50	0.15	1	1	105	160	
TAP_0.22_50	0.22	1	1	80	130	4
TAP_0.33_50	0.33	1	1	50	85	
TAP_0.47_50	0.47	2	1	32	55	
TAP_0.68_50	0.68	3	1	25	38	4
TAP_1.0_50	1.0	4	1	16	26	4
TAP_1.5_50	1.5	5	2	13	18	4
TAP_2.2_50	2.2	6	2	8	12	6
TAP_3.3_50	3.3	7	3	6.2	9	6
TAP_4.7_50	4.7	8	3	3.5	6.5	6
TAP_6.8_50	6.8	9	4	2.2	4.2	6
TAP_10_50	10	11	6	1.8	3	8

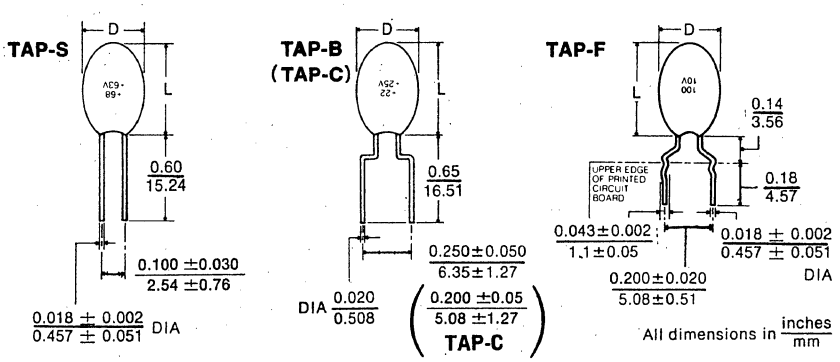
† Branded with voltage value in bracket.

For intermediate capacitance and voltage values, consult your local ITT representative.

Outline Dimensions (Maximum)

Case Size	Diameter-D Inches	Length-L Inches
1	0.157	0.275
2	0.177	0.275
3	0.196	0.314
4	0.196	0.334
5	0.216	0.354
6	0.236	0.374
7	0.255	0.393
8	0.334	0.452
9	0.374	0.531
10	0.374	0.551
11	0.393	0.551
12	0.413	0.591
13	0.413	0.630
14	0.433	0.650
15	0.433	0.669

TAP-S Standard Case Size 1-8
TAP-B Standard Case Size 1-15
TAP-F Standard Case Size 1-15



ITT Components Subminiature Epoxy Molded Solid Tantalum Capacitors

TAR

A Unit of International Telephone and Telegraph Corporation

- Axial Leads For Automatic Insertion
- Subminiature Size For High Component Density
- Rugged Precision Molded Construction
- Polarity Positively Identified By Tapered Nose
- Extremely Low Leakage Current
- High Surge Capability
- Reliability-Long Term Stability
- Outstanding Performance Over Wide Temperature Range

Catalog Ordering Information

TAR A 1.0 M 35 — General Specifications

- 35 — Voltage
- M — Tolerance: M ±20%, K ±10%, J ±5%
- 1.0 — Capacity in µF
- A — Case Size

Standard Packaging is Tape and Reel

Case A 3000 pcs/reel
Case B 2000 pcs/reel
Case C 1000 pcs/reel

Ratings

Capacitance: 0.1 to 68 µF
Tolerance Range: ±20%, ±10%, ±5%
Voltage: 6.3 to 35 volts DC
Temperature Range: Continuous operation between −55°C to +85°C
Impedance @ 100 kHz:

Case Size	Impedance maximum
A	≤ 06.8 µF = 26 ohms ≥ 0.68 µF = 10 ohms
B, C	5 ohms

Temperature	−55°C	+85°C
% Change	−8	+12

Capacitance Change With Temperature: The change in capacitance from +25°C to a given temperature.

Standard Ratings

Insert Tolerance Letter in the space to complete Ordering Code.

Code #	Capacitance µF	Case Size	Maximum Leakage µA @ 25°C	Maximum Dissipation Factor %
6.3 Volts — DC; 8 volts — DC Surge @ 85°C				
TARA8.2_6.3	8.2	A	1	6
TARA10_6.3	**10.0**	A	1	6
TARA12_6.3	12.0	A	1	6
TARB22_6.3	**22.0**	B	1	6
TARB27_6.3	27.0	B	2	6
TARB33_6.3	**33.0**	B	2	6
TARC56_6.3	56.0	C	4	6
TARC68_6.3	**68.0**	C	4	6
10 Volts — DC; 13 volts — DC Surge @ 85°C				
TARA4.7_10	**4.7**	A	1	6
TARA5.6_10	5.6	A	1	6
TARA6.8_10	**6.8**	A	1	6
TARA8.2_10	8.2	A	1	6
TARB18_10	**18.0**	B	1	6
TARB22_10	**22.0**	B	2	6
TARC39_10	39.0	C	4	6
TARC47_10	**47.0**	C	4	6
16 Volts — DC; 20 Volts — DC Surge @ 85°C				
TARA3.3_16	**3.3**	A	1	6
TARA3.9_16	3.9	A	1	6
TARA4.7_16	**4.7**	A	1	6
TARB12_16	12.0	B	2	6
TARB15_16	**15.0**	B	2	6
TARC27_16	27.0	C	4	6
TARC33_16	**33.0**	C	4	6
20 Volts — DC; 26 Volts — DC Surge @ 85°C				
TARA2.7_20	2.7	A	1	6
TARA3.3_20	3.3	A	1	6
TARA3.9_20	3.9	A	1	6
TARB8.2_20	8.2	B	2	6
TARB10_20	**10.0**	B	2	6
TARC18_20	18.0	C	4	6
TARC22_20	**22.0**	C	4	6

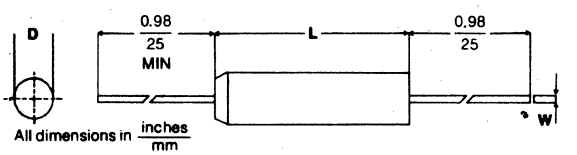
Code #	Capacitance µF	Case Size	Maximum Leakage µA @ 25°C	Maximum Dissipation Factor %
25 Volts — DC; 33 Volts — DC Surge @ 85°C				
TARA1.5_25	**1.5**	A		
TARA1.8_25	1.8	A		
TARA2.2_25	**2.2**	A	1	6
TARB2.7_25	2.7	A		
TARB3.3_25	**3.3**	A		
TARB3.9_25	3.9	B	1	
TARB4.7_25	**4.7**	B	1	
TARB5.6_25	5.6	B	2	6
TARB6.8_25	**6.8**	B	2	
TARC8.2_25	8.2	B	3	
TARC10_25	**10.0**	B	3	
TARC12_25	12.0	C	4	6
TARC15_25	**15.0**		4	
35 Volts — DC; 46 Volts — DC Surge @ 85°C				
TARA0.1_35	**0.1**			
TAR0.12_35	0.12			
TARA0.15_35	**0.15**	A	1	6
TARA0.18_35	0.18			
TARA0.22_35	**0.22**			
TARA0.27_35	0.27			
TARA0.33_35	**0.33**			
TARA0.39_35	0.39	A	1	6
TARA0.47_35	**0.47**			
TARA0.56_35	0.56			
TARA0.68_35	**0.68**	A		
TARA0.82_35	0.82	A		
TARA1.0_35	**1.0**	A	1	6
TARA1.2_35	1.2	A		
TARB1.5_35	**1.5**	A		
TARB1.8_35	1.8		1	
TARB2.2_35	**2.2**		1	
TARB2.7_35	2.7	B	1	6
TARB3.3_35	**3.3**		1	
TARB3.9_35	3.9		2	
TARB4.7_35	**4.7**	B	2	
TARC5.6_35	5.6	C	3	
TARC6.8_35	**6.8**	C	3	6
TARC8.2_35	8.2	C	4	
TARC10_35	**10.0**	C	4	

All capacitors are supplied in the highest voltage available at a given capacitance value and case size.

BOLDFACE items shown are preferred value (E6 range) readily available for delivery.

Outline Dimensions

Case Size	Diameter — D inches ±0.010	Length — L inches ±0.010	Lead Wire Diameter — W inches ±.0.002
A	0.10	0.29	0.02
B	0.17	0.34	0.02
C	0.19	0.53	0.02



ITT Components

A Unit of International Telephone and Telegraph Corporation

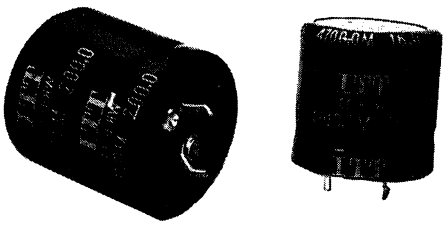
Aluminum Electrolytic Capacitors

PC Mount Power Filtering

ORDERING INFORMATION

FHW 470 M 200

- Series Designation (FHW - Low Profile)
- Nominal Capacitance (Micro Farads)
- Tolerance Designation (as specified)
- Rated Voltage (DC) (FTW - small diameter)

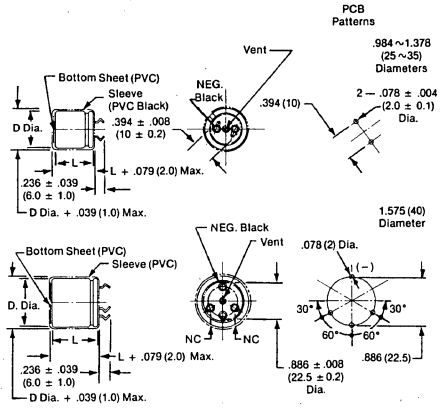


Standard Capacitance Range: FHW Series
(Case Diameters and Lengths in mm)

WV / μF	16	25	35	50	63	80	100	160	180	200	250
100										25x25	25x25
220								25x25	30x25	30x25	30x30
330								30x25	30x30	30x30	35x30
470								30x30	35x30	35x30	40x30
680								35x30	40x30	35x40	40x40
1000				25x25	25x25	30x25	30x30	40x30	40x40	51x40	
2200			25x25	30x25	30x30	30x30	40x30				
3300		25x25	30x25	30x30	35x30	40x30	51x40				
4700	25x25	30x25	30x30	35x30	40x30	51x40	51x40				
6800	30x25	30x30	35x30	40x40	51x40	51x40	63.5x40				
10000	30x30	35x30	40x40	51x40	63.5x40	63.5x40	63.5x40				
15000	35x30	40x40	51x40	63.5x40	63.5x40	63.5x50					
22000	40x40	51x40	63.5x40	63.5x50							

Standard Capacitance Range: FTW Series
(Case Diameters and Length in mm)

WV / μF	16	25	35	50	63	80	100	160	180	200	250
220									25x40	25x40	25x50
330								25x40	25x40	25x50	30x50
470					22.4x25	22.4x30	22.4x30	25x50	25x50	30x50	
680					22.4x30	22.4x40	22.4x40	30x50	30x50		
1000			22.4x25	22.4x25	22.4x30	22.4x40	25x40				
2200		22.4x25	22.4x30	22.4x40	25x40	25x50	30x50				
3300	22.4x25	22.4x30	22.4x40	25x40	25x50	30x50					
4700	22.4x30	22.4x40	25x40	25x50	30x50						
6800	22.4x40	25x40	25x50	30x50							
10000	25x40	25x50	30x50								
15000	30x50	30x50									



PERFORMANCE SPECIFICATIONS:

Operating Temperature Range: −40°C to +85°C (−40°F to +185°F)

Leakage Current: 0.02 CV or 2 mA whichever is less
(measured after 3 minutes of rated voltage)
C = Nominal Capacitance
V = Rated Voltage

Capacitance Tolerance: ±20% (M)
(measured at 20°C (68°F), 120 Hz)

Dissipation Factor: (measured at 20°C (68°F), 120 Hz)

FHW Series:

Rated Voltage	16	25	35	50	63-100	160-250
Up to 2200μF	—	—	0.13	0.10	0.08	0.10
3300μF to 6800μF	0.20	0.18	0.15	0.13	0.15	—
10,000μF	0.25	0.20	0.18	0.18	0.18	—
15,000μF to 22,000μF	0.30	0.25	0.20	0.20	0.20	—

FTW Series:

Rated Voltage	16-25	36-63	80-100	160-250
Up to 2200μF	0.20	0.18	0.15	0.10
3300μF to 6800μF	0.25	0.20	0.20	—
10,000μF to 15,000μF	0.35	0.30	—	—

Impedance Ratio at Low Temperature: 120 Hz

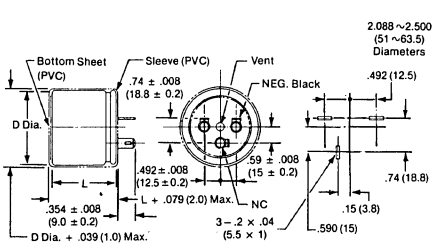
Ratio Z / WV	16	25-35	50-100	160-250
Z @ −25°C (−68°F)/Z @ +20°C (+68°F)	3	2	1.5	2
Z @ −40°C (−40°F)/Z @ +20°C (+68°F)	12	4	3	8

Surge Voltage:

DC Rated Voltage	16	25	35	50	63	80	100	160	180	200	250
Surge Voltage	20	32	44	63	79	100	125	200	225	250	300

Load Life: 1000 hrs @ +85°C (185°F), rated voltage
Capacitance Change Max.: Within ±20% of initial value
Leakage Current: Within specified value
Dissipation Factor: Within ±150% of specified value

Shelf Life: 1000 hrs @ +85°C (+185°F), no voltage applied
Capacitance Change Max.: Within ±20% of initial value
Leakage Current: Within ±200% of specified value
Dissipation Factor: Within ±150% of specified value

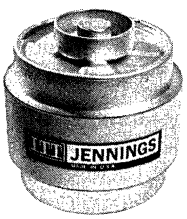


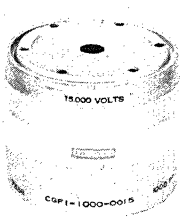
ITT COMPONENTS • 3201 South Standard Street • Santa Ana, California 92705 • Phone: (714) 751-3900 • TWX: 910-595-1744 • Telex: 69-1389

vacuum capacitors

ITT Jennings offers the broadest available line of high voltage capacitors for radio frequency applications. Units are available in glass and ceramic envelopes with working voltage ratings of 2 kv to 36 kv, at capacitance values to 5000 pfd, with current ranges to 420 Amps RMS (air-cooled) and 1,000 Amps RMS (water-cooled), depending upon capacity, frequency, and working voltage. The design of ITT Jennings Vacuum and Gas capacitors allows a number of electrical, mechanical and environmental advantages which include:

1) HIGH VOLTAGE—The high dielectric strength allows maximum voltage levels for a given capacitance rating.
2) HIGH CURRENT—Extremely low losses occur because of the dielectric, low loss glass and ceramic envelopes, and heavy copper construction. ITT Jennings capacitors are able to handle large currents at high RF frequencies that would destroy other types of capacitors.
3) COMPACT DESIGN—Units are quite small for their power handling capabilities.
4) HIGH Maximum to Minimum CAPACITY RATIO—Capacity change ratios are available to 140:1, making them desirable for wide tuning ranges.
5) SELF-HEALING—The design construction permits moderate overloads that would damage other materials.
6) HIGH ALTITUDE OPERATION—Vacuum capacitors are free from internal degradation due to extreme environmental conditions.





VACUUM FIXED CAPACITORS

Peak Voltage Kilovolts				Capacity pF	Continuous RMS Amperes[2] (Max.)	Nominal Dimensions[3] (Inches)	
Test 60 Hz	RF Working[1] (Peak)		Type*			Length	Diameter
5	3	G	JCSL	1000, 1500, 2000	75	4.0	2.9
15	9		JCSF	25, 40, 50, 80, 120, 150	40	1.7	1.7
15	9		JCS	250, 400, 500	90	4.0	3.1
15	9		MCI	500, 750, 1000	120	4.1	4.1
15	9		MMC	1500, 2000, 5000	220	13.0	9.3
15	9		MMCI	2000	200	4.9	6.1
15	9	C	CFDP	1500, 2000	200	3.3	5.6
12	7		CFDS	1000	95	4.6	3.6
20	12	G	MC	500, 750, 1000	150	8.4	5.0
30	18		MLC	500, 750, 1000	200	9.3	4.5
30	18	C	CY	1, 2, 3, 5	12	3.3	0.8
35	25		CLF1	6, 12, 25, 50, 75, 100	85	6.5	2.3
30	20		CLF1	150, 200, 250	90	6.5	2.6
25	15		CFED	500, 750, 1000	160	3.8	4.6
35	21		CFFP	2000, 2500	400	5.8	8.2
55	33	G	MMHC	450	210	9.3	6.1
60	36	C	CFHD	12, 25, 50, 100, 200	145	5.2	3.4
55	33		CFHP	450	300	5.5	5.6
50	30		CFHP	1000, 2000	425	6.2	8.2

GAS FIXED CAPACITORS

Peak Voltage Kilovolts				Capacity pF	Continuous RMS Amperes[2] (Max.)	Nominal Dimensions[3] (Inches)	
Test 60 Hz	RF+DC	RF Working	Type*			Length	Diameter
20	18	12	C CGF1-1000	1000	215	3.5	4.8
35	30	21	CGF2-1000	1000	270	4.0	6.0
50	40	25	CGF2-500	500	290	5.5	5.7

VACUUM CAPACITORS, TRIMMABLE

Peak Voltage Kilovolts				Continuous RMS Amps, Max.	Nominal Dimensions (Inches)	
Test 60 Hz	RF Working (Peak)	Type	Capacity Range (pF)		Length	Diameter
10	6	CTV3 (10 models)[4]	338-1377	150	5.3	4.5
20	12	CTV1 (5 models)[4]	76-346	125	5.3	4.5
50	35	CTV2 (6 models)[4]	18-137	85	5.3	4.5

* G = Glass; C = Ceramic

[1] The maximum RF working voltage that can be applied over the 2-32 MHz frequency range while not exceeding the RF current rating.

[2] RF current rating is dependent upon capacity, frequency and working voltage. Write for complete applications data.

[3] Dimensions of largest unit in a series.

[4] Number of models required to cover capacity range.

SEND FOR CATALOG NO. C103A.

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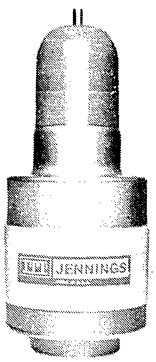
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum variable capacitors

Peak Voltage Kilovolts				Capacity pF	Continuous RMS Amperes[2] (Max.)	Nominal Dimensions[3] (Inches)	
Test 60 Hz	RF Working[1] (Peak)		Type*			Length	Diameter
5	3	G	UCSL	4-250, 5-500	35	4.1	2.2
5	3		USL	5-500	35	5.8	2.4
5	3		UCSL	5-750, 7-1000, 10-1500, 20-2000	60	8.3	3.1
3	2		UCSL	50-3000, 100-5000	55	8.8	4.1
5	3	C	CSV1	5-500	45	5.8	2.4
5	5		CMV2	6-500	38	3.6	1.8
5	5		CMV1	8-650	40	4.3	1.7
5	3		CVCE	10-750	80	7.1	3.4
3	3		CVCJ	7-1000	70	7.6	3.1
3	3		CMV1	8-1000	40	4.3	1.7
5	3		CSV1	10-1000	70	5.0	3.1
5	3		CVCD	10-1500, 20-2000, 50-3000	100	8.3	4.6
5	5		CMV2	20-2000	45	5.3	3.8
5	5		CMV1	25-4000	70	6.5	3.3
15	9	G	UCSB	5-100	40	4.9	2.4
15	9		UCS	5-200, 10-300, 25-500	60	9.0	3.1
15	9		UCSXF	12-1000, 15-1200	70	10.0	4.3
15	9		UCSX	25-700, 25-1000	70	9.8	3.7
15	9		VMMC	50-1000, 100-2000	200	15.6	6.1
12	7		UCSXF	20-1500, 50-2300	70	10.0	5.1
15	9	C	CVDP	35-1500, 50-2300	100	9.8	5.6
15	9	G	VMMC	100-5000	200	21.3	9.2
15	9	C	CADD	3-30	20	4.1	1.3
15	9		CSVF	12-500	70	7.9	3.6
15	9		CVDD	6.5-50, 10-100	65	6.6	2.4
15	9		CVDD	10-300, 20-500	95	7.5	3.4
20	12		CVEP	25-500, 50-1000, 100-1500	210	10.2	7.2
15	9		CVDD	25-1000	150	8.0	4.6
15	9		CVEP	100-2000	200	10.2	7.2
30	18		CVFA	10-75	50	8.8	2.7
55	33		CVHP	10-250, 25-450, 30-650	240	11.9	7.2
40	24		CVFP	15-250, 25-450	170	9.6	5.6
50	30		CWV2	25-450, 30-650 (water cooled)	800	17.9	7.6
40	24		CAV2	35-1000 (air cooled)	425	11.7	7.6
40	24		CVFP	35-1000	225	11.7	7.2
50	30		CVHP	60-1000	250	14.5	8.0
50	30		CWV1	100-1000 (water cooled)	800	21.6	8.6
50	30		CAV3	40-1000 (air cooled)	500	14.5	8.6
60	36		CWV1	100-1600 (water cooled)	1000	23.0	12.5
40	24		CWV2	100-1600 (water cooled)	790	25.0	8.6
35	21		CVFP	100-1500, 100-2000	220	14.5	8.2



GAS VARIABLE CAPACITORS

Peak Voltage Kilovolts				Capacity pF	Continuous RMS Amperes[2] (Max.)	Nominal Dimensions[3] (Inches)	
Test 60 Hz	RF Working[1]		Type*			Length	Diameter
5	3	C	CHV1	1.5-45	15	2.9	0.9
15	9		CHV1	2.5-50	25	6.4	1.4

* G = Glass; C = Ceramic

[1] RF working voltage is the maximum RF voltage that can be applied to the capacitor over the 2-32 MHz frequency range, provided the RF current rating is not exceeded.

[2] RF current rating is dependent upon capacity, frequency and working voltage. Write for complete applications data.

[3] Dimensions of largest unit in a series.

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rf capacitors

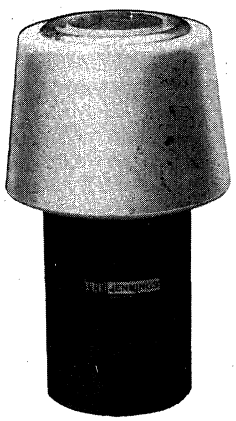
ITT Jennings titanate capacitors offer the highest kVA ratings for use in applications where life and reliability are a prime requisite. A variety of dielectric materials are available to allow flexibility of design for application requirements in transmitter, radar, induction or dielectric heating, lasar, electronic welding or X-ray equipments.

A complete high power RF testing laboratory is used to verify capacitor ratings under actual operate conditions. Power testing is available to 100 KW. A MIL approved environmental test laboratory guarantees full compliance for both military or commercial requirements.

Humidity resistant coatings on external surfaces of capacitors allow operation in open air without external flashovers. ITT Jennings application engineers are available to assist the equipment design engineer in the most cost effective approach for a variety of applications.

See note below.

J1WC01UJ (WATER COOLED)



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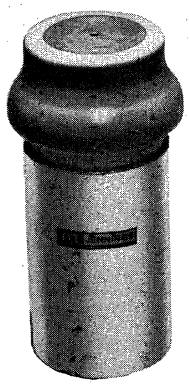

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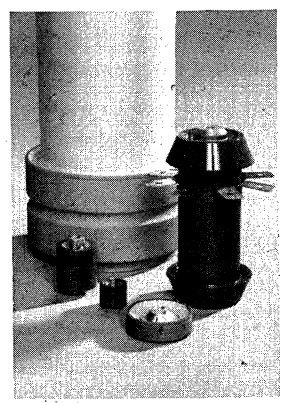
J1HT57

J1HT50, 58



ITT JENNINGS Model Number	Capacitance (pF)	Cap. Tol. (± %)	Operate Volts (kVDC)	Temp. Coeff. (ppm/°C)	Temp. Coeff. Tol. (ppm/°C)	1 MHz		10 MHz		30 MHz	
						RF amps	KVAR	RF amps	KVAR	RF amps	KVAR
J1HT50CG250K752*	25	10	7.5	NPO	30	.84	4.4	3.1	6.1	5.6	6.6
J1HT50CG500K752*	50	10	7.5	NPO	30	1.7	8.8	4.2	5.6	7.6	6.0
J1HT50UJ620K752*	62	10	7.5	N750	120	2.1	9.0	5.6	5.9	10.1	5.4
J1HT50UJ750K752*	75	10	7.5	N750	120	2.5	13.2	6.2	8.1	9.0	5.6
J1HT50UJ101K752*	100	10	7.5	N750	120	3.4	19.0	7.3	8.7	9.2	4.6
J1HT57CG250K153*	25	10	15	NPO	30	1.7	18.5	6.2	22.0	6.7	8.6
J1HT57CG500K153*	50	10	15	NPO	30	3.3	35.0	7.4	18.0	8.1	7.1
J1HT57UJ101K153*	100	10	15	N750	120	4.6	35.0	12.0	22.0	15.0	11.1
J1HT57UJ201K752*	200	10	7.5	N750	120	5.1	23.0	8.5	6.2	15.0	6.0
J1HT58UJ500K752*	50	10	7.5	N750	120	1.7	8.9	5.0	5.6	8.5	6.0
J1HT58XX501M502	500	20	5.0	X5U	(Hi K)	1.1	0.4	2.5	0.2	3.0	0.1
J2HT60XX682N352	6800	30	3.5	X5U	(Hi K)	30		Available upon request			
J1FT40UJ202J852	2000	5	8.5	N750	120	50		Available upon request			
J1FT40UJ602M852	6000	20	8.5	N750	120	50		Available upon request			
J1FT40UJ122K852	1200	10	8.5	N750	120	50		Available upon request			
J1WC01UJ252M143	2500	20	14.0	N750	120	150		Available upon request			
J1WC01UJ502M123	5000	20	12.0	N750	120	150		Available upon request			
J1WC01UJ762M143	7600	20	14.0	N750	120	300		Available upon request			
J4SC01UJ402M323	4000	20	32.0	N750	120	72		Available upon request			
J4SC01TJ502K253	5000	10	25.0	N750	120	72		Available upon request			

* NOTE: Other capacities and models are available to this line of RF capacitors. If you have a special application please check with our applications department for capacitors with ratings other than those listed.

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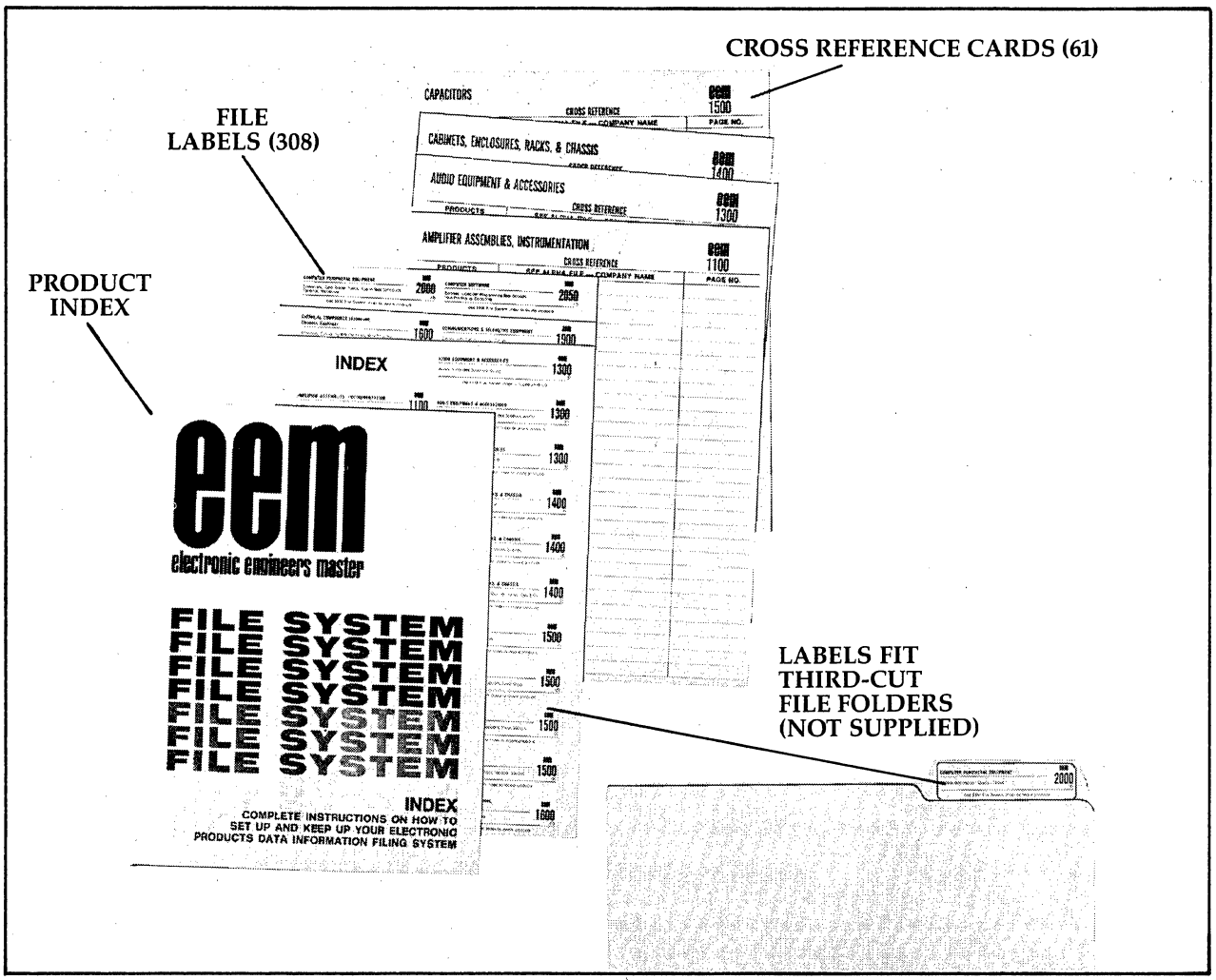

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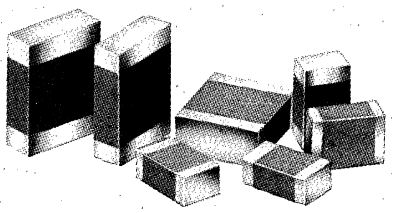
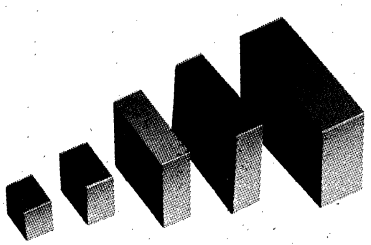
JOHANSON DIELECTRICS
Ceramic Chip Capacitors

Ultra High Capacitance Chip Capacitors



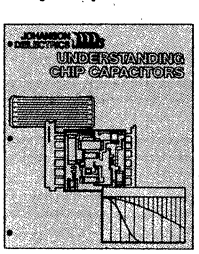
Fourteen configurations are available in four basic dielectrics: NPO/COG, BX/X7R, Z5U, and Y5V characteristics, to meet MIL-C-55681A and EIA 198B specifications. Capacitors feature high volume efficiency of capacitance, and are ideal for hybrid circuit applications.

High Voltage Chip Capacitors



Available in either NPO/COG or BX/X7R dielectric, these units are designed to obtain high voltage values to 4000 VDCW. Typical applications include high voltage power supplies and voltage multiplier circuits.

Understanding Chip Capacitors



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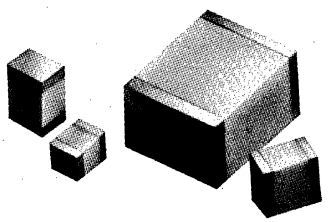
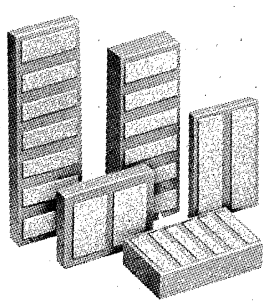
High Q Microwave Chip Capacitors



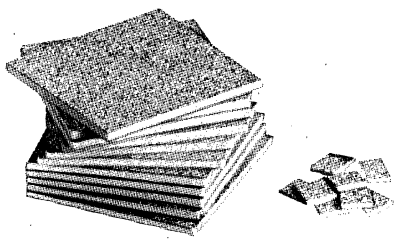
High Q microwave chip capacitors are available in four basic sizes, displaying excellent performance in the VHF, UHF and microwave ranges. The configuration, insertion loss and resonance-free performance make these chips ideal for microstrip and hybrid MIC applications.

Multiple Capacitor Arrays



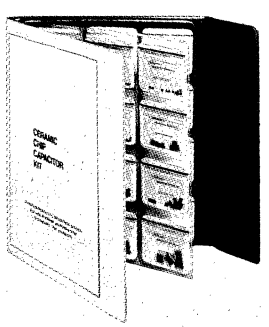
Custom designed multiple capacitor elements are ideal for multiple circuit coupling, filtering, bypass and high voltage multiplier circuits. Multiple capacitor arrays are practical replacements for individually bonded chips in hybrid circuits and are available in a variety of dielectric characteristics.

Ceramic Capacitor Wafers (Single Layer)



Ideally suited for micromodule and miniature hybrid integrated circuits where low profile requirements preclude the use of conventional multilayer chip capacitors. These units are used as bypass, shifter, blocking and filtering elements, (to 18 GHz in microwave applications). Custom configurations are also available for high voltage applications to 15 KV.

Chip Kit



Designer kits contain standard size chips in popular capacitance values and dielectric characteristics with palladium silver terminations. Kits are supplied in a special vinyl cover for convenient shelf storage with each chip value individually packaged for easy access. Available with NPO/COG dielectric No. S-900, BX/X7R and Y5V dielectric No. S-905 and ceramic capacitor wafers (single layer) No. S-910.

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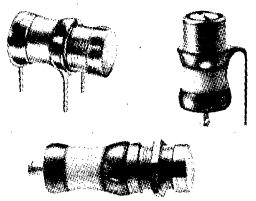
Johanson

Variable Capacitors

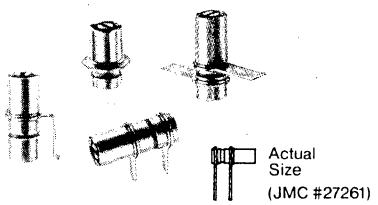
Standard Air Capacitors



- ☐ Capacitance ranges: .8-10pf to 1-30pf
- ☐ Q's to >10,000
- ☐ Excellent tuning stability and low dynamic noise
- ☐ Patented* self-locking constant torque adjustment mechanism
- ☐ Qualified to MIL-C-14409D, QPL approved
- ☐ Engineering prototype kit JK-500

*U. S. Patent No. 3,469,160

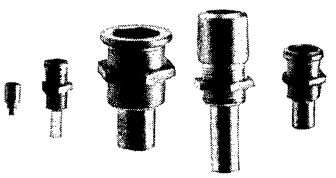
Giga-Trim® Capacitors



- ☐ Capacitance ranges: .3-1.2pf to .8-8pf
- ☐ Q's over 4000 at 250 MHz
- ☐ Ideal for microwave oscillators and filters
- ☐ Qualified to MIL-C-14409D, QPL approved
- ☐ New Zero TC versions
- ☐ Engineering prototype kit JK-272

*U. S. Patent No. 3,469,160

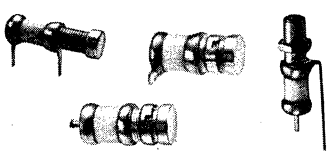
Microwave Tuning Elements



- ☐ Provide a unique money-saving means of introducing a variable reactance into waveguides, cavities, and other microwave structures
- ☐ High resolution
- ☐ Patented* self-locking constant torque adjustment mechanism

*U. S. Patent No. 3,469,160

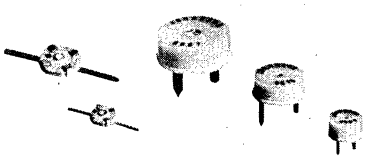
Miniature Air Capacitors



- ☐ Capacitance ranges: .35-3.5pf to .8-10pf
- ☐ Q's to >10,000
- ☐ Patented* self-locking constant torque adjustment mechanism
- ☐ Ideal for miniature microwave, VHF and UHF applications
- ☐ Engineering prototype kit JK-500

*U. S. Patent No. 3,469,160

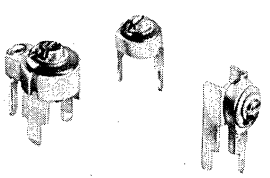
Thin-Trim®/ Seal-Trim® Ceramic Capacitors



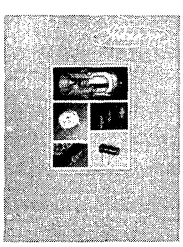
- ☐ Capacitance ranges: .2-.6pf to 20-100pf
- ☐ Q's to >3000 at 100 MHz
- ☐ Ideal for sub-miniature hybrid circuit applications
- ☐ Seal-Trims impervious to all standard PCB cleaning solvents
- ☐ Conform to MIL-C-81 requirements
- ☐ Engineering prototype kits available

U. S. Patent No. 4,179,722

Variable Ceramic Capacitors



- ☐ Low cost
- ☐ Broad tuning ranges: 1.7-6pf to 6.0-70pf
- ☐ Top, side and bottom tuning styles available
- ☐ Ideal for crystal oscillators, CATV amplifiers and all varieties of test and communication equipment
- ☐ Engineering prototype kit JK-930



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Johanson

Manufacturing Corporation

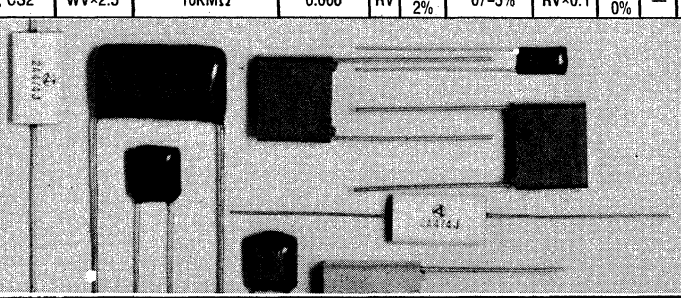
400 Rockaway Valley Road
Boonton, New Jersey 07005

(201) 334-2676
TWX 710-987-8367

OKAYA

PLASTIC FILM CAPACITORS

		DWV	IR (min)		Dielectric Dissipation Factor (min) (1,000 Hz)	Solder (max)		Cold Resistance ΔC	Dry Heat (min)		Temp. Cycling		Cycled Moisture		Humidity		Life		Operating Temperature Range	Application
			≧ 0.33μF	< 0.33μF			Δ C		IR	Δ C	IR	Δ C	IR	Δ C	IR	Δ C	IR	Δ C		
	Test Condition	2 ~ 5 sec	20°C 100 VDC		1 KHz 100 Hz	2 cycles 5 sec @ 270°C		At minimum operating temperature	At maximum operating temperature		100 cycles — 30 minutes @ max/min opt. temperature		2 hours @ 70°C 1 hour @ -20°C 40 cycles 90-95% RH		500 hours WV × 100% (DC) +60°C 90-95% RH		1000 hours WV × 140% (DC) +85°C			
Polyester	CQ92MA	WV×2.5	30KMΩ	10KMΩ	0.006	RV	±2%	0/-8%	4.5KMΩ	+5 0%	RV	±5%	RV×½	±3%	RV×⅓	±5%	RV×½	±3%	-55°C ~ + 85°C	Communications Equipment
Polyester	CQ92MB	WV×2.5	30KMΩ	10KMΩ	0.006	RV	±2%	0/-5%	4.5KMΩ	+5 0%	RV	±5%	RV×½	±3%	RV×⅓	±5%	RV×½	±3%	-40°C ~ + 85°C	General Communication Equipment
Polyester	CQP92MC	WV×2.5	30KMΩ	10KMΩ	0.006	RV	±2%	0/-5%	RV×.15	+5 0%	RV	±5%	RV×½	±3%	RV×⅓	±5%	RV×½	±3%	-40°C ~ + 85°C	Consumer Electronics
Polyester	C2SEC	WV×2.5	30KMΩ		0.006	RV	±2%	0/-5%	4.5KMΩ	+5 0%	RV	±5%	RV×½	±3%	RV×⅓	±5%	RV×½	±3%	-40°C ~ + 85°C	Consumer Electronics
Polyester	CQ14MA	WV×2.5	30KMΩ	10KMΩ	0.006	RV	±2%	0/-8%	4.5KMΩ	+5 0%	RV	±5%	RV×½	±3%	RV×⅓	±5%	RV×½	±3%	-55°C ~ + 85°C	Communications Equipment
Metalized Polyester	CF93MMA	WV×1.75	30KMΩ	10KMΩ	0.008	RV	±2%	0/-8%	RV×0.1	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-40°C ~ + 85°C	Communications Equipment
Metalized Polyester	C7NEV	WV×1.75	9KMΩ	3KMΩ	0.008	RV	±2%	0/-8%	RV×1/75	+7 0%	RV	±2%	RV×½	±2%	RV×⅓	±5%	RV×½	±5%	-45°C ~ +105°C	Communications Equipment
Metalized Polyester	C7NE	WV×1.75	9KMΩ	3KMΩ	0.008	RV	±2%	0/-8%	RV×1/20	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-45°C ~ + 85°C	Box Type
Metalized Polyester	C7NEH	WV×1.75	30KMΩ	10KMΩ	0.008	RV	±2%	0/-8%	RV×1/20	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-45°C ~ +105°C	Box Type
Metalized Polyester	CF91TMMA	WV×1.75	30KMΩ	10KMΩ	0.008	RV	±2%	0/-8%	RV×0.1	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-40°C ~ + 85°C	Communications Equipment
Polystyrene	CQ08, 09SA	WV×2.5	100KMΩ		0.001	RV	±1.5%	-150ppm/°	RV×0.5	—	RV	±1%	—	—	RV×⅓	±5%	RV×½	±3%	-10°C ~ + 70°C	Consumer Electronics
Polystyrene	CQ08, 09SC	WV×2.5	100KMΩ		0.001	RV	±1.5%	-150ppm/°	RV×0.5	—	RV	±1%	—	—	RV×⅓	±5%	RV×½	±3%	-10°C ~ + 70°C	Consumer Electronics
PP	CQ92PP	WV×2.5	100KMΩ		0.001~0.0015	RV	±1%	+3/0%	RV×0.1	0 -5%	RV	±2%	RV×½	±2%	RV×⅓	±3%	RV×½	±3%	-40°C ~ + 85°C	Ultra Precision
MPP	C3NP	WV×1.75	100KMΩ		0.001	RV	±1%	+3/0%	RV×0.1	0 -5%	RV	±2%	RV×½	±2%	RV×⅓	±3%	RV×½	±3%	-40°C ~ + 70°C	Consumer Electronics
MPP	CF78MPP	WV×1.75	5KMΩ		0.001	—	—	+3/0%	—	—	—	—	—	—	RV×½	±3%	RV×½	±3%	-25°C ~ + 70°C	Power Switching
MPC	CF91TMPC	WV×2.5	50KMΩ	16KMΩ	0.003	RV	±1%	0/-1.25%	10KMΩ	0 -1%	RV	±2%	RV×½	±3%	RV×⅓	±5%	RV×½	±2%	-55°C ~ +125°C	Consumer Electronics
Metalized Polyester	HFC-II	WV×1.75	30KMΩ	10KMΩ	0.008	RV	±2%	0/-8%	RV×0.1	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-40°C ~ + 85°C	Audio
Metalized Polyester	HFV-I	WV×1.75	30KMΩ	10KMΩ	0.008	RV	±2%	0/-8%	RV×0.1	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-40°C ~ + 85°C	Audio
Metalized Polyester	HFV-II, III	WV×1.75	30KMΩ	10KMΩ	0.006	RV	±2%	0/-8%	RV×0.1	+5 0%	RV	±2%	RV×½	±2%	RV×⅓	±8%	RV×½	±5%	-40°C ~ + 85°C	Audio
Metalized Polyester	CS1, CS2	WV×2.5	10KMΩ		0.006	RV	±2%	0/-5%	RV×0.1	+5 0%	—	—	—	—	RV×⅓	±5%	RV×½	±3%	-40°C ~ + 70°C	Audio



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MICA CAPACITORS

STANDARD MICA CAPACITORS

Style	Maximum Capacitance (pf) 100V	300V	500V	1000V	1500V	2000V	2500V
DM04	330	200	—	—	—	—	—
DM05	430	330	—	—	—	—	—
DM10	470	360	270	—	—	—	—
DM12	1200	1000	510	—	—	—	—
DM15	1500	1200	750	—	—	—	—
DM19	8200	6200	5100	1000	—	—	—
DM20	18,000	12,300	10,000	5600	3000	—	—
DM30	40,000	30,000	22,000	11,000	8200	3000	2700
DM42	100,000	69,000	51,000	—	—	—	—

DM SERIES — Entire Range, Fully Professional.

KZ SERIES — Low Cost/Replace NPO ceramic CK-06/7.

KZDM SERIES — Low Cost DM10 and DM15 direct, plug-in replacements for high volume applications.

KSAX — Axial Mica — Available to 680pf/100V — Available tape and reel.

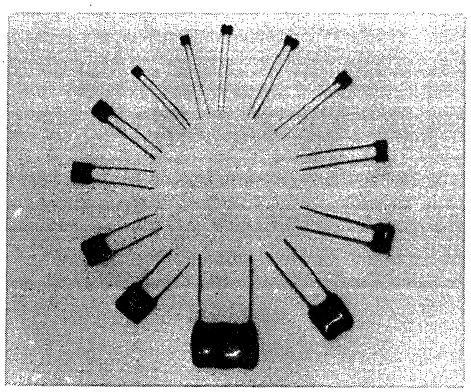
Taping and Reeling available on DM12 and DM15 sizes. Radial per Panasert type.

High voltage available to 2500VDC.

Tolerances ±½%, 1%, 2%, and 5% available in any value.

LOW COST SERIES

Style	Cap (pf)	L	W	T	S
KZ4	1-43	0.195	0.235	0.140	0.100
KZ5	44-82	0.235	0.275	0.140	0.100
KZ8	83-220	0.355	0.395	0.160	0.200
KZ10	221-330	0.435	0.475	0.160	0.236
KZ12	331-510	0.515	0.550	0.180	0.315
KZ15	511-800	0.630	0.670	0.180	0.394
KZDM10	1-100	0.275	0.230	0.140	0.157
KZDM15	1-220	0.420	0.275	0.160	0.236



ELECTROLYTIC CAPACITORS

MINIATURE RADIAL & AXIAL; LARGE CV; SWITCHER TYPES

Style	Capacitance (mfd)	Voltage	Description
KAET/KSET	0.47 to 3300	6.3-100	Axial/Radial for general purpose applications.
KSET-LN	0.1 to 47	6.3-50	Low Leakage Radials. Tantalum Replacements.
KGPF/KGPK	1000 to 22,000	10-100	High Capacity Radials. 3 Lead wires for extra support.
KSMM	0.47 to 10,000	6.3-100	Miniaturized version of KSET radial type.
KTSMB	0.47 to 47	6.3-50	Ultra miniature radial. All units have 0.295" diameter.
KLC120	100 to 10,000	6.3-100	Axial long life — high reliability.
KLC121	2.2 to 470	160-450	Axial high voltage extension of the KLC120 series.
KLC033	15 to 22,000	6.3-350	Axial −55°C to +85°C. Extra long life and reliability.

FILM CAPACITORS

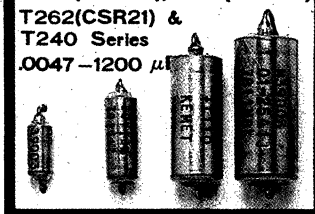
Style	Capacitance (mfd)	Voltage	Description
KMMR	0.022-2.20	250	Radial Metallized Polyester with epoxy coating.
KMDDE	0.022-1.00	100-250	Radial Metallized Polyester.
KMTBE	0.022-1.00	100-250	Axial Version of KMDDE Metallized Polyester.
KMRA	0.001-0.47	50	Radial Polyester with epoxy coating. Tape and Reel available.
KPXH	0.0001-0.01	50 and 100	Axial Polypropylene. Low Cost. Tape and Reel available.
KPRH	0.0001-0.01	50 and 100	Radial Polypropylene. Low Cost.
KPRA	0.001-0.10	100	Radial Polypropylene with epoxy coating. Tape and Reel available.
KSXA	0.0001-0.01	50	Axial polystyrene. Low Cost. Tape and Reel available.

KEMET

UNION CARBIDE — ELECTRONICS DIVISION
TANTALUM, CERAMIC & FILM CAPACITORS

UNION CARBIDE

T110,T212(CSR13),T210,T140, T242(CSR23),T252(CSR33) T262(CSR21) & T240 Series .0047–1200 μF

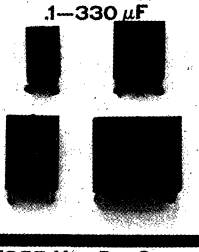


T322 & T323(CX05) Series .15–68 μF

T310 Series .1–330 μF

T330 Series .1–220μF

T340 Series .1–330 μF



T120, T222 (CSR09) & T220 Series

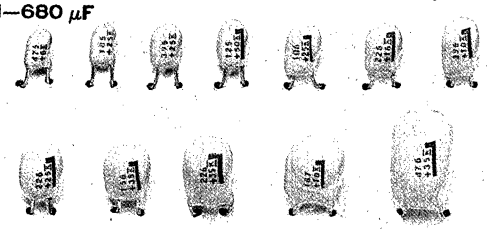
.0047–22 μF

T361, T362, T363(CX02), T368 & T369(CX12) Series .1–330 μF

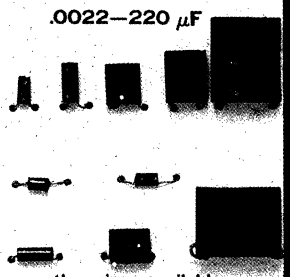
T362

T368

T350,T351,T352,T353,T354 & T355 UltraDip Series .1–680 μF



T370–T382 Micron Series .0022–220 μF



other sizes available

Tantalum Chip Capacitors

T411, T412(CWR01) .1–68 μF

T421, T422(CWR02) .1–100 μF

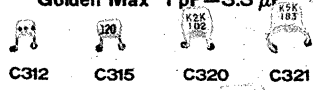
Ceramic Chip Capacitors 1 pF–1.2 μF

*Popular Styles

*1206 *1210 *0805 1005 1805 1608 *1812 *1825 2225

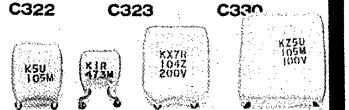
(CDR01) (CDR02)(CDR03)(CDR04)(CDR05)(CDR06)

Golden Max 1 pF–3.3 μF



C312 C315 C320 C321

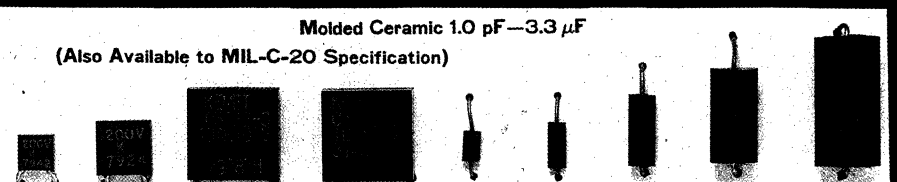
C322 C323 C330



C331 C333 C340 C350

Molded Ceramic 1.0 pF–3.3 μF

(Also Available to MIL-C-20 Specification)



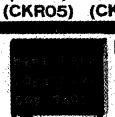
C052 (CK05) (CKR05) C062 (CK06) (CKR06) C512 C522 C114 (CK12) (CKR11) C124 (CK13) (CKR12) C192 (CK14) (CKR14) C202 (CK15) (CKR15) C222 (CK16) (CKR16)

C630 "Mighty Max" 10–220,000 pF

Flat Kap .001–1.0 μF

F110, F120, F130

F310(CFR04R), F311 (CFR04A), F320, F321, F330 & F331



8 Case Sizes Available

4 Case Sizes Available

8 Case Sizes Available

Metallized Polycarbonate Film .001–22 μF

F141

F241(CRH01-5)

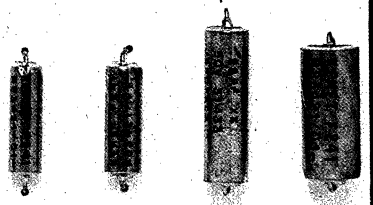
F242(CRH06-0)

F245(CHR01A,D,G,K & N)

F246(CHR01B,E,H,L &P)

F247(CHR01C,F,J,M & R)

F248(CHR10)



NOTICE

Any capacitor misapplied may fail and thereby damage other circuit components. Please refer to specific KEMET Application Notes, available free of charge from the address below, for a more complete description of capacitor characteristics.

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® CAPACITOR REFERENCE & INDEX

UNION CARBIDE

SOLID TANTALUM CAPACITORS*

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CRH03	32	CRH00	32

MILITARY SPECIFICATION

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* KEMET® CAPACITOR OEM SALES REPRESENTATIVES 33

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

MIL-C-39003* ORDERING INFORMATION FOR CSR09 (T222), CSR13 (T212), CSR21 (T262), CSR23 (T242), CSR33 (T252), & CSR91 (T213) CAPACITORS

CSR XX B 565 K M

TYPE
Capacitors, Fixed, Solid Electrolyte, Tantalum Established Reliability

STYLE
Tubular Case — Always Sleeved
09 — Miniature — T222
13 — Standard — T212
21 — Standard, low ESR — T262
23 — Extended Range — T242
33 — Extended Range Low Leakage — T252
91 — Non-Polar — T213

VOLTAGE

Symbol	VDC Working 85°C	VDC Working 125°C	VDC Surge 85°C	VDC Surge 125°C
B	6	4	8	5
C	10	7	13	9
D	15	10	20	12
E	20	13	26	16
F	35	23	46	28
G	50	33	65	40
H	75	50	98	64
J	100	67	130	86

CAPACITANCE
Expressed in picofarads (1 microfarad = 1,000,000 picofarads). First two digits represent significant figures. Last digit specifies the number of zeros to follow.

Examples
565 — 5,600,000 = 5.60 μF
564 — 560,000 = .56 μF
563 — 56,000 = .056 μF

CAPACITANCE TOLERANCE
J — ±5%
K — ±10%
M — ±20%

FAILURE RATE LEVEL IN % PER 1000 HOURS
M — 1%
P — 0.1%
R — 0.01%
S — 0.001%

* This Military Part Numbering System is obsolete in accordance with the current specifications. The correct current designation for a CSR part number is the MIL Specification Number, followed by the Specification (slash) Sheet Number and Dash Number (i.e. — MIL-C-39003/01-2270). However, the part number breakdown shown above is still widely used and is shown for reference.

KEMET APPROVED FAILURE RATE LEVELS MIL-C-39003E

STYLE	DESCRIPTION	KEMET SERIES	APPROVED FAILURE RATE LEVEL
CSR09	Polar-Subminiature	T222	S (0.001% /K hrs.)
CSR13	Polar-Standard MIL Case	T212	S (0.001% /K hrs.)
CSR21	Polar-Standard, low ESR, MIL Case	T262	S (0.001% /K hrs.)
CSR23	Polar-Extended Range	T242	R (0.01% /K hrs.)
CSR33	Polar-Extended Range Low Leakage	T252	R (0.01% /K hrs.)
CSR91	Non-Polar	T213	S (0.001% /K hrs.)

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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T110 SERIES POLAR TYPE & T212 (CSR13)

KEMET standard MIL case hermetic sealed T110 Series are the leading solid tantalum capacitors in use today. They are compact, ruggedly built, designed for minaiturized circuitry, and are especially suited for coupling, by-pass, filtering and R-C timing circuits. They exhibit excellent stability, extremely low DC leakage current, dissipation factor, and impedance over a wide temperature and frequency range.

Available in standard EIA capacitance values from .0047-330 μF in ±20%, ±10%, and ±5% tolerances and working voltages from 6-125 VDC.

Higher CV values in comparable case sizes are available in KEMET T140 Series.

Included in the following T110 Series table is a complete listing of T212 Series, qualified as MIL-C-39003 CSR13 capacitors. KEMET is approved to manufacture to the S (0.001%/K hrs.) failure rate level. For additional information refer to KEMET Cat. F-1851.

T110 ORDERING INFORMATION*

T 110 A 105 K 050 A S - C

TANTALUM

SERIES
T110, T212 (CSR13),
T262 (CSR21)

CASE SIZE
A/B/C/D

PICOFARAD CODE
First two digits represent significant figures. Third digit specifies number of zeros to follow.

CAPACITANCE TOLERANCE
M — ±20%
K — ±10%
J — ±5%

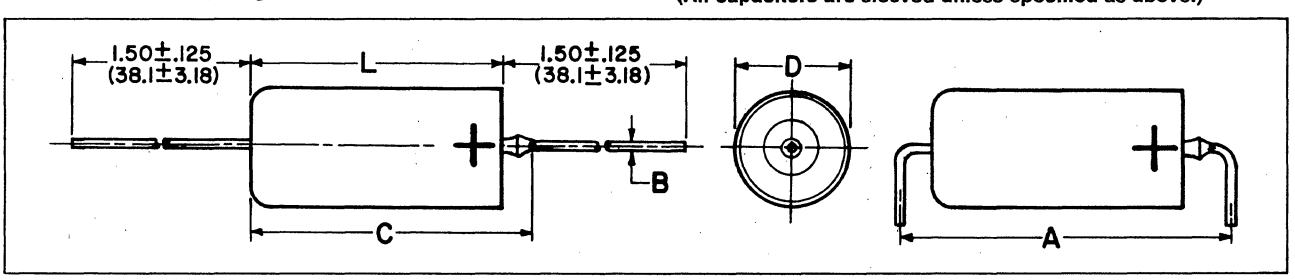
VOLTAGE
At 85°C

FAILURE RATE†
A — Not Applicable
L — Obsolete per MIL-C-39003
M — 1%/K hrs.
P — 0.1%/K hrs.
R — 0.01%/K hrs.
S — 0.001%/K hrs.
† L, M, P, R & S Failure Rates available for T212 capacitors only.

LEAD MATERIAL
S — Standard
Available on special order at additional cost: (Contact your sales representative.)
F — Bare Nickel
G — Gold Plated Nickel
I — Alloy 180 (Bare)

SPECIFICATION (when necessary)
C100 — Uninsulated Capacitors
C7000 — Reeling Per EIA Specification RS-296C
C7200 — Reeling Per EIA Specification RS-296D
Other — As Applicable
(All capacitors are sleeved unless specified as above.)

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS — INCHES & (MILLIMETERS)

Case Size	UNINSULATED D ±0.005 (0.13)	UNINSULATED L ±0.031 (0.79)	INSULATED D ±0.010 (0.25)	INSULATED L ±0.031 (0.79)	A Nominal	B ±0.001 (0.03)	C Maximum	Max. Wt. Grams
A	0.125 (3.18)	0.250 (6.35)	0.135 (3.43)	0.286 (7.26)	0.5 (12.7)	0.020 (0.51)	0.422 (10.72)	0.57
B	0.175 (4.45)	0.438 (11.13)	0.185 (4.70)	0.474 (12.04)	0.7 (17.78)	0.020 (0.51)	0.610 (15.49)	1.41
C	0.279 (7.09)	0.650 (16.51)	0.289 (7.34)	0.686 (17.42)	1.0 (25.4)	0.025 (0.64)	0.822 (20.88)	5.0
D	0.341 (8.66)	0.750 (19.05)	0.351 (8.92)	0.786 (19.96)	1.1 (27.94)	0.025 (0.64)	0.922 (23.42)	8.5

*** For Military Ordering Information, see page 3.**

For further details consult T110 Series Catalog F-1851

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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T110 SERIES
PRODUCT RANGE

Capacitance		Case	Rated Voltage (V)										Case
µF	Code	Size	6	10	15	20	35	50	60	75	100	125	Size
0.0047	472						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.0056	562						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.0068	682						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.0082	822						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.010	103						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.012	123						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.015	153						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.018	183						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.022	223						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.027	273						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.033	333						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	1-3	
0.039	393						0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	A
0.047	473					0.1-3	0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	
0.056	563					0.1-3	0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	
0.068	683					0.1-3	0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	
0.082	823					0.1-3	0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	
0.10	104					0.5-3	0.1-3	0.1-3	0.5-3	0.5-3	0.5-3	2-3	
0.12	124	A				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.15	154					0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.18	184					0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.22	224					0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.27	274					0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.33	334				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.39	394				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.47	474				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.56	564				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.68	684				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
0.82	824				0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	B
1.0	105			0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	0.5-3	2-3	
1.2	125			0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	0.5-3	2-3	
1.5	155			0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	1-4	1-3	2-3	
1.8	185			0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	0.5-4	1-4	1-3	2-3	
2.2	225		0.5-4	0.5-4	0.5-4	0.5-4	1-4	1-4	1-4	1.5-4	1.5-3	2-3	
2.7	275		0.5-4	0.5-4	0.5-4	0.5-4	1-4	1-4	1-4	1.5-4	1.5-3	6-3	
3.3	335		0.5-4	0.5-4	0.5-4	1-4	1-4	2-4	2-4	2-4	6-3	6-3	
3.9	395		0.5-4	0.5-4	0.5-4	1-4	1-4	2-4	2-4	2-4	6-3	6-3	C
4.7	475		0.5-4	0.5-4	1-4	1-4	1-4	3-4	3-4	6-4	6-3	6-3	
5.6	565		0.5-4	0.5-4	1-4	1-4	1-4	3-4	3-4	6-4	6-3	6-3	
6.8	685		0.5-6	1-6	1-6	1-6	2-4	3-4	4-4	10-4	6-3	6-3	
8.2	825		0.5-6	1-6	1-6	1-6	3-4	3-4	5-4	10-4	6-3	6-3	D
10.0	106		0.5-6	1-6	1-6	1-6	3-4	3-4	6-4	10-4	6-3	6-3	
12.0	126		0.5-6	1-6	1-6	1-6	3-4	3-4	6-4	10-4			
15.0	156		1-6	1-6	2-6	2-6	3-4	6-4	9-4	10-4			
18.0	186		1-6	1-6	2-6	3-6	6-4	6-4	10-4				
22.0	226		1-6	2-6	3-6	3-6	6-4	6-4	12-4				
27.0	276	B	1-6	2-6	3-6	3-6	6-4						
33.0	336		1-6	2-6	3-6	3-6							
39.0	396		1-6	2-6	3-6	3-6	6-4						
47.0	476		2-6	3-6	6-6	6-6	10-4						
56.0	566		2-6	3-6	6-6	6-6							
68.0	686		3-6	3-6	6-6	6-6							
82.0	826		3-6	3-6	6-6	6-6							
100.0	107	C	3-6	6-6	6-6	10-6							
120.0	127		6-6	6-6	6-6								
150.0	157		6-6	10-6	10-6								
180.0	187		6-6	10-6									
220.0	227		6-8	10-6									
270.0	277	D	6-8										
330.0	337		10-8										

Dissipation Factor (%)

DC Leakage (µA)

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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T210, T211, T220, T240 GR500 SERIES GRADED RELIABILITY

For the ultimate in high reliability and design in KEMET's GR500 Capacitors with failure rates as low as .001% per 1,000 hours. These Capacitors are manufactured to KEMET's Specification GR500 and meet or exceed all requirements of MIL-C-39003. Capacitance ranges are shown below in ordering information.

GR500 Capacitors offer a demonstrated failure rate calculated from the most sophisticated and accurate reliability measurement method in the capacitor industry. Each production lot of these capacitors is subjected to accelerated life testing on a 100% basis under low impedance circuit conditions. The subsequent accumulated data are applied to Weibull Analysis for establishing the demonstrated failure rate. These test results, including the Weibull plot and a summary of failure rate calculations, are supplied with each shipment of capacitors.

In addition, all KEMET GR500 Capaciotrs are temperature cycled 5 times from −65°C to +125°C and receive seal test, leakage current, capacitance, dissipation factor, X-Ray, and visual and mechanical inspection on a 100% basis.

For a copy of Graded Reliability Specification GR500 and additional information on these capacitors, contact your KEMET Sales Representative.

GR500 ORDERING INFORMATION

T 210 A 125 K 020 P S

TANTALUM

SERIES*
Solid electrolyte, graded high reliability, hermetically sealed.

CASE SIZE
A/B/C/D

CAPACITANCE PICOFARAD CODE
First two digits represent significant figures. Third digit specifies number of zeros to follow.

CAPACITANCE TOLERANCE
M — ±20%
K — ±10%
J — ±5%

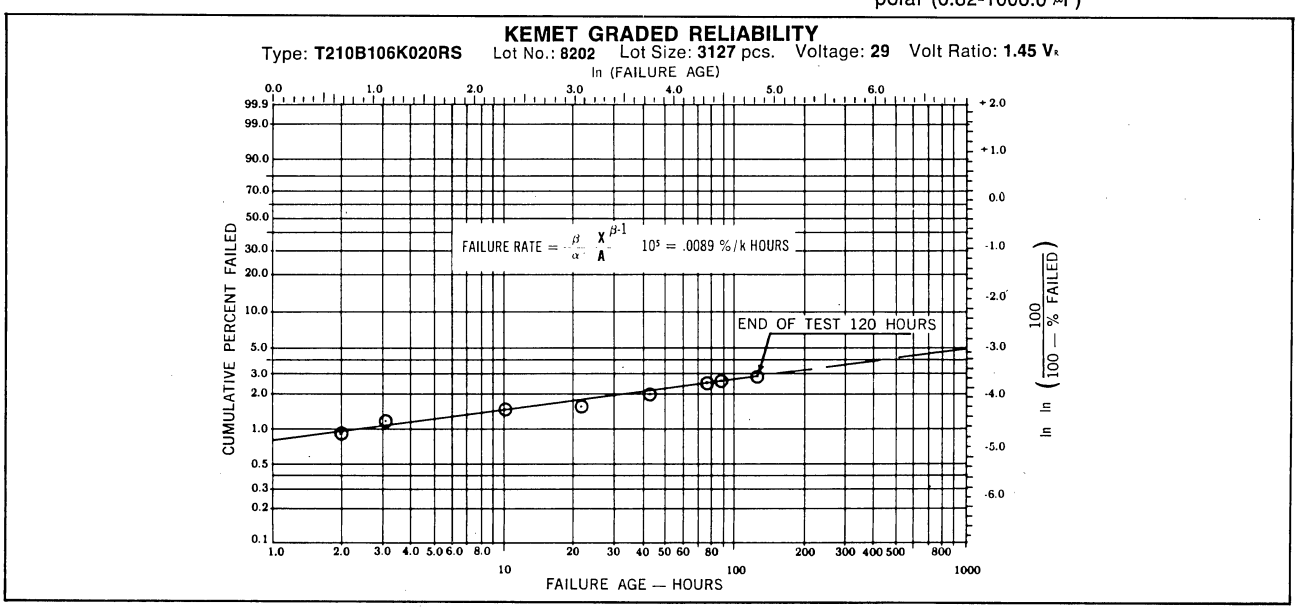
VOLTAGE
At 85°C

GRADED FAILURE RATE
% Per 1000 Hours
M — 1 R — 0.01
P — 0.1 S — 0.001

LEAD MATERIAL
S — Standard (Solder-coated nickel)
Available on special order at additional cost: (Contact your sales representative.)
F — Bare Nickel
G — Gold Plated Nickel

SERIES*
210 — GR500/J — Axial lead, polar (0.0047-330.0 μF)
211 — GR500/N — Axial lead, non-polar (0.0023-160.0 μF)
220 — GR500/Z — Axial lead, subminiature, polar (0.0047-27.0 μF)
240 — GR500/A — Axial lead, super capacitance, polar (0.82-1000.0 μF)

KEMET GRADED RELIABILITY



For further details consult GR500/J & N (F-2697) & GR500/A (F-2792) & GR500/Z (F-2837) Specification Catalogs.

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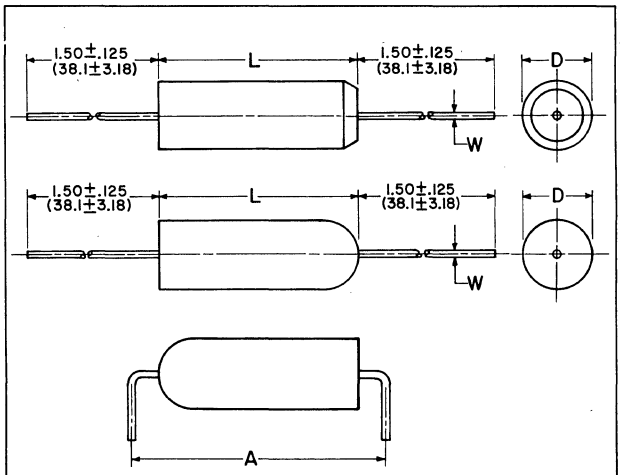
KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T310 SERIES
POLAR MOLDED

Plastic molded, self-insulating, using the same State-of-the-Art process techniques employed in the production of KEMET popular T110 capacitors. Designed for lead wire pre-forming and use in automatic insertion equipment. Exhibit low leakage current, good capacitance stability and low dissipation factor characteristics. C.V. range .10 to 330 μF, 6 to 50 VDC. Will operate continuously from −55°C to +85°C at full rated voltage and with ⅔ voltage to 125°C. Solderable and weldable, high purity solder coated lead wires. Ideal for application in commercial and industrial electronic equipment. For additional information refer to KEMET T310 Series Product Catalog.

CAPACITOR OUTLINE DRAWINGS



NOTE:
T310 SERIES CAPACITORS ARE SUPPLIED WITH BEVELED OR ROUNDED ENDS.

DIMENSIONS INCHES & (MILLIMETERS)

Case Size	D ±0.010 (0.25)	L ±0.010 (0.25)	Lead Wire Diameter - W ±0.001 (0.03)	For PC Board Layout - A
A	.138 (3.51)	.390 (9.91)	.025 (0.64)	0.6 (15.24)
B	.190 (4.83)	.562 (14.27)	.025 (0.64)	0.8 (20.32)
C	.300 (7.62)	.710 (18.03)	.025 (0.64)	1.0 (25.40)
D	.365 (9.27)	.875 (22.23)	.025 (0.64)	1.1 (27.94)

T310 ORDERING INFORMATION

T 310 A 104 M 050 A S

TANTALUM

SERIES
Molded Polar, Solid Tantalum

CASE SIZE
A/B/C/D

CAPACITANCE IN PICOFARADS
First two digits are significant figures.
Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M — ±20% K — ±10% J — ±5%

VOLTAGE RATING
At 85°C

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard

T310 SERIES PRODUCT RANGE

Capacitance μF	Code	Case Size	Rated Voltage (V) 6	10	15	20	35	50	Case Size
0.1	104	A				1-4	1-4	1-4	A
0.12	124					1-4	1-4	1-4	
0.15	154					1-4	1-4	1-4	
0.18	184					1-4	1-4	1-4	
0.22	224					1-4	1-4	1-4	
0.27	274					1-4	1-4	1-4	
0.33	334				1-4	1-4	1-4	1-4	
0.39	394				1-4	1-4	1-4	1-4	
0.47	474				1-4	1-4	1-4	1-4	
0.56	564				1-4	1-4	1-4	1-4	
0.68	684				1-4	1-4	1-4	1-4	
0.82	824				1-4	1-4	1-4	1-4	
1.0	105			1-4	1-4	1-4	1-4	1-4	
1.2	125			1-6	1-6	1-6	1-6	1-6	
1.5	155			1-6	1-6	1-6	1-6	1-6	
1.8	185			1-6	1-6	1-6	1-6	1-6	
2.2	225		1-6	1-6	1-6	1-6	1-6	1-6	B
2.7	275		1-6	1-6	1-6	1-6	1-6	1-6	
3.3	335		1-6	1-6	1-6	1-6	1-6	2-6	
3.9	395		1-6	1-6	1-6	1-6	1-6	5-6	
4.7	475		1-6	1-6	1-6	1-6	1-6	5-6	
5.6	565		1-6	1-6	1-6	1-6	1-6	5-6	
6.8	685		1-6	1-6	1-6	1-6	2-6	5-6	
8.2	825		1-6	1-6	1-6	1-6	5-6	5-6	
10.0	106		1-6	1-6	1-6	1-6	5-6	5-6	C
12.0	126		1-6	1-6	1-6	1-6	5-6	5-6	
15.0	156		1-6	1-6	2-6	2-6	5-6	10-6	
18.0	186		1-6	1-6	2-6	5-6	10-6	10-6	
22.0	226	B	1-6	2-6	3-6	5-6	10-6	10-6	D
27.0	276		1-6	2-6	5-6	5-6	10-6		
33.0	336		1-6	2-6	5-6	5-6	10-6		
39.0	396		1-6	5-6	5-6	10-6	10-6		
47.0	476		2-6	5-6	5-6	10-6	10-6		
56.0	566		5-6	5-6	10-6	10-6			
68.0	686	C	5-6	5-6	10-6	10-6			
82.0	826		5-6	5-6	10-6	10-6			
100.0	107		5-10	10-10	10-10	10-10			
120.0	127		5-10	10-10	10-10				
150.0	157		5-10	10-10	10-10				
180.0	187		10-10	10-10					
220.0	227		10-10	10-10					
270.0	277	D	10-10						
330.0	337		10-10						

Dissipation Factor (%)
DC Leakage (μA)

For further details consult T310 Series Catalog F-2622

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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T322 & T323 (CX01 & CX05) SERIES (MINIATURE) — EXTENDED RANGE — PRECISION MOLDED

Extended range molded solid tantalum capacitors designed specifically for high speed automatic insertion applications. These capacitors offer an extremely high capacitance to volume ratio while still maintaining excellent performance characteristics. Supplied in four axial-lead tubular case sizes, these capacitors are ideally suited for use in printed wiring boards and all applications requiring a high degree of packaging density. The low impedance at high frequencies offered by this capacitor is especially suitable for decoupling required by high speed computers. T322 Series dimensions and tight lead wire-to-body concentricity permit installation by same automatic insertion equipment used for diodes and resistors. Available in working voltages of 2 (68 μF maximum), 4, 6, 10, 15, 20, 25, 35, and 50 (4.7 μF maximum) volts. Operating temperature range −55°C to +85°C at full rated voltage and with ⅔ voltage to 125°C with no voltage derating required. For additional information refer to KEMET T322 Product Catalog Form Number F-2875. These capacitors are also available in certain values per MIL-C-49137/1 & 5.

T322 & T323 (CX01 & CX05) ORDERING INFORMATION

T 32X A 474 M 035 A S

TANTALUM

SERIES
Subminiature, Molded, Polar, Solid Tantalum. Insert appropriate number to replace letter "X" — 322 or 323 (CX01 & CX05).

CASE SIZE
A, B, C or D

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is number of zeros following.

CAPACITANCE TOLERANCE
M — 20% *
K — ±10% *
J — ±5%

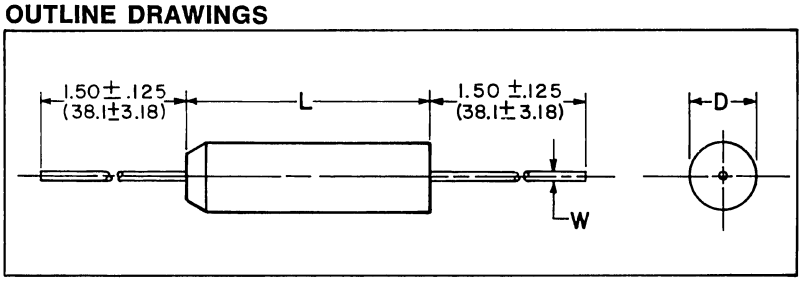
VOLTAGE RATING

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard

* M and K Tolerances available only for T323 Capacitors.

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS — INCHES & (MILLIMETERS)

Case Size	D (Max.)	L (Max.)	W
A	0.095 (2.41)	0.260 (6.6)	0.020 (0.51)
B	0.110 (2.79)	0.290 (7.37)	0.020 (0.51)
C	0.180 (4.57)	0.345 (8.76)	0.020 (0.51)
D	0.180 (4.57)	0.420 (10.67)	0.020 (0.51)

T322 SERIES PRODUCT RANGE

Capacitance μF	Capacitance Code	Case Size	Rated Voltage (V) 2	4	6	10	15	20	25	35	50	Case Size
0.1	104									0.5-3	0.5-3	
0.12	124									0.5-3	0.5-3	
0.15	154									0.5-3	0.5-3	A
0.18	184									0.5-3	0.5-3	
0.22	224									0.5-3	0.5-3	
0.27	274									0.5-3	0.5-3	
0.33	334									0.5-3	0.5-3	
0.39	394									0.5-3	0.5-3	
0.47	474								0.5-3	0.5-3	0.5-3	
0.56	564								0.5-3	0.5-3	0.5-3	B
0.68	684								0.5-3	0.5-3	0.5-3	
0.82	824	A							0.5-3	0.5-3	0.5-3	
1.0	105							0.5-4	0.5-3	0.5-3	0.5-3	
1.2	125							0.5-4	0.5-3	0.5-3	0.5-3	
1.5	155						0.5-4	0.5-4	0.5-3	0.6-3	0.8-4	C
1.8	185						0.5-4	0.5-4	0.5-3	0.6-3	0.8-4	
2.2	225					0.5-4	0.5-4	0.5-4	0.6-3	0.8-3	1.1-4	
2.7	275					0.5-4	0.5-4	0.5-4	0.6-3	0.8-3	1.1-4	
3.3	335				0.5-4	0.5-4	0.5-4	0.7-4	0.9-3	1.2-4	1.7-4	D
3.9	395				0.5-4	0.5-4	0.5-4	0.7-4	0.9-3	1.2-4	1.7-4	
4.7	475			0.5-8	0.5-4	0.5-4	0.7-4	1.0-4	1.2-4	1.5-4	2.4-4	
5.6	565			0.5-8	0.5-4	0.5-4	0.7-4	1.0-4	1.5-4	1.7-4		
6.8	685		0.5-10	0.5-8	0.5-6	0.7-6	1.0-6	1.4-6	1.5-4	2.4-4		
8.2	825		0.5-10	0.5-8	0.5-6	0.7-6	1.1-6	1.4-6	1.5-4	2.4-4		
10.0	106		0.5-10	0.5-8	0.6-6	1.0-6	1.5-6	2.0-6	1.5-4	3.5-4		
12.0	126		0.5-10	0.5-8	0.9-6	1.0-6	1.5-6	2.0-6	2.5-4			
15.0	156		0.5-10	0.6-8	0.9-6	1.5-6	1.5-6	3.0-6	3.8-4			
18.0	186	B	0.5-10	0.6-8	0.9-6	1.5-6	2.3-6	3.0-6				
22.0	226		0.5-10	0.9-8	1.4-6	1.5-6	3.0-6	4.4-6				
27.0	276		0.5-10	0.9-8	1.4-6	2.2-6	3.3-6					
33.0	336		0.7-10	1.4-8	1.5-6	3.0-6	5.0-6					
39.0	396		0.7-10	1.4-8	2.0-6	3.0-6						
47.0	476	C	1.0-10	1.9-8	2.8-6	3.0-6						
56.0	566		1.0-10	1.9-8	2.8-6	3.3-6						
68.0	686		1.4-10	2.8-8	4.1-6	4.7-6						
				D								

Dissipation Factor (%)
DC Leakage (μA)

For further details consult T322 Series Catalog F-2875

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T330 SERIES
PRECISION MOLDED — RADIAL LEAD

KEMET T330 Series, polar-type, radial lead rectangular Precision Molded Tantalum (PMT) capacitors are primarily designed for applications that demand full use of the premium space available in printed circuitry and high density packaging. Compact, space saving T330 Series capacitors provide superior packing factor and space utilization compared with tubular units of the same microcoulomb (CV) rating.

T330 Series capacitors employ a rectangular sintered, dry tantalum anode, transfer molded in precision dies with a high impact resistant plastic having excellent electrical, physical, and moisture resistant properties. The A Case is printed with polarity marking whereas B, C, and D Cases have the polarity symbol permanently molded on top of the plastic case. The radius on the two vertical edges at the positive end of B, C, and D Cases can also be used as a sensing dimension for automatic insertion processes. The location of the standoffs may serve a similar sensing function for the A Case. These standoffs, located in the base of all case sizes, provide vents for air circulation and also allow easy removal of flux residues from leadwire and circuit board solder joints.

T330 Series capacitors are highly reliable and exhibit performance characteristics typical of military test standards. They are available in capacitance values ranging from 0.1 to 220 microfarads in ±20, ±10, and ±5% tolerance levels, and in working voltages from 6 to 50 volts. At 85°C the capacitors will operate continuously at full rated voltage. They are rated to 125°C when operated at ⅔ of nameplate voltage. In addition, they feature exceptionally low DC leakage and Dissipation Factor characteristics. These capacitors meet or exceed the environmental requirements (except hermeticity tests) of MIL-C-39003.

They are ideal for by-pass, coupling, and timing applications in computers, military ordnance, industrial, entertainment, and consumer electronic equipment.

T330
ORDERING INFORMATION

T 330 A 104 M 035 A S

TANTALUM

SERIES
Radial Lead
Precision Molded Polar
Solid Tantalum

CASE SIZE
A/B/C/D

CAPACITANCE IN PICOFARADS
First two digits are significant figures.
Third digit is the number of zeros following.

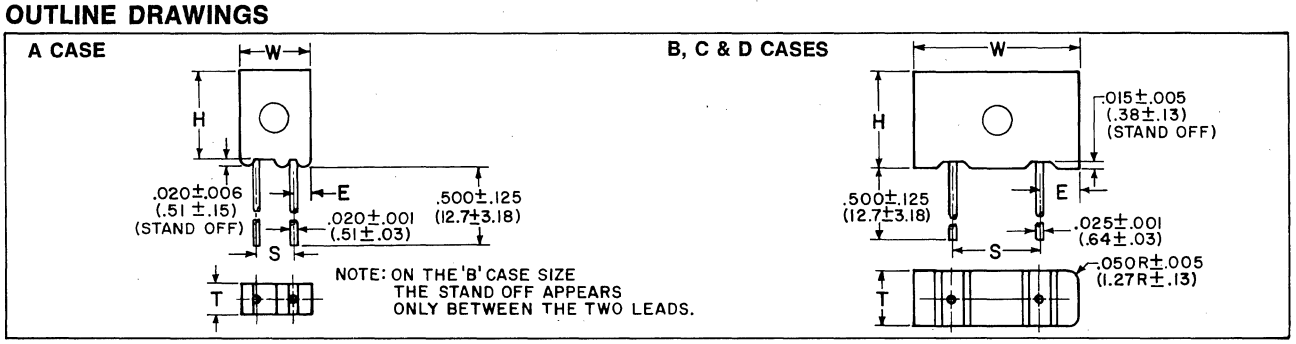
CAPACITANCE TOLERANCE
M — ±20% — Standard
K — ±10% — Available on request
J — ±5% — Available on request

VOLTAGE RATING

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard (Solder-Coated Nickel)

CAPACITOR
OUTLINE DRAWINGS



DIMENSIONS — INCHES & (MILLIMETERS)

Case Size	H Case Height	W Case Width	T Case Thickness	E Case To Wire	S Lead Spacing
A	0.345 ±0.008 (8.76 ±0.203)	0.230 ±0.005 (5.84 ±0.127)	0.105 ±0.005 (2.67 ±0.127)	0.050 ±0.010 (1.27 ±0.25)	0.125 ±0.005 (3.18 ±0.127)
B	0.225 ±0.015 (5.71 ±0.38)	0.285 ±0.015 (7.24 ±0.38)	0.170 ±0.015 (4.32 ±0.38)	0.042 ±0.010 (1.07 ±0.25)	0.200 ±0.005 (5.08 ±0.127)
C	0.325 ±0.015 (8.26 ±0.38)	0.325 ±0.015 (8.26 ±0.38)	0.170 ±0.015 (4.32 ±0.38)	0.062 ±0.010 (1.57 ±0.25)	0.200 ±0.005 (5.08 ±0.127)
D	0.375 ±0.015 (9.53 ±0.38)	0.600 ±0.015 (15.24 ±0.38)	0.195 ±0.015 (4.95 ±0.38)	0.200 ±0.010 (5.08 ±0.25)	0.200 ±0.005 (5.08 ±0.127)

For further details consult T330 Series Catalog F-1885

Union Carbide Corporation, Electronics Division
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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T330 SERIES PRODUCT RANGE

T330A

Capacitance µF	Code	Case Size	Rated Voltage (V) 6	10	15	20	25	35	50	Case Size
0.1	104							1-3	1-3	
0.12	124							1-3	1-3	
0.15	154							1-3	1-3	
0.18	184							1-3	1-3	
0.22	224							1-3	1-3	
0.27	274							1-3	1-3	
0.33	334							1-3	1-3	
0.39	394							1-3	1-3	
0.47	474							1-3	1-3	
0.56	564							1-3	1-3	
0.68	684							1-3	1-3	
0.82	824							1-3	1-4	
1.0	105							1-3	1-4	A
1.2	125							1-4	1-4	
1.5	155							1-4	1-4	
1.8	185	A						1-4		
2.2	225							1-4		
2.7	275							1-4		
3.3	335						1-4			
3.9	395						1-4			
4.7	475						1-4			
5.6	565					1-6				
6.8	685					1-6				
8.2	825				1-6					
10.0	106			1-6						
12.0	126			1-6						
15.0	156			1-6						
18.0	186		1-6							
22.0	225		1-6							

Dissipation Factor (%)

DC Leakage (µA)

T330B, C & D

Capacitance µF	Code	Case Size	Rated Voltage (V) 6	10	15	25	35	50	Case Size
0.1	104						1-6	1-6	
0.12	124						1-6	1-6	
0.15	154						1-6	1-6	
0.18	184						1-6	1-6	
0.22	224						1-6	1-6	
0.27	274						1-6	1-6	
0.33	334						1-6	1-6	B
0.39	394						1-6	1-6	
0.47	474						1-6	1-6	
0.56	564						1-6	1-6	
0.68	684						1-6	1-6	
0.82	824						1-6	1-6	
1.0	105						1-6	1-6	
1.2	125						1-6	1-6	
1.5	155						1-6	1-6	
1.8	185						1-6	1-6	
2.2	225						1-6	1-6	
2.7	275					1-6	1-6	1-6	
3.3	335					1-6	1-6	2-6	
3.9	375				1-6	1-6	1-6	5-6	C
4.7	475				1-6	1-6	1-6	5-6	
5.6	565			1-6	1-6	1-6	1-6	5-6	
6.8	685			1-6	1-6	1-6	2-6	5-6	
8.2	825			1-6	1-6	1-6	5-6	5-6	
10.0	106		1-6	1-6	1-6	1-6	5-6	5-6	D
12.0	126		1-6	1-6	1-6	1-6	5-6	5-6	
15.0	156	B	1-6	1-6	2-6	2-6	5-6	10-6	
18.0	186		1-6	1-6	5-6	5-6	10-6	10-6	
22.0	226		1-6	2-6	5-6	5-6	10-6		
27.0	276		1-6	2-6	5-6	5-6	10-6		
33.0	336		1-6	2-6	5-6	5-6	10-6		
39.0	396		1-6	5-6	10-6	10-6			
47.0	476	C	2-6	5-6	10-6	10-6			
56.0	566		5-6	5-6	10-6				
68.0	686		5-6	5-6	10-6				
82.0	826		5-6	5-6	10-6				
100.0	107		5-6	10-6					
120.0	127	D	5-6	10-6					
150.0	157		5-6	10-6					
180.0	187		10-6						
220.0	227		10-6						

T340 SERIES
PRECISION MOLDED — RADIAL LEAD

The compact space saving T340 Series is transfer molded in precision dies with a high impact resistant plastic having excellent electrical, physical, and moisture resistant properties.

Marking is provided on the top of the case to allow visual inspection for proper polarity and placement after insertion. In addition, positive polarity identification is achieved by an easily recognized molded radius on the positive end of the case. This physical polarity identification is readily observed after capacitor placement as a further aid to the top marking in prevention of possible reverse insertion.

Standoffs, located in the base of all case sizes, provide vents for air circulation and also allow easy removal of flux residues from leadwire and circuit board solder joints. With very low impedance and ESR values, the T340 Series features exceptionally low DC leakage and DF characteristics.

T340 Series capacitors are highly reliable and exhibit performance characteristics typical of military test standards.

T340
ORDERING INFORMATION

T 340 A 105 M 035 A S

TANTALUM

SERIES
Radial Lead,
Precision Molded Polar,
Solid Tantalum

CASE SIZE
A/B/C/D/E/F

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M — ±20% — Standard
K — ±10% — Available on request
J — ±5% — Available on request

VOLTAGE RATING

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard (solder-coated copperweld)

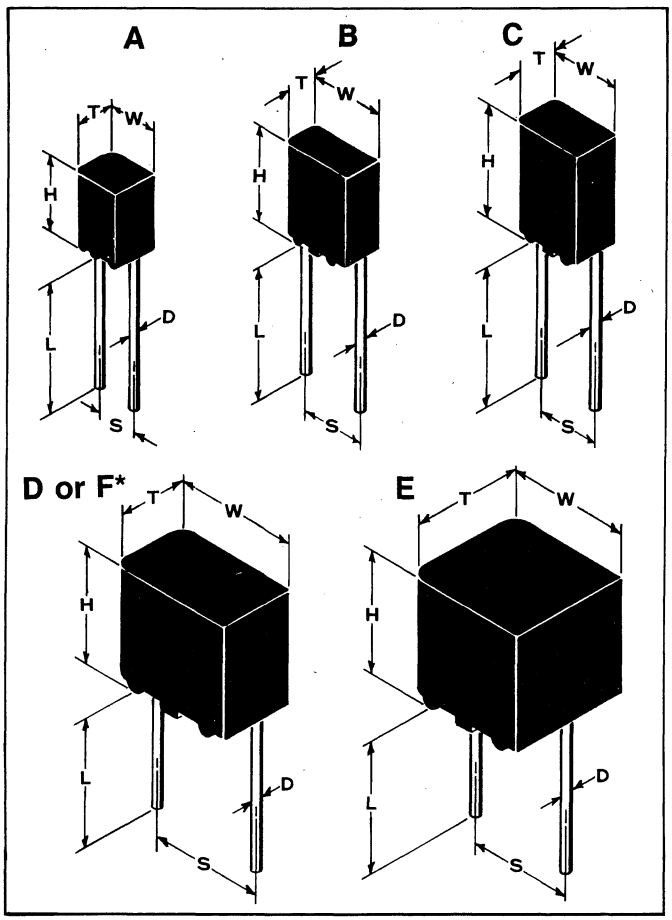
Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T340 SERIES

CAPACITOR OUTLINE DRAWINGS



* 'F' case size is same as 'D', but with .200" (5.0mm) lead spacing. Specify 'T340F' when ordering for this spacing.

T340 SERIES PRODUCT RANGE

Capacitance µF	Code	Case Size	Rated Voltage (V) 6	10	15	25	35	50	Case Size
0.1	104						1.0-6	1.0-6	
0.12	124						1.0-6	1.0-6	
0.15	154						1.0-6	1.0-6	A
0.18	184						1.0-6	1.0-6	
0.22	224						1.0-6	1.0-6	
0.27	274						1.0-6	1.0-6	
0.33	334						1.0-6	1.0-6	
0.39	394						1.0-6	1.0-6	
0.47	474						1.0-6	1.0-6	
0.56	564	A					1.0-6	1.0-6	
0.68	684						1.0-6	1.0-6	
0.82	824						1.0-6	1.0-6	B
1.0	105						1.0-6	1.0-6	
1.2	125						1.0-6	1.0-6	
1.5	155					1.0-6	1.0-6	1.1-6	
1.8	185						1.0-6	1.1-6	
2.2	225						1.0-6	1.5-6	
2.7	275					1.0-6	1.0-6	1.5-6	
3.3	335				1.0-6	1.0-6	1.0-6	2.5-6	
3.9	395				1.0-6	1.0-6	1.0-6	3.0-6	C
4.7	475			1.0-6	1.0-6	2.0-6	2.5-6	3.5-6	
5.6	565			1.0-6	1.0-6	2.0-6	2.5-6	4.0-6	
6.8	685		1.0-6	1.0-6	1.0-6	3.0-6	3.0-6	5.0-6	
8.2	825		1.0-6	1.0-6	1.0-6	3.0-6	4.0-6	6.0-6	
10.0	106		1.0-6	1.0-6	3.0-6	3.5-6	4.0-6	7.0-6	D/F
12.0	126	B	1.0-6	1.0-6	3.0-6	3.5-6	5.0-6	8.0-6	
15.0	156		1.0-6	3.0-6	3.5-6	4.0-6	5.0-6	9.0-6	
18.0	186		1.0-6	3.0-6	4.0-6	5.0-6	8.0-6	10-6	
22.0	226		2.5-6	3.0-6	4.0-6	5.5-6	8.0-6	10-6	
27.0	276		2.5-6	3.0-6	5.0-6	7.0-6	10-6		
33.0	336		2.5-6	5.0-6	5.0-6	8.0-6	10-6		
39.0	396	C	2.5-6	5.0-6	5.0-6	10-6			
47.0	476		3.0-6	5.0-6	5.0-6	10-6	10-6		
56.0	566		5.0-6	5.0-6	5.0-6				E
68.0	686		5.0-6	5.0-6	5.0-6	10-6			
82.0	826		5.0-6	5.0-6	5.0-6				
100.0	107		5.0-6	10-6	10-6				
120.0	127		5.0-6	10-6	10-6				
150.0	157	D/F	8.0-6	10-6	10-6				
180.0	187		10-6						
220.0	227		10-6	10-6	10-6				
330.0	337	E	10-8						

Dissipation Factor (%)

DC Leakage (µA)

DIMENSIONS INCHES & MILLIMETERS

Case Size	Maximum Case Height* H inches	mm	Maximum Case Width W inches	mm	Maximum Case Thickness T inches	mm	Lead Spacing S inches ±0.020	mm ±0.5	Lead Length L inches ±0.078	mm ±2.0	Lead Diameter D inches ±0.001	mm ±0.3
A	0.287	7.3	0.185	4.7	0.165	4.2	0.100	2.5	0.600	15.0	0.020	0.50
B	0.327	8.3	0.283	7.2	0.157	4.0	0.200	5.0	0.600	15.0	0.020	0.50
C	0.413	10.5	0.287	7.3	0.169	4.3	0.200	5.0	0.600	15.0	0.020	0.50
D	0.413	10.5	0.484	12.3	0.287	7.3	0.400	10.0	0.600	15.0	0.025	0.65
E	0.413	10.5	0.484	12.3	0.484	12.3	0.400	10.0	0.600	15.0	0.025	0.65
F	0.413	10.5	0.484	12.3	0.287	7.3	0.200	5.0	0.600	15.0	0.025	0.65

* Includes Standoff Height of 0.015 ±.005" (0.38 ±0.13mm) for All Case Sizes.

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T350, T351, T352, T353, T354 & T355 SERIES

FEATURES AND APPLICATIONS

The new KEMET 'UltraDip' Capacitors offers the designer of quality instruments and entertainment systems the widely recognized advantages inherent in solid tantalum capacitors at competitive prices.

The T350, T351, T352, T353, T354 and T355 Series are miniature dipped solid tantalum capacitors which provide the designer with the advantage of compactness plus low leakage and low DF performance characteristics for filtering, bypassing, coupling, blocking and RC timing circuits. This series features a capacitance range from 0.1 to 680 microfarads at voltages from 3 to 50 VDC. 'UltraDip' capacitors utilize the same sophisticated materials and processes which have advanced Union Carbide to the leadership position in solid tantalum capacitors.

The plastic case provides a tough barrier coating and maintains precision of lead wire spacing within ±0.015 inch. The new gold color epoxy utilized permits Laser marking with outstanding permanency and legibility. These Laser marked gold color epoxy products meet all visual requirements of MIL-I-46058. All case sizes are printed with capacitance, voltage, polarity and vendor identification.

Solid tantalum devices exhibit no degradation failure mode during shelf storage and show a constantly decreasing failure rate (i.e., absence of wearout mechanism) during life tests.

The 'UltraDip' Series provides self-insulating cases which are resistant to shock and vibration. These capacitors exhibit low DCL, ESR and Impedance and have excellent temperature stability.

T350, T351, T352, T353, T354 & T355 SERIES ORDERING INFORMATION

T 35X A 105 M 035 A S

TANTALUM

SERIES
Insert appropriate number to replace letter "X" — 350, 351, 352, 353, 354 or 355.

CASE SIZE
A, B, C, D, E, F, & G

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

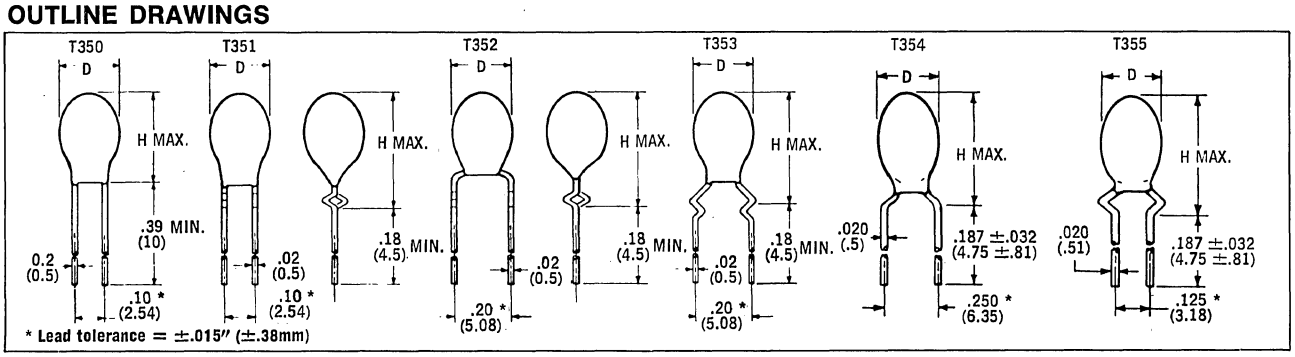
CAPACITANCE TOLERANCE
M — ±20%
K — ±10%

VOLTAGE RATING
For 6.4 Volts Use 006

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS — INCHES (MILLIMETERS)

Case Size	All D Diameter	T350 H* Length	T351 H* Length	T352 H* Length	T353 H* Length	T354 H* Length	T355 H* Length
A	.175 (4.5)	.280 (7.1)	.380 (9.6)	.400 (10.2)	.400 (10.2)	.340 (8.6)	.340 (8.6)
B	.175 (4.5)	.300 (7.6)	.390 (9.9)	.410 (10.4)	.410 (10.4)	.350 (8.9)	.350 (8.9)
C	.196 (5.0)	.330 (8.4)	.420 (10.7)	.440 (11.2)	.440 (11.2)	.380 (9.6)	.380 (9.6)
D	.196 (5.0)	.340 (8.6)	.430 (10.9)	.450 (11.4)	.450 (11.4)	.390 (9.9)	.390 (9.9)
E	.216 (5.5)	.350 (8.9)	.440 (11.2)	.460 (11.7)	.460 (11.7)	.400 (10.2)	.400 (10.2)
F	.236 (6.0)	.390 (9.9)	.480 (12.2)	.500 (12.7)	.500 (12.7)	.440 (11.2)	.440 (11.2)
G	.250 (6.3)	.400 (10.2)	.490 (12.4)	.510 (13.0)	.510 (13.0)	.450 (11.4)	.450 (11.4)
H	.300 (7.6)	.400 (10.2)	.500 (12.7)	.520 (13.2)	.520 (13.2)	.470 (11.9)	.470 (11.9)
J	.330 (8.4)	.500 (12.7)	use T353	use T353	.580 (14.7)	.550 (14.0)	use T354
K	.350 (8.9)	.530 (13.5)			.630 (16.0)	.610 (15.5)	
L	.350 (8.9)	.630 (16.0)			.730 (18.5)	.710 (18.1)	
M	.400 (10.2)	.670 (17.0)			.760 (19.3)	.740 (18.8)	

* Note: All "H" Dimensions are from Capacitor seating plane to top of Capacitor.

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T350, T351, T352, T353, T354 & T355 PRODUCT RANGE

Capacitance		RATED VOLTAGE (V)							
μF	Code	3	6.3	10	16	20	25	35	50
0.10	104							A0.5-3	A0.5-3
0.12	124							A0.5-3	A0.5-3
0.15	154							A0.5-3	A0.5-3
0.18	184							A0.5-3	A0.5-3
0.22	224							A0.5-3	A0.5-3
0.27	274							A0.5-3	A0.5-3
0.33	334							A0.5-3	A0.5-3
0.39	394							A0.5-3	B0.5-3
0.47	474							A0.5-3	B0.5-3
0.56	564							A0.5-3	B0.5-3
0.68	684							A0.5-3	B0.5-3
0.82	824							A0.5-3	B0.5-3
1.0	105					A0.5-3	A0.5-3	A0.5-3	B0.5-3
1.2	125					A0.5-5	A0.5-5	B0.5-5	D0.5-5
1.5	155				A0.5-5	A0.5-5	A0.5-5	B0.5-5	E0.6-5
1.8	185				A0.5-5	A0.5-5	A0.5-5	C0.5-5	E0.7-5
2.2	225			A0.5-5	A0.5-5	A0.5-5	B0.5-5	C0.6-5	E0.9-5
2.7	275			A0.5-5	A0.5-5	B0.5-5	B0.5-5	D0.7-5	F1.0-5
3.3	335		A0.5-5	A0.5-5	A0.5-5	B0.5-5	B0.7-5	D0.9-5	F1.3-5
3.9	395		A0.5-5	A0.5-5	B0.5-5	C0.6-5	C0.7-5	E1.0-5	G1.5-5
4.7	475	A0.5-5	A0.5-5	A0.5-5	B0.6-5	C0.8-5	C0.9-5	E1.3-5	G1.9-5
5.6	565	A0.5-5	A0.5-5	B0.5-5	C0.7-5	D0.9-5	E1.1-5	F1.5-5	H2.2-5
6.8	685	A0.5-5	A0.5-5	B0.5-5	C0.8-5	D1.1-5	E1.4-5	F1.9-5	J2.7-5
8.2	825	A0.5-6	B0.5-6	C0.6-6	E1.0-6	E1.3-6	E1.6-6	G2.3-6	J3.2-6
10.0	106	A0.5-6	B0.5-6	C0.8-6	E1.2-6	E1.6-6	E2.0-6	G2.8-6	K4.0-6
12.0	126	B0.5-6	C0.6-6	E0.9-6	E1.4-6	F1.9-6	G2.4-6	J3.3-6	K4.8-6
15.0	156	B0.5-6	C0.7-6	E1.2-6	E1.8-6	F2.4-6	G3.0-6	J4.2-6	L6.0-6
18.0	186	C0.5-6	D0.9-6	E1.4-6	F2.2-6	G2.8-6	H3.6-6	K5.0-6	L7.2-6
22.0	226	C0.5-6	D1.1-6	E1.8-6	F2.6-6	G3.5-6	H4.4-6	K6.2-6	M8.8-6
27.0	276	D0.6-6	E1.3-6	F2.1-6	H3.2-6	J4.3-6	J5.4-6	L7.5-6	
33.0	336	D0.8-6	E1.6-6	F2.6-6	H4.0-6	J5.3-6	J6.6-6	L9.2-6	
39.0	396	E0.9-6	F1.9-6	G3.1-6	J4.8-6	K6.2-6	K7.8-6	M10-6	
47.0	476	E1.1-6	F2.3-6	H3.8-6	J5.6-6	K7.5-6	K9.4-6	M10-6	
56.0	566	F1.3-6	G2.7-6	H4.4-6	K6.8-6	L8.9-6	L10-6		
68.0	686	F1.6-6	G3.3-6	H5.4-6	K8.2-6	L10-6	L10-6		
82.0	826	G1.9-8	H3.9-8	J6.5-8	L9.8-8	M10-8			
100.0	107	G2.4-8	H4.8-8	J8.0-8	L10-8	M10-8			
120.0	127	H2.8-8	J5.8-8	K9.6-8	M10-8				
150.0	157	H3.6-8	J7.2-8	K10-8	M10-8				
180.0	187	J4.3-8	K8.6-8	L10-8					
220.0	227	J5.3-8	K10-8	L10-8					
270.0	277	K6.4-8	L10-8						
330.0	337	K7.9-9	L10-8						
390.0	397	L9.3-9							
470.0	477	L10-9							
560.0	567	M10-9							
680.0	687	M10-9							

Case Size

Dissipation Factor (%)

DC Leakage (μA)

T361, T362, T363 (CX02), T368 & T369 (CX12) SERIES

DIPPED — ECONOMICAL/ .1-330 μF 6-50 VDC/ LOW DC LEAKAGE

KEMET dipped solid tantalum capacitors offer the designer of quality instruments and entertainment systems the widely-recognized advantages inherent in solid tantalum capacitors at prices competitive to conventional electrolytic capacitors. Their concept is the result of the application of KEMET's superior know-how in the production of Military and High Reliability tantalum capacitors coupled with the unique automated assembly methods developed for computer-part production. These capacitors are dipped in a new gold color resin with easy-to-read laser markings.

These capacitors are also available in certain values per MIL-C-49137/2: T363 (CX02) and T369 (CX12). T369 capacitors are available in A & B cases only.

T361, T362, T363 (CX02), T368 & T369 (CX12) ORDERING INFORMATION

T 36X B 155 M 050 A S

TANTALUM

SERIES
Insert appropriate number to replace letter "X"
361, 362, 363 (CX02), 368 or 369 (CX12)

CASE SIZE
A, B, C or D. T361 & T369 capacitors available only in A & B cases.

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M — ±20% *
K — ±10% *
J — ±5%

VOLTAGE RATING

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard

* T363 & T369 capacitors available only at M & K tolerances.

Union Carbide Corporation, Electronics Division
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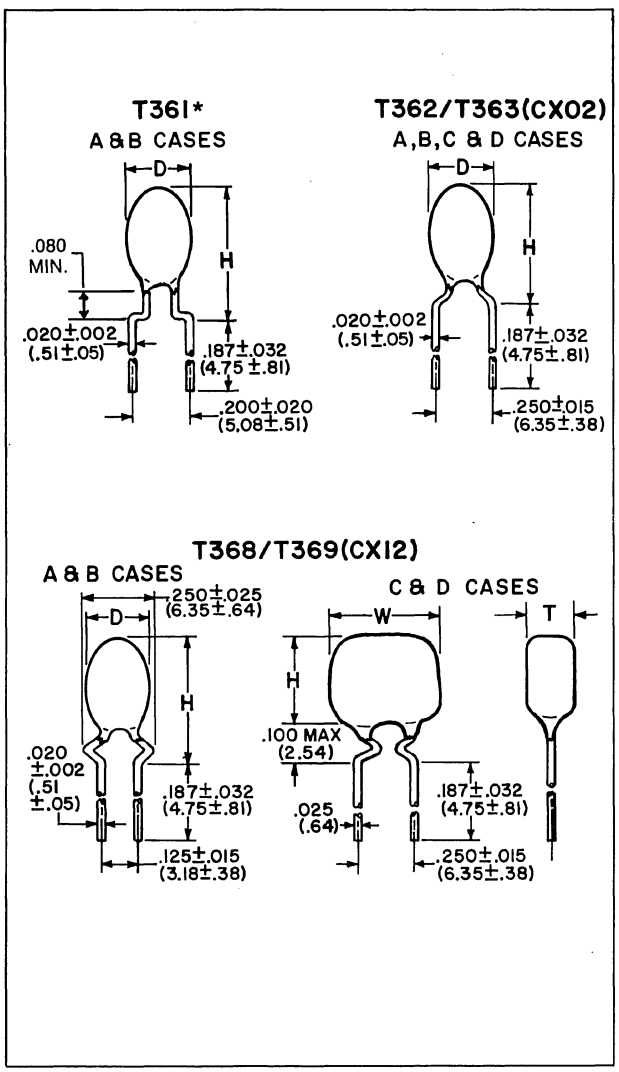
KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

CAPACITOR OUTLINE DRAWINGS



T361, T362, T363, T368 & T369 SERIES PRODUCT RANGE

Capacitance µF	Code	Case Size	Rated Voltage (V) 6	10	15	20	25	35	50	Case Size
0.1	104							1-4	1-4	
0.12	124							1-4	1-4	
0.15	154							1-4	1-4	
0.18	184							1-4	1-4	
0.22	224							1-4	1-4	
0.27	274							1-4	1-4	
0.33	334							1-4	1-4	
0.39	394							1-4	1-4	
0.47	474	A						1-4	1-4	A
0.56	564							1-4	1-4	
0.68	684							1-4	1-4	
0.82	824						1-4	1-4	1-4	
1.0	105					1-4	1-6	1-4	1-4	
1.2	125					1-6	1-6	1-6	1-6	
1.5	155				1-6	1-6	1-6	1-6	1-6	
1.8	185				1-6	1-6	1-6	1-6	1-6	
2.2	225			1-6	1-6	1-6	1-6	1-6	1-6	B
2.7	275			1-6	1-6	1-6	1-6	1-6	2-6	
3.3	335		1-6	1-6	1-6	1-6	1-6	2-6	2-6	
3.9	395		1-6	1-6	1-6	1-6	1-6	2-6	2-6	
4.7	475		1-6	1-6	1-6	2-6	2-6	2-6	2-6	
5.6	565		1-6	1-6	1-6	2-6	2-6	2-6	3-6	
6.8	685		1-6	1-6	1-6	2-6	2-6	2-6	3-6	
8.2	825		1-8	1-8	1-8	2-8	2-8	3-8	4-8	C
10.0	106		1-8	1-8	2-8	3-8	2-8	5-8	5-8	
12.0	126		1-8	1-8	2-8	3-8	4-8	5-8	6-8	
15.0	156		1-8	2-8	3-8	3-8	5-8	5-8	6-8	
18.0	186	B	1-8	2-8	3-8	4-8	5-8	5-8	6-8	D
22.0	226		2-8	3-8	3-8	5-8	9-8	8-8	10-8	
27.0	276		2-8	3-8	5-8	5-8	9-8	10-8		
33.0	336		3-8	3-8	5-8	10-8	9-8	10-8		
39.0	396		3-8	5-6	5-8	10-8	10-8	10-8		
47.0	476		3-8	5-8	10-8	10-8	15-8	10-8		
56.0	566		4-8	5-8	10-8	15-8	15-8			
68.0	686		4-8	10-8	10-8	15-8	15-8			
82.0	826		5-10	10-10	15-10	15-10				
100.0	107		10-10	10-10	20-10	20-10				
120.0	127	C	10-10	15-10	20-10					
150.0	157		10-10	20-10	20-10					
180.0	187		15-10	20-10						
220.0	227	D	20-10	20-10						
270.0	277		20-10							
330.0	337		20-10							

└ Dissipation Factor (%)
└ DC Leakage (µA)

DIMENSIONS INCHES & (MILLIMETERS)

Case Size	T361 D Diameter	T361 H Height	T362/T363 D Diameter	T362/T363 H Height	T368/T369 D Diameter	T368/T369 T Thickness	T368/T369 W Width	T368/T369 H Height
A	0.175 (4.45)	0.434 (11.02)	0.175 (4.45)	0.350 (8.89)	0.175 (4.45)	—	—	0.350 (8.89)
B	0.250 (6.35)	0.552 (14.02)	0.250 (6.35)	0.500 (12.70)	0.250 (6.35)	—	—	0.500 (12.70)
C	—	—	0.350 (8.89)	0.650 (16.51)	—	0.250 (6.35)	0.450 (11.43)	0.440 (11.18)
D	—	—	0.400 (10.16)	0.750 (19.05)	—	0.275 (6.99)	0.600 (15.24)	0.660 (16.76)

* T361 style is electrically identical to T362 style, except for lead spacing and lead diameter (available in A & B cases only).

For further details consult T361, T362, T363, T368 & T369 Catalog F-2638

Union Carbide Corporation, Electronics Division
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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

MICRON SERIES

The KEMET Micron Series is a complete line of microminiature solid tantalum capacitors designed to provide maximum electrical performance and capacitance-to-volume ratio for microminiaturized, high density, and integrated circuits. The capacitors consist of ultra-small anode assemblies encapsulated in epoxy. The CV range is 0.0022-220 μF, 2-50 volts. Capacitance values are identified by color codes. For additional information, including non-polar styles, refer to KEMET Micron Series Product Catalog (Form F-2710).

CAPACITANCE COLOR CODING
T370, T371, T372, T373, T374, T376, T380, T382, T384, T386

Color	Code for Capacitance in Picofarads	
	1st & 2nd Dot	3rd Dot Decimal Multiplier
Black*	0	1
Brown	1	10
Red	2	100
Orange	3	1,000
Yellow	4	10,000
Green	5	100,000
Blue	6	1,000,000
Violet	7	10,000,000
Grey	8	—
White	9	—

* Black Dot is not marked on black case.

MICRON ORDERING INFORMATION

T 3XX B 472 M 035 A S

TANTALUM

SERIES*

CASE SIZE

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M — ±20% J — ±5%
K — ±10% L — +40%, −20%

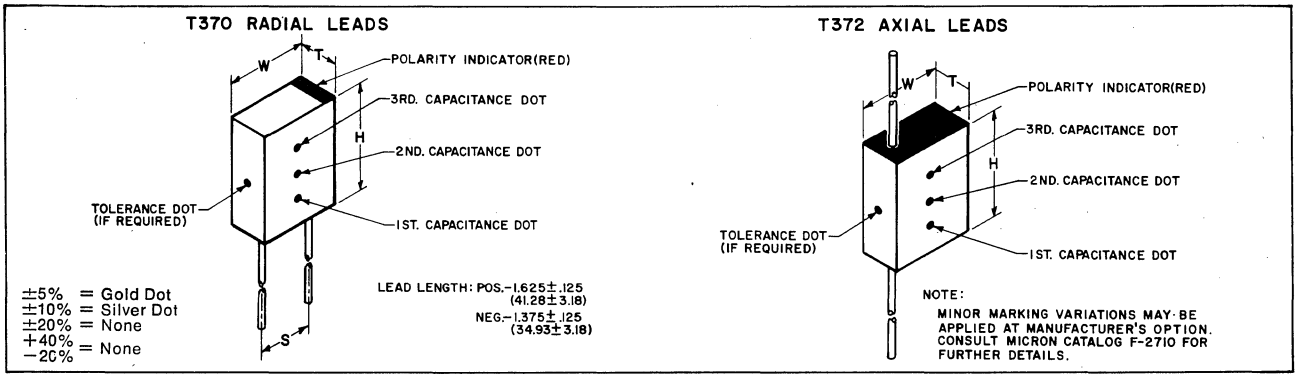
VOLTAGE RATING

FAILURE RATE LEVEL
A — Not Applicable

LEAD MATERIAL
S — Standard (solder-coated nickel)
G — Gold-plated nickel (optional for T380 & T382 Series. Consult your sales representative.)

*** Insert appropriate numbers to replace XX's for Series desired. T370, T371, T372, T373, T374, T376, T380, T382, T384 or T386.**

CAPACITOR OUTLINE DRAWINGS
T370 & T372



DIMENSIONS
INCHES & (MILLIMETERS)

Case Size	H Maximum	W Maximum	T Maximum	S LEAD SPACING	Lead Diameter ±0.001 (0.03)
A	0.125 (3.18)	0.070 (1.78)	0.040 (1.02)	0.050 ±0.015 (1.27 ±0.38)	0.010 (0.25)
B	0.165 (4.19)	0.120 (3.05)	0.070 (1.78)	0.100 ±0.020 (2.54 ±0.51)	0.010 (0.25)
C	0.225 (5.72)	0.185 (4.70)	0.075 (1.91)	0.150 ±0.020 (3.81 ±0.51)	0.010 (0.25)
D	0.290 (7.37)	0.220 (5.59)	0.110 (2.79)	0.180 ±0.025 (4.57 ±0.64)	0.016 (0.41)
E	0.310 (7.87)	0.230 (5.84)	0.130 (3.30)	0.200 ±0.025 (5.08 ±0.64)	0.016 (0.41)
F	0.475 (12.07)	0.375 (9.53)	0.150 (3.81)	0.300 ±0.025 (7.62 ±0.64)	0.016 (0.41)

For further details consult T370 (Micron) Catalog F-2710

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

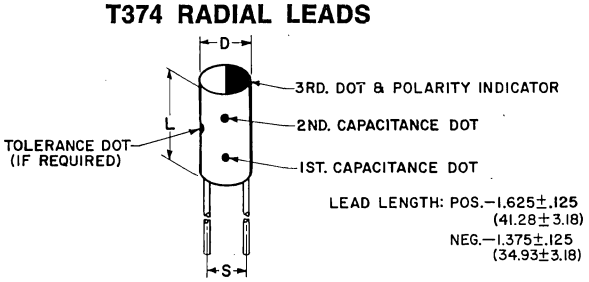
UNION CARBIDE

MICRON SERIES
T370 & T372
PRODUCT RANGE

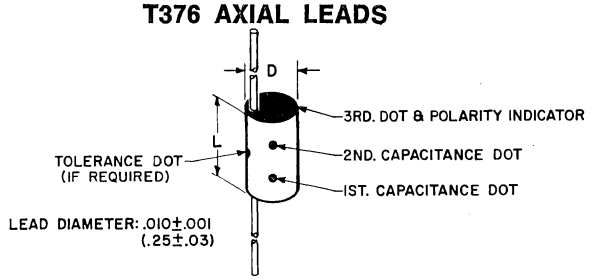
Capacitance µF	Code	Case Size	Rated Voltage (V) 2	3	4	6	10	15	20	25	35	Case Size
0.0022	222								0.5-10			A
0.0033	332								0.5-10			
0.0047	472								0.5-10		1.0-8	
0.0068	682								0.5-10		1.0-8	
0.010	103								0.5-10		1.0-8	
0.015	153								0.5-10		1.0-8	
0.022	223								0.5-10		1.0-8	
0.033	333								0.5-10		1.0-8	B
0.047	473								0.5-10		1.0-8	
0.068	683	A							0.5-10		1.0-8	
0.1	104								0.5-10		1.0-8	
0.15	154								0.5-10		1.0-8	
0.22	224								0.5-10		1.0-8	
0.33	334							0.5-10			1.0-8	
0.47	474						0.5-10				1.0-8	
0.68	684					0.5-10				1.0-6	1.0-8	
1.0	105				0.5-10				1.0-6		1.0-8	C
1.5	155			0.5-10				1.0-6			1.0-8	
2.2	225		0.5-15				1.0-6			1.0-6	2.0-8	
3.3	335					1.0-6			1.0-6		2.0-8	D
4.7	475				1.0-10				1.0-6		2.0-8	
6.8	685			1.0-10			1.0-6			2.0-6	3.0-8	
10.0	106	B	1.0-15			1.0-6			2.0-6	3.0-6	9.0-8	E
15.0	156				1.0-10			2.0-6	3.0-6		9.0-8	F
22.0	226	C		1.0-15			2.0-6	3.0-6			9.0-8	
33.0	336					2.0-10	3.0-6			9.0-8		
47.0	476	D			2.0-10	3.0-10			9.0-8			
68.0	686				3.0-10			9.0-8				
100.0	107	E					9.0-8		DC Leakage (µA)			
150.0	157					9.0-10						
220.0	227	F		9.0-15					Dissipation Factor (%)			

T374 & T376
CAPACITOR OUTLINE DRAWINGS

T374 RADIAL LEADS



T376 AXIAL LEADS



DIMENSIONS
INCHES & (MILLIMETERS)

Case Size	L Maximum	D Maximum	S Lead Spacing	Lead Diameter ±0.001 (0.03)
A	0.125 (3.18)	0.070 (1.78)	0.050 ±0.015 (1.27 ±0.38)	0.010 (0.25)
B	0.160 (4.06)	0.070 (1.78)	0.050 ±0.015 (1.27 ±0.38)	0.010 (0.25)
C	0.200 (5.08)	0.080 (2.03)	0.050 ±0.015 (1.27 ±0.38)	0.010 (0.25)
D	0.225 (5.72)	0.100 (2.54)	0.070 ±0.020 (1.78 ±0.51)	0.010 (0.25)
E	0.250 (6.35)	0.150 (3.81)	0.120 ±0.025 (3.05 ±0.64)	0.016 (0.41)

For further details consult T370 (Micron) Catalog F-2710

Union Carbide Corporation, Electronics Division
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KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

MICRON SERIES
T374 & T376
PRODUCT RANGE

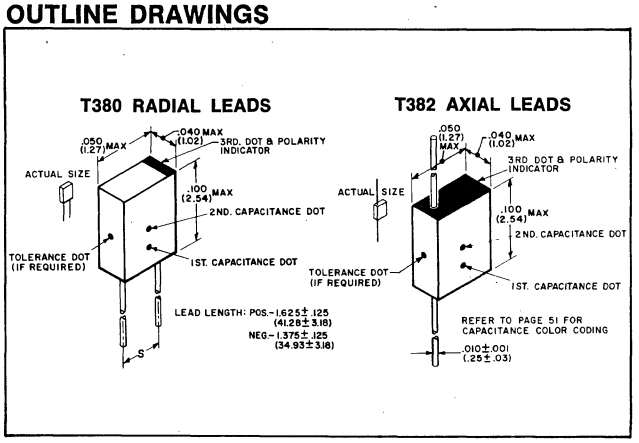
Capacitance µF	Code	Case Size	Rated Voltage (V) 2	3	4	6	10	15	20	35	50	Case Size
0.0022	222								0.5-10		1.0-8	
0.0033	332								0.5-10		1.0-8	
0.0047	472								0.5-10		1.0-8	
0.0068	682								0.5-10		1.0-8	
0.01	103								0.5-10		1.0-8	
0.015	153								0.5-10	1.0-8		B
0.022	223								0.5-10	1.0-8		
0.033	333								0.5-10	1.0-8		
0.047	473	A							0.5-10	1.0-8		
0.068	683								0.5-10	1.0-8		
0.1	104								0.5-10	1.0-8		
0.15	154								0.5-10	1.0-8		
0.22	224								0.5-6	1.0-8		
0.33	334							0.5-6	1.0-6	1.0-8		C
0.47	474						0.5-6		1.0-6	1.0-8		
0.68	684					0.5-6		1.0-6	1.0-6	1.0-8		D
1.0	105				0.5-10		1.0-6		1.0-6	1.0-8		
1.5	155			0.5-10		1.0-6		1.0-6	1.0-6	1.5-8		E
2.2	225		0.5-15		1.0-10		1.0-6		1.0-6	1.5-8		
3.3	335			1.0-10		1.0-6		1.0-6	1.5-6			
4.7	475	B	1.0-15		1.0-10		1.0-6		1.5-6			
6.8	685			1.0-10		1.0-6			1.5-6			
10.0	106	C	1.0-15		1.0-10			1.5-6				
15.0	156			1.0-10			1.5-6					
22.0	226	D	1.0-15			1.5-6						
33.0	336				1.5-10							
47.0	476	E		1.5-10								

DC Leakage (µA)
Dissipation Factor (%)

MICRON SERIES
T380, T382
(SMALLEST LEADED ENCAPSULATED SOLID TANTALUM CAPACITORS AVAILABLE)
POLAR-EPOXY ENCAPSULATED — RECTANGULAR SHAPE — RADIAL OR AXIAL LEADS

- 0.0047 to 0.47µF
- 2 to 20 VDC
- −55°C to +125°C
- 130% Surge Voltage Rating
- ±20%, ±10%, and ±5% Tolerances also Available

CAPACITOR OUTLINE DRAWINGS



For further details consult T370 (Micron) Catalog F-2710

T380 & T382 MICRON PRODUCT RANGE

Capacitance µF	Code	Case Size	Rated Voltage (V) 2	4	6	10	15	20	Case Size
0.0047	472							0.5-10	
0.0068	682							0.5-10	
0.010	103							0.5-10	
0.015	153							0.5-10	
0.022	223							0.5-10	
0.033	333							0.5-10	
0.047	473	A						0.5-10	A
0.068	683							0.5-10	
0.10	104						0.5-10		
0.15	154					0.5-10			
0.22	224				0.5-10				
0.33	334			0.5-10					
0.47	474		0.5-10						

DC Leakage (µA)
Dissipation Factor (%)

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

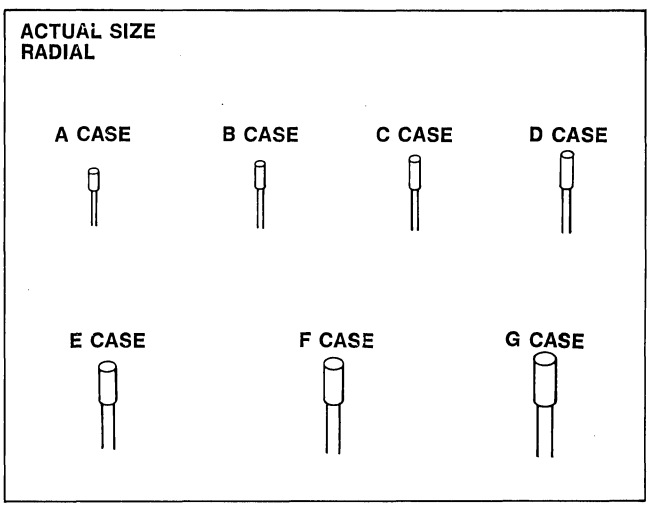
KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

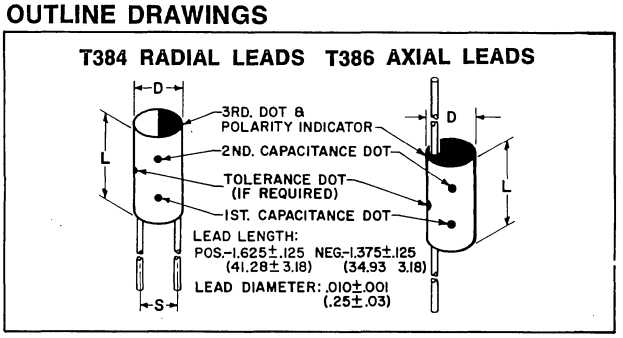
MICRON SERIES
T384, T386

POLAR/EPOXY ENCAPSULATED/HIGH EFFICIENCY/CYLINDRICAL SHAPE

- 0.0010-22 μF
- −55°C to +125°C
- 2 to 20 VDC
- Solder-Coated Nickel Leads
- High Charge (CV) Efficiency
- ±20%, ±10%, and ±5% Tolerances also Available



CAPACITOR OUTLINE DRAWINGS



DIMENSIONS INCHES & (MILLIMETERS)

Case Size	L Case Length Maximum	D Case Diameter Maximum	S Lead Spacing ±0.015 (±0.38)
A	0.110 (2.79)	0.067 (1.70)	0.050 (1.27)
B	0.125 (3.18)	0.067 (1.70)	0.050 (1.27)
C	0.145 (3.68)	0.067 (1.70)	0.050 (1.27)
D	0.160 (4.06)	0.077 (1.96)	0.050 (1.27)
E	0.190 (4.83)	0.077 (1.96)	0.050 (1.27)
F	0.200 (5.08)	0.080 (2.03)	0.050 (1.27)
G	0.215 (5.46)	0.098 (2.49)	0.070 (1.78)

T384 & T386 PRODUCT RANGE

Capacitance μF	Capacitance Code	Case Size	Rated Voltage (V) 2	3	4	6	10	15	20	Case Size
0.0022	222								0.5-10	
0.0033	332							A & B	0.5-10	
0.0047	472							CASE	0.5-10	
0.0068	682								0.5-10	
0.010	103								0.5-10	
0.015	153								0.5-10	A
0.022	223								0.5-10	
0.033	333	A							0.5-10	
0.047	473								0.5-10	
0.068	683								0.5-10	
0.10	104								0.5-10	
0.15	154								0.5-6	
0.22	224							0.5-6	0.5-6	B
0.33	334						0.5-6	0.5-6	1.0-6	C
0.47	474					0.5-6	0.5-6	1.0-6		D
0.68	684				0.5-10	0.5-6	1.0-6		1.0-6	
1.0	105			0.5-10	0.5-10	1.0-6		1.0-6	1.0-6	E
1.5	155		0.5-15	0.5-10	1.0-10		1.0-6	1.0-6	1.0-6	F
2.2	225	B	0.5-15	1.0-10		1.0-6	1.0-6	1.0-6	1.0-6	G
3.3	335	C	1.0-15		1.0-10	1.0-6	1.0-6	1.0-6		
4.7	475	D		1.0-10	1.0-10	1.0-6	1.0-6			
6.8	685		1.0-15	1.0-10	1.0-10	1.0-6				
10.0	106	E	1.0-15	1.0-10	1.0-10					
15.0	156	F	1.0-15	1.0-10						
22.0	226	G	1.0-15							

* DC Leakage (μA)
Dissipation Factor (%)

For further details consult T370 (Micron) Catalog F-2710

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

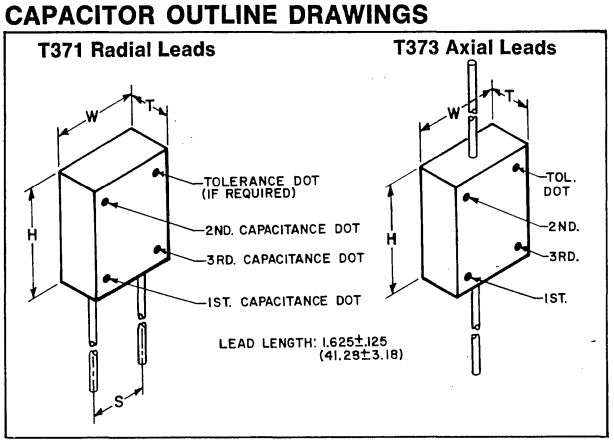
UNION CARBIDE

MICRON SERIES
T371 & T373

THE FOLLOWING ADDITIONAL MICRON SERIES ARE ALSO AVAILABLE: NON-POLAR, AXIAL OR RADIAL LEADS, RECTANGULAR SHAPE, EPOXY ENCAPSULATED

• .001 to 33 μF • 2 to 50 VDC • −55°C to +125°C

CAPACITOR OUTLINE DRAWINGS



Case Size	H Case Height Maximum Radial	H Case Height Maximum Axial	W Case Width Maximum	T Thick-ness Maximum	S *Lead Spacing	Lead Diameter ±0.001 (±0.03)
A	0.135 (3.43)	0.175 (4.45)	0.120 (3.05)	0.070 (1.78)	0.100 (2.54)	0.010 (0.25)
B	0.160 (4.06)	0.210 (5.33)	0.120 (3.05)	0.070 (1.78)	0.100 (2.54)	0.010 (0.25)
C	0.200 (5.08)	0.240 (6.10)	0.140 (3.56)	0.080 (2.03)	0.100 (2.54)	0.010 (0.25)
D	0.180 (4.57)	0.220 (5.59)	0.125 (3.18)	0.125 (3.18)	0.100 (2.54)	0.010 (0.25)
E	0.235 (5.97)	0.275 (6.99)	0.190 (4.83)	0.105 (2.67)	0.125 (3.18)	0.010 (0.25)
F	0.240 (6.10)	0.280 (7.11)	0.140 (3.56)	0.180 (4.57)	0.100 (2.54)	0.010 (0.25)
G	0.270 (6.86)	0.310 (7.87)	0.290 (7.37)	0.155 (3.94)	0.200 (5.08)	0.016 (0.41)
H	0.315 (8.00)	0.370 (9.40)	0.180 (4,57)	0.220 (5.59)	0.150 (3.81)	0.016 (0.41)
J	0.335 (8.51)	0.390 (9.91)	0.230 (5.84)	0.230 (5.84)	0.200 (5.08)	0.016 (0.41)

* A, B, C, D, E, F Cases: ±0.020 (±0.51). G, H, J Cases: ±0.025 (±0.64).

For further details consult T370 (Micron) Catalog F-2710

T411, T412 (CWR01), T421 & T422 (CWR02) SERIES — TANTALUM CHIP CAPACITORS

KEMET Tantalum Chip Capacitors present, at an economical price, maximum volumetric efficiency and high temperature capability. They are manufactured using a Union Carbide developed copper coating process that permits assembly temperatures up to 300°C for a short duration and continuous operating temperatures to 175°C when derated linearly to 25% of the 85°C voltage rating. T412 (CWR01) and T422 (CWR02) per MIL-C-55365 are KEMET's military equivalent capacitors of the 411 and 421. They are specially designed for use in hybrid circuit and PC board applications using solder reflow bonding techniques. The anode connection consists of a solder coated nickel tab. Cathode connection is made to the solder coating surrounding the body of the chip. Standard capacitance values are from 0.1 to 100 μF with unlisted values available on special order. Voltage range is 4 to 50 VDC. For information on chips that are suitable for other bonding techniques (including epoxy), contact your KEMET representative.

For further details consult T411, T412, T421 & T422 Catalog F-2715

Union Carbide Corporation, Electronics Division
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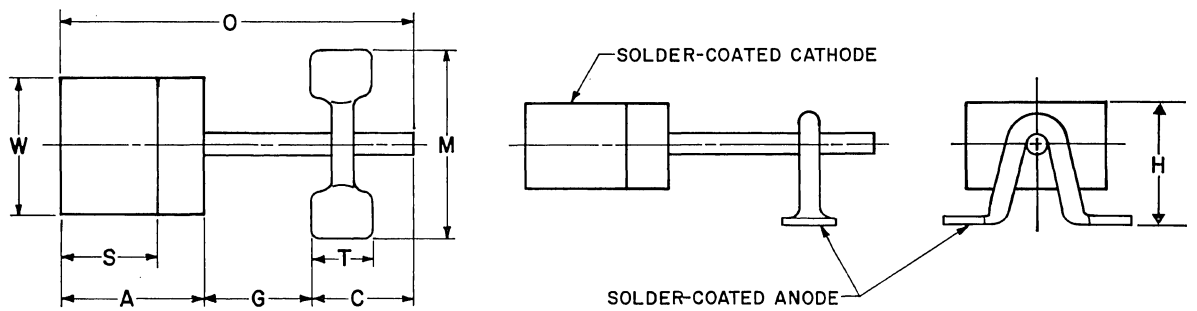
KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

T411, T412 (CWR01), T421 & T422 (CWR02) SERIES — TANTALUM CHIP CAPACITORS

CAPACITOR OUTLINE DRAWINGS

T411 SERIES — STANDARD RECTANGULAR CHIP CAPACITORS

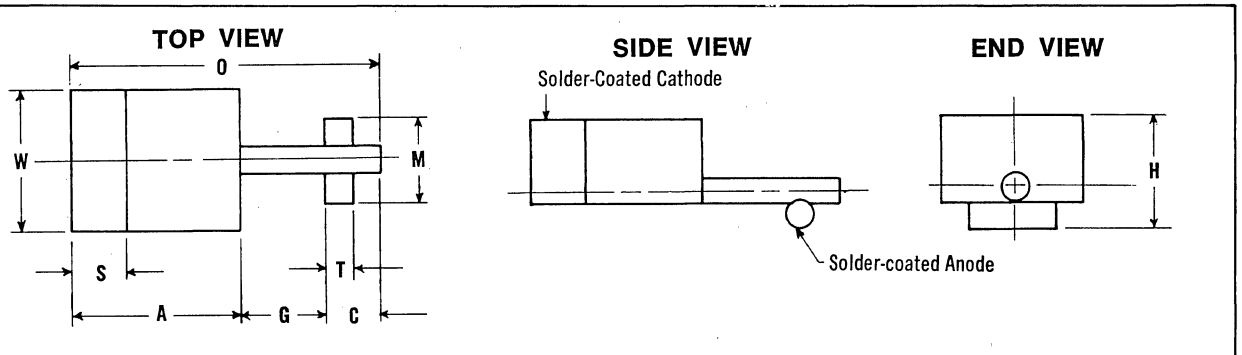


DIMENSIONS
INCHES & (MILLIMETERS)

Case Size	O Max.	W Max.	A Max.	S* Min.	G Min.	T Max.	C Max.	M Max.	H Max.	Wt. Max. Grams
A	0.185 (4.70)	0.100 (2.54)	0.080 (2.03)	30%	0.055 (1.40)	0.045 (1.14)	0.050 (1.27)	0.100 (2.54)	0.070 (1.78)	.06
B	0.230 (5.84)	0.130 (3.30)	0.125 (3.18)	40%	0.040 (1.02)	0.055 (1.40)	0.065 (1.65)	0.150 (3.81)	0.070 (1.78)	.11
C	0.270 (6.86)	0.160 (4.06)	0.165 (4.19)	40%	0.040 (1.02)	0.055 (1.40)	0.065 (1.65)	0.150 (3.81)	0.070 (1.78)	.18
D	0.335 (8.51)	0.170 (4.32)	0.215 (5.46)	40%	0.040 (1.02)	0.065 (1.65)	0.080 (2.03)	0.150 (3.81)	0.100 (2.54)	.28
E	0.340 (8.64)	0.180 (4.57)	0.220 (5.59)	40%	0.040 (1.02)	0.065 (1.65)	0.080 (2.03)	0.150 (3.81)	0.150 (3.81)	.35

* S — Solderable area expressed as percentage of Dimension A.

T421 SERIES MINIATURE RECTANGULAR CHIP CAPACITORS



DIMENSIONS
INCHES & (MILLIMETERS)

Case Size	O Max.	W Max.	A Max.	S* Min.	G Min.	T Max.	C Max.	M Max.	H Max.	Wt. Max. Grams
A	0.190 (4.83)	0.070 (1.78)	0.100 (2.54)	40%	0.025 (0.64)	0.055 (1.40)	0.065 (1.65)	0.070 (1.78)	0.060 (1.52)	.05
B	0.205 (5.21)	0.120 (3.05)	0.120 (3.05)	40%	0.025 (0.64)	0.050 (1.27)	0.060 (1.52)	0.070 (1.78)	0.060 (1.52)	.09
C	0.250 (6.35)	0.160 (4.06)	0.165 (4.19)	40%	0.025 (0.64)	0.050 (1.27)	0.060 (1.52)	0.090 (2.29)	0.080 (2.03)	.18
D	0.305 (7.75)	0.170 (4.32)	0.215 (5.46)	40%	0.025 (0.64)	0.055 (1.40)	0.065 (1.65)	0.090 (2.29)	0.110 (2.79)	.35
E	0.315 (8.00)	0.175 (4.45)	0.220 (5.59)	40%	0.025 (0.64)	0.060 (1.52)	0.070 (1.78)	0.090 (2.29)	0.150 (3.81)	.51

* S — Solderable area expressed as percentage of Dimension A.

For further details consult T411, T412, T421 & T422 Catalog F-2715

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® SOLID TANTALUM CAPACITORS

UNION CARBIDE

PRODUCT RANGE

T411

Capacitance µF	Code	Case Size	Rated Voltage (V) 4	6	10	15	20	25	30	35	50	50*	Case Size
0.1	104										0.5-4	1.0-4	B
0.15	154										0.5-4	1.0-4	
0.22	224									0.5-4	1.0-4		
0.33	334									0.5-4	1.0-4		
0.47	474							0.5-4		1.0-4	1.0-4		C
0.68	684	A					0.5-4		1.0-4		1.0-4		
1.0	105					0.5-4		1.0-4		1.0-4	2.0-4		D
1.5	155				0.5-6		1.0-6		1.0-6		2.0-6		
2.2	225			0.5-6		1.0-6		1.0-6		2.0-6	3.0-6		E
3.3	335		0.5-6		1.0-6		1.0-6		2.0-6		3.0-6		
4.7	475			1.0-6		1.0-6		2.0-6		3.0-6			
6.8	685	B	1.0-6		1.0-6		2.0-6		3.0-6				
10.0	106			1.0-6		2.0-6		3.0-6					
15.0	156	C	1.0-6		2.0-6		3.0-6						
22.0	226			2.0-6		3.0-6							
33.0	336	D	2.0-6		3.0-6								
47.0	476			3.0-6									
68.0	686	E	3.0-6										

DC Leakage (µA)
Dissipation Factor (%)

* B case only

T421

Capacitance µF	Code	Case Size	Rated Voltage (V) 4	6	10	15	20	25	35	50	Case Size
0.1	104									0.5-4	A
0.15	154									0.5-4	
0.22	224									0.5-4	
0.33	334								0.5-4	1.0-4	B
0.47	474							0.5-4		1.0-4	
0.68	684	A						0.5-4	1.0-4	2.0-4	
1.0	105						0.5-4	1.0-4		2.0-4	C
1.5	155					0.5-6		1.0-6		2.0-6	
2.2	225				0.5-6		1.0-6		2.0-6	3.0-6	D
3.3	335			0.5-6		1.0-6		2.0-6		3.0-6	
4.7	475		0.5-6		1.0-6			2.0-6	3.0-6	3.0-6	E
6.8	685			1.0-6			2.0-6	3.0-6	3.0-6		
10.0	106	B	1.0-6			2.0-6	3.0-6	3.0-6			
15.0	156				2.0-6		3.0-6				
22.0	226			2.0-6		3.0-6	3.0-6				
33.0	336	C	2.0-6		3.0-6	3.0-6					
47.0	476	D		3.0-6	3.0-6						
68.0	686		3.0-6	3.0-6							
100.0	107	E	3.0-6								

DC Leakage (µA)
Dissipation Factor (%)

T412 (CWR01) & T422 (CWR02)

Capacitance µF	Code	Case Size	Rated Voltage (V) 3	4	6	10	15	20	25	30	35	50	Case Size
0.1	104										0.5-4	0.5-4	A
0.15	154											0.5-4	
0.22	224										0.5-4	1.0-4	B
0.33	334							0.5-4			0.5-4	1.0-4	
0.47	474							0.5-4	0.5-4	1.0-4	1.0-4	1.0-4	C
0.68	684	A					0.5-4	0.5-4	0.5-4	1.0-4	1.0-4	2.0-4	
1.0	105					0.5-4	0.5-4	1.0-4	1.0-4		1.0-4	2.0-4	D
1.5	155				0.5-4	0.5-6	0.5-6	1.0-6	1.0-6	1.0-6	1.1-4	2.0-6	
2.2	225		1.0-4		0.5-6	1.0-4	1.0-6	1.0-4	1.0-6		2.0-6	3.0-6	
3.3	335			0.5-6	1.0-4	1.0-6	1.0-6	1.0-6	2.0-6	2.0-6	2.3-4	3.0-6	E
4.7	475	B	1.0-4	0.5-6	1.0-6	1.0-6	1.0-6	1.9-4	2.0-6		3.0-6	3.0-6	
6.8	685			1.0-6	1.0-6	1.0-6		2.0-6	3.0-6	3.0-6	4.8-6		
10.0	106			1.0-6	1.0-6		2.0-6	3.0-6	3.0-6				
15.0	156	C	1.0-6	1.0-6		2.0-6		3.0-6					
20.0	206					3.0-6							
22.0	226				2.0-6	3.0-6	3.0-6	3.0-6					
33.0	336	D		2.0-6	3.0-6	3.0-6	3.0-6						
47.0	476	E	2.8-6		3.0-6	9.4-6							
68.0	686			3.0-6	3.0-6								
100.0	107			3.0-6									

DC Leakage (µA)
Dissipation Factor (%)

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

The basic capacitor element is called a chip and consists of formulated ceramic dielectric materials in layers interspersed with metal electrode layers. The entire structure is fired together at high temperature, after which conductive terminations are applied on opposite ends to contact protruding electrode edges. Chips may be terminated with materials suitable for hybrid-circuit substrate assembly. More usually, chips are furnished with protecting encapsulation and leadwires.

KEMET multilayer ceramic capacitors are produced in a plant designed specifically for capacitor manufacture. The process features a high degree of mechanization as well as precise controls over raw materials and process conditions. Manufacturing is supplemented by extensive Technology, Engineering, and Quality Assurance programs. Extensive application in aerospace and military programs attests to the reliability of KEMET capacitors. No capacitors exceed the failure rate qualifications held by KEMET capacitors under military specifications.

KEMET ceramic capacitors are offered in the three most popular temperature characteristics. These are designated by the Electronics Industry Association (EIA) as the ultra-stable C0G (known in the vernacular as NPO), the stable X7R (military BX or BR), and the general purpose Z5U. A wide range of sizes and lead arrangements are available to provide capacitance from 1 picofarad through 6.8 microfarads in 50, 100, and 200 volt ratings.

MOLDED CASES WITH RADIAL LEADS
CAPACITOR OUTLINE DRAWINGS

C052

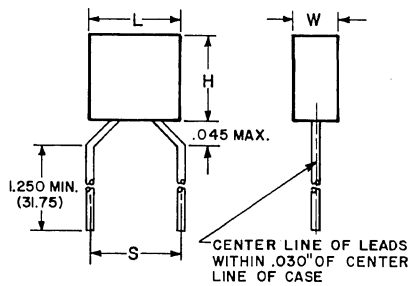


FIGURE A

C062, C512 & C522

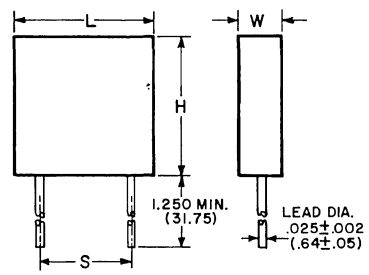


FIGURE B

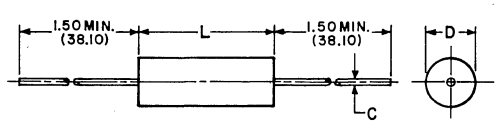
DIMENSIONS
INCHES & (MILLIMETERS)

KEMET Figure	KEMET Case Size	Military Styles MIL-C-11015*	MIL-C-39014*	MIL-C-20*	H Height	L Length	W Width	S Lead Spacing
A	C052	CK05	CKR05	CCR05/CC05	0.190 ±0.010 (4.83 ±0.25)	0.190 ±0.010 (4.83 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.200 ±0.015 (5.08 ±0.38)
B	C062	CK06	CKR06	CCR06/CC06	0.290 ±0.010 (7.73 ±0.25)	0.290 ±0.010 (7.73 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.200 ±0.015 (5.08 ±0.38)
B	C512	—	—	CCR07/CC07	0.480 ±0.020 (12.19 ±0.51)	0.480 ±0.020 (12.19 ±0.51)	0.140 ±0.010 (3.56 ±0.25)	0.400 ±0.020 (10.16 ±0.51)
B	C522	—	—	CCR08/CC08	0.480 ±0.020 (12.19 ±0.51)	0.480 ±0.020 (12.19 ±0.51)	0.240 ±0.010 (6.10 ±0.25)	0.400 ±0.020 (10.16 ±0.51)

* Note: Per MIL-C-11015 and C-39014, BX/BR only. — Per MIL-C-20, CG/CH only.

MOLDED CASES WITH AXIAL LEADS

C114 to C222



DIMENSIONS
INCHES & (MILLIMETERS)

Case Size	Military Styles MIL-C-11015	MIL-C-39014	L	D	C
C114	CK12	CKR11	0.160 ±0.010 (4.06 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.019 ±0.002 (0.48 ±0.05)
C124	CK13	CKR12	0.250 ±0.010 (6.35 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.019 ±0.002 (0.48 ±0.05)
C192	CK14	CKR14	0.390 ±0.010 (9.91 ±0.25)	0.140 ±0.010 (3.56 ±0.25)	0.025 ±0.002 (0.64 ±0.05)
C202	CK15	CKR15	0.500 ±0.020 (12.70 ±0.51)	0.250 ±0.015 (6.35 ±0.38)	0.025 ±0.002 (0.64 ±0.05)
C222	CK16	CKR16	0.690 ±0.030 (17.53 ±0.76)	0.350 ±0.020 (8.89 ±0.51)	0.025 ±0.002 (0.64 ±0.05)

Union Carbide Corporation, Electronics Division
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KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

MOLDED RADIAL AND AXIAL CERAMIC CAPACITOR ORDERING INFORMATION

C 052 K 102 K 2 X 5 C A

CERAMIC

***CASE SIZE**
(See table below)

SPECIFICATION
Standard & Military
A — GR900 High Reliability (Chips)
B — GR900 High Reliability (Leaded Devices)
C — Standard
E — KEMET Military Equivalent
T — MIL-C-39014C Slash Sheets 1, 2 & 5
K — MIL-C-11015D
G — MIL-C-20

CAPACITANCE
In picofarad code: First two digits are significant figures and third is number of zeros following (except 9 indicates division by 10).
Examples: 0.1 μF = 100,000 pF = 104 and 9.1 pF = 919.

CAPACITANCE TOLERANCE

Standard	Others
M — ±20%	H — ±3%
K — ±10%	G — ±2%
J — ±5%	F — ±1%
Z — +80% −20%	B — ±0.1 pF
	C — ±0.25 pF
P — GMV (Guar. Min. Value)	D — ±0.5 pF

X — Special
Standard tolerances for each Series are shown in the repetitive parts lists. See catalog F-2644Q

WORKING VOLTAGE
1 — 100 5 — 50
2 — 200 0 — Other

†TEMPERATURE CHARACTERISTIC

INTERNAL CONSTRUCTION
1 — High Temperature Solder. For Z5U Temperature Characteristic only.
5 — Ultra-High Temperature Solder. For all other Temperature Characteristics.

LEAD MATERIAL
C — Standard
Available on special order at additional cost: (Contact your sales representative.)
D — Gold Dumet
G — Gold Plated Nickel
E — Copperweld (Solder Coated)
R — Copper (Solder Coated)

FAILURE RATE
A — Not Applicable (Standard)
L — Obsolete (inactive for new design)
M — 1.0% R — 0.01%
P — 0.1% S — 0.001%

***CASE SIZE**

Radial	Axial
C052	C114
C062	C124
C512	C192
C522	C202
	C222

MIL-C-11015, MIL-C-39014, MIL-C-20 PRODUCT RANGE

MOLDED RADIAL SERIES

KEMET Case Size	Style	Voltages	Capacitance Range
C052	CK05 CKR05	200V 100V 50V	10-1000 pF 1200-10,000 pF 12,000-100,000 pF
C062	CK06 CKR06	200V 100V 50V	1200-10,000 pF 12,000-100,000 pF 120,000-1,000,000 pF
C052	CC05 CCR05	200V 100V 50V	1-330 pF 360-1800 pF 2000-3300 pF
C062	CC06 CCR06	200V 100V 50V	360-1800 pF 2000-4700 pF 5100-18,000 pF
C512	CC07 CCR07	200V 100V 50V	2200-4700 pF 5600-12,000 pF 15,000-100,000 pF
C522	CC08 CCR08	200V 100V 50V	3900-4700 pF 15,000-18,000 pF 56,000-68,000 pF

MOLDED AXIAL SERIES

KEMET Case Size	Style	Voltages	Capacitance Range
C114	CK12 CKR11	100V 50V	10-4700 pF 5600-10,000 pF
C124	CK13 CKR12	100V 50V	5600-10,000 pF 12,000-47,000 pF
C192	CK14 CKR14	100V 50V	12,000-100,000 pF 56,000-270,000 pF
C202	CK15 CKR15	100V 50V	56,000-330,000 pF 470,000-1,000,000 pF
C222	CK16 CKR16	100V 50V	470,000-1,000,000 pF 2,200,000-3,300,000 pF
C114	CC75 CCR75	200V 100V 50V	0.10-75 pF 82-240 pF 270-680 pF
C124	CC76 CCR76 CCR77	200V 100V 50V	82-130 pF 270-680 pF 750-1000 pF
C192	CC77 CCR77	200V 100V 50V	150-680 pF 750-2200 pF 2400-5600 pF
C202	CC78 CCR78	200V 100V 50V	820-3300 pF 3900-12,000 pF 15,000-27,000 pF
C222	CC79 CCR79	200V 100V 50V	3900-8200 pF 10,000-39,000 pF 47,000-82,000 pF

†TEMPERATURE CHARACTERISTIC

KEMET Designator	Military Equivalent	EIA Equivalent	Capacitance Change With Temp.		
			Temp. Range °C	Measured Without DC Bias Voltage	Measured With Bias (Rated Voltage)
G (Ultra Stable)	NPO, CG, BP	COG	−55 to +125	±30 ppm/°C	±30 ppm/°C
X (Stable)	BX	X7R	−55 to +125	±15%	+15% −25%
R (Stable)	BR	X7R	−55 to +125	±15%	+15% −40%
U (General Purpose)	—	Z5U	+10 to +85	+22% −56%	N/A

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

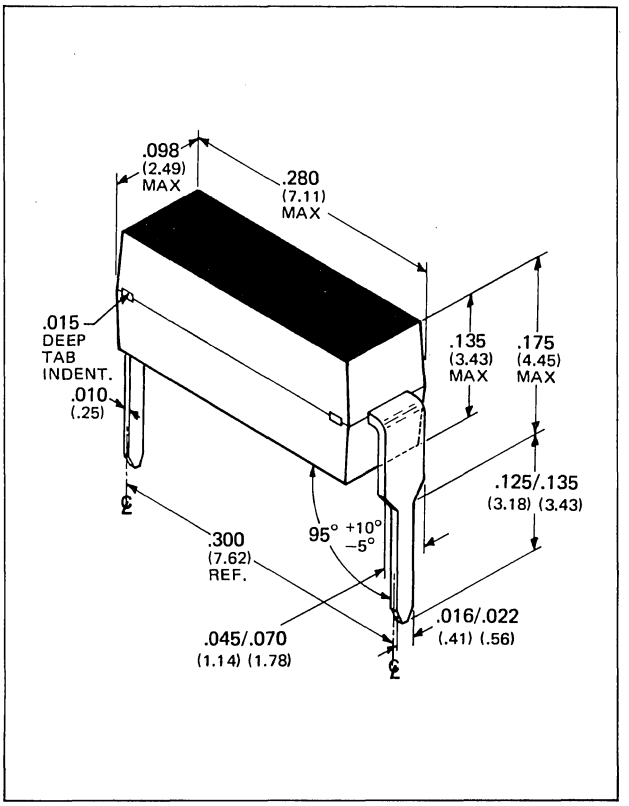
KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

MIGHTY MAX C630 SERIES MOLDED MULTILAYER CERAMIC CAPACITORS

Dimensional stability, electrical integrity, printed circuit board compatibility, and economical price — these are the characteristics of KEMET's C630 Series Mighty Max molded multilayer ceramic capacitors.

The Mighty Max features ease of insertion into printed circuit boards which utilize automatic insertion machines, common to the electronic packaging industry. C630's exhibit the same cross sectional dimensions and pin-to-pin registrations found in a typical 14 pin (or more) D.I.P. integrated circuit (0.300" x 0.100"). This compact design makes the Mighty Max physically compatible with standard configurations, where component height is critical. Coming to you in a single case size, the KEMET C630 Mighty Max is available in a capacitance range from 10 pF to 220,000 pF, in 50 to 100 volt ratings. Their reliable performance is assured through automated manufacture and precision process control techniques that provide uniform dielectric thickness, excellent electrode integrity, and electrode-to-termination continuity. Internal construction consists of the same superior multilayer body used in KEMET's other molded and dipped ceramic capacitor products. Encapsulation consists of a moisture and shock resistant plastic molding that exceeds flame test requirements of Underwriters Laboratory Standard 94V-O.



C630 ORDERING INFORMATION

C	630	C	104	K	5	X	5	C	A

CERAMIC

SIZE CODE

SPECIFICATION
C — Standard

CAPACITANCE CODE
Expressed in picofarads (pF)
First two digits — significant figures.
Third digit — number of zeros.

CAPACITANCE TOLERANCE
J — ±5% Z — +80%, −20%
K — ±10% P — GMV
M — ±20%

WORKING VOLTAGE
1 — 100 5 — 50

DIELECTRIC
G — COG
X — X7R
U — Z5U

SOLDER
5 — Ultra-High temperature

LEAD MATERIAL
C — Standard

FAILURE RATE
A — Not Applicable

Dielectric	Voltage	Capacitance Range
COG	100V 50V	10 pF — 560 pF 10 pF — 3900 pF
X7R	100V 50V	150 pF — 0.027 μF 150 pF — 0.1 μF
Z5U	100V 50V	0.01 μF — 0.047 μF 0.01 μF — 0.22 μF

Dielectric	Capacitance Tolerance
COG	J — ±5% K — ±10%
X7R	K — ±10% M — ±20%
Z5U	M — ±20% Z — +80% −20% P — GMV

For further details on C630 Mighty Max Capacitors consult catalog F-2886

Union Carbide Corporation, Electronics Division
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KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

GR900 SERIES

CERAMIC HIGH RELIABILITY CAPACITORS

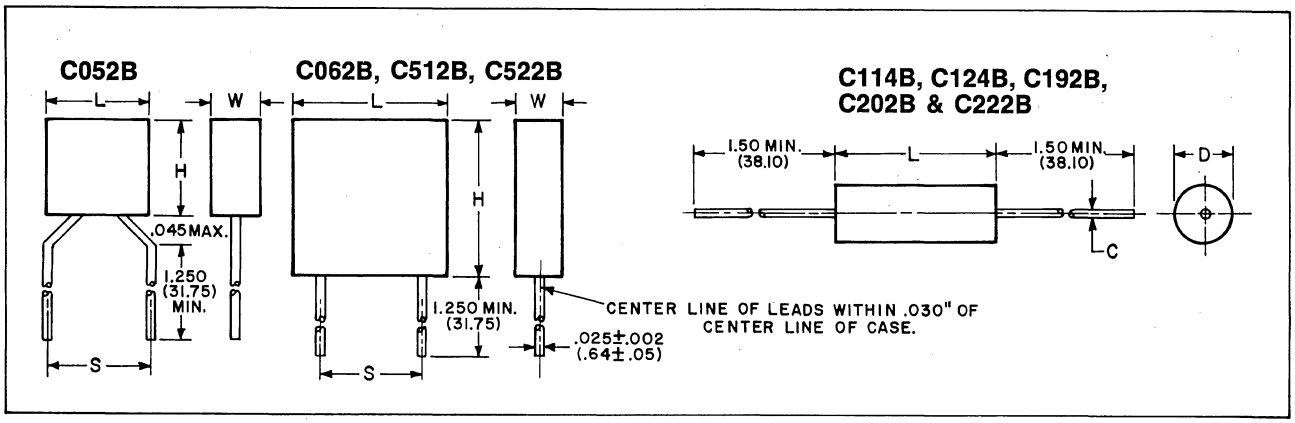
GR900 capacitors are intended for use in any application where the chance of failure must be reduced to the lowest possible level. While any well-made multilayer ceramic capacitor is an inherently reliable device, GR900 capacitors receive special attention in all phases of manufacture including raw materials selection, special designs, Class 100 Clean Room production, individual batch testing (not group sample per mil spec), ultrasonic scanning, and destructive physical analysis. These capacitors are built to the highest known standards in the industry today and exceed new EIA specification RS 469 for Destructive Physical Analyses. These parts are well worth the added investment in comparison to the cost of a device or system failure.

Typical applications include:

1. Medical: heart pacemakers, pain control devices, life signs monitoring, eye sight improvement and electroencephalographic equipment.
2. Aerospace: space exploration (Viking, Apollo, Venus Lander, etc.); Communications Satellites; Space Shuttle/IUS; Sky Lab.
3. Military: F-15 Radar, Trident Submarine, Patriot, Hawk Missile and Captor Programs.
4. Consumer: transportation failsafe (elevators and rail), airline navigation systems, smoke alarms and undersea cable amplifiers.

A data package is sent with each shipment which contains a destructive physical analysis (DPA) photograph representing each batch used in manufacture of the parts. Also, a certificate of compliance is included, stating that the parts meet all applicable requirements of the appropriate military specification to the best failure level to which KEMET is approved.

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS INCHES & (MILLIMETERS)

RADIAL LEAD

Case Size	Military Equivalent Styles	H Height	L Length	W Width	S Lead Spacing
C052	CC05, CCR05 CK05, CKR05	0.190 ±0.010 (4.83 ±0.25)	0.190 ±0.010 (4.83 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.200 ±0.015 (5.08 ±0.38)
C062	CC06, CCR06 CK06, CKR06	0.290 ±0.010 (7.37 ±0.25)	0.290 ±0.010 (7.37 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.200 ±0.015 (5.08 ±0.38)
C512	CC07, CCR07	0.480 ±0.020 (12.19 ±0.51)	0.480 ±0.020 (12.19 ±0.51)	0.140 ±0.010 (3.56 ±0.25)	0.400 ±0.020 (10.16 ±0.51)
C522	CC08, CCR08	0.480 ±0.020 (12.19 ±0.51)	0.480 ±0.020 (12.19 ±0.51)	0.240 ±0.010 (6.10 ±0.25)	0.400 ±0.020 (10.16 ±0.51)

AXIAL LEAD

Case Size	L	D	C	Military Styles MIL-C-11015	Military Styles MIL-C-39014
C114	0.160 ±0.010 (4.06 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.020, +0.000, −0.003 (0.51, +0.00, −0.08)	CK12	CKR11
C124	0.250 ±0.010 (6.35 ±0.25)	0.090 ±0.010 (2.29 ±0.25)	0.020, +0.000, −0.003 (0.51, +0.00, −0.08)	CK13	CKR12
C192	0.390 ±0.010 (9.91 ±0.25)	0.140 ±0.010 (3.56 ±0.25)	0.025, +0.004, −0.002 (0.64, +0.10, −0.05)	CK14	CKR14
C202	0.500 ±0.020 (12.70 ±0.51)	0.250 ±0.015 (6.35 ±0.38)	0.025, +0.004, −0.002 (0.64, +0.10, −0.05)	CK15	CKR15
C222	0.690 ±0.030 (17.35 ±0.76)	0.350 ±0.020 (8.89 ±0.51)	0.025, +0.004, −0.002 (0.64, +0.10, −0.05)	CK16	CKR16

For further information consult GR900 Specification Bulletins F-2872 & F-2873

Union Carbide Corporation, Electronics Division
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KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

GR900 SERIES
CERAMIC HIGH RELIABILITY CAPACITORS
RADIAL & AXIAL CAPACITANCE RANGES

CASE SIZE	KEMET NPO CAPACITORS (TEMPERATURE CHARACTERISTIC G)			KEMET BX CAPACITORS (TEMPERATURE CHARACTERISTIC X)		
	VOLTAGE	CAPACITANCE RANGE-pF	KEMET PART NUMBER	VOLTAGE	CAPACITANCE RANGE-pF	KEMET PART NUMBER
MOLDED RADIAL						
C052	200	1-2,200	C052B(1)2G5CA	200	10-10,000	C052B(1)2X5CA
	100	360-3,900	C052B(1)1G5CA	100	1,200-47,000	C052B(1)1X5CA
	50	2,200-3,900	C052B(1)5G5CA	50	12,000-150,000	C052B(1)5X5CA
C062	200	390-10,000	C062B(1)2G5CA	200	1,200-47,000	C062B(1)2X5CA
	100	2,200-18,000	C062B(1)1G5CA	100	12,000-180,000	C062B(1)1X5CA
	50	5,100-18,000	C062B(1)5G5CA	50	120,000-1,000,000*	C062B(1)5X5CA
C512	200	2,200-47,000	C512B(1)2G5CA	200	2,000-270,000	C512B(1)2X5CA
	100	5,600-100,000	C512B(1)1G5CA	100	2,000-1,000,000	C512B(1)1X5CA
	50	15,000-100,000	C512B(1)5G5CA	50	2,000-2,200,000	C512B(1)5X5CA
C522	200	3,900-100,000	C522B(1)2G5CA	200	2,000-330,000	C522B(1)2X5CA
	100	15,000-180,000	C522B(1)1G5CA	100	2,000-2,200,000	C522B(1)1X5CA
	50	56,000-180,000	C522B(1)5G5CA	50	2,000-3,300,000	C522B(1)5X5CA
MOLDED AXIAL						
C114	200	1-330	C114B(1)2G5CA	200	10-1,000	C114B(1)2X5CA
	100	82-680	C114B(1)1G5CA	100	1,200-4,700	C114B(1)1X5CA
	50	270-1,000	C114B(1)5G5CA	50	4,700-18,000	C114B(1)5X5CA
C124	200	82-560	C124B(1)2G5CA	200	1,200-2,200	C124B(1)2X5CA
	100	270-1,000	C124B(1)1G5CA	100	2,700-10,000	C124B(1)1X5CA
	50	820-1,800	C124B(1)5G5CA	50	10,000-47,000	C124B(1)5X5CA
C192	200	150-4,700	C192B(1)2G5CA	200	2,700-18,000	C192B(1)2X5CA
	100	470-6,800	C192B(1)1G5CA	100	22,000-47,000	C192B(1)1X5CA
	50	2,700-8,200	C192B(1)5G5CA	50	47,000-100,000	C192B(1)5X5CA
C202	200	820-22,000	C202B(1)2G5CA	200	22,000-68,000	C202B(1)2X5CA
	100	3,900-22,000	C202B(1)1G5CA	100	56,000-220,000	C202B(1)1X5CA
	50	15,000-22,000	C202B(1)5G5CA	50	180,000-820,000	C202B(1)5X5CA
C222	200	3,900-33,000	C222B(1)2G5CA	200	68,000-330,000	C222B(1)2X5CA
	100	15,000-82,000	C222B(1)1G5CA	100	330,000-1,000,000	C222B(1)1X5CA
	50	47,000-82,000	C222B(1)5G5CA	50	1,000,000-3,300,000	C222B(1)5X5CA

(1) Complete KEMET Part Number by inserting capacitance and capacitance tolerance, as applicable as shown in ordering information on this page.
* 680,000 and 820,000 pF values not yet available to full GR900 requirements. NPO CAPACITANCE TOLERANCE: ±1%, ±2%, ±5%, ±10%, ±20% (±0.5 pF is the tightest tolerance available, 1 thru 10 pF) TEMPERATURE CHARACTERISTIC "G"
BX CAPACITANCE TOLERANCE: ±5%, ±10%, ±20% TEMPERATURE CHARACTERISTIC "X"

SPECIFIC REQUIREMENTS GR900/R & GR900/A ORDERING INFORMATION

C 124 B 223 K 1 X 5 C A

MULTILAYER CERAMIC CAPACITORS

PHYSICAL DIMENSIONS
(See page 26)

HI REL SPECIFICATIONS APPLY:
B — Leaded devices

CAPACITANCE PICOFARAD CODE
First two digits are significant figures of capacitance value and third digit is the number of zeros to follow in stating capacitance in picofarads. For example, "223" is 22,000 pF. The third- digit number "9" indicates a divisor of 10; for example, "229" is 2.2 pF.

CAPACITANCE TOLERANCE
M — ±20% J — ±5% F — ±1%
K — ±10% G — ±2% D — ±0.5 pF

RATED VOLTAGE
1 — 100 2 — 200 5 — 50

FAILURE RATE
A — Standard — Meets or exceeds MIL-C-20, level R or MIL-C- 39014, level S

LEAD MATERIAL
C — Standard — Radial: Tinned Copper
Axial: Tinned Copperweld

INTERNAL CONSTRUCTION
5 — Ultra-High Temperature Solder

TEMPERATURE CHARACTERISTICS
(See table below)

TEMPERATURE CHARACTERISTICS CAPACITANCE CHANGE WITH TEMPERATURE −55°C to +125°C

Part Number Letter	Without D.C. Bias	With Rated D.C. Voltage Applied	Other Nomenclature		
			EIA	Military	Common
G	±30 ppm/°C	±30 ppm/°C	COG	CG, BP	NPO
X	±15%	+15%, −25%	X7R	BX	—

For further information consult GR900 Specification Bulletins F-2872 & F2873

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® MULTILAYER CERAMIC CAPACITORS

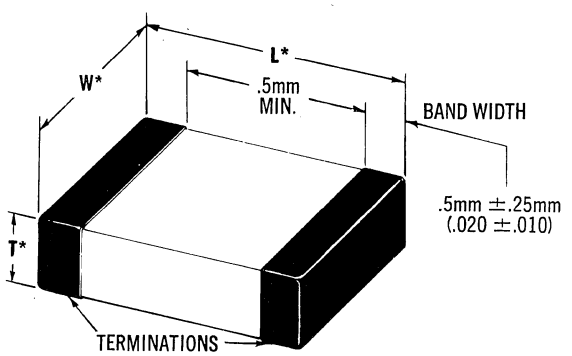
UNION CARBIDE

GR900 SERIES

HYBRID CERAMIC CHIP CAPACITORS

CAPACITOR OUTLINE DRAWING

* On Solderguard I, 'L', 'W' & 'T' dimensions, add .5mm to 'L' & .25mm to 'W' & 'T' dimensions for 'H' type terminations.



DIMENSIONS — MILLIMETERS & (INCHES)

Size Code	L Length	W Width	T Thickness Max.
0805	2.0 ±0.2 (0.78 ±.008)	1.25 ±0.2 (.049 ±.008)	1.4 (.055)
1005	2.5 ±0.2 (.098 ±.008)	1.25 ±0.2 (.049 ±.008)	1.5 (.059)
1210	3.2 ±0.2 (.126 ±.008)	2.5 ±0.2 (.098 ±.008)	1.5 (.059)
1805	4.5 ±0.3 (.177 ±.012)	1.25 ±0.3 (.049 ±.012)	1.5 (.059)
1808	4.5 ±0.3 (.177 ±.012)	2.0 ±0.3 (.078 ±.012)	2.0 (.079)
1812	4.5 ±0.3 (.177 ±.012)	3.2 ±0.3 (.126 ±.012)	2.0 (.079)
1825	4.5 ±0.3 (.177 ±.012)	6.4 ±0.3 (.252 ±.012)	2.0 (.079)
2225	5.6 ±0.4 (.220 ±.016)	.64 ±0.4 (.252 ±.016)	2.0 (.079)

GR900 CERAMIC CHIP ORDERING INFORMATION

C 0805 A 103 K 5 X A H

CERAMIC

SIZE CODE
See table below

SPECIFICATION
A — KEMET GR900 (CHIPS)

CAPACITANCE CODE
Expressed in Picofarads (pF)
First two digits — significant figures.
Third digit — number of zeros.
(Use 9 for 1.0 thru 9.9 pF.
Example: 2.2 pF — 229).

CAPACITANCE TOLERANCE

K — ±10%	F — ±1%
M — ±20%	G — ±2%
P — (GMV)	J — ±5%
C — ±0.25 pF	Z — +80%, −20%
D — ±0.5 pF	X — Other

VOLTAGE
1 — 100 2 — 200 5 — 50 0 — Other

TEMPERATURE CHARACTERISTIC
Designated by Capacitance Change over Temperature Range
G — NPO (±30 ppm/°C)
X — BX (±15%; +15%, −25% with bias)

FAILURE RATE LEVEL (%/1,000 HOURS)
A — Standard — Meets or exceeds MIL-C-55681, level R

END METALLIZATION
H — SolderGuard I (Standard-Tinned)
T — Silver
G — Gold Plated
V — Palladium Silver (Standard-Untinned)
Z — Other

Voltage	Capacitance pF: Temperature Characteristic G COG	Capacitance pF: Temperature Characteristic X X7R
0805 SIZE		
200V	1-150	180-560
100V	1-330	180-3300
50V	1-560	180-15,000
1005 SIZE		
200V	1-330	330-1200
100V	1-680	330-5600
50V	1-1000	330-22,000
1210 SIZE		
200V	1-1500	470-4700
100V	1-2200	470-18,000
50V	1-3300	470-100,000

Voltage	Capacitance pF: Temperature Characteristic G COG	Capacitance pF: Temperature Characteristic X X7R
1805 SIZE		
200V	220-1000	1200-2700
100V	220-1500	1200-12,000
50V	220-2200	1200-47,000
1808 SIZE		
200V	330-2200	2200-8200
100V	330-5600	2200-33,000
50V	330-4700	2200-100,000
1812 SIZE		
200V	330-3900	1200-15,000
100V	330-6800	1200-56,000
50V	330-10,000	1200-220,000

Voltage	Capacitance pF: Temperature Characteristic G COG	Capacitance pF: Temperature Characteristic X X7R
1825 SIZE		
200V	2700-8200	6800-33,000
100V	2700-12,000	6800-150,000
50V	2700-18,000	6800-470,000
2225 SIZE		
200V	2700-10,000	18,000-47,000
100V	2700-18,000	18,000-180,000
50V	2700-22,000	18,000-1,000,000*

* 680,000 and 820,000 pF values not yet available to full GR900 requirements.

For further information consult GR900 Specification Bulletins F-2872 & F-2873

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

GOLDEN MAX

DIPPED CERAMIC CAPACITORS

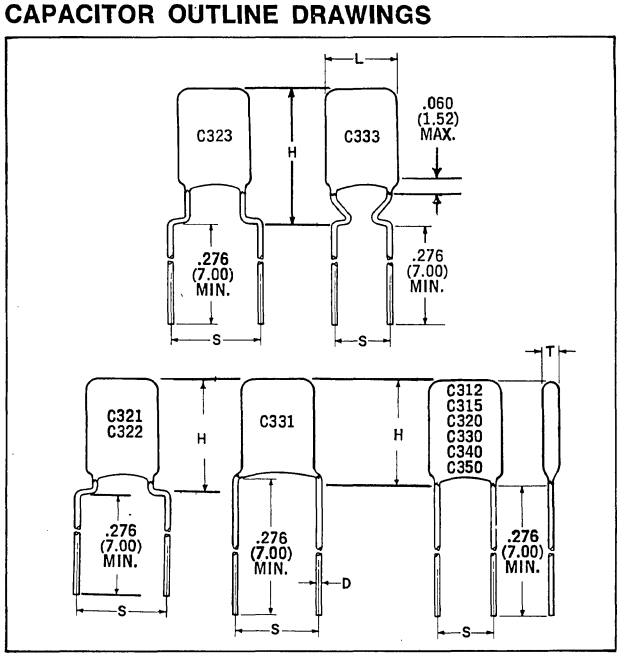
DIPPED CASES WITH RADIAL LEADS

The KEMET "Golden Max" product line provides maximum range conformally-coated capacitors in three dielectrics — COG Ultra-Stable; X7R Stable and Z5U General Purpose. The six case sizes include over 300 CV values in a capacitance range of 1.0 pF to 3.3 μF in 50, 100, and 200 volts. Their reliable performance is built-in through automated manufacture and precision process control techniques that assure uniform dielectric thickness, excellent electrode integrity, and electrode-to-termination continuity. Internal construction consists of the same superior multilayer body used in KEMET's molded capacitors. Encapsulation consists of a multi-layer moisture and shock resistant coating that meets the flame test requirements of Underwriter's Laboratory Standard 94V-O.

This new plastic resin is gold color with easy-to-read laser markings.

Additional CV values, sizes and lead configurations are available on special order.

CAPACITOR OUTLINE DRAWINGS



GOLDEN MAX ORDERING INFORMATION

C 320 C 102 M 1 G 5 C A

CERAMIC

CASE SIZE
(See Table Below)

SPECIFICATION
C — Standard

CAPACITANCE CODE
Expressed in Picofarads (pF)
First two digits - significant figures
Third digit - number of zeros (use 9 for 1.0 thru 9.9 pF. Example: 2.2 pF - 229)

CAPACITANCE TOLERANCE

D — ±0.5 pF	K — ±10%
F — ±1%	M — ±20%
G — ±2%	P — 0, +100% (GMV)
J — ±5%	Z — −20%, +80%

VOLTAGE
2 — 200
1 — 100
5 — 50

DIELECTRIC
EIA Designation
G — COG (NPO) — Ultra-stable
R — X7R — Stable
U — Z5U — General Purpose

INTERNAL CONSTRUCTION
1. High Temperature Solder — Standard for Z5U
5. Ultra-High Temperature Solder — Standard for X7R and COG

LEAD MATERIAL
C — Standard

FAILURE RATE
A — Not Applicable

MAXIMUM DIMENSIONS — INCHES & (MILLIMETERS)

Case Size	L Max.	H Max.	T Max.	S** ±.030	D +.004 −.001	Case Size	L Max.	H Max.	T Max.	S** ±.030	D +.004 −.001
C312	0.120 (3.05)	0.160 (4.06)	0.100 (2.54)	0.100 (2.54)	0.016 (0.41)	C323*	0.200 (5.08)	0.320 (8.13)	0.125 (3.18)	0.200 (5.08)	0.020 (0.51)
C315	0.150 (3.81)	0.210 (5.33)	0.100 (2.54)	0.100 (2.54)	0.016 (0.41)	C330*	0.300 (7.62)	0.360 (9.14)	0.150 (3.81)	0.200 (5.08)	0.020 (0.51)
C320*	0.200 (5.08)	0.260 (6.60)	0.125 (3.18)	0.100 (2.54)	0.020 (0.51)	C331*	0.300 (7.62)	0.360 (9.14)	0.150 (3.81)	0.250 (6.35)	0.020 (0.51)
C321*	0.200 (5.08)	0.260 (6.60)	0.125 (3.18)	0.250 (6.35)	0.020 (0.51)	C333*	0.300 (7.62)	0.390 (9.91)	0.150 (3.81)	0.200 (5.08)	0.020 (0.51)
C322*	0.200 (5.08)	0.260 (6.60)	0.125 (3.18)	0.200 (5.08)	0.020 (0.51)	C340	0.400 (10.16)	0.460 (11.68)	0.150 (3.81)	0.200 (5.08)	0.020 (0.51)
						C350	0.500 (12.70)	0.560 (14.22)	0.200 (5.08)	0.400 (10.16)	0.025 (.064)

Note: 1 inch = 25.4mm.

Note: * Case Sizes C320/C321/C322/C323, and C330/C331/C333 are identical electrically but differ in lead spacing.
** Measured at seating plane.

For further details on Golden Max Ceramic Capacitors consult Catalog F-2795

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

GOLDEN MAX
DIPPED CERAMIC CAPACITORS
DIPPED CASES WITH RADIAL LEADS

PRODUCT RANGE

Case Size	Rated Voltage	Capacitance Range		
		COG Dielectric	X7R Dielectric	Z5U Dielectric
C312	200V 100V 50V	1.0 pF-100 pF 120 pF-220 pF	180 pF-680 pF 820 pF-2700 pF 3300 pF-0.01 μF	1500 pF-2700 pF 4700 pF-0.01 μF
C315	200V 100V 50V	10 pF-220 pF 270 pF-560 pF	270 pF-1500 pF 1000 pF-5600 pF 5600 pF-0.015 μF	1500 pF-5600 pF 6800 pF-0.022 μF
C32X	200V 100V 50V	1.0 pF-2200 pF 680 pF-5600 pF	1000 pF-0.012 μF 4700 pF-0.068 μF 0.012 μF-0.12 μF	6800 pF-0.068 μF 0.027 μF-0.22 μF
C33X	200V 100V 50V	2700 pF-0.01 μF 6800 pF-0.022 μF	0.015 μF-0.068 μF 0.082 μF-0.27 μF 0.15 μF-1.0 μF	0.082 μF-0.33 μF 0.27 μF-1.0 μF
C340	200V 100V 50V	0.012 μF-0.033 μF 0.027 μF-0.047 μF	0.082 μF-0.18 μF 0.33 μF-0.68 μF 1.2 μF-2.2 μF	0.39 μF-1.0 μF 1.2 μF-2.2 μF
C350	200V 100V 50V	0.039 μF-0.056 μF 0.056 μF-0.1 μF	0.22 μF-0.33 μF 0.82 μF-1.5 μF 2.7 μF-0.33 μF	1.2 μF-1.5 μF 2.7 μF-3.3 μF

AVAILABLE CAPACITANCE TOLERANCES

Dielectric	Capacitance Ratings	Available Capacitance Tolerances
COG	1.0 pF-9.1 pF 10 pF-24 pF 27 pF-51 pF 56 pF-up	O — ±0.5 pF J — ±5%, K — ±10% G — ±2%, J — ±5%, K — ±10% F — ±1%, G — ±2%, J — ±5%, K — ±10%
X7R	All	K — ±10%, M — ±20%
Z5U	All	M — ±20%, Z — −20% +80%, P — −0%, +100%

For further details on Golden Max Ceramic Capacitors, consult Catalog F-2795

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

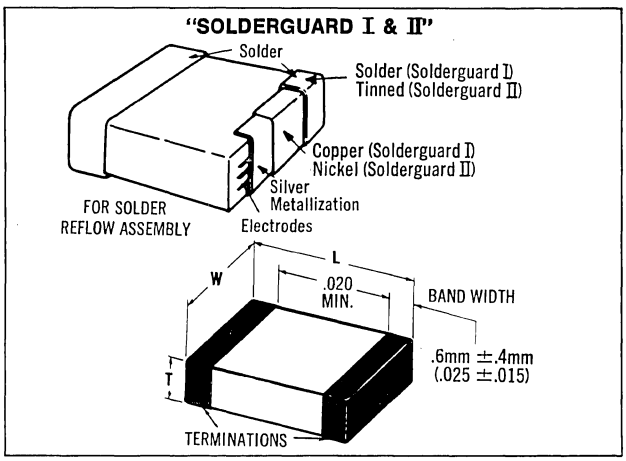
KEMET® MULTILAYER CERAMIC CAPACITORS

UNION CARBIDE

CHIP CAPACITORS FOR HYBRID CIRCUITS

Standard Solderguard (I & II) chips feature a unique barrier layer of copper or nickel in the end metallization that prevents silver leaching or scavenging and subsequent open circuits during assembly. The "Solderguard" chips will withstand solder reflow temperatures with little or no degradation of electrical continuity or performance. Silver palladium end termination is also available as standard. Other terminations available on special order include silver, gold and gold-palladium. KEMET chips are available in C0G, X7R and Z5U temperature characteristics in 50, 100 and 200 volt ratings.

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS — MILLIMETERS & (INCHES)

Size Code	L Length	W Width	T Thickness Max.
0805	2.0 ±0.2 (.078 ±.008)	1.25 ±0.2 (.049 ±.008)	1.4 (.055)
1005	2.5 ±0.2 (.098 ±.008)	1.25 ±0.2 (.049 ±.008)	1.5 (.059)
1206	3.2 ±0.2 (.126 ±.008)	1.6 ±0.2 (.063 ±.008)	1.5 (.059)
1210	3.2 ±0.2 (.126 ±.008)	2.5 ±0.2 (.098 ±.008)	1.5 (.059)
1805	4.5 ±0.3 (.177 ±.012)	1.25 ±0.3 (.049 ±.012)	1.5 (.059)
1808	4.5 ±0.3 (.177 ±.012)	2.0 ±0.3 (.078 ±.012)	2.0 (.079)
1812	4.5 ±0.3 (.177 ±.012)	3.2 ±0.3 (.126 ±.012)	2.0 (.079)
1825	4.5 ±0.3 (.177 ±.012)	6.4 ±0.3 (.252 ±.012)	2.0 (.079)
2225	5.6 ±0.4 (.220 ±.016)	6.4 ±0.4 (.252 ±.016)	2.0 (.079)

RATINGS & PART NUMBER REFERENCE

	Capacitance (pF)									MIL-C-55681 Capacitance (pF)			
	COG			X7R			Z5U			BP (NPO)	BX		
Size Code	Min.* Cap.	200V Min.-Max.	100 or 50 V Min.-Max.	Min.* Cap.	100V Min.-Max.	50V Min.-Max.	Min.* Cap.	100V Min.-Max.	50V Min.-Max.	100V Min.-Max.	100V Min.-Max.	50V Min.-Max.	MIL Type
0805	1	1-150	180-330	300	330-3900	4700-12,000	4700	4700-5600	6800-22,000	10-180	120-3300	3900-4700	CDR01
1005	1	1-330	390-680	330	330-5600	6800-18,000	6800	6800-10,000	12,000-47,000	N/A			—
1206	1	1-470	560-1000	1000	1000-10,000	12,000-47,000	12,000	12,000-22,000	27,000-100,000				
1210	560	560-1800	2200-3300	12,000	12,000-27,000	33,000-100,000	27,000	27,000-56,000	68,000-220,000	N/A			—
1805	470	470-1000	1200-2200	2700	2700-12,000	15,000-47,000	15,000	15,000-27,000	33,000-100,000	220-270	3900-10,000	12,000-22,000	CDR02
1808	470	470-2200	2700-4700	4700	4700-33,000	39,000-100,000	39,000	39,000-56,000	68,000-220,000	330-1000	12,000-33,000	39,000-68,000	CDR03
1812	470	470-3900	4700-10,000	10,000	10,000-68,000	82,000-220,000	82,000	82,000-150,000	180,000-560,000	1200-3300	39,000-56,000	82,000-180,000	CDR04
1825	4700	4700-8200	10,000-22,000	82,000	82,000-150,000	180,000-470,000	180,000	180,000-330,000	390,000-1,200,000	3900-5600	68,000-150,000	220,000-330,000	CDR05
2225	3300	3300-10,000	12,000-27,000	100,000	100,000-270,000	330,000-1,000,000	330,000	330,000-470,000	560,000-1,500,000	6800-10,000	N/A	390,000-470,000	CDR06

* Add 0.3mm to L, W & T dimensions for Solderguard I and Palladium-Silver chips.

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET®

FILM CAPACITORS

UNION CARBIDE

FLAT KAP FILM CAPACITORS

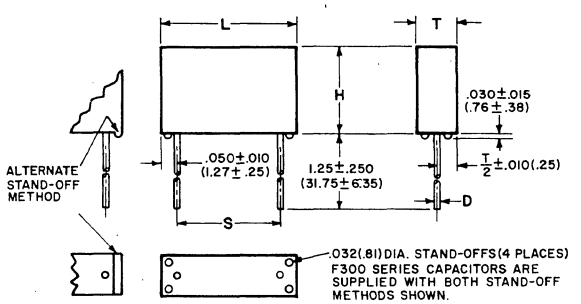
Flat Kaps are small ultra stable film capacitors ideally suited for filters, A/D converters, integrators, multivibrator timing capacitors, and other applications where capacitance stability is essential. This stability is obtained by locking the capacitor body in place with a solid impregnant. Outstanding electrical characteristics and volumetric efficiencies, up to 20 times greater than mica, glass, and porcelain are derived from the unique vacuum deposited dielectric, parylene.

Available in three different temperature coefficient of capacitance characteristics: −200 ±30, 0 ±50, and 0 ±100 ppm/°C over the operating range −55°C to +125°C. Capacitors are tested in accordance with MIL-C-55514 and are stocked in all standard values down to ±1% tolerance. Tighter tolerances and non-standard values are available from 0.001 μF to 1 μF on special order. For additional information refer to KEMET Film Capacitor Catalog.

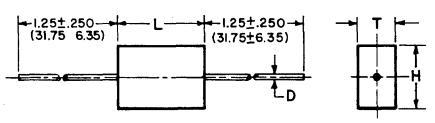
F110, F120 & F130 Hermetically Sealed Radial Lead Flat Kaps also available.

CAPACITOR OUTLINE DRAWINGS

F310 (MILITARY CFR04R), F320 & F330 RADIAL LEADS



F311 (MILITARY CFR04A), F321 & F331 AXIAL LEADS



FLAT KAP ORDERING INFORMATION

F 331 A 1201 G 050 A

FILM

***SERIES**
(Listed Below)

CASE SIZE

PICOFARAD CODE
First three digits represent significant figures. Fourth digit specifies number of zeros to follow.

CAPACITANCE TOLERANCE
K — ±10%
J — ±5%
G — ±2%
F — ±1%
D — ±0.5%

VOLTAGE

FAILURE RATE LEVEL
In Percent/1000 hr.
A — Non-Applicable
M — 1.0% P — 0.1%
R — 0.01% S — 0.001%

***SERIES**
300 Plastic Encapsulation, Flat Kaps
310 (CFR04R Per MIL-C-55514/3) A Temp. Coef., (−200 ±30 ppm) Molded, Radial Leads
311 (CFR04A Per MIL-C-5514/3) A Temp. Coef., (−200 ±30 ppm) Molded, Axial Leads
320 †B Temp. Coef., (0 ±100 ppm) Molded, Radial Leads
321 †B Temp. Coef., (0 ±100 ppm) Molded, Axial Leads
330 †C Temp. Coef., (0 ±50 ppm) Molded, Radial Leads
331 †C Temp. Coef., (0 ±50 ppm) Molded, Axial Leads

† A Temperature coefficient available through all ratings. B & C temperature coefficient available all ratings to 0.1 μF and to 0.22 μF on special order.

Flat Kap film capacitors are also available in hermetically sealed cases.

F320, F321, F330 & F331 capacitors are available from 0.001 μF through 0.22 μF only.

DIMENSIONS INCHES & (MILLIMETERS)

Case Size	H ±0.030 (±0.76)	L ±0.015 (±0.38)	T ±0.015 (±0.38)	S ±0.005 (±0.13)	D ±0.001 (±0.03)
A	0.280 (7.11)	0.500 (12.70)	0.125 (3.18)	0.400 (10.16)	0.020 (0.51)
B	0.375 (9.53)	0.500 (12.70)	0.195 (4.95)	0.400 (10.16)	0.025 (0.64)
C	0.375 (9.53)	0.600 (15.24)	0.195 (4.95)	0.500 (12.70)	0.025 (0.64)
D	0.375 (9.53)	0.600 (15.24)	0.295 (7.49)	0.500 (12.70)	0.025 (0.64)
E	0.375 (9.53)	0.750 (19.05)	0.500 (12.70)	0.650 (16.51)	0.025 (0.64)
F	0.375 (9.53)	1.000 (25.40)	0.600 (15.24)	0.900 (22.86)	0.032 (0.81)
G	0.375 (9.53)	1.500 (38.10)	0.600 (15.24)	1.400 (35.56)	0.032 (0.81)
H	0.550 (13.97)	1.500 (38.10)	0.600 (15.24)	1.400 (35.56)	0.032 (0.81)
J	0.375 (9.53)	0.600 (15.24)	0.225 (5.72)	0.500 (12.70)	0.025 (0.64)

For further details consult Flat Kap Film Capacitors Catalog F-2274

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

KEMET®

FILM CAPACITORS

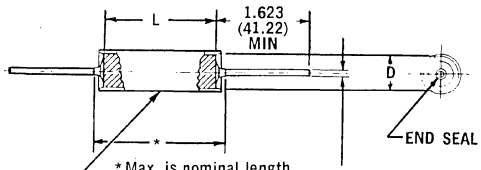
UNION CARBIDE

METALLIZED POLYCARBONATE FILM CAPACITORS

(MIL-C-83421/1A, MIL-C-39022/9 AND MIL-C-39022/10)

KEMET Metallized Polycarbonate Film Capacitors are designed for circuits requiring stable performance characteristics over a wide temperature range, small size, and operational reliability. They meet the same excellent quality standards associated with all other Union Carbide products. Electrical features include high insulation resistance, low dielectric absorption, low dissipation factor, and full voltage rating to 100°C. In addition, they are AC rated and have the self-healing properties that are inherent in a metallized dielectric. Typical applications include filtering, by-pass, timing, SCR commutating, and 400 cycle AC power circuits. Construction consists of high-purity metallized polycarbonate film with sprayed metal end terminations, hermetically sealed in ultra-small solder-coated tubular metal cases. The capacitance range is 0.001 to 22 μF with a DC voltage rating range of 30 to 600 volts. The 400 Hz AC voltage ratings range is 22 to 240 VRMS. The appropriate series are capable of meeting MIL-C-83421 CRH and MIL-C-39022 CHR requirements (see table below). For additional information refer to the KEMET Film Catalog Form F-2871.

CAPACITOR OUTLINE DRAWING



LEAD DIA. FOR F241 THRU F247 CAPACITORS

Case diameters .312 (7.92) and less: .025 (.64), 22 AWG
Case diameters .400 (10.16) and .500 (12.70): .032 (.81) 20 AWG
Case diameters .562 (14.27) and over: .040 (1.02), 18 AWG

LEAD DIA. FOR F248 CAPACITORS

Case diameters of .175 (4.45) and .195 (4.95): .020 (.51) 24 AWG
Case diameters of .235 (5.97) and .312 (7.92): .025 (.64) 22 AWG
Case diameters of .400 (10.16) and over: .032 (.81) 20 AWG

Millimeters are in parenthesis — 1 inch = 25.4mm

F24__ PART NUMBER IDENTIFICATION

F 241 A 1002 G 100 A

FILM CAPACITOR

SERIES
KEMET Metallized Polycarbonate

***KEMET REFERENCE NUMBER**
(See Table Below)

PICOFARAD CODE
First three digits represent significant figures.
Fourth digit specifies number of zeros to follow.

CAPACITANCE TOLERANCE

K — ±10%	G — ±2%	D — ±0.5%
J — ±5%	F — ±1%	C — ±0.25%

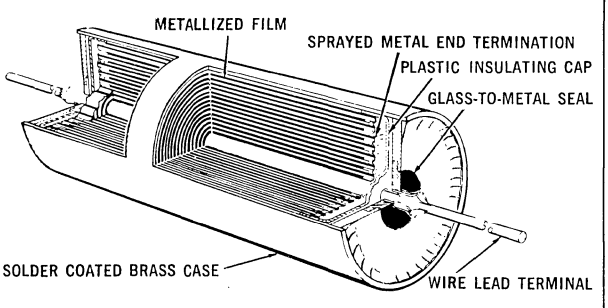
Note: C — 0.25% and D — 0.5% tolerances are available upon request.

VOLTAGE
Direct Reading

FAILURE RATE

A — Not Applicable	R — 0.01%/1,000 hr.
M — 1.0%/1,000 hr.	S — 0.001%/1,000 hr.
P — 0.1%/1,000 hr.	

TYPICAL HERMETICALLY SEALED METALLIZED CAPACITOR



Marking — Capacitors are printed with KEMET Series designation, tolerance, voltage, and date code.

*KEMET REFERENCE NUMBERS

KEMET Series		*	30 VDC	50 VDC	100 VDC	200 VDC	400 VDC
F241	MIL-C-83421/1	1	CRH01	CRH02	CRH03	CRH04	CRH05
F242	MIL-C-83421/1	2	CRH06	CRH07	CRH08	CRH09	CRH00
F245	MIL-C-39022/9	1	CHR01A	CHR01D	CHR01G	CHR01K	CHR01N
F246	MIL-C-39022/9	2	CHR01B	CHR01E	CHR01H	CHR01L	CHR01P
F247	MIL-C-39022/9	3	CHR01C	CHR01F	CHR01J	CHR01M	CHR01R

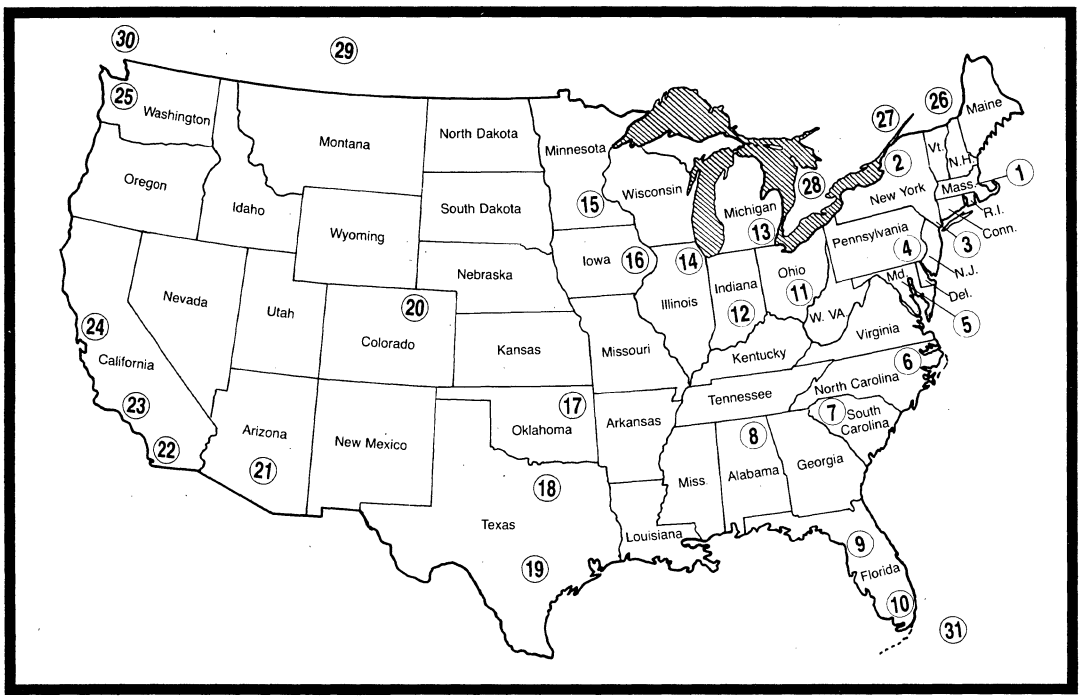
KEMET Series		50 VDC	100 VDC	200 VDC	300 VDC	400 VDC	600 VDC
F248	MIL-C-39022/10	CHR10	CHR10	CHR10	CHR10	CHR10	CHR10

* Quality Level

For further details consult Metallized Polycarbonate Film Capacitors Catalog F-2867

Union Carbide Corporation, Electronics Division
P.O. Box 5928, Greenville, SC 29606 / (803) 963-6300

UNION CARBIDE CORPORATION
ELECTRONIC DIVISION — U.S. HEADQUARTERS



KEMET® CAPACITOR OEM SALES REPRESENTATIVES

1. **UNION CARBIDE-ELECTRONICS DIVISION**
400 Unicorn Park Drive
Woburn, MA 01801
Phone: (617) 938-5400

2. **UNION CARBIDE-ELECTRONICS DIVISION**
300 Tulip Street
Liverpool, NY 13088
Phone: (315) 451-0720

3. **UNION CARBIDE-ELECTRONICS DIVISION**
150 White Plains Road, Room 207
Tarrytown, NY 10591
Phone: (914) 332-4000
TWX: 710-567-1222

4. **UNION CARBIDE-ELECTRONICS DIVISION**
347 North Pottstown Pike
Exton, PA 19341
Phone: (215) 363-8310

5. **UNION CARBIDE-ELECTRONICS DIVISION**
Grosvenor Century Plaza, Suite 126
10630 Little Patuxent Parkway
Columbia, MD 21044
Phone: (301) 992-5600

6. **UNION CARBIDE-ELECTRONICS DIVISION**
3101 Poplarwood Court, Suite 120
Box 95100
Raleigh, NC 27625
Phone: (919) 872-2877

7. **UNION CARBIDE-ELECTRONICS DIVISION**
Piedmont Center, Suite 406
33 Villa Road
Greenville, SC 29615
Phone: (803) 242-5789
TWX: 810-281-2235

8. **UNION CARBIDE-ELECTRONICS DIVISION**
500 Wynn Drive, Suite 301E
Huntsville, AL 35803
Phone: (205) 830-1090

9. **UNION CARBIDE-ELECTRONICS DIVISION**
4950 West Kennedy Blvd., Suite 400
Tampa, FL 33609
Phone: (813) 872-1861
TWX: 810-876-1568

10. **UNION CARBIDE-ELECTRONICS DIVISION**
1620 South Federal Highway, Suite 801A
Pompano Beach, FL 33062
Phone: (305) 785-1990

11. **UNION CARBIDE-ELECTRONICS DIVISION**
250 East Wilson Bridge Road, Suite 165
Worthington, OH 43085
Phone: (614) 436-1510

12. **UNION CARBIDE-ELECTRONICS DIVISION**
Fidelity Bank Plaza, Suite 260
11550 North Meridian St.
Carmel, IN 46032
Phone: (317) 844-7756
TWX: 810-260-2639

13. **UNION CARBIDE-ELECTRONICS DIVISION**
39201 Seven Mile Road, Suite 300
Livonia, MI 48152
Phone: (313) 591-0555

14. **UNION CARBIDE-ELECTRONICS DIVISION**
Woodfield Office Plaza
1111 Plaza Drive, Suite 414
Schaumburg, IL 60195
Phone: (312) 843-1030
TWX: 910-291-2493

15. **UNION CARBIDE-ELECTRONICS DIVISION**
6600 France Avenue, Suite 420
Edina, MN 55435
Phone: (612) 929-4642

16. **SELTEC SALES CORPORATION**
1930 St. Andrews Drive, N.E.
P.O. Box 2172
Cedar Rapids, IA 52406
Phone: (319) 393-1114
TWX: 910-525-1329

17. **UNION CARBIDE-ELECTRONICS DIVISION**
Exchange Bank Tower, Suite 914
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Tulsa, OK 74145
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18. **UNION CARBIDE-ELECTRONICS DIVISION**
Waterway Office Tower, Suite 700
433 East Las Colinas Blvd.
Irving, TX 75039
Phone: (214) 556-0009
TWX: 910-860-5750

19. **UNION CARBIDE-ELECTRONICS DIVISION**
111 West Anderson Lane, Suite 205
Austin, TX 78752
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20. **UNION CARBIDE-ELECTRONICS DIVISION**
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Suite 232
Englewood, CO 80112
Phone: (303) 773-0494

21. **UNION CARBIDE-ELECTRONICS DIVISION**
4651 South Lakeshore Dr., Suite 3
Tempe, AZ 85282
Phone: (602) 831-2151
TWX: 910-951-0125

22. **UNION CARBIDE-ELECTRONICS DIVISION**
8840 Complex Dr., Suite 125
San Diego, CA 92123
Phone: (714) 560-0768

23. **UNION CARBIDE-ELECTRONICS DIVISION**
4676 Admiralty Way, Suite 302
Marina del Rey, CA 90291
Phone: (213) 821-8824
TWX: 910-343-6244

24. **UNION CARBIDE-ELECTRONICS DIVISION**
2680 Bayshore Frontage Road, Suite 106
Mountain View, CA 94043
Phone: (415) 969-9390

25. **UNION CARBIDE-ELECTRONICS DIVISION**
301 116th Ave., S.E., Suite 240
Bellevue, WA 98004
Phone: (206) 455-4009

26. **DESKIN SALES CORPORATION**
290 Benjamin Hudon Street
Ville St. Laurent, Quebec
H4N 1J4
Phone: (514) 331-2860
TWX: 610-421-3793
Telex: 05-827584

27. **DESKIN SALES CORPORATION**
130 Slater Street, Suite 225
Ottawa, Ontario
K1P 5H6
Phone: (613) 238-4542
Telex: 053-4516

28. **DESKIN SALES CORPORATION**
77D Steelcase Road, West
Markham, Ontario
L3R 2M4
Phone: (416) 475-1412
TWX: 610-492-5113

29. **DESKIN SALES CORPORATION**
102-12604 126 Street
Edmonton, Alberta
T5L 0X6
Phone: (403) 451-4805
TWX: 610-831-1660

30. **DESKIN SALES CORPORATION**
105-3930 Jacombs Road
Richmond, B.C.
V6V 1Y6
Phone: (604) 273-4963
TWX: 610-922-5036

31. **CARIBBEAN AREA INQUIRIES — ISLA CARIBE ELECTRO SALES**
Ponce de Leon #1057
Santurce, Puero Rico 00907
Phone: (809) 722-5140
(809) 724-1572
(809) 724-0917

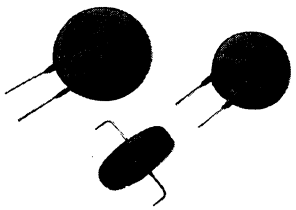
Union Carbide Corporation, Electronics Division, P.O. Box 5928, Greenville, S.C. 29606, (803) 963-6300

CERAMIC CAPACITORS

MAIDA DEVELOPMENT COMPANY

"DOMESTIC CAPACITOR MANUFACTURERS SINCE 1947"

HIGH VOLTAGE DISCS



Applications: Voltage multipliers, high voltage power supplies.

X5R HIGH VOLTAGE DISCS — 10, 15, 20 KV

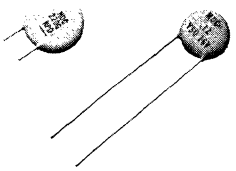
Voltage	Capacitance Range
10 KV	500pF — 2000pF
15 KV	500pF — 1500pF
20 KV	500pF — 1000pF

Applications: High voltage operation such as TV deflection circuits where corona is a problem.

ANTI-CORONA DISCS — 1 thru 6 KV

Class	T.C.	Max. Capacitance 1 KV	Max. Capacitance 6 KV
1	N750	680pF	180pF
	N1500	1100pF	300pF
	N2200	1600pF	430pF
	N3300	2700pF	750pF
2	Z5P	11000pF	3000pF
	X7R	14000pF	3900pF
	Z5U	27000pF	5100pF

500 VOLT DISCS



Applications: Hi Q capacitance stability. General purpose, by-pass, coupling, etc.

500 VOLT DISCS — CLASS 1 and 2

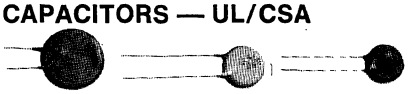
Class	T.C.	Capacitance Range
1	P100 — N5600	3pF — 5100pF
2	Z5P/X7R	470pF — 12000pF
	Z5U	1000pF — 27000pF
	Z5V	1600pF — 47000pF

Applications: High capacitance density where D.F. and T.C. are not critical.

LOW-VOLTAGE DISCS — CLASS 3 — 16, 25, 50 VOLTS

Voltage	T.C.	Capacitance Range
16VDC	Y5S	.01mF — .15mF
25VDC	Y5S	.01mF — .15mF
50VDC	Y5S	.01mF — .1mF

CAPACITORS — UL/CSA

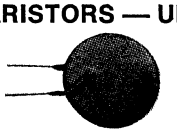


Applications: Line-by-pass, antenna coupling, across-the-line. Double protection for above.

CAPACITORS

Type	Approval	T.C.	Max. Cap.
UWAUW	UL/CSA	Z5U	10000pF
DP	UL/CSA	Z5U	5000pF

VARISTORS — UL



Applications: Across-the-line, transient overvoltage protection, energy absorption to 80 joules.

VARISTORS (UL APPROVED)

Series	Voltage VAC	Voltage VDC	VDC @ 1mA	V Clamp @ 10A
Z121	120	160	170 min.	310 max.
Z131	130	175	184 min.	330 max.
Z151	150	200	210 min.	380 max.

CLOSE TOLERANCE DISCS

Applications: ±0.5%, ±1.0%, ±2.0% tolerances.

NPO (COG) CLOSE TOLERANCE DISCS

Voltage	T.C.	Capacitance Range
500VDC	NPO	16pF — 470pF

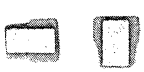
LEADLESS DISCS CLASS 1

Applications: UHF circuits with very low inductance.

LEADLESS DISCS — CLASS 1

Voltage	T.C.	Capacitance Range
500VDC	NPO-N1500	1.8pF — 39pF

500 VOLT TRAPEZOIDS



Applications: Solder into slot for minimum lead inductance.

500 VOLT TRAPEZOIDS — CLASS 1 and 2

Class	T.C.	Capacitance Range
1	P100-N1500	1.5pF — 51pF
2	Z5P-Z5U	150pF — 1000pF

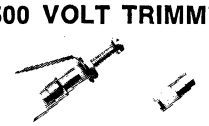
500 VOLT BUTTON FEEDTHRUS

Applications: High frequency by-pass, integral mounting surface, low inductance. Hollow pins available.

500 VOLT BUTTON FEEDTHRUS

Class	T.C.	Capacitance Range
1	S2L-S3N	3.0pF — 39pF
2	Z5P-Z5U	470pF — 1000pF

500 VOLT TRIMMER



Applications: Variable capacitive circuit elements of the screw adjustment type.

500 VOLT TRIMMERS

Material	Style	Capacitance Range
Steatite	610A	0.8pF — 4.0pF
Steatite	900A	0.5pF — 2.4pF
N220	655C	2.5pF — 9.5pF
N400	720C	3.0pF — 15.0pF

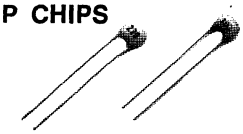
MULTILAYER CHIP CAPACITORS

Applications: Hybrid circuits.

MULTILAYER CHIP CAPACITORS — NPO, X7R, Z5U

Voltage	Max. Capacitance Value NPO	X7R	Z5U
50VDC	.012mF	.27mF	.6mF
100VDC	9100pF	.22mF	.51mF
200VDC	5600pF	.1mF	.27mF

MULTILAYER RADIAL LEAD DIP CHIPS



Applications: High volumetric efficiency in printed circuit boards.

MULTILAYER RADIAL LEAD DIP CHIPS — NPO, X7R, Z5U

Voltage	Max. Capacitance Value NPO	X7R	Z5U
50VDC	.062mF	1.2mF	3.3mF
100VDC	.042mF	1.0mF	2.2mF
200VDC	.027mF	.56mF	1.0mF

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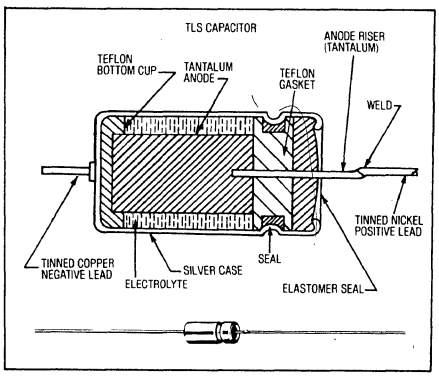
MALLORY

TANTALUM WET SLUG CAPACITORS

TLS-TLH EXTENDED CAPACITANCE MINIATURE POLAR HIGH CAPACITANCE — LOW DC LEAKAGE



STANDARD AND EXTENDED RANGE RATINGS

Mallory TLS wet slug tantalum capacitors are available in 4 miniature case sizes with high capacitance at dual voltage ratings for 85°C and 125°C operation. The TLH is a higher capacitance version of the TLS with the same high performance and reliability. TLS-TLH capacitors exhibit very low DCL, low ESR, with electrical stability over a broad temperature range from −55°C to +125°C.

The low DCL characteristic of TLS-TLH capacitors is ideally suited for critical timing circuits. The miniature size and rugged construction of the TLS-TLH is intended for applications where space is a premium and resistance to shock and vibration is a requirement.

High reliability and long life is assured by the rugged mechanical construction of the TLS-TLH. A combination elastomer-teflon seal assembly is firmly seated in a silver case by a precision groove and roll-over crimp that virtually eliminates electrolyte leakage. The tantalum anode is firmly seated in the case by teflon shock pads.

The TLS is in accord with EIA Specifications RS-228 and meets all requirements of MIL-C-3965 and can be used as a replacement for applications where Type CL64, CL65 are used.

As a cost savings Mallory offers the CTL silver-plated, copper-alloy case capacitor in the same ratings, case sizes, end seal construction as the TLS. Refer to CTL TIB 4-610A for complete details. Refer to TIB 4-604 for TLS data.

SPECIFICATIONS

- **CAPACITANCE:** To 2200 μF
- **VOLTAGE:** 6 to 125 VDC @ 85°C; 4 to 85 VDC @ 125°C
- **TOLERANCE:** ±20: ±10: ±5: on special order
- **CASE SIZES:** 4 sizes, .188″ x .453″ to .375″ x 1.062″
- **TEMPERATURE:** −55°C to 125°C

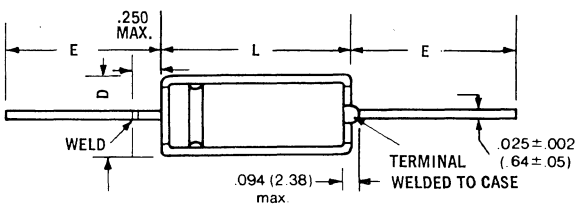
KEY FEATURES

- High capacitance per case size
- Extremely low DCL
- Long operating life
- Wide operating temperature range
- Rugged mechanical construction

APPLICATIONS

- Filter, coupling, bypass circuits
- Critical timing circuits
- Low source impedance circuits
- High charging current circuits

SIZE AND CONFIGURATIONS



CASE SIZE	UNINSULATED DIAMETER D ±.016 IN. (±.40mm)	UNINSULATED LENGTH L +.031 −.016 IN. (+.80 −.40mm)	INSULATED DIAMETER D MAXIMUM IN. (mm)	INSULATED LENGTH L MAX. IN. (mm)	E LEAD LENGTH ±.25 IN. (±6.35mm)
A	.188 (4.78)	.453 (11.51)	.219 (5.56)	.608	1.50 (38.10)
B	.281 (7.14)	.641 (16.28)	.312 (7.94)	.796	2.25 (57.15)
C	.375 (9.53)	.766 (19.46)	.406 (10.32)	.921	2.25 (57.15)
F	.375 (9.53)	1.062 (26.99)	.406 (10.32)	1.217	2.25 (57.15)

Note: The case insulation shall extend .016 inch minimum, .062 maximum beyond each end. However, when a shrink-fitted insulation is used, it shall lap over the ends of the capacitor body.

MAXIMUM CAPACITANCE — VOLTAGE PER CASE SIZE

CASE SIZE	WORKING VOLTAGE (WVDC) / MAXIMUM CAPACITANCE IN μF										
	6	8	10	15	25	30	50	60	75	100	125
A	220	180	150	100	68	56	33	27	22	4.7	36
B	820	680	560	390	270	220	120	100	82	22	14
C	1500	1500	1200	820	560	470	270	220	180	43	25
F	2200	1800	1500	1000	680	560	330	270	220	86	56

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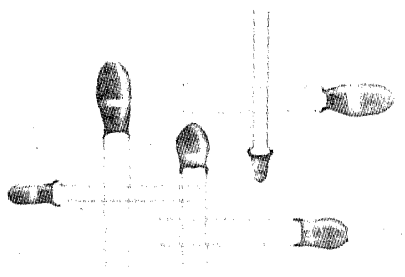
TANTALUM SOLID ELECTROLYTE CAPS

TDC TYPE — LOW COST DIPPED EPOXY



HIGH CAPACITANCE/VOLTAGE PER CASE SIZE

The TDC is a Solid Electrolyte Tantalum Capacitor which features a self insulating, hard, dip coated epoxy protective covering.

This capacitor exhibits an extremely high volumetric efficiency (CV product per unit volume) and is supplied in four (4) case sizes to cover a wide range of ratings.

TDC's are supplied with space saving, solderable, radial leads which are formed to provide a mounting standoff for easy assembly and soldering operations.

The TDC is ideally suited for commercial and industrial applications where low cost and the inherent features of a Solid Electrolyte Tantalum Capacitor are required. These features include excellent stability at high and low temperatures, low DC leakage and equivalent series resistance, wide operating temperature range, long storage and shelf life and excellent impedance verses frequency and temperature characteristics.

For additional information send for 4-810B.

SPECIFICATIONS

- **CAPACITANCE:** .10 to 330 μF
- **VOLTAGE:** 6 to 50 VDC
- **TOLERANCE:** ±20% Standard ±10% Optional
- **Temperature:** −55°C to 85°C, 125°C with voltage derating
- **CASE SIZES:** 4 sizes from .175" to .350" to .400" to .750"

KEY FEATURES

- Low cost
- Flame retardant case
- High capacitance per case size
- Long life

APPLICATIONS

- Bypass, coupling, timing
- Filtering in consumer and industrial equipment

OUTLINE DIMENSIONS

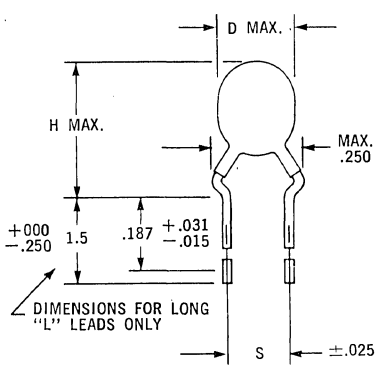


FIG. I
E & F CASE SIZE
.125 LEAD SPACING

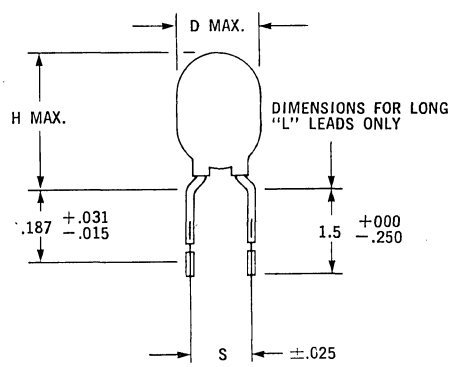


FIG. II
E, F, G & H CASE SIZE
.250 LEAD SPACING

CASE	DIAMETER HEIGHT D In. (mm)	H In. (mm)	LEADS SPACE In. (mm)	CODE	DIA. In. (mm)	AWG
E	.175 (4.45)	.350 (8.89)	.125 (3.17) .250 (6.35)	N W	.020 (.51) .025 (.64)	#24 #22
F	.250 (6.35)	.500 (12.7)	.125 (3.17) .250 (6.35)	N W	.020 (.51) .025 (.64)	#24 #22
G	.350 (8.89)	.650 (16.51)	.250 (6.35)	W	.025 (.64)	#22
H	.400 (10.16)	.750 (19.05)	.250 (6.35)	W	.025 (.64)	#22

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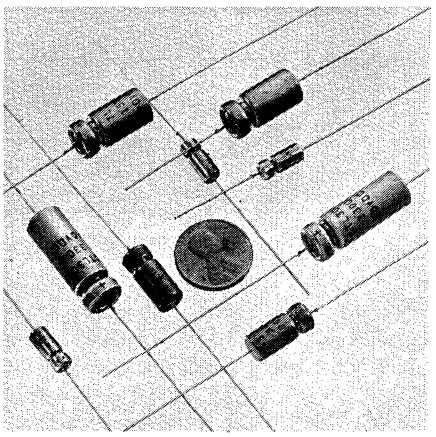
TANTALUM WET SLUG CAPACITORS

CTL TYPE — LOW COST, MINIATURE, HIGH CAPACITANCE, POLAR



LOWER COST — LOW DC LEAKAGE

STANDARD AND EXTENDED RANGE RATINGS

The CTL wet slug tantalum capacitor is now available in a new improved proprietary silver plated copper alloy case. The CTL offers at lower cost the same ratings, case sizes, and electrical performance as silver case wet slug capacitors.

The miniature size and rugged construction of the CTL is identical to the Mallory TLS wet slug capacitor. The sintered tantalum anode is firmly seated in the case on a teflon shock pad. The anode riser extends through a combination elastomer-teflon seal assembly which is seated in the case by a precision groove and roll-over crimp. The double seal construction virtually eliminates electrolyte leakage.

The CTL offers a cost savings as an exact replacement for silver case wet slug tantalum capacitors.

Refer to TIB 4-610A.

HIGHLIGHTS

- **CAPACITANCE:** To 2200 μF
- **VOLTAGE:** 6 to 125 VDC @ 85°C; 4 to 85 VDC @ 125°C
- **TOLERANCE:** ±20%, ±10%; ±5% on special order
- **CASE SIZES:** 4 sizes, .188″ x .453″ to .375″ x 1.062″
- **TEMPERATURE:** −55°C to 125°C

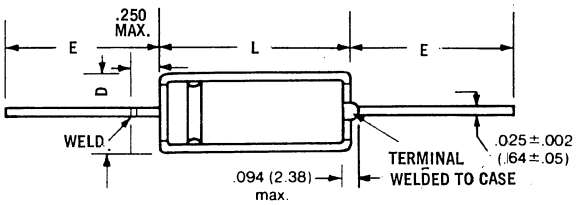
KEY FEATURES

- High capacitance per case size
- Extremely low DCL
- Long operating life
- Wide operating temperature range
- Rugged mechanical construction

APPLICATIONS

- Filter, coupling, bypass circuits
- Critical timing circuits
- Low source impedance circuits
- High charging current circuits

SIZE AND CONFIGURATIONS



CASE SIZE	UNINSULATED DIAMETER D ±.016 IN. (±.40mm)	UNINSULATED LENGTH L +.031 −.016 IN. (+.80 −.40mm)	INSULATED DIAMETER D MAXIMUM IN. (mm)	INSULATED LENGTH L MAX. IN. (mm)	E LEAD LENGTH ±.25 IN. (±6.35mm)
A	.188 (4.78)	.453 (11.51)	.219 (5.56)	.608	1.50 (38.10)
B	.281 (7.14)	.641 (16.28)	.312 (7.94)	.796	2.25 (57.15)
C	.375 (9.53)	.766 (19.46)	.406 (10.32)	.921	2.25 (57.15)
F	.375 (9.53)	1.062 (26.99)	.406 (10.32)	1.217	2.25 (57.15)

Note: The case insulation shall extend .016 inch minimum, .062 maximum beyond each end. However, when a shrink-fitted insulation is used, it shall lap over the ends of the capacitor body.

MAXIMUM CAPACITANCE — VOLTAGE PER CASE SIZE

CASE SIZE	WORKING VOLTAGE (WVDC) MAXIMUM CAPACITANCE IN μF										
	6	8	10	15	25	30	50	60	75	100	125
A	220	180	150	100	68	56	33	27	22	4.7	3.6
B	820	680	560	390	270	220	120	100	82	22	14
C	1500	1500	1200	820	560	470	270	220	180	43	25
F	2200	1800	1500	1000	680	560	330	270	220	86	56

For high-volume applications any capacitance value from 1.7 ΩF to the maximum capacitance of this table may be ordered.

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TANTALUM WET SLUG CAPACITORS

CMT TYPE — LOW COST, SUBMINIATURE

LOWER COST, SUBMINIATURE TUBULAR WET SLUG — POLAR

The CMT copper alloy case wet slug tantalum capacitor offers highest capacitance in subminiature size at lowest cost. The proprietary copper alloy case provides a significant cost savings over similar miniature capacitors in silver cases. The size and rugged construction of the CMT is intended for applications where space is a premium and resistance to shock and vibration is a requirement. The low and stable DCL characteristic of the CMT is ideally suited for application in timing circuits. Excellent high frequency performance and stable operation over a wide temperature range allow use in a variety of applications.

The rugged construction of the CMT includes mounting the tantalum anode on a shock pad positioned in a copper alloy case. A nickel lead wire is welded to the anode. The use of sulphuric acid electrolyte assures good low temperature impedance and capacitance characteristics. Special treatment of the copper alloy case prevents attack by the sulphuric acid. The capacitor is sealed by roll-crimping onto a special elastomer seal. An insulating sleeve covers the case and red epoxy encapsulant that protects the seal and encloses the positive lead wire weld. The CMT is suitable for use in automatic insertion equipment and can be furnished lead-tape and reel packaged.

For additional information send for TIB-4-609A.

HIGHLIGHTS

- **CAPACITANCE:** To 470 μF
- **VOLTAGE:** 6 to 60 VDC
- **TOLERANCE:** ±10%, ±20%
- **CASE SIZES:** 4 sizes .115″ x .300″ to .225″ x .778″
- **TEMPERATURE:** −55°C to +85°C

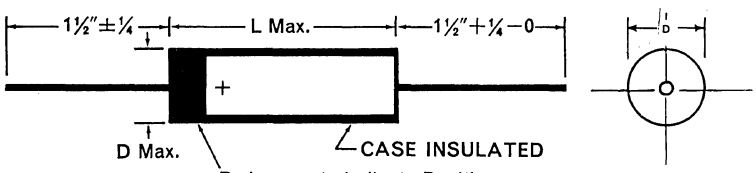
KEY FEATURES

- Highest CV per given volume
- Low, stable DCL
- Excellent shelf and operating life
- Rugged mechanical construction

APPLICATIONS

- Timing circuits, filter coupling, bypass circuits

SIZE AND CONFIGURATIONS



Lead Size: .020″ ±.001 Diameter

Lead Material: Positive, Tinned Nickel; Negative, Tinned Copper

Polarity Marking: Plus Signs Around the Anode End

CASE SIZE	LENGTH	DIAMETER	APPROXIMATE WEIGHT (PER UNIT IN GRAMS)
D	.300	.115	0.40
A	.403	.115	0.50
B	.600	.145	1.00
C	.778	.225	2.60

MAXIMUM CAPACITANCE — VOLTAGE PER CASE SIZE

CASE CODE	WORKING VOLTAGE (WVDC) MAXIMUM CAPACITANCE IN μF						
	6	10	15	20	30	50	60
D	15	10	8	6.8	6	4.0	3.3
A	47	30	20	15	10	6.8	5.6
B	180	120	80	60	45	30	22
C	470	330	220	150	120	78	68

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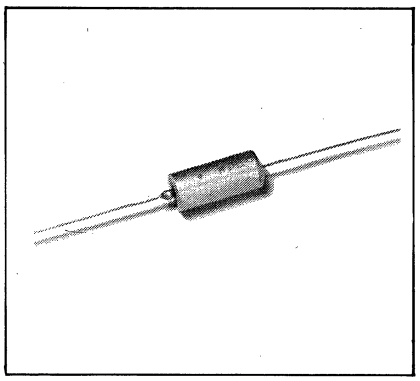
TANTALUM SOLID ELECTROLYTE CAPACITORS

THF TYPE — HIGH RIPPLE PERFORMANCE

FOR SWITCHING REGULATOR POWER SUPPLY APPLICATIONS



ONE THF CAPACITOR CAN REPLACE UP TO FOUR CSR TYPES

The THF is designed to provide stable capacitance, low impedance, and higher ripple current capability at high frequency. A patented special configuration anode offers lower ESR and impedance at frequencies above 1 kHz through 100 kHz. The lower power loss characteristics of the THF makes it suitable for output filtering in switching regulator power supplies.

The inherent electrical stability and lower power loss of the THF allows it to carry the same ripple current that would require up to four conventional solid tantalum capacitors. Savings in cost, space, and weight can be realized by use of the THF in high frequency ripple current applications.

The military version of the THF is approved to meet all the requirements of military specification MIL-C-39003/9 Style CSR21. Refer to Bulletin 4-819 for specifications and MIL part numbers. Refer to TIB 4-805B for complete details.

SPECIFICATIONS

- **Capacitance**
  5.6 to 330 μF
- **Voltage**
  6 to 50 VDC
- **Tolerance**
  Standard ±20% — ±10% optional
- **Temperature**
  −80°C to +125°C
- **Case Size**
  2 sizes, .29 x .69 & .35 x .79 inches

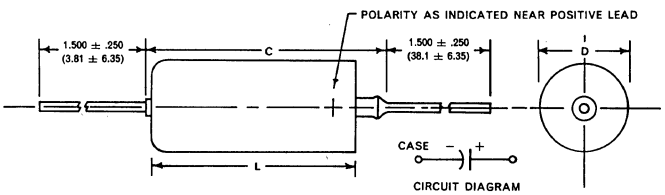
KEY FEATURES

- High Ripple Current
- Low ESR
- Lower Impedance at High Frequencies
- Small Size
- Extremely Stable Capacitance
- Hermetic Seal
- Long Life

APPLICATIONS

- Switching Regulators
- High Frequency Power Supplies
- By-pass Filtering

SIZE AND CONFIGURATIONS



CASE CODE	UNINSULATED CASE DIMENSIONS D: +.016 −.010 IN. (+.41 −.25mm)	UNINSULATED CASE DIMENSIONS L: ±.031 IN. (±.79mm)	INSULATED CASE DIMENSIONS D: +.016 −.010 IN. (+.41 −.25mm)	INSULATED CASE DIMENSIONS L: ±.031 IN. (±.79mm)	OVERALL DIMENSIONS C MAX. IN. (mm)	LEAD DIAMETER A: +.005 −.001 IN. (+.127 −.025mm)
F	.279 (7.08)	.650 (16.5)	.289 (7.34)	.686 (17.4)	.822 (20.9)	.025 (.635)
G	.341 (8.66)	.750 (19.1)	.351 (8.91)	.786 (19.9)	.622 (23.4)	.025 (.635)

MAXIMUM CAPACITANCE — VOLTAGE PER CASE SIZE

CASE CODE	WORKING VOLTAGE (WVDC) 6	10	15	20	35	50
	MAXIMUM CAPACITANCE IN μF					
F	180	120	68	47	22	18
G	330	220	150	100	47	22

MAXIMUM RIPPLE CURRENT @ 100 kHz PER RATED WORKING VOLTAGE @ 25°C

WVDC	6	10	15	20	35	50
MAXIMUM RMS RIPPLE IN mA	4300	3900	3600	3300	2700	2300

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MALLORY
ELECTRICAL/ELECTRONIC GROUP
EMHART

MALLORY TANTALUM SOLID ELECTROLYTIC CAPACITORS

TYPE	DESCRIPTION	TERMINALS	TEMP. RANGE (°C)	Volt. Range (WVDC)	CAP. RANGE (μF)	STD. TOL. (% μF)	CASE SIZES DIA. x LGTH. (Inches) H x W x D (Inches)	FEATURES	TIB*
TAS TXA	Metal Tubular, Axial Lead Hermetic Seal	Wire Leads 22 AWG 24 AWG	−80 to +125	6 to 100	.0047 to 1000	±5 ±10 ±20	.125x.250 .175x.438 .279x.650 .341x.750	Standard Capacitance - TAS Extended Capacitance - TXA Low DC Leakage Temperature Stable High Capacity, Long Shelf Life	4-801A
TFR	Metal Case, Tubular, Axial Lead Hermetic Seal	Wire Leads 22 AWG	−55 to +125	6 to 50	22 to 330	±5 ±10 ±20	.289x.686 .351x.786	MIL-C-39003 CSR21 High Frequency, High Ripple Capability, High Reliability	4-819
TAE	Metal Tubular, Epoxy Fill Axial Lead	Wire Leads 22 AWG 24 AWG	−55 to +85	6 to 100	.0047 to 1000	±10 ±20	.126x.265 .175x.325 .175x.452 .279x.650 .341x.750	High Shock & Vibration Capability	4-85
TER TXE TXR	Mylar Sleeved, Metal Tubular, Axial Lead Hermetic Seal	Wire Leads 22 AWG 24 AWG	−55 to +125	6 to 100	.0047 to 1000	±5 ±10 ±20	.135x.286 .185x.474 .289x.686 .351x.786	MIL-C-39003D CSR13, 23, 33 High Reliability	4-813A
TNR	Metal Tubular, Axial Lead Non Polar	Wire Leads 22 AWG 24 AWG	−55 to +125	6 to 100	.0023 to 160	±5 ±10 ±20	.161x.575 .207x.955 .314x1.35 .376x1.55	MIL-C-39003D CSR 91 High Reliability, Non-Polar Application	4-815
THF	Mylar Sleeved, Metal Tubular, Axial Lead Hermetic Seal	Wire Leads 22 AWG	−80 to +125	6 to 50	5.6 to 330	±10 ±20	.289x.686 .351x.786	4.5 Amps Ripple Capability, Low ESR at High Freq. from 1 kHz-100 kHz	4-805B
TAN TXN	Metal Case Tubular Hermetic Seal	Wire Leads 22 AWG 24 AWG	−55 to +125	6 to 50 VNP	2.8 to 500	±5 ±10 ±20	.161x .575 .207x .955 .314x1.350 .376x1.550	Non-Polar, Standard and Extended Range Capacity	4-817
TIM	Rectangular, Molded Epoxy Radial Lead	Wire Leads Single Ended 22 AWG 24 AWG	−55 to +125	3 to 50	.082 to 220	±10 ±20	.340x.228x.105 .225x.285x.170 .335x.360x.170 .375x.600x.195	High Density Mounting, Automatic Insertion Capability	4-806B
TAC	Molded Epoxy, Tubular, Axial Lead	Wire Leads 22 AWG 24 AWG	−55 to +125	3 to 50	.082 to 68	±10 ±20	.105x.300 .148x.350 .180x.350 .200x.540	Automatic Insertion Capability, High Shock & Vibration Capability	4-807C
TDM	Epoxy Dipped, Rectangular Radial Lead	Wire Leads Single Ended 24 AWG	−55 to +85	6 to 50	.10 to 330	±10 ±20	.27x.27x.18 .33x.32x.21 .37x.40x.22 .40x.40x.25 .46x.48x.32 .56x.58x.32	Low Profile, Low Cost, High Volumetric Efficiency	4-810B
TDC	Plastic Dipped, Radial Lead	Wire Leads LD Spacing .125 & .250	−55 to +85	6 to 50	.10 to 330	±10 ±20	.17x.35 .25x.50 .35x.65 .40x.75	Low Cost, Extended Capacitance, Temp. Stable, Long Storage Life	4-810B
TDL	Plastic Dipped, Radial Lead	Wire Leads LD Spacing .10 & .20	−55 to +85	3 to 50	.10 to 330	±10 ±20	.18x.28 .20x.30 .26x.36 .34x.40 .40x.56 .44x.68	Low Cost, Low Profile, Long Storage Life	4-810B
TDR	Plastic Dipped, Radial Lead	Wire Leads Lead Space .125 & .250	−55 to +85	6 to 50	.10 to 330	±10 ±20	.175x.350 .250x.500 .350x.650 .400x.750	MIL-C-49137/2 CX02 CX12	4-816

* Technical Information Bulletin

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MALLORY
ELECTRICAL/ELECTRONIC GROUP
EMHART

MALLORY

TANTALUM WET SLUG CAPACITORS

TYPE	DESCRIPTION	TERMINALS	TEMP. RANGE (°C)	Volt. Range (WVDC)	CAP. RANGE (μF)	STD. TOL. (% μF)	CASE SIZES DIA. x LGTH. (Inches) H x W x D (Inches)	FEATURES	TIB*
TLX TXX	Silver Tubular, Axial Lead, Hermetic Seal Mylar Sleeve	Wire Leads 22 AWG	−55 to +125	6 to 125	1.7 to 2200	±5 ±10 −15 +20 −15 +30 −15 +50	.219x .608 .312x .796 .406x .921 .406x1.217	MIL-C-39006 CLR65 & CLR69 High CV, Long Life, High Reliability	4-612
CL66 CL67	Silver Tubular, Axial Lead, Hermetic Seal	Wire Leads 22 AWG	−55 to +125	6 to 125	1.7 to 2200	±5 ±10 ±20	.219x .608 .312x .796 .406x .921 .406x1.217	MIL-C-3965 CL66, CL67 Rugged Construction Long Life	4-6111B
TLW	Silver Tubular, Axial Lead, Hermetic Seal Kapton Sleeve	Wire Leads 22 AWG	−55 to +175	6 to 100	2.5 to 1200	±5 ±10 ±2	.219x .608 .312x .796 .406x .921 .406x1.217	High Cap, High Temp. to 175°C	4-611B
TLT	Tantalum Case, Tubular, Axial Lead Hermetic Seal	Nickel Wire Heads 22 AWG	−55 to +125	6 to 100	2.5 to 1200	±5 ±10 ±20	.312x .796 .406x .921 .406x1.217	MIL-C-39006 CLR79 High CV Reverse Voltage Capability, High Reliability	4-616
TLS TLH	Silver Tubular, Axial Lead Elastomer Seal	Wire Leads 22 AWG	−55 to +125	6 to 125	1.7 to 2200	±5 ±10 −15 +20 −15 +30 −15 +50	.219x .608 .312x .796 .406x .921 .406x1.217	MIL-C-3965 Styles CL64 & CL65, Low DCL, Wide Temp. Range	4-604
CTL	Copper Alloy Tubular, Axial Lead Elastomer Seal	Wire Leads 22 AWG	−55 to +125	6 to 125	3.6 to 1200	±10 −15 +20 −15 +30 −15 +50	.219x .608 .312x .796 .406x .921 .406x1.217	Low Cost, Low DCL, Wide Temp. Range	4-610A
CMT	Copper Alloy Tubular, Red Plastic, Case Insulated	Wire Leads 24 AWG	−55 to +85	6 to 60	1 to 450	±20	.115x.300 .115x.403 .145x.600 .225x.778	Low Cost, High Cap, Miniature Size	4-609A
MTP	Silver Tubular, Red Plastic, Axial Lead Case Insulated	Wire Leads 24 AWG	−55 to +85	6 to 60	3.3 to 470	±20	.115x.300 .115x.403 .145x.600 .225x.778	High Cap, Miniature Size	4-606A
MTPH	Silver Tubular, Red Plastic, Axial Lead Case Insulated	Wire Leads 24 AWG	−55 to +85	6 to 60	4.7 to 470	±10 ±20	.115x.403 .145x.600 .225x.778	High Reliability, Miniature Size	4-614
TAP	Silver Tubular, Black Plastic, Axial Lead Case Insulated	Wire Leads 24 AWG	−55 to +85	6 to 90	2 to 330	−15 +75 −15 +50 −15 +20 −10 +20 ±10	.226x.504 .226x.560 .226x.847	Low ESR, Miniature Size	4-602
TNT	Silver Tubular, Yellow Plastic, Axial Lead Case Insulated	Wire Leads 24 AWG	−55 to +85	3 to 50	2 to 80	−15 +75	.163x.347 .163x.472	Low DCL, Miniature Size	4-601
TAH	Silver Tubular, Green Plastic, Axial Lead Case Insulated	Wire Leads 24 AWG	−55 to +125	4 to 60	2 to 330	−15 +75 ±10 −10 +20 −15 +20 −15 +50	.238x.470 .238x.600 .238x.810	Miniature Size, Wide Temp. Range, Low DCL	4-603
XTM XTK XTH XTL XTV	Metal Can, Single or Dual Ended, Hermetic Seal	Wire Leads, Screw, Stud, Solder Lug, Turret	−55 to +200	20 to 900	2 to 2200	−15 +75 −15 +50 ±20	.656x.438x1.78 .875x.540x4.06 1.13 x.600x2.81	MIL-C 39006 CLR10, 14 & 17 High Reliability, Rugged Construction Very High Temp., High Cap & Voltage	4-84A
TL	Metal Case, Rectangular, Glass to Metal Seal	Solder Lugs	−55 to +125	15 to 150	70 to 2400	±20	1.062x1.275x.690 1.375x1.275x.690 1.625x1.275x.690 2.000x1.275x.690 2.500x1.275x.690	MIL-C-3965 Style CL55, Low DCL, Wide Temp. Range	4-79A

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MALLORY
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EMHART

MALLORY

ALUMINUM ELECTROLYTIC CAPACITORS

TYPE	DESCRIPTION	TERMINALS	TEMP. RANGE (°C)	VOLTAGE RANGE (WVDC)	CAP. RANGE (μF)	STANDARD TOLERANCE (% μF)	CASE SIZES DIA.xLGTH. (INCHES) HxWxD (INCHES)	FEATURES	TIB*
TT	Aluminum Tubular, Axial Lead	Wire Leads	−40 to +85	3 to 150	1 to 5400	−10 +100	.26x .62 to .75 .31x .62 to .75 .37x .62 to 1.50 .44x1.00 to 2.00 .50x1.00 to 2.00 .62x1.00 to 1.50	Miniature, All Welded Construction Low DCL, Low ESR	4-104
TTX	Aluminum Tubular, Axial Lead	Wire Leads	−55 to +85 Excursions to 105°C	3 to 150	1 to 4400	−10 +75	.26x .62 to .75 .31x .62 to .75 .37x .62 to 1.50 .44x1.00 to 2.00 .50x1.00 to 2.00 .62x1.00 to 1.50	Miniature, All Welded Construction Low DCL, Low ESR	4-105
TCW	Aluminum Tubular, Axial Lead	Wire Leads	−20 to +85	3 to 450	2 to 36,000	−10 +75 −10 +50	.50x1.12 to 2.12 .62x1.12 to 2.62 .75x1.12 to 2.75 .87x1.37 to 3.12 1.00x1.37 to 3.89	All Welded Construction	4-103
TCX	Aluminum Tubular, Axial Lead	Wire Leads	−55 to +105	3 to 150	12 to 26,000	−10 +75 −10 +50	.50x1.12 to 2.12 .62x1.12 to 2.62 .75x1.12 to 2.62 .87x1.12 to 3.12 1.00x1.12 to 3.62	High Temperature Computer Grade Low DCL, Low ESR All Welded Constructeion	0-311
TCG	Aluminum Tubular, Axial Lead	Wire Leads	−40 to +85	6 to 450	3 to 23,000	−10 +75 −10 +50 −10 +100	.50x1.12 to 2.12 .62x1.12 to 2.62 .75x1.12 to 2.62 .87x1.12 to 3.12 1.00x1.12 to 3.62	Computer Grade High Cap, Low DCL, Low ESR All Welded Construction	4-307
VPR	Aluminum Can, Vertical Mount Single Ended	Wire Leads, Plug-in	−55 to +105	6 to 150	22 to 20,000	−10 +100 −10 +75 −10 +50	.50x1.00 to 1.62 .75x1.12 to 3.62 .87x1.12 to 3.62 1.00x1.12 to 3.62	Miniature, All Welded Low DCL, Low ESR Low ESL, High Temperature, High Ripple Current	4-106
FP PFP	Aluminum Can, Twist-Tab or PC Vertical Mount	Solder Lugs, Wire Wrap, PC Lugs	−30 to +85	6 to 450	22 to 20,000	−10 +150 −10 +100 −10 +50	.75x1.50 to 3.00 1.00x1.50 to 4.00 1.37x1.50x5.00	Single or Multi-Section	4-101
CGS	Aluminum Can, Bracket Mount	Solder Lugs, Screw Inserts	−40 to +85	3 to 450	10 to 920,000	−10 +75 −10 +50	1.00x1.75 to 4.12 1.37x1.75 to 5.62 1.75x2.12 to 5.62 2.00x2.12 to 5.62 2.50x3.12 to 5.62 3.00x3.62 to 8.62	Computer Grade Low DCL, Low ESR High Performance	4-303

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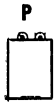
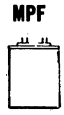
ALUMINUM ELECTROLYTIC CAPACITORS

TYPE	DESCRIPTION	TERMINALS	TEMP. RANGE (°C)	VOLTAGE RANGE (WVDC)	CAP. RANGE (μF)	STANDARD TOLERANCE (% μF)	CASE SIZES DIA.xLGTH. (INCHES) HxWxD (INCHES)	FEATURES	TIB*
CGR	Aluminum Can, Bracket Mount	Low or High Post Screw Inserts	−55 to +85	3 to 150	140 to 320,000	−10 +75 −10 +50	1.37x1.75 to 5.62 1.75x2.12 to 5.62 2.00x2.12 to 5.62 2.50x3.12 to 5.62 3.00x3.62 to 5.62	Computer Grade Low DCL, Extremely Low ESR High Ripple Current	4-313
CGO	Aluminum Can Bracket Mount	Low or High Post Screw Inserts	−55° to +85	5 to 55	2800 to 67000	−20 +20	1.37 x 2.12 to 5.62	Low, Controlled ESR ±30% Symmetrical Capacitance Tolerance High Ripple Current	4-314
SFC	Aluminum Can, Bracket or Buss-Bar Mount	Buss-Bar Screw	−40 to +85	6 to 50	6800 to 100,000	−0 +100	3.00x4.12 3.00x5.62	Computer Grade Low DCL, Ultra-Low ESR, Ultra-High Ripple Capability Low ESL	4-310
HC NP	Bakelite Case, Single Ended	Screw	−20 to +85	3 to 450 3 to 450NP	65 to 40,000 30 to 32,000	−10 +150 −10 +100 −10 +50 ±25%	1.44x2.75 to 2.06x4.37	Rugged Hi-Pot Case, Versatile Mounting NP—Non-Polar	4-301

MOTOR START & MOTOR RUN CAPACITORS

P 	Bakelite Case, Round Single Ended	Screw, Solder Lugs, Quick Connect	−40 to +65	AC Volts 110 to 330	21 to 1326	−0 +20	1.44x2.75 to 4.37 1.81x3.37 to 4.37 2.06x3.37 to 4.37 2.56x4.37	Motor Start, Intermittent AC Duty EIA Type 1 & 2	4-401
CRN	Terne Plate Steel Can, Round, Oval & Rectangular, Single Ended	Quick Connect, Solder Lugs	−55 to +70 (PCB Free)	AC Volts 170 to 660	1 to 60	±10% ±6%	1.69x2.16x1.31 to 9.50x3.66x1.97	Motor Run, Continuous AC Duty Non-PCB	4-403
MPD MPF 	Terne Plate Steel Can, Round & Flat Oval Single Ended	Quick Connect Solder Lugs	−40 to +70 (PCB Free)	AC Volts ≤240V Dry 330V to 440V w/Fluid	3 to 70 μF	±10% ±6%	1¾″ Dia., 2″ Dia. 2½″ Dia. 2⅝″—5¾″ HT. plus Flat Ovals	Motor Run Continuous AC Duty Non-PCB Metallized Film	4-404

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MALLORY
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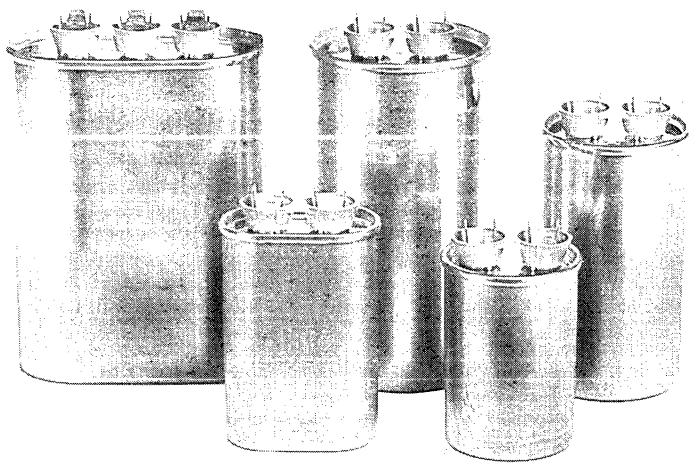
MALLORY

AC-METALLIZED POLYPROPYLENE FILM CAPACITORS

NON-PCB TYPE CAPACITORS



SPECIFICATIONS

- **Capacitance**
  2 to 70 μF
- **Voltage**
  180 VAC to 240 VAC-Dry
  330 VAC to 440 VAC-Oil Filled
- **Operating Frequency**
  50 to 60 Hertz
- **Capacitance Tolerance**
  ±10% Standard and ±6% Special
- **Dissipation Factor**
  0.1% Max.
- **Case Temperature**
  −40°C to +70°C (Std.)
  −40°C to +90°C (Optional)
- **Case Styles**
  Round, Flat Ovals, Rectangular
- **Case Sizes**
  Round 1¾", 2", 2½" dia.
  Flat Oval 1¼", 1½", 1¾", 2"
  industry types
  Height 2⅝" up to 5¾"

KEY FEATURES

- Internal Protector
- Environmentally Acceptable with Biodegradable Dielectric Fluid
- Wide Range of Case Styles and Sizes
- Long Life and High Reliability
- Double Rolled Seams
- Steel Cases

SUGGESTED APPLICATIONS

- Air Conditioning
- Business Machines
- Fan Motors
- Power Supplies
- Refrigeration
- Industrial Control
- Phase Shifting
- H.I.D. Lighting

NON-PCB WITH U.L. RECOGNIZED PROTECTOR

Mallory Non-PCB capacitors contain Metallized Polypropylene Dielectric and a biodegradable fluid for environmental compatibility. They also incorporate a U.L. recognized internal protective device to minimize the hazard of case rupture in the event of capacitor failure. These capacitors are useful in a variety of applications where continuous operation is required on the normal AC Power source available in home and industry.

They offer good reliability and long life and are designed to meet the intent of EIA Standard RS-456 — characteristic "E" or "F." For additional information send for Technical Information Bulletin 4-404B.

FOR COMPLETE DETAILS
WRITE FOR TECHNICAL INFORMATION BULLETIN 4-404B

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MALLORY
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EMHART

MINIGLOSSARY BASIC CAPACITOR FORMULAS

I. Capacitance (farads)

English: $C = \frac{.224\ K\ A}{t_D}$

Metric: $C = \frac{.0884\ K\ A}{t_D}$

II. Energy stored in capacitors (Joules, watt-sec)

$E = \frac{1}{2}\ CV^2$

III. Linear charge of a capacitor (Amperes)

$I = C\frac{dV}{dt}$

IV. Total Impedance of a capacitor (ohms)

$Z = \sqrt{R_s^2 + (X_C - X_L)^2}$

Where Rs = ESR

V. Capacitive Reactance (ohms)

$X_C = \frac{1}{2\pi fC}$

VI. Inductive Reactance (ohms)

$X_L = 2\pi fL$

VII. Phase Angles:

Ideal Capacitors: Current leads voltage 90°
Ideal Inductors: Current lags voltage 90°
Ideal Resistors: Current in phase with voltage

VIII. Dissipation Factor

$DF = \tan\delta\ (\text{loss angle}) = \frac{ESR}{X_c} = (2\pi fC)\ (ESR)$

IX. Power Factor

PF = Sine δ (loss angle) = Cos φ (phase angle)
PF = DF (when less than 10%)

X. Quality Factor (dimensionless)

$Q = \text{Cotan}\ \delta\ (\text{loss angle}) = \frac{1}{DF}$

XI. Equivalent Series Resistance (ohms)

$ESR = (DF)\ (Xc) = (DF)\ (\frac{1}{2}\pi fC)$

XII. Power Loss (watts)

Power loss $= (2\pi fCV^2)\ (DF)$

XIII. KVA (Kilowatts)

$KVA = 2\pi fCV^2 \times 10^{-3}$

XIV. Temperature Characteristic (ppm/°C)

$TC = \frac{Ct - C_{25}}{C_{25}\ (T_t - 25)} \times 10^6$

XV. Cap Drift (%)

$C.D. = \frac{C_1 - C_2}{C_1} \times 100$

XVI. Reliability of Ceramic Capacitors

$\frac{L_o}{L_t} = \left(\frac{V_t}{V_o}\right)^x \left(\frac{T_t}{T_o}\right)^\tau$

XVII. Capacitors in Series (current the same)

Any number: $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} \text{---} + \frac{1}{C_N}$

Two: $C_T = \frac{C_1\ C_2}{C_1 + C_2}$

XVIII. Capacitors in Parallel (voltage the same)

$C_T = C_1 + C_2 \text{---} + C_N$

XIX. Aging Rate

A.R. = % Δ C/decade of time

XX. Decibels

$db = 20 \log \frac{V_1}{V_2}$

Metric prefixes:

Pico	$\times 10^{-12}$
Nano	$\times 10^{-9}$
Micro	$\times 10^{-6}$
Milli	$\times 10^{-3}$
Deci	$\times 10^{-1}$
Deca	$\times 10$
Kilo	$\times 10^{3}$
Mega	$\times 10^{6}$
Giga	$\times 10^{9}$
Tera	$\times 10^{12}$

Symbols:

K = Dielectric Constant
A = Area
t_D = Dielectric thickness
V = Voltage
t = time
R_S = Series Resistance
f = frequency
L = Inductance
δ = Loss angle
φ = Phase angle
x + y = Exponent effect of voltage and temp
L_o = Operating life
L_t = Test life
V_t = Test voltage
V_o = Operating voltage
T_t = Test temperature
T_o = Operating temperature

TYPE 202/203 DIPPED TANTALUM CAPACITORS

TYPE 202

Designed to take advantage of high purity tantalum powder resulting in smaller size units and minimum cost, with very low leakage current and excellent stability over both temperature and time, with a very limited distribution. Ideal for by-passing, coupling and timing applications.

SPECIFICATIONS

Capacitance Range: 0.1 to 330 μF
Rated Working Voltage: 3.15 to 35 VDC
Capacitance Tolerance: ±20%; ±10%
Operating Temperature Range: −55°C to +85°C
DC Leakage Current (Rated Voltage, 5 min., 25°C): 0.01 CV (μA or 0.5 μA)
Conform to the test method of Capacitor Flame Test in UL 1414.

ALLOWABLE REVERSE VOLTAGE

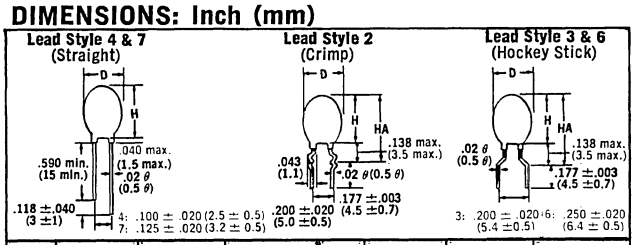
10% of rated voltage or 0.5 V, whichever is greater, at 25°C; 3% of rated voltage or 0.5 V, whichever is greater, at 85°C.

STANDARD RATINGS, SHOWING CASE SIZES

CAP. (μF) \ RV (VDC)	3.15	6.3	10	16	20	25	35
.10							1
.15							1
.22							1
.33							1
.47							1
.68							1
1.0							1
1.5						1	2
2.2					1	2	3
3.3				1	2	3	4
4.7			1	2	3	4	5
6.8		1	2	3	4	5	6
10	1	2	3	4	5	6	7
15	2	3	4	5	6	7	8
22	3	4	5	6	7	8	9
33	4	5	6	7	8	9	10
47	5	6	7	8	9	10	
68	6	7	8	9	10		
100	7	8	9	10			
150	8	9	10				
220	9	10					
330	10						

NOTE: Intermediate non-standard values available. 1000 Pcs. Minimum.

DIMENSIONS: Inch (mm)



Case Size	D Max.	H Max.	HA Max.	Case Size	D Max.	H Max.	HA Max.
1	.142 (3.6)	.236 (6.0)	.374 (9.5)	6	.217 (5.5)	.335 (8.5)	.473 (12)
2	.150 (3.8)	.256 (6.5)	.394 (10)	7	.217 (5.5)	.374 (9.5)	.512 (13)
3	.157 (4.0)	.276 (7.0)	.414 (10.5)	8	.256 (6.5)	.453 (11.5)	.591 (15.0)
4	.189 (4.8)	.295 (7.5)	.433 (11)	9	.295 (7.5)	.512 (13.0)	.650 (16.5)
5	.197 (5.0)	.315 (8.0)	.453 (11.5)	10	.394 (8.0)	.551 (14.0)	.689 (17.5)

ORDERING INFORMATION

202 L 3151 106 M 4

TYPE

FAILURE RATE
L: 2%/1000 Hrs.

VOLTAGE RATING

Code	Volts	Code	Volts	Code	Volts
3151	3.15	1602	16	2502	25
6301	6.3	2002	20	3502	35
1002	10				

CAPACITANCE IN PICOFARADS
First two digits are significant figures.
Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M = ±20%, K = ±10%

LEAD STYLE

Lead Style	Lead Space Inch	Lead Space mm	Code	Lead Style	Lead Space Inch	Lead Space mm	Code
Straight .100″	.100	2.5	4	Hockey Stick .250″	.250	6.4	6
Straight .125″	.125	3.2	7	Tape & Reel .200″	.200	5.0	C (Reel) A (Roll) W/O Core
Crimp .200″	.200	5.0	2	Tape & Reel .100″	.100	2.5	H
Hockey Stick .200″	.200	5.0	3	Tape & Ammo Pack .200″	.200	5.0	B

TYPE 203 Miniature Microdip

SPECIFICATIONS

Combines the efficiency and smaller size of tantalums with the best electrical parameters available.

Operating Temperature Range: −55°C to +85°C
Rated Working Voltage: 3.15, 6.3, 10, 16, 20, 25, 35 VDC
Capacitance Range: 0.01 to 10 MFD
Capacitance Tolerance: ±20% (M)
DC Leakage Current: 0.01 x CV or 0.5 μA, whichever is greater
Conform to the test method of Capacitor Flame Test in UL 1414.

LEAD MATERIAL

Solder plated, nickel-silver alloy.

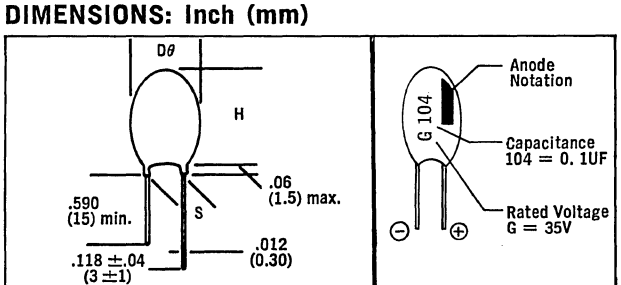
STANDARD RATINGS, SHOWING CASE SIZES

CAP. (μF) \ RV (VDC)	3.15	6.3	10	16	20	25	35
0.01							1
0.015							1
0.022							1
0.033							1
0.047							1
0.068							1
0.1							1
0.15							1
0.22							1
0.33						1	2
0.47					1		2
0.68				1		2	3
1.0			1		2		3
1.5		1		2		3	
2.2	1		2		3		
3.3		2		3			
4.7	2		3				
6.8		3					
10.0	3						

ALLOWABLE REVERSE VOLTAGE

10% of rated voltage or 0.5 V, whichever is greater, at 25°C; 3% of rated voltage or 0.5 V, whichever is greater, at 85°C.

DIMENSIONS: Inch (mm)



Case Code	D Max.	H Max.	S ±.02 (0.5)	R/V	Code	R/V	Code
1	.110 (2.8)	.177 (4.5)	.06 (1.5)	3.15	A	20	E
2	.118 (3.0)	.208 (5.3)	.06 (1.5)	6.3	B	25	F
3	.126 (3.2)	.236 (6.0)	.06 (1.5)	10	C	35	G
				16	D		

ORDERING INFORMATION

203 L 6301 155 M 1

MATSUO TYPE NUMBER

FAILURE RATE LEVEL
L: 2%/1000 Hrs.

DC RATED VOLTAGE (in millivolts)
First three digits are significant figures.
Fourth digit is the number of zeros following.

CAPACITANCE IN PICOFARADS
First two digits are significant figures.
Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M: ±20%

LEAD STYLE

MATSUO ELECTRONICS Dept. EM, 12831 Western Avenue / Garden Grove, CA 92641 / (714) 898-0707 / (213) 594-6659 / TWX: 910-596-1828

MATSUO® TYPE 221 DIPPED TANTALUM CAPACITORS

SEVEN CASE SIZES; 188 STANDARD RATINGS

SPECIFICATIONS

Capacitance Range: 0.1 to 470 μF
Rated Working Voltage: 3.15, 6.3, 10, 16, 20, 25, 35 & 50 VDC
Capacitance Tolerance: ±20% (M); ±10% (K); ±5% (J)
Operating Temperature Range: −55°C to +125°C
DC Leakage Current (Rated Voltage, 5 min., 20°C): 0.01 CV (μA) or 0.5 μA, whichever is greater; special order low leakage: 0.001 CV (μA) or 0.05 μA

SURGE VOLTAGE

Maximum change in capacitance after rated surge voltage is applied in series with a 1000 ohm resistor at the rate of ½ minute on, 4½ minutes off, for 1000 successive test cycles at 85°C: within ±5% of initial value. Dissipation factor and DC leakage: within initial specifications.

DC Rated Voltage at 85°C	3.15	6.3	10	16	20	25	35	50
DC Surge Voltage at 85°C	4.0	8.0	13	20	25	32	44	63

Capacitors shall withstand the surge voltage applied in series with a 100 ohm resistor at the rate of ½ minute on, 4½ minutes off, for 1000 successive test cycles at 85°C. After test, capacitors shall meet the requirements in Table 1.

Table 1

Capacitance Change	Within 5% of initial value
Dissipation Factor	Within initial requirement specified
DC Leakage Current	Within initial requirement specified

STANDARD RATINGS, SHOWING CASE SIZES

MFD \ WV	3.15	6.3	10	16	20	25	35	50
.1						→	1	2
.12						→	1	2
.15						→	1	2
.18						→	1	2
.22						→	1	2
.27						→	1	2
.33						→	1	2
.39						→	1	2
.47						→	1	2
.56						→	1	2
.68						→	1	2
.82						→	1	2
1.0						→	1	2
1.2						→	1	3
1.5						1	2	3
1.8						1	2	3
2.2					1	→	2	4
2.7					1	→	2	4
3.3				1	→	2	3	4
3.9				1	→	2	3	4
4.7			1	→	2	3	4	5
5.6			1	2	→	3	4	5
6.8	→	1	→	2	3	→	4	5
8.2	→	1	2	3	→	4	5	6
10	1	→	2	3	→	4	5	6
12	1	2	3	→	→	4	5	6
15	→	2	3	→	4	5	6	7
18	2	3	→	4	→	5	6	7
22	2	3	→	4	5	6	6	7
27	2	3	4	5	→	6	7	
33	3	→	4	5	6	6	7	
39	3	→	4	5	6	→	7	
47	→	4	5	6	6	→	7	
56	→	4	5	6	→	7		
68	4	→	5	6	→	7		
82	4	5	6	→	7			
100	→	5	6	→	7			
120	5	6	→	7				
150	5	6	→	7				
180	→	6	7					
220	→	6	7					
270	6	7						
330	6	7						
390	7							
470	7							

CAPACITANCE STABILITY

Maximum change in capacitance after temperature cycling from 25°C; −55°C, within ±12% of initial value; 85°C, within 12% of initial value. DC leakage at 85°C, within ten times the initial value at 25°C.

Dissipation Factor (at 120 Hz)
Max. Dissipation Factor in percent.

Capacitance (MFD)	−55°C	+85°C	+20°C
0.1 to 1.0	5	4	4
1.2 to 5.6	8	6	6
6.8 to 68.0	11	8	8
82.0 to 330.0	12	10	10
470.0	12	10	10

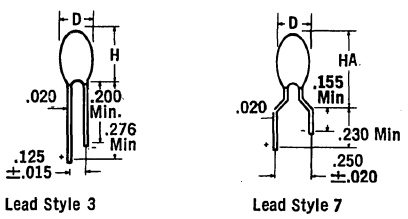
MOISTURE RESISTANCE

Maximum change in capacitance after 500 hours at 40°C, 90/95% R.H.: within ±5% of initial value; dissipation factor and DC-leakage current, within initial requirements.

LIFE TEST

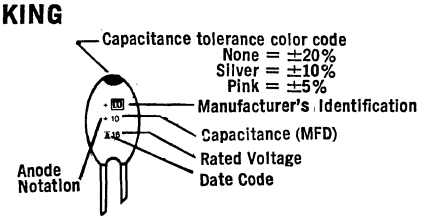
Maximum change in capacitance after 1000 hours at 85°C with rated DC voltage applied: within ±10% of initial value. Dissipation factor, within initial requirements; DC leakage, 125% max. of initial specifications.

DIMENSIONS: Inch (mm)



Lead Style 3 Lead Style 7

MARKING



Case Size	D. Max.	H Max.	HA Max.
1	0.157 (4.0)	0.315 (8.0)	0.335 (8.5)
2	0.177 (4.5)	0.335 (8.5)	0.374 (9.5)
3	0.197 (5.0)	0.374 (9.5)	0.413 (10.5)
4	0.217 (5.5)	0.453 (11.5)	0.472 (12.0)
5	0.256 (6.5)	0.540 (13.7)	0.571 (14.5)
6	0.295 (7.5)	0.630 (16.0)	0.640 (16.1)
7	0.335 (8.5)	——	0.790 (20.0)

ORDERING INFORMATION

221 M 3151 106 M 3

TYPE 221

FAILURE RATE
M: 1%/1000Hr.

VOLTAGE RATING

Code	Vol	Code	Vol	Code	Vol	Code	Vol
3151	3.15	1602	16	3502	35	1002	10.
6301	6.3	2002	20	5002	50	2502	25

CAPACITANCE IN PICOFARADS
First two digits are significant figures.
Third digit is the number of zeros following.

CAPACITANCE TOLERANCE
M = ±20%
K = ±10%
J = ±5%

LEAD STYLE

Code	Space
*1	0.100
3	0.125
*5	0.200
7	0.250

* Non Standard. Available upon Request.

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TYPE 265/268 TANTALUM CHIP CAPACITORS

TYPE 265

For PCB and Hybrid Applications
Precision Molded Construction

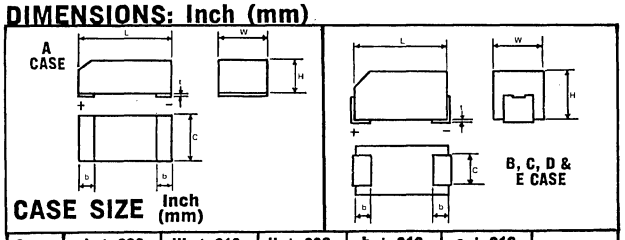
SPECIFICATIONS

Capacitance Range: 0.1 to 100 μF
Rated Working Voltage: 3.15, 6.3, 10, 16, 20, 25 & 35 VDC
Capacitance Tolerance: ±20% (M); ±10% (K)
Operating Temperature Range: −55°C to +125°C (−55°C to +150°C special order).
DC Leakage Current (Rated Voltage, 5 min. 25°C): 0.01 CV (μA) or 0.5 μA, whichever is greater.
Conforms to UL 1414.

STANDARD RATINGS, SHOWING CASE SIZES

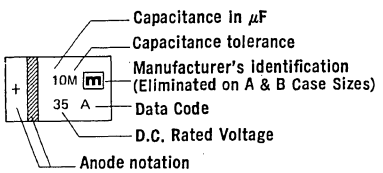
CAP. (μF) \ R.V. (VDC)	3.15	6.3	10	16	20	25	35
.1						→	A, B
.15						→	A, B
.22						→	A, B
.33						A	B
.47					A	→	B
.68				A	→	B	C
1.0			A	→	B	→	C
1.5	→	A	→	B	→	→	C
2.2	A	→	B	→	→	C	D
3.3	→	B	→	→	C	→	D
4.7	B	→	→	C	→	D	E
6.8	→	→	C	→	D	→	E
10	→	C	→	D	→	→	E
15	C	→	D	→	→	E	
22	→	→	D	→	E		
33	→	D	→	E			
47	D	→	E				
68	→	E					
100	E						

DIMENSIONS: Inch (mm)



Case Code	L ±.008 (0.2)	W ±.012 (0.3)	H ±.008 (0.2)	b ±.012 (0.3)	c ±.012 (0.3)	t
A	.180 (4.6)	.100 (2.5)	.070 (1.7)	.030 (0.8)	.100 (2.5)	.006 (0.15)
B	.180 (4.6)	.100 (2.5)	.100 (2.5)	.030 (0.8)	.063 (1.6)	.004 (0.10)
C	.315 (8.0)	.180 (4.6)	.070 (1.7)	.050 (1.3)	.118 (3.0)	.004 (0.10)
D	.315 (8.0)	.180 (4.6)	.100 (2.5)	.050 (1.3)	.118 (3.0)	.004 (0.10)
E	.315 (8.0)	.180 (4.6)	.195 (5.0)	.050 (1.3)	.118 (3.0)	.006 (0.15)

MARKING



ORDERING INFORMATION

265 L 3502 106 M 1

MATSUO Type Number
FAILURE RATE LEVEL L: 2%/1000 h
RATED VOLTAGE

Code	VDC	Code	VDC
3151	3.15	2002	20
6301	6.3	2502	25
1002	10	3502	35
1602	16		

CAPACITANCE IN PICOFARADS First two digits are significant figures. Third digit is the number of zeros following.
CAPACITANCE TOLERANCE M = ±20%, K = ±10%
LEAD STYLE

TYPE 268

Subminiature Rectangular
For Automatic Insertion, PCB or Hybrid

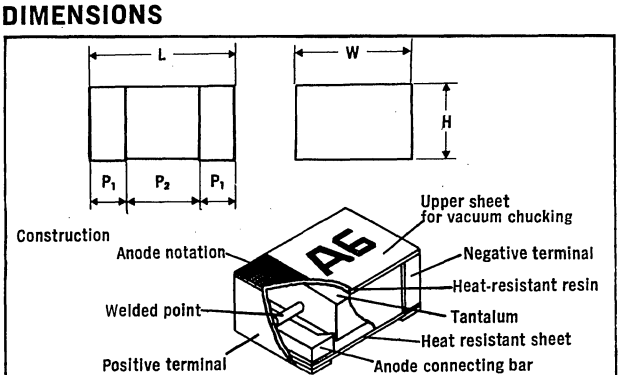
SPECIFICATIONS

Operating Temperature Range: −55 ~ +125°C
Maximum Operating Temperature for DC Rated Voltage: +85°C
Rated Working Voltage: 4, 6.3, 10, 16, 20, 25, 35 VDC
Capacitance Range: 0.1 to 100 μF
Capacitance Tolerance: ±20%
Failure Rate Level: 2%/1000 Hrs.
DC Leakage Current (Rated Voltage, 5 min. 25°C): 0.01 CV (μA) or 0.5 μA, whichever is greater.

STANDARD RATINGS, SHOWING CASE SIZES

CAP. (μF) \ R.V. (VDC)	4	6.3	10	16	20	25	35
0.1						→	A
0.15						→	A
0.22						→	A
0.33						→	A
0.47						A	B
0.68					A	→	B
1.0				A	→	→	B
1.5			A	→	→	B	C
2.2	→	A	→	→	B	→	C
3.3	A	→	→	B	→	→	C
4.7	→	→	B	→	→	C	
6.8	→	B	→	→	C		
10	B	→	→	C			
15	→	→	C				
22	→	C					
33	C	D					
47		D					
68	D						
100	D						

DIMENSIONS



Case Code	L ±0.3 (.012)	W ±0.3 (.012)	T ±0.3 (.012)	P_1 ±0.1 (.004)	P_2 ±0.1 (.004)
A	3.4 (0.134)	1.6 (0.063)	1.5 (0.063)	0.85 (0.034)	1.7 (0.067)
B	3.4 (0.134)	2.8 (0.110)	1.8 (0.071)	0.85 (0.034)	1.7 (0.067)
C	5.6 (0.221)	3.2 (0.126)	2.1 (0.083)	1.3 (0.051)	3.0 (0.118)
D	5.6 (0.221)	4.5 (0.177)	3.1 (0.122)	1.3 (0.051)	3.0 (0.118)

mm (inch)

ORDERING INFORMATION

268 L 3502 105 M

MATSUO Type Number
FAILURE RATE L: 2%/1000 Hrs.
RATED VOLTAGE

Code	VDC	Code	VDC
4001	4	2002	20
6301	6.3	2502	25
1002	10	3502	35
1602	16		

CAPACITANCE IN PICOFARADS First two digits are significant figures. Third digit is the number of zeros following.
CAPACITANCE TOLERANCE M = ±20%
PACKAGING 8mm & 12mm tape and reel

TYPE 242/245 MOLDED TANTALUM CAPACITORS

TYPE 242

For High Density Packaging

Impact resistant rectangular molded case. Uniform lead location for automatic insertion. Low impedance at high frequencies. Ideal for noise bypassing in high speed logic circuits. High capacitance in miniature case.

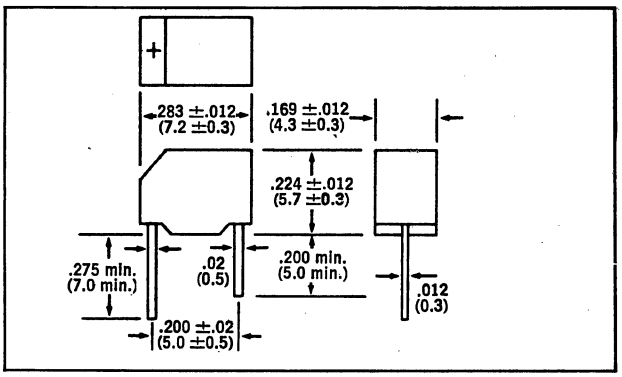
SPECIFICATIONS

Capacitance Range: 0.1 to 47 μF
Rated Working Voltage: 6.3, 10, 16, 20, 25, 35 & 50 VDC
Capacitance Tolerance: ±20% (M); ±10% (K)
Operating Temperature Range: −55°C to +125°C
DC Leakage Current (Rated Voltage, 5 min.): (20°C): 0.01 CV or 0.5 μA, whichever is greater; (85°C): 0.5 CV or 5.0 μA, whichever is greater.
Conforms to UL 1414.

STANDARD RATINGS

CAP. (μF) \ R.V. (VDC)	6.3	10	16	20	25	35	50
0.1	→	→	→	→	→	•	•
0.15	→	→	→	→	→	•	•
0.22	→	→	→	→	→	•	•
0.33	→	→	→	→	→	•	•
0.47	→	→	→	→	→	•	•
0.68	→	→	→	→	→	•	•
1.0	→	→	→	→	→	•	•
1.5	→	→	→	→	→	•	•
2.2	→	→	→	→	→	•	•
3.3	→	→	→	→	→	•	•
4.7	→	→	→	→	•	•	
6.8	→	→	→	•	→	•	
10	→	→	•	→	•		
15	→	•	→	•			
22	•	→	•				
33	→	•					
47	•						

DIMENSIONS: Inch (mm)



ORDERING INFORMATION

242 M 1602 106 M

TYPE

FAILURE RATE LEVEL
M: 1%/1000 Hrs.

VOLTAGE RATING

Code	Volts	Code	Volts
6301	6.3	2502	25
1002	10	3502	35
1602	16	5002	50
2002	20		

CAPACITANCE TOLERANCE
M = ±20%
K = ±10%

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

TYPE 245

Hybrid Capacitor — Fuse

Eliminates the noise generated at rise time in ultra-high speed logical circuits such as TTL and ECL. Built-in fuse functions either as thermal fuse under small current or as electric fuse under larger currents.

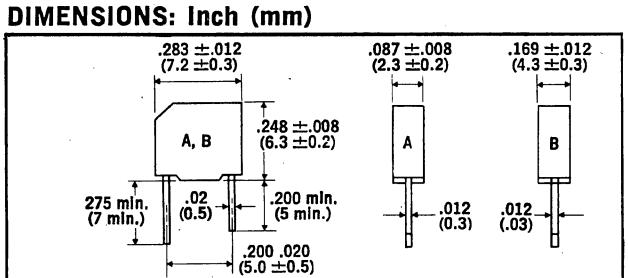
SPECIFICATIONS

Operating Temperature Range: −55°C to +125°C (For temperature above 85°C, derate voltage to 67% of R.V.)
Rated Voltage: 10 VDC to 50 VDC
Capacitance Range: 1.0 to 33 MFD
Capacitance Tolerance: ±20% (M)
DC Leakage Current: 1 (Rated voltage, 5 minutes, 25°C) 0.01 CV or 0.5 μA whichever is greater.
Conforms to UL 1414.
Circuit Breaking Performance
Built-in fuse functions as a thermal fuse at current of less than 5 amperes. At current of more than 5 amperes, built-in fuse functions by the current flowing through fuse.
Available on tape in ammo-pack or reel.

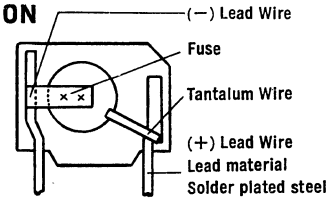
STANDARD RATINGS

CAP. (μF) \ R.V. (VDC)	10	16	20	25	35	50
1.0	→	→	→	→	A	A
2.2	→	→	→	→	B	
3.3	→	A	→	→	B	
4.7	→	→	→	B	B	
6.8	→	→	B	→	B	
10	→	B	→	B		
15	B	→	B			
22	→	B				
33	B					

DIMENSIONS: Inch (mm)



CONSTRUCTION



ORDERING INFORMATION

245 M 1602 335 M

TYPE

FAILURE RATE LEVEL
M: 1%/1000 Hrs.

VOLTAGE RATING

Code	Volts
1002	10
1602	16
2002	20
2502	25
3502	35
5002	50

CAPACITANCE TOLERANCE
M = ±20%

CAPACITANCE IN PICOFARADS
First two digits are significant figures. Third digit is the number of zeros following.

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TYPE 501/553/602 FILM CAPACITORS

TYPE 501 POLYESTER

Highly stable resin dipped film capacitor with superior performance.

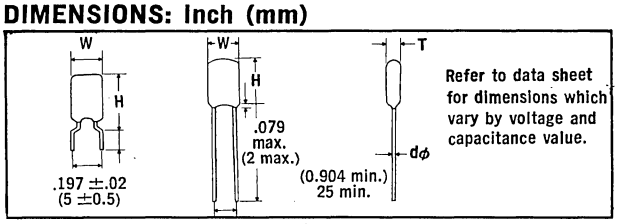
SPECIFICATIONS

Operating Temperature: −40°C ~ +125°C
Maximum Operating Temperature for DC Rated Voltage: +85°C.
DC Rated Voltage: 50, 100, 200 VDC. (For operation at 125°C the voltage is 50% of 85°C ratings).
Capacitance Range: 0.001 ~ 0.22 μF
Capacitance Tolerance: ±5%, ±10%
Failure Rate Levels: P: 0.1%/1000 h. N: 0.5%/1000 h.
Available on tape and reel.

STANDARD RATINGS

50 VOLT	100 VOLT	200 VOLT
.001 to.22 MFD	.001 to .22 MFD	.001 to .1 MFD

DIMENSIONS: Inch (mm)



ORDERING INFORMATION

501 N 5002 104 K 2

- TYPE: 501
- FAILURE RATE: N: 0.5%/1000 Hrs. P: 0.1%/1000 Hrs.
- RATED VOLTAGE

Code	Volts
5002	50
1003	100
2003	200

- CAPACITANCE IN PICOFARADS: 104
- CAPACITANCE TOLERANCE: K: = ±10%, J: = 5%
- LEAD STYLE: 1: Straight, 2: Hockey stick (50 volt only)

TYPE 553 POLYESTER

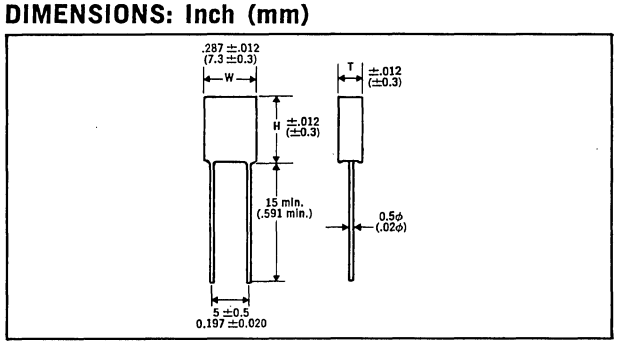
Super Miniature metallized polyester film capacitor with high ratio of capacitance/voltage in a small package. Low impedance and high stability. Molded body.

SPECIFICATIONS

Operating Temperature: −40°C ~ +105°C
DC Rated Voltage Range: 50 VDC*, 63 VDC*
Nominal Capacitance Range: .01 μF to 1.0 μF
Capacitance Tolerance: ±5%, ±10%
* For operation at 105°C the voltage shall be derated to 50% of R.V.
Available on tape and reel.

MFD	VOLTS 50	VOLTS 63	DIMENSIONS H	DIMENSIONS T
0.1	→	•	.276 (7.0)	.102 (2.6)
0.15	→	•	.335 (8.5)	.142 (3.6)
0.22	→	•	.335 (8.5)	.142 (3.6)
0.33	→	•	.374 (9.5)	.181 (4.6)
0.47	→	•	.413 (10.5)	.205 (5.2)
0.68	•		.413 (10.5)	.205 (5.2)
1.0	•		.453 (11.5)	.244 (6.2)

DIMENSIONS: Inch (mm)



ORDERING INFORMATION

553 A 6302 104 K

- TYPE: 553
- FAILURE RATE: A: Not Applicable
- RATED VOLTAGE

Code	VDC
6302	63
5002	50

- CAPACITANCE IN PICOFARADS: 104
- CAPACITANCE TOLERANCE: K

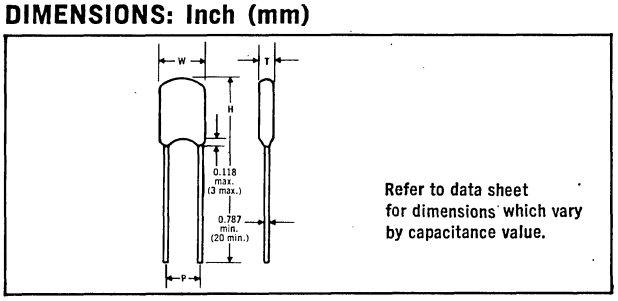
TYPE 602 POLYPROPYLENE

602 capacitors were designed for applications requiring high accuracy, excellent stability, low dielectric absorption, very high insulation resistance and low temperature coefficient. Available on tape and reel.

SPECIFICATIONS

Operating Temperature Range: −40°C to +85°C
D.C. Rated Voltage: 100 VDC
Capacitance Range: 0.001 to 0.22 MFD, E-12 series
Capacitance Tolerance: ±2% (G), ±1% (F), ±5% available on special order
Dielectric Withstanding Voltage: 2 times D.C. rated voltage for 1 minute
Insulation Resistance: 100,000 MΩ at 20°C
10,000 MΩ min. at 85°C
Dissipation Factor: <0.15 MFD 0.1% max.
≥0.15 MFD 0.2% max.
at 20°C, 1000 Hz

DIMENSIONS: Inch (mm)



ORDERING INFORMATION

602 M 1003 103 G 1

- TYPE: 602
- FAILURE RATE: M: 1%/1000 Hrs.
- RATED VOLTAGE
- CAPACITANCE IN PICOFARADS: 103
- CAPACITANCE TOLERANCE: G
- LEAD STYLE OR PACKAGING: 1: Straight, 4: Crimp, C: Tape & reel

MATSUO ELECTRONICS Dept. EM, 12831 Western Avenue / Garden Grove, CA 92641 / (714) 898-0707 / (213) 594-6659 / TWX: 910-596-1828

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TANTALUM SOLID, WET AND CHIP CAPACITORS

5900 Australian Avenue, West Palm Beach, FL 33407 (305) 842-3201 TWX: 510-952-7618

MIL SLASH NO.	DESIGNATION		M/E STYLE	DESCRIPTION	CAPACITANCE RANGE	VOLTAGE RANGE
WET SLUG MIL-C-3965						
/1	CL14	CL16	43XW	Hermetic Seal, Screw Mount, Cylindrical Case	3.5- 200 µf	20-630v
/19	CL17	CL18	43XW	Hermetic Seal, Stud Mount, Cylindrical Case	12-1300 µf	30-630v
/21	CL55		43JW	Hermetic Seal, Rectangular Module	70-2400 µf	15-150v
/4	CL64	CL65	40LW	Elastomer Seal, Axial Lead, Tubular Case	1.7- 560 µf	6-125v
/24	CL66	CL67	40SW	Hermetic Seal, Axial Lead, Tubular Case	1.7- 560 µf	6-125v
MIL-C-39006				Established Reliability		
/18	CLR10		43XW	Extended Range, Axial Lead, Tubular Case	2.0- 140 µf	8-360v
/19	CLR14		43XW	Extended Range, Cylindrical Case, Solder Lug Terminal	3.5- 200 µf	20-630v
/20	CLR17		43XW	Extended Range, Cylindrical Case, Solder Lug Terminal	12-1300 µf	30-630v
/09D	CLR65-	8000	40SW	Glass-to-Tantalum Hermetic Seal, Axial Lead, Tubular Case	1.7-1200 µf	6-125v
/22C	CLR79		40AW	Hermetic Seal, Non-Silver Case, Axial Lead, Tubular Case	1.7-1200 µf	6-125v
SOLID SLUG MIL-C-26665B						
	CS12	CS13	40SS	Hermetic Seal, Axial Lead, Tubular Case	.0047- 330 µf	6-100v
MIL-C-39003				Established Reliability		
/02	CSR09		40TS	Polar, Miniature, Hermetic Seal, Axial Lead, Tubular Case	.047- 18 µf	6- 75v
/01	CSR13		40SS	Polar, Hermetic Seal, Axial Lead, Tubular Case	.0047- 330 µf	6-100v
/03	CSR23		40XS	Polar, Extended Range, Hermetic Seal, Axial Lead, Tubular Case	1.2-1000 µf	6- 50v
/06	CSR33		40YS	Polar, Extended Range, Hermetic Seal, for Low Impedance Application	1.2-1000 µf	6- 50v
/04	CSR91		40NS	Non-Polar, Hermetic Seal, Axial Lead, Tubular Case	.0023- 160 µf	6-100v
SOLID CHIP MIL-C-55365/4				Established Reliability		
	CWR06		49BC	Polar Hybrid Tantalum Chip	.1- 100 µf	4- 50v
WET SLUG						
	40AW			Hermetic, Non-Silver Case, Axial Lead, Tubular Case	1.7-1200 µf	6-125v
	40CW			Miniature, Polar, Non-Hermetic, Tubular, Axial Lead	3.3- 450 µf	6- 60v
	40EW			Extended Range, Polar, Non-Hermetic, Tubular, Axial	6.8-1800 µf	6-125v
	43JW			Hermetic, Rectangular Module, Spade Lugs	35-22,000 µf	6-150v
	40LW			Polar, Non-Hermetic, Tubular, Axial Lead	1.7-1100 µf	6-125v
	40PW			Polar, Non-Hermetic, Tubular, Axial Lead	1.7-1100 µf	6-125v
	40SW			Hermetic, Polar, Glass to Tantalum Seal, Tubular, Axial	1.7-1200 µf	6-125v
	40TW			Hermetic, Non-Silver Case, Tubular, Axial, High Temp.	1.7-1200 µf	6-125v
	43XW			Hermetic, Cylindrical Case, Stud or Screw Mount	3.5-1300 µf	20-630v
	40YW			Miniature, Non-Acid Electrolyte, Polar, Tubular, Non-Hermetic	0.1- 320 µf	6- 60v
SOLID CHIP						
	49BC			Polar, Hybrid Chip Tantalum Capacitor	0.1- 100 µf	4- 50v
SOLID SLUG						
	40CS			Polar, Miniature Non-Hermetic, Tubular Metal Case, Axial Lead	.0047- 68 µf	2- 50v
	41DS			Polar, Dipped, Non-Hermetic, Radial Lead	0.1- 330 µf	6- 50v
	40ES			Polar, Non-Hermetic, Tubular Metal Case, Axial Lead	.0047- 330 µf	6-100v
	47FS			Polar, Hermetic, Feed-Thru, Screw Mount	3.9- 60 µf	6- 75v
	41GS			Polar, Dipped, Non-Hermetic, Miniature, Radial Lead	0.1- 680 µf	3- 50v
	41KS			Polar, Dipped, Low Profile, Non-Hermetic, Radial Lead	0.1- 270 µf	6- 35v
	40NS			Non-Polar, Hermetic, Tubular Case, Axial Lead	.0023- 160 µf	6-100v
	41PS			Polar, Non-Hermetic, Rectangular Plastic Case, Radial Lead	0.1- 220 µf	6- 50v
	40SS			Polar, Standard Hermetic, Tubular Case, Axial Lead	.0047- 330 µf	6-100v
	40TS			Polar, Miniature Hermetic, Tubular Case, Axial Lead	.0047- 39 µf	4-100v
	40XS			Polar, Extended Range, Hermetic Tubular, Axial Lead	0.82-1000 µf	6- 60v
	40YS			Polar, Extended Range, Hermetic, For Low Impedance Applications	1.2-1000 µf	6- 50v

TANTALUM WET FOIL CAPACITORS

6071 St. Andrews Road, Columbia, SC 29210 (803) 772-2500 TWX: 810-666-2622

MIL SLASH NO.	DESIGNATION		M/E STYLE	DESCRIPTION	CAPACITANCE RANGE	VOLTAGE RANGE
WET FOIL MIL-C-3965						
/17	CL20	CL21	40AF	Polar, Etched Foil, Tubular Case, Axial Lead	1- 580 µf	15-150v
/18	CL22	CL23	40BF	Non-Polar, Etched Foil, Tubular Case, Axial Lead	0.5- 350 µf	15-150v
/15	CL30	CL31	40AG	Polar, Plain Foil, Tubular Case, Axial Lead	0.27- 300 µf	3-300v
/16	CL32	CL33	40BG	Non-Polar, Plain Foil, Tubular Case, Axial Lead	0.12- 400 µf	3-300v
/9	CL51		43KG	Polar, Plain Foil, KSR, Hermetic Rectangular Module	40- 960 µf	15-150v
/10	CL52		43JG	Non-Polar, Plain Foil, KSR, Hermetic Rectangular Module	20- 600 µf	15-150v
/11	CL53		43KF	Polar, Etched Foil, KSR, Hermetic Rectangular Module	70-3500 µf	15-150v
/12	CL54		43JF	Non-Polar, Etched Foil, KSR, Hermetic Rectangular Module	35-2100 µf	15-150v
/22	CL70	CL71	40RF	Polar, High Etched Foil, Tubular Case, Axial Lead	16- 920 µf	15-150v
/23	CL72	CL73	40SF	Non-Polar, High Etched Foil, Tubular Case, Axial Lead	0.75- 590 µf	15-150v
MIL-C-39006				Established Reliability		
/01	CLR25		40EF	Polar, Etched Foil, Hermetic and Non-Hermetic, Axial Lead	1.0- 580 µf	15-150v
/02	CLR27		40FF	Non-Polar, Etched Foil, Hermetic and Non-Hermetic, Axial Lead	0.5- 350 µf	14-150v
/03	CLR35		40EG	Polar, Plain Foil, Hermetic and Non-Hermetic, Axial Lead	0.15- 160 µf	15-450v
/04	CLR37		40FG	Non-Polar, Plain Foil, Hermetic and Non-Hermetic, Axial Lead	0.1- 100 µf	15-375v
/16	CLR71		40TF	Polar, High Etched Foil, Hermetic and Non-Hermetic, Axial Lead	1.6- 920 µf	15-150v
/17	CLR73		40VF	Non-Polar, High Etched Foil, Hermetic and Non-Hermetic, Axial Lead	0.75- 590 µf	15-150v

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ALUMINUM ELECTROLYTIC CAPACITORS

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Mepco/Electra Series	Operating Temp.	D.C.V. Range	Capacitance Range (μf)	Standard Cap. Tolerance	Min. Case Size In Inches	Max. Case Size In Inches	Min. Case Size In MM	Max. Case Size In MM	Life*
3050 Axial	−40 to +85°C	6V to 450V	3 to 28,000	−10 +50% −10 +75%	.5X 1.125	1.0X 3.625	12.7X 28.57	25.4X 92.07	2000 Hrs.
3052 Axial	−55 to +105°C	5V to 250V	17 to 38,000	−10 +50% −10 +75%	.625X 1.125	1.0X 3.625	15.9X 28.57	25.4X 92.07	2000 Hrs.
3070 Miniature Axial	−40 to +85°C	6.3V to 385V	.33 to 10,000	−10 +50% ±20	.177X .394	.827X 1.575	4.5X 10.0	21.0X 40.0	2000 Hrs.**
3120 Large Can Computer Grade	−55 to +105°C	6V to 300V	110 to 700,000	−10 +50% −10 +75%	1.375X 2.125	3.0X 8.625	34.92X 53.97	76.2X 219.07	2000 Hrs.
3126 Large Can Computer Grade	Per Mil-C-39018/04	5V to 150V	220 to 220,000	−10 +50%	1.375X 2.125	3.0X 5.625	34.92X 53.97	76.2X 142.88	Per M39018/04
3186 Large Can Computer Grade	−40 to +85°C	5V to 450V	75 to 650,000	−10 +50% −10 +75%	1.375X 2.125	3.0X 8.625	34.92X 53.97	76.2X 219.07	1000 Hrs.
3188 Large Can Computer Grade	−40 to +85°C	5V to 400V	170 to 590,000	−10 +50% −10 +75%	1.375X 2.125	3.0X 8.625	34.92X 53.97	76.2X 219.07	2000 Hrs.
3191 Large Can Computer Grade	−55 to +85°C	5V to 55V	2800 to 200,000	+20%	1.375X 2.125	2.0X 5.625	34.92X 53.97	50.8X 142.87	2000 Hrs.
3427 Single Ended/ Radial	−40 to +85°C	6.3V to 450V	12 to 35,000	−10 +50% −10 +75%	.750X 1.125	1.0X 3.625	19.1X 28.6	25.4X 92.1	2000 Hrs.
3428 Single-Ended/ Radial	−55 to +105°C	6.3V to 250V	19 to 17,000	−10 +50% −10 +75%	.750X 1.125	1.0X 3.625	19.1X 28.6	25.4X 92.1	2000 Hrs.
3475 Miniature Radial	−40 to +85°C	6.3V to 100V	.22 to 4700	±20%	.197X .433	.630 1.221	5.0X 11.0	16.0X 31.07	1000 Hrs.
3476 Miniature Radial	−40 to +85°C for 100V or less −25 to +85°C for 160V or greater	6.3V to 450V	0.47 to 10,000	±20%	.197X .433	.709X 1.399	5X 11	18X 40	1000 Hrs.
3477 Miniature Radial	−40 to +85°C	6.3V to 100V	0.1 to 4,700	±20%	.197X .433	.709X 1.399	5X 11	18X 40	1000 Hrs.
3478 Miniature Radial	−40 to +80°C	6.3V to 50V	0.1 to 100	±20%	.197X .551	.394X .591	5X 14	10x 15	1000 Hrs.
3479 Miniature Radial	−40 to +85°C	10V to 100V	470 to 22,000	±20%	.866X 1.181	1.181X 2.008	22X 30	30X 51	1000 Hrs.
3480 Miniature Radial	−55 to +105°C	6.3V to 100V	0.47 to 10,000	±20%	.197X .433	.709X 1.399	5X 11	18X 40	1000 Hrs.
3481 Miniature Radial	−55 to +105°C	10V to 100V	2.2 to 1000	−10 +100%	.315X .453	.492X 1.673	8X 11.5	12.5X 42.5	2000 Hrs.
3482 Miniature Radial	−55 to +105°C	7.5V to 100V	82 to 16,500	−10 +75%	.752X 1.252	1.000X 3.626	19.1X 31.8	25.4X 92.1	2000 Hrs.
3487 Snap-In	−40 to +85°C	6.3V to 250V	22 to 100,000	±20%	.866X 1.0	1.575X 3.15	22X 25	40X 80	1000 Hrs.
3500 A.C. Motor Start	−20 to +65°C	110V to 330V	21-25 Through 1000-1200	±3%	1.44X 2.75	2.56X 4.38	3.66X 6.99	6.50X 17.75	40K to 75K Starts

* Life: If capacitors are operated properly, life should exceed 10 yrs. Measured at max. temp. with full applied voltage.
** 3073 Series — 1000 Hrs.

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FILM CAPACITORS

6071 St. Andrews Road, Columbia, SC 29210 (803) 772-2500 TWX: 810-666-2622

MEPCO/ELECTRA SERIES NEW	PREVIOUS	12 NC	CONSTRUCTION	ENCLOSURE	LEAD	VOLTAGE VDC/VAC	CAPACITANCE RANGE (μF)	TOLERANCE ±%
POLYESTER								
708D1	61F & AE	—	FILM/FOIL	WRAP & POT	AXIAL	80-200 VDC AVAILABLE TO 600	.001 THRU 1.0 AVAILABLE TO 2.0	2, 5, 10
708D2	63F (CTM)	—	FILM/FOIL	WRAP & POT	AXIAL	50-300 VDC (125°C)	.001 THRU 1.0	5, 10
711D1	75F	—	FILM/FOIL	MOLDED	RADIAL	50-600 VDC	.001 THRU 1.0	5, 10
719D1	65F	—	FILM/FOIL	POTTED	RADIAL	50 VDC	.001 THRU 1.0	5, 10
701A1	C281A	341	METALIZED	MOLDED	AXIAL	VDC 100, 250, 400 / VAC 63, 160, 220	.01 THRU 4.7	5, 10
708A1	BA	—	METALIZED	WRAP & POT	AXIAL	100-200 VDC	.10 THRU 10.0	5, 10
713A1	C280	342/352	METALIZED	CONFORMAL	RADIAL	VDC 100, 250, 400, 630 / VAC 63, 160, 220, 220	.001 THRU 6.8	10, 20
712A1	—	365-368	METALIZED	EPOXY	RADIAL	VDC 100, 250, 400 / VAC 63, 160, 220	.001 THRU 5.6	10
719A1	C280MA	344	METALIZED	POTTED	RADIAL	VDC 63, 100, 250, 400 / VAC 40, 63, 160, 220	.01 THRU 6.8	5, 10
POLYCARBONATE								
708G1	74F51	—	FILM/FOIL	WRAP & POT	AXIAL	100-200 VDC	.001 THRU 1.0	5, 10
701B1	C281C	341	METALIZED	MOLDED	AXIAL	VDC 100, 250, 400, 630, 1000 / VAC 63, 160, 220, 220, 250	.01 THRU 4.7	5, 10
708B1	74F01	—	METALIZED	WRAP & POT	AXIAL	100-200 VDC	.10 THRU 10.0	5, 10
719B1	C280MC	344	METALIZED	POTTED	RADIAL	100-630 VDC / 63-220 VAC	.01 THRU 6.8	5, 10
POLYSTYRENE								
704C1	POCO	424-431	FILM/FOIL	WRAPPED	AXIAL	VDC 63, 160, 250, 630 / VAC 25, 63, 125, 200	51PF THRU .39	1, 2, 5
708C1	—	444-447	FILM/FOIL	WRAP & POT	AXIAL	VDC 63, 160, 250, 630 / VAC 25, 63, 125, 250	.0068 THRU .160	1, 2, 5
719C1	—	443	FILM/FOIL	POTTED	RADIAL	VDC 63 / VAC 25	100 PF THRU .033	1% ONLY
POLYPROPYLENE								
704E1	—	455-459	FILM/FOIL	WRAPPED	AXIAL	VDC 63 160, 250 / VAC 25, 63, 125	47 PF THRU .022	2, 5
719E1	—	357-5	FILM/FOIL	POTTED	RADIAL	VDC 250 / VAC 160	.39 THRU .82	5, 10
719H1	—	357-6/9	METALIZED	POTTED	RADIAL	VDC 630, 1000, 1500, 2000 / VAC 300, 400, 600, 700	.0015 THRU .33	5, 10
711H1	—	—	METALIZED	MOLDED (CAN)	TERMINAL	180 & 330 VAC	5 THRU 70 MFD	GMV 10%
POLYESTER & PAPER — CLASS X VDE APPROVED								
701J1	—	330	METALIZED	MOLDED	AXIAL	250 VAC	.01 THRU .47	10, 20
719J1	—	330	METALIZED	POTTED	RADIAL	250 VAC	.01 THRU 1.0	10, 20

VARIABLE CAPACITORS

Columbia Road, Morristown, NJ 07960 (201) 539-2000 TWX: 710-986-7437

FILM DIELECTRIC

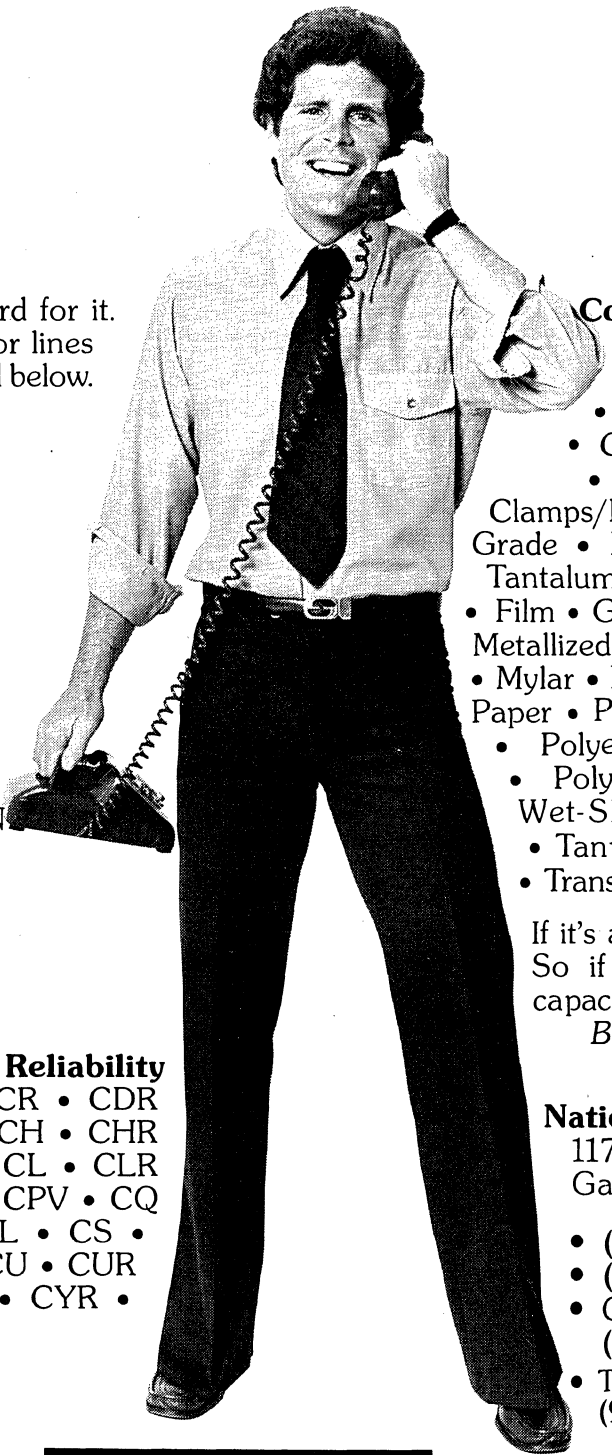
Mepco/Electra Part Number (Type)	Capacitance Range (pf)	Dielectric Material	Operating Temperature Range
2800C (808/HT 10/C010)	1-5 to 12-120	PTFE Teflon® Polypropylene Polycarbonate	−40°C to +85°C or −40°C to +70°C
2800D (809)	1-3.5 to 5-60	PTFE Teflon® or Polyimide/FEP	−40°C to +125°C

TUBULAR CERAMIC DIELECTRIC

Mepco/Electra Part Number (Type)	Capacitance Range (pf)	Dielectric Material	Operating Temperature Range
2500A (801/802)	0.5-3.0 to 1.0-6.5	Low Loss Ceramic	−50°C to +100°C

For information on Mepco/Electra's RESISTORS/POTENTIOMETERS/MILITARY COMPONENTS, see pages 1•1998, 1•2141 and 1•1674.

"National Capacitor carries every type capacitor with the largest inventory in the USA"



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- EMCON
- MALLORY
- MATSUO
- MURATA-ERIE
- PLASTIC-CAP
- SAN FERNANDO
- SEACOR
- SPRAGUE-GOODMAN
- UNITED CHEMICON
- WEST-CAP
- WESTLAKE

CAPACITOR TYPES

Military/Established Reliability
CA • CB • CC • CCR • CDR • CE • CFR • CG • CH • CHR • CJ • CK • CKR • CL • CLR • CM • CMR • CP • CPV • CQ • CQR • CRH • CRL • CS • CSR • CT • CTM • CU • CUR • CV • CWR • CY • CYR • CZ • CZR • PC

Commercial/Industrial
AC Motor Start/Run • Aluminum Electrolytic • Bathtub • Button Mica • Chip • Ceramic Disc • Ceramic Monolithic • Clamps/Brackets • Computer Grade • Dipped Mica • Dipped Tantalum • Feed-Thru/Filters • Film • Glass • High Voltage • Metallized Film • Mica Trimmers • Mylar • Nonpolar • Oil Filled • Paper • Piston • Polycarbonate • Polyester • Polypropylene • Polysulfone • Tantalum Wet-Slug • Tantalum-Solid • Tantalum-Foil • Trimmers • Transmitting Mica • Variables

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Garden Grove, CA 92641.

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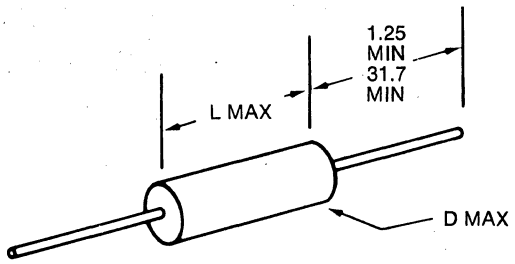


MECHANICAL SPECIFICATIONS

BODY CONSTRUCTION: Glass to metal seal

LEAD MATERIAL: .020 Dia. — Solderable tinned copper

MARKING:

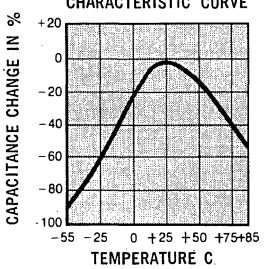
Parts will be marked with the following:

Trademark — Capacitance — Tolerance Letter Designation Voltage (size permitting)

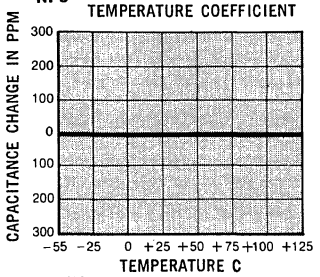
EIA specifications apply regarding Q, TC tol and CAP tol on all units of 10 pF or less

TYPICAL TEMPERATURE CHARACTERISTIC CURVES

Z5U TYPICAL TEMPERATURE CHARACTERISTIC CURVE



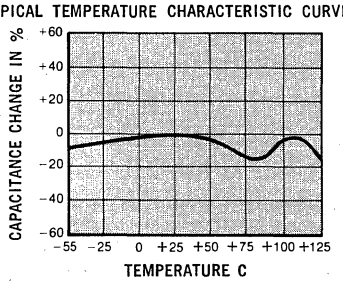
NPO TEMPEROTURE COEFFICIENT



NOTE: IPPM equals 0.0001%

TYPICAL TEMPERATURE CHARACTERISTIC CURVE

X7R



HOW TO ORDER

GT07 B CG 101 J

SIZE:

WVDC: (B = 50V)[1] (D = 100V) (F = 200V)

DIELECTRIC: (CG = NPO) (BM = X7R) (BN = Z5U)

CAPACITANCE CODE:[2]

TOLERANCE:[3]

1. **WVDC AVAILABLE:** 50 VDC, 100 VDC, 200 VDC
2. 101 = 100 pF i.e., the third digit signifies number of zeroes
3. **MINIMUM AVAILABLE CAPACITANCE TOLERANCES:**
   B = ±.1 pF (10 pF and below) J = ±5% (10 pF and above)
   C = ±.25 pF (10 pF and below) K = 10% (5.6 pF and above)
   D = ±.5 pF (10 pF and below) M = 20% (2.7 pF and above)
   F = ±1% (10 pF and above) Z = +80%, −20% (all values)
   G = 2% (10 pF and above) P = +100%, −0% (GMV — all values)

NPO (COG) CHARACTERISTICS

WORKING VOLTAGE: 50/100/200 VDC
Higher voltages available on request

TEMPERATURE COEFFICIENT: 0 ±30 PPM/°C, −55°C to +125°C (EIA Characteristic COG)

DISSIPATION FACTOR: Min. Q of 1000 at 1 MHz. Meets provisions of EIA standard for capacitance less than 30 pF and greater than 1000 pF

INSULATION RESISTANCE: 100 K megohms or 1000 megohm-microfarads, whichever is less at 25°C, at rated voltage

DIELECTRIC STRENGTH: 250% rated voltage with 50 mA maximum charging current

CAPACITANCE TOLERANCES AVAILABLE: ±1%, ±2%, ±5%, ±10%, ±20%

Meets or exceeds requirements of MIL-C-20

MCI PART NO.	GT07			GT10			GT14			Capacitance Characteristic EIA
L MAX	In. .170		mm 4.32	In. .260		mm 6.60	In. .400		mm 10.16	
D MAX	.100		2.54	.100		2.54	.150		3.81	
Capacitance in pF	WVDC 200	100	50	WVDC 200	100	50	WVDC 200	100	50	
1.0										109
1.2										129
1.5										159
1.8										189
2.2										229
2.7										279
3.3										339
3.9										399
4.7										479
5.6										569
6.8										689
8.2										829
10										100
12										120
15										150
18										180
22										220
27										270
33										330
39										390
47										470
56										560
68										680
82										820
100										101
120										121
150										151
180										181
220										221
270										271
330										331
390										391
470										471
560										561
680										681
820										821
1000										102
1200										122
1500										152
1800										182
2200										222
2700										272
3300										332
3900										392
4700										472
5600										562
6800										682
8200										822
10,000										103

Metuchen Capacitors Inc. / 420 Park Avenue, Perth Amboy, NJ 08861 / (201) 442-0500 / TWX 710-998-0892

METUCHEN CAPACITORS INC.

Glass Sealed Axial-Leaded Ceramic Capacitors

RUGGED, RELIABLE, AND IDEAL FOR AUTOMATIC INSERTION

X7R CHARACTERISTICS

WORKING VOLTAGE: 50/100/200 VDC
Higher voltages available on request

TEMPERATURE COEFFICIENT: ±15% from −55°C to +125°C (EIA Characteristic X7R)

DISSIPATION FACTOR: 2.5% maximum at 1 kHz, 25°C

INSULATION RESISTANCE: 100 K megohms or 1000 megohm-microfarad whichever is less at 25°C, at rated voltage

DIELECTRIC STRENGTH: 250% rated voltage with 50 mA maximum charging current

CAPACITANCE TOLERANCES AVAILABLE: ±5%, ±10%, ±20%, +80% −20%, or +100% −0%

Meets or exceeds requirements of MIL-C-39014

MCI PART NO.	GT07			GT10			GT14			
L MAX	In. .170		mm 4.32	In. .260		mm 6.60	In. .400		mm 10.16	
D MAX	.100		2.54	.100		2.54	.150		3.81	
Capacitance in pF	WVDC 200	100	50	WVDC 200	100	50	WVDC 200	100	50	Capacitance Characteristic EIA
10										100
12										120
15										150
18										180
22										220
27										270
33										330
39										390
47										470
56										560
68										680
82										820
100										101
120										121
150										151
180										181
220										221
270										271
330										331
390										391
470										471
560										561
680										681
820										821
1000										102
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1800										182
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2700										272
3300										332
3900										392
4700										472
5600										562
6800										682
8200										822
10,000										103
12,000										123
15,000										153
18,000										183
22,000										223
27,000										273
33,000										333
39,000										393
47,000										473
56,000										563
68,000										683
82,000										823
100,000										104
120,000										124
150,000										154
180,000										184
220,000										224
270,000										274
330,000										334

Z5U CHARACTERISTICS

WORKING VOLTAGE: 50/100 VDC

DISSIPATION FACTOR: 3% maximum at 1 kHz, 25°C
Meets or exceeds requirements of MIL-C-11015

TEMPERATURE COEFFICIENT: +22%, −56% from +10°C to +85°C (EIA Characteristic Z5U)

INSULATION RESISTANCE: 100 K megohms or 500 megohm-microfarad, whichever is less at 25°C, at rated voltage

DIELECTRIC STRENGTH: 250% rated voltage with 50 mA maximum charging current

CAPACITANCE TOLERANCES AVAILABLE: ±20%, +80% −20%, or +100% −0%

Meets or exceeds requirements of MIL-C-11015

MCI PART NO.	GT07			GT10			GT14			
L MAX	In. .170		mm 4.32	In. .260		mm 6.60	In. .400		mm 10.16	
D MAX	.100		2.54	.100		2.54	.150		3.81	
Capacitance in pF	WVDC 100	50		WVDC 100	50		WVDC 100	50		Capacitance Characteristic EIA
10										100
12										120
15										150
18										180
22										220
27										270
33										330
39										390
47										470
56										560
68										680
82										820
100										101
120										121
150										151
180										181
220										221
270										271
330										331
390										391
470										471
560										561
680										681
820										821
1000										102
1200										122
1500										152
1800										182
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2700										272
3300										332
3900										392
4700										472
5600										562
6800										682
8200										822
10,000										103
12,000										123
15,000										153
18,000										183
22,000										223
27,000										273
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39,000										393
47,000										473
56,000										563
68,000										683
82,000										823
100,000										104
120,000										124
150,000										154
180,000										184
220,000										224
270,000										274
330,000										334
390,000										394
470,000										474
560,000										564
680,000										684
820,000										824
1,000,000										105
1,200,000										125
1,500,000										155
1,800,000										185
2,200,000										225

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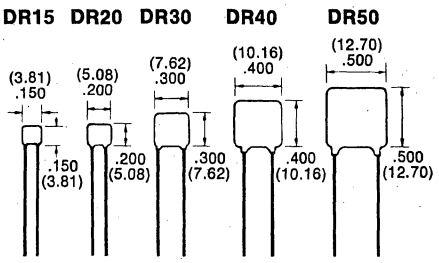
METUCHEN CAPACITORS INC.

Epoxy Coated Sub-Miniature Radial-Leaded Ceramic Capacitors

MCI PART NUMBERS



MAXIMUM PHYSICAL DIMENSIONS

MCI PART NO.	DR15	DR20	DR30	DR40	DR50
S ±.030	.100 (2.54)	.100 (2.54)	.200 (5.08)	.200 (5.08)	.400 (10.16)
D +.004 −.001	.016 (.406)	.020 (.508)	.020 (.508)	.020 (.508)	.025 (.635)
T MAX	.100 (2.54)	.125 (3.18)	.150 (3.81)	.150 (3.81)	.200 (5.08)
AWG#	26	24	24	24	22

S = Lead spacing D = Lead size T = Body thickness mm are in parentheses

MECHANICAL SPECIFICATIONS

BODY CONSTRUCTION: Dipped epoxy

LEAD MATERIAL: Solderable tinned copper

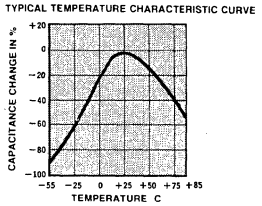
MARKING:
Parts will be marked with the following:

Trademark — Capacitance — Tolerance Letter Designation Voltage (size permitting)

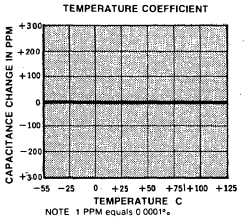
EIA specifications apply regarding Q, TC tol and CAP tol on all units 10 pF or less

TYPICAL TEMPERATURE CHARACTERISTIC CURVES

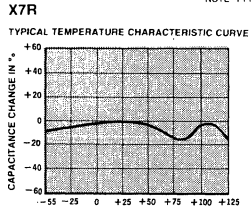
Z5U



NP0



X7R



HOW TO ORDER

DR15 B CG 101 J

SIZE:

WVDC: (B = 50V)[1] (D = 100V) (F = 200V)

DIELECTRIC: (CG = NPO) (BM = X7R) (BN = Z5U)

CAPACITANCE CODE:[2]

TOLERANCE:[3]

1. **WVDC AVAILABLE:** 50 VDC, 100 VDC, 200 VDC
2. 101 = 100 pF i.e., the third digit signifies number of zeroes
3. **MINIMUM AVAILABLE CAPACITANCE TOLERANCES:**
   B = ±.1 pF (10 pF and below) J = ±5% (10 pF and above)
   C = ±.25 pF (10 pF and below) K = ±10% (5.6 pF and above)
   D = ±.5 pF (10 pF and below) M = ±20% (2.7 pF and above)
   F = ±1% (10 pF and above) Z = +80%, −20% (all values)
   G = ±2% (10 pF and above) P = +100%, −0% (GMV — all values)

Z5U CHARACTERISTICS

CAPACITANCE RANGE: .001 MFD to 4.7 MFD

WORKING VOLTAGE: 50/100/200 VDC
Higher voltages available on request

TEMPERATURE COEFFICIENT: +22%, −56% from +10°C to +85°C (EIA Characteristic Z5U)

DISSIPATION FACTOR: 3% maximum at 1 kHz, 25°C

INSULATION RESISTANCE: 100 K megohms or 500 megohm-microfarad, whichever is less at 25°C, at rated voltage

DIELECTRIC STRENGTH: 250% rated voltage with 50 mA maximum charging current

CAPACITANCE TOLERANCES AVAILABLE: ±20%, +80% −20%, or +100% −0%

MCI PART NO.	DR15			DR20			DR30			DR40			DR50			Cap. Char. EIA
Cap. in pF	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	
1000																102
1200																122
1500																152
1800																182
2200																222
2700																272
3300																332
3900																392
4700																472
5600																562
6800																682
8200																822
10,000																103
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68,000																683
82,000																823
100,000																104
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330,000																334
390,000																394
470,000																474
560,000																564
680,000																684
820,000																824
1,000,000																105
1,200,000																125
1,500,000																155
1,800,000																185
2,200,000																225
2,700,000																275
3,300,000																335
3,900,000																395
4,700,000																475

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METUCHEN CAPACITORS INC.

Epoxy Coated Sub-Miniature Radial-Leaded Ceramic Capacitors

NPO (COG) CHARACTERISTICS

WORKING VOLTAGE: 50/100/200 VDC
Higher voltages available on request
TEMPERATURE COEFFICIENT: 0 ±30 PPM/°C, −55° to 125°C (EIA Characteristic COG)
DISSIPATION FACTOR: Min. Q of 1000 at 1 MHz. Meets provisions of EIA standard for capacitance less than 30 pF and greater than 1000 pF
INSULATION RESISTANCE: 100 K megohms or 1000 megohm-microfarads, whichever is less at 25°C, at rated voltage
DIELECTRIC STRENGTH: 250% rated voltage with 50 mA maximum charging current
CAPACITANCE TOLERANCES AVAILABLE: ±1%, ±2%, ±5%, ±10%, ±20%
Meets or exceeds requirements of MIL-C-20

MCI PART NO	DR15			DR20			DR30			DR40			DR50			Cap. Char. EIA
Cap. in pF	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	
1.0																109
1.2																129
1.5																159
1.8																189
2.2																229
2.7																279
3.3																339
3.9																399
4.7																479
5.6																569
6.8																689
8.2																829
10																100
12																120
15																150
18																180
22																220
27																270
33																330
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47																470
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8200																822
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27,000																273
33,000																333
39,000																393
47,000																473
56,000																563
68,000																683
82,000																823
100,000																104

X7R CHARACTERISTICS

TEMPERATURE COEFFICIENT: ±15% from −55°C to +125°C (EIA Characteristic X7R)
DISSIPATION FACTOR: 2.5% maximum at 1 kHz, 25°C
CAPACITANCE TOLERANCES AVAILABLE: ±5%, ±10%, ±20%, +80% −20%, or +100% −0%
Meets or exceeds requirements of MIL-C-39014
Working Voltage, Insulation Resistance and Dielectric Strength same as NPO Radial

MCI PART NO.	DR15			DR20			DR30			DR40			DR50			Cap. Char. EIA
Cap. in pF	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	
10																100
12																120
15																150
18																180
22																220
27																270
33																330
39																390
47																470
56																560
68																680
82																820
100																101
120																121
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2200																222
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82,000																823
100,000																104
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220,000																224
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330,000																334
390,000																394
470,000																474
560,000																564
680,000																684
820,000																824
1,000,000																105
1,200,000																125
1,500,000																155
1,800,000																185
2,200,000																225
2,700,000																275
3,300,000																335
3,900,000																395
4,700,000																475

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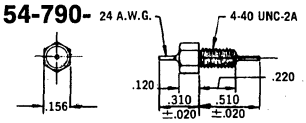
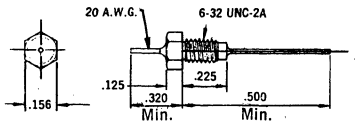
METUCHEN CAPACITORS INC.

Feed-Thru Ceramic Capacitors RESIN SEAL

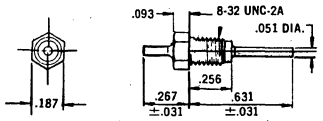
TYPES 54-790-



54-779-



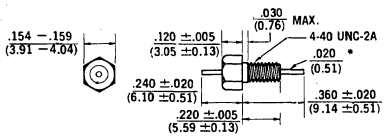
54-713-



Working Voltage +85°C	Working Voltage +125°C	Cap. pF	Ordering Number
200	100	10	54-790-001-100M
200	100	100	54-790-001-101M
200	100	500	54-790-001-501Z
200	100	1000	54-790-001-102P
200	100	22,000	54-790-001-223Z
200	100	10	54-779-001-100M
200	100	100	54-779-001-101M
200	100	500	54-779-001-501P
200	100	1000	54-779-001-102P
200	100	22,000	54-779-001-223Z
200	100	10	54-713-001-100M
200	100	100	54-713-001-101M
200	100	1000	54-713-001-102Z
200	100	5000	54-713-001-502P

SERIES SCI 910X/911X/912X

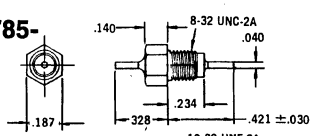
* For 24 gauge tinned copper leads, replace "X" with "0"; for 26 gauge tinned steel leads (.016 Dia.) replace "X" with "2." When steel lead is used, maximum DC current is 5 amps. 24 AWG (.020) leads are available, contact factory for part numbers.



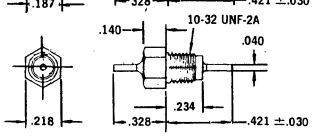
Series	SCI 910X	SCI 911X	SCI 912X
VOLTAGE	50 WVDC	100 WVDC	200 WVDC 115 VAC 60 Hz
DC AMPS. MAX.	10	10	10
CAPACITANCE (GMV)	100 pF	100 pF	100 pF
	1000	1000	1000
	5000	5000	5000
	.01 μF	.01 μF	.01 μF
	.027	.027	
	.05	.05	

HIGH CAPACITY MULTI-LAYER FEED-THRU CAPACITORS

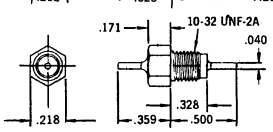
TYPES 54-785-



54-786-013

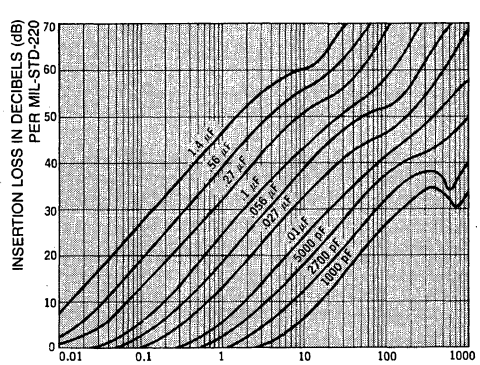


54-786-021
014



Working Voltage @ 125°C	Cap. μF	Ordering Number
100	.05	54-785-005-503P
100	.3	54-786-013-304Z
50	.5	54-786-021-504Z
50	1.0	54-786-014-105Z

FEED-THROUGH CAPACITORS — TYPICAL INSERTION LOSS



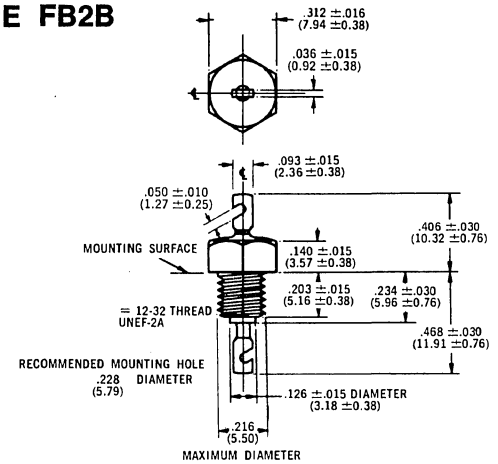
All Feed-thru Capacitors and RFI Filters stocked by MCI are manufactured in the U.S.A. by **Spectrum Control Inc. . .**
The world's leading manufacturer of Electro-Magnetic Components. Distributed for Spectrum Control, Inc.

Metuchen Capacitors Inc. / 420 Park Avenue. Perth Ambov. NJ 08861 / (201) 442-0500 / TWX 710-998-0892

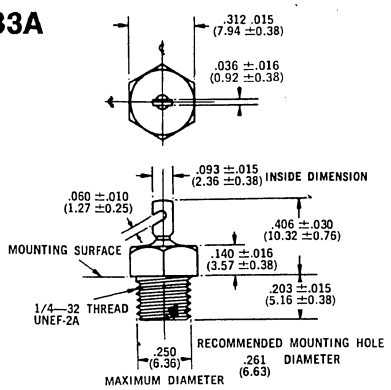
METUCHEN CAPACITORS INC.

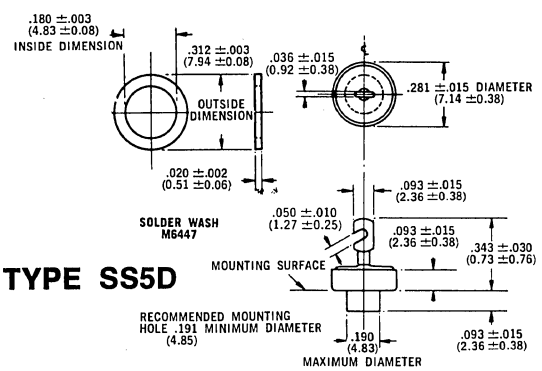
Feed-Thru Ceramic Capacitors

TYPE FB2B

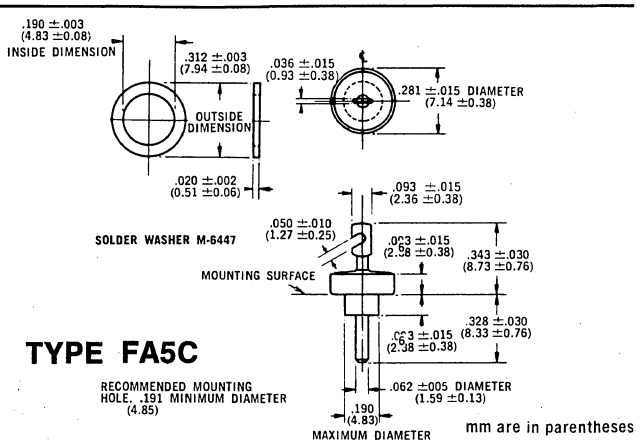


TYPE SB3A





TYPE SS5D



TYPE FA5C

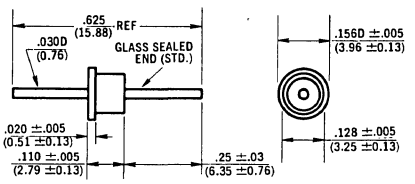
mm are in parentheses

Ordering Number	Type	Tolerance %	Capacitance pF
54-794-002-101M	FA5C-1012	20	100
54-794-002-471M	FA5C-4712	20	470
54-794-002-102P	FA5C-102W	GMV	1000
54-804-002-101M	FB2B-1012	20	100
54-804-002-471M	FB2B-4712	20	470
54-804-002-102P	FB2B-102W	GMV	1000

Ordering Number	Type	Tolerance %	Capacitance pF
54-803-004-101M	SS5D-1012	20	100
54-803-004-471M	SS5D-4712	20	470
54-803-004-102P	SS5D-102W	GMV	1000
54-807-002-101M	SB3A-1012	20	100
54-807-002-471M	SB3A-4712	20	470
54-807-002-102P	SB3A-102W	GMV	1000

SERIES SCI 9900/9910/9920

All units are hermetically sealed (glass to metal) on one end, while the other end is epoxy sealed. These units are also available reversed with the hermetic seal at the opposite end. To order, add "R" to the end of the part number; e.g. 9900-502R. Installation: Series 9900 units are designed to be soldered in place. Maximum soldering temperature is +200°C (400°F).



Series	SCI 9900	SCI 9910	SCI 9920
VOLTAGE	50 WVDC	100 WVDC	200 WVDC 115 VAC 60 Hz
DC AMPS. MAX.	5	5	5
CAPACITANCE (GMV)	100 pF 500 1000 1200 2700 5000 .015 μF	100 pF 500 1000 1200 2700 5000	100 pF 500 1000 1200

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The world's leading manufacturer of Electro-Magnetic Components. Distributed for Spectrum Control, Inc.

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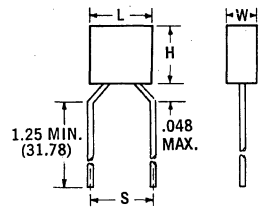
METUCHEN CAPACITORS INC.

NPO Ceramic Capacitors QUALIFIED TO MIL-C-20

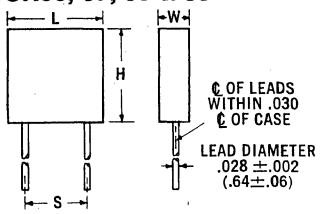
- 0 ±30 ppm/°C Per MIL-C-20
- .1 to 100,000 Pf −55°C +125°C
- Low Dissipation Factor
- Tight Tolerances

RADIAL LEAD CAPACITORS

CCR05



CCR06, 07, 08 & 09



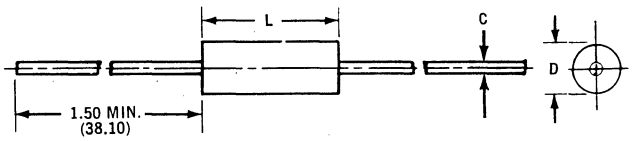
Mil. Equiv.	H & L	W	S
CCR05	.190 ±.010	.090 ±.010	.200 ±.015
CCR09	.190 ±.010	.090 ±.010	.100 ±.015
CCR06	.290 ±.010	.090 ±.010	.200 ±.015
CCR07	.480 ±.020	.140 ±.010	.400 ±.020
CCR08	.480 ±.020	.240 ±.010	.400 ±.020

ER	Slash Sheet	Volt	Cap. Range pF
CCR05 CCR09	35	200 100 50	1-330 360-1800 2200-3300
CCR06	36	200 100 50	360-1800 2000-4700 5100-18,000
CCR07	37	200 100 50	2200-4700 5600-12,000 15,000-100,000
CCR08	38	200 100 50	3900-4700 15,000-18,000 56,000-68,000

All dimensions shown in inches.

AXIAL LEAD CAPACITORS

CCR75, 76, 77, 78 & 79



Mil. Equiv.	L	D	Lead Size
CCR75	.160 ±.010	.090 ±.010	.016
CCR76	.250 ±.010	.090 ±.010	.016
CCR77	.390 ±.010	.140 ±.010	.025
CCR78	.500 ±.020	.250 ±.015	.025
CCR79	.690 ±.020	.350 ±.015	.025

ER	Slash Sheet	Volt	Cap. Range pF
CCR75	27	200 100 50	.1-75 82-240 270-680
CCR76	28	200 100 50	82-130 270-680 750-1000
CCR77	29	200 100 50	150-680 750-2200 2400-5600
CCR78	30	200 100 50	820-3300 3900-12,000 15,000-27,000
CCR79	31	200 100 50	3900-10,000 15,000-39,000 47,000-82,000

FIXED CAPACITORS, CERAMIC DIELECTRIC (TEMPERATURE COMPENSATING), ESTABLISHED RELIABILITY

ER **CCR05** **CG** (0 ±30 ppm/°C) **102** **G** **R**

STYLE
05 = Radial .190x.190 75 = Axial .160x.090
09 = Radial .190x.190 76 = Axial .250x.090
06 = Radial .290x.290 77 = Axial .390x.140
07 = Radial .480x.480 78 = Axial .500x.250
08 = Radial .480x.480 79 = Axial .690x.350

CAPACITANCE
Nominal capacitance expressed in picofarads (pF) by three-digit number, first two digits represent significant figures, last digit specifies number of zeroes to follow. When the nominal value is less than 10 pF, the letter 'R' indicates the decimal point and the succeeding digit(s) represent significant figure(s). For example: 1R0 indicates 1.0 pF; R75 indicates 0.75 pF and 0R5 indicates 0.5 pF.

CAPACITANCE TOLERANCE
C = ±.25 pF
D = ±.5 pF
F = ±1%
G = ±2%
J = ±5%
K = ±10%

FAILURE RATE LEVEL
Expressed in % per 1000 hours
M = 1.0%
P = 0.1%
R = 0.01%

CERAMIC CAPACITORS AND FILTERS FOR MILITARY, AIRCRAFT, COMMUNICATIONS AND COMPUTER INDUSTRY...

ADDITIONAL PRODUCTS IN STOCK

RFI/EMI Filters (Spectrum Control)
MIL-F-15733/23 Thru/61

Ceramic Capacitors
Glass Encapsulated (MCI)
Temperature Compensating (NPO Thru N 5600)
MIL-C-11015
CK05BX100K Thru CK06BX105K
CK12BX100K Thru CK16BR335K
MIL-C-39014
CKR05BX100KS Thru CKR06BX105KS
CKR11BX100KS Thru CKR16BX335KS
MIL-C-20

CCR05	CCR08	CCR75	CCR78
CCR06	CCR09	CCR76	CCR79
CCR07		CCR77	

All Tolerances as close as 1% available

Feed-Thru Capacitors (Spectrum Control and USCC)

Close Tolerance NPO Capacitors
Radial and axial leads
Capacitance values from .5 PF to .1 MF
Tolerance as close as 1%

Miniature dipped ceramic capacitors
NPO (Values to .1 MF)
X7R (Values to 1 MF)
Z5U (Values to 4.7 MF)

Special Testing Available
Burn-In
Temperature Cycling
Thermal Shock
Insertion Loss
Environmental Testing

Metuchen Capacitors Inc. / 420 Park Avenue, Perth Amboy, NJ 08861 / (201) 442-0500 / TWX 710-998-0892

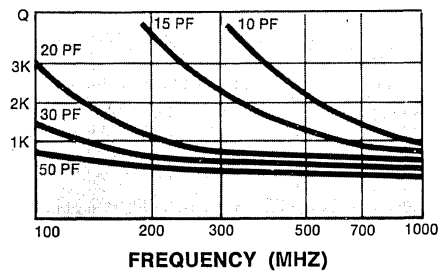
Ultra-Q Miniature Microwave Ceramic Capacitors QUALIFIED TO MIL-C-55681B

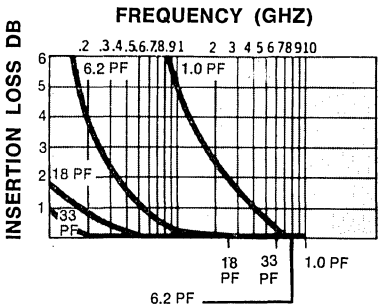
A state of the art ceramic capacitor designed for use at microwave frequencies. The superior dielectric properties of the ceramic material furnish extremely high Q and lowest loss of any type capacitor available. A minimum Q of 10,000 is guaranteed at 1 MHz. Units are available in either chip form or various leaded configurations. Typical applications include low noise FET circuits, high frequency, low noise receiver front ends and UHF microwave hybrids.

GENERAL SPECIFICATIONS

CAPACITANCE RANGE: .1 pF through 1000 pF
WORKING VOLTAGE: 50 through 500 VDC (see tables)
Q @ 1 MHz: 10,000 minimum
DISSIPATION FACTOR @ 1 MHz: less than .0001
INSULATION RESISTANCE: more than 100,000 megohms @ 25°C, 10,000 meg @ 125°C
TEMPERATURE COEFFICIENT: +90 ±20 ppm/°C
OPERATING TEMPERATURE RANGE: −55°C to +125°C
CAPACITANCE TOLERANCE: B = ±.1 pF, C = ±.25 pF, D = ±.5 pF (values <5 pF), F = ±1%, G = ±2%, J = ±5%, K = ±10% (values ≥5 pF)
CHIP TERMINATION: Palladium silver
DIELECTRIC STRENGTH: 250% of WVDC rating
CAPACITANCE DRIFT: ±.1% or .1 pF, whatever is greater

TYPICAL FREQUENCY CHARACTERISTICS



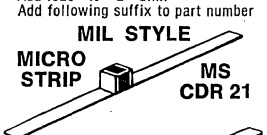


	SIZE	MIL STYLE	L + W	T. max.
	01	CDR11	.050″ ±.015	.050″
	013	CDR13	.110″ ±.015	.100″

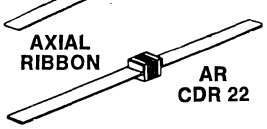
MIL-STYLE	WVDC	CAP. RANGE pF
CDR11 & CDR12	50	.1-1000
CDR13 thru CDR25	500	.1-100
	300	110-200
	200	220-470
	100	510-620
	50	680-1000

LEAD STYLES AVAILABLE
Add .020″ to "L" dim.
Add following suffix to part number

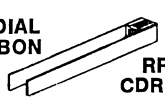
MIL STYLE
MICRO STRIP — MS CDR 21



AXIAL RIBBON — AR CDR 22

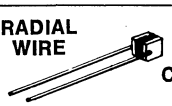


RADIAL RIBBON — RR CDR 24

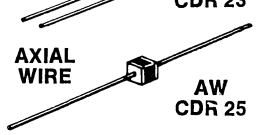


Leads size: 013 .093″x.004″ silver

RADIAL WIRE — RW CDR 23



AXIAL WIRE — AW CDR 25



Leads: #26 AWG tinned copper

SIZE 01 .050 x .050 x .050 Cap. pF	Part Number	WVDC	SIZE 01 .050 x .050 x .050 Cap. pF	Part Number	WVDC	SIZE 013 .110 x .110 x .100 Cap. pF	Part Number	WVDC	SIZE 013 .110 x .110 x .100 Cap. pF	Part Number	WVDC	SIZE 013 .110 x .110 x .100 Cap. pF	Part Number	WVDC
0.1	01Q108B	50V	6.2	01Q629J	50V	0.1	013Q108B	500V	5.6	013Q569J	500V	110	013Q111J	300V
0.2	01Q208B	50V	6.8	01Q689J	50V	0.2	013Q208B	500V	6.2	013Q629J	500V	120	013Q121J	300V
0.3	01Q308B	50V	7.5	01Q759J	50V	0.3	013Q308B	500V	6.8	013Q689J	500V	130	013Q131J	300V
0.4	01Q408B	50V	8.2	01Q829J	50V	0.4	013Q408B	500V	7.5	013Q759J	500V	150	013Q151J	300V
0.5	01Q508B	50V	9.1	01Q919J	50V	0.5	013Q508B	500V	8.2	013Q829J	500V	160	013Q161J	300V
0.6	01Q608B	50V	10	01Q100J	50V	0.6	013Q608B	500V	9.1	013Q919J	500V	180	013Q181J	300V
0.7	01Q708B	50V	11	01Q110J	50V	0.7	013Q708B	500V	10	013Q100J	500V	200	013Q201J	300V
0.8	01Q808B	50V	12	01Q120J	50V	0.8	013Q808B	500V	11	013Q110J	500V			
0.9	01Q908B	50V	13	01Q130J	50V	0.9	013Q908B	500V	12	013Q120J	500V			
1.0	01Q109C	50V	15	01Q150J	50V	1.0	013Q109C	500V	13	013Q130J	500V			
1.1	01Q119C	50V	16	01Q160J	50V	1.1	013Q119C	500V	15	013Q150J	500V	220	013Q221J	200V
1.2	01Q129C	50V	18	01Q180J	50V	1.2	013Q129C	500V	16	013Q160J	500V	240	013Q241J	200V
1.3	01Q139C	50V	20	01Q200J	50V	1.3	013Q139C	500V	18	013Q180J	500V	270	013Q271J	200V
1.4	01Q149C	50V	22	01Q220J	50V	1.4	013Q149C	500V	20	013Q200J	500V	300	013Q301J	200V
1.5	01Q159C	50V	24	01Q240J	50V	1.5	013Q159C	500V	22	013Q220J	500V	330	013Q331J	200V
1.6	01Q169C	50V	27	01Q270J	50V	1.6	013Q169C	500V	24	013Q240J	500V	360	013Q361J	200V
1.7	01Q179C	50V	30	01Q300J	50V	1.7	013Q179C	500V	27	013Q270J	500V	390	013Q391J	200V
1.8	01Q189C	50V	33	01Q330J	50V	1.8	013Q189C	500V	30	013Q300J	500V	430	013Q431J	200V
1.9	01Q199C	50V	36	01Q360J	50V	1.9	013Q199C	500V	33	013Q330J	500V	470	013Q471J	200V
2.0	01Q209C	50V	39	01Q390J	50V	2.0	013Q209C	500V	36	013Q360J	500V			
2.1	01Q219C	50V	43	01Q430J	50V	2.1	013Q219C	500V	39	013Q390J	500V			
2.2	01Q229C	50V	47	01Q470J	50V	2.2	013Q229C	500V	43	013Q430J	500V			
2.7	01Q279C	50V	51	01Q510J	50V	2.7	013Q279C	500V	47	013Q470J	500V	510	013Q511J	100V
3.0	01Q309C	50V	56	01Q560J	50V	3.0	013Q309C	500V	51	013Q510J	500V	560	013Q561J	100V
3.3	01Q339C	50V	62	01Q620J	50V	3.3	013Q339C	500V	56	013Q560J	500V	620	013Q621J	100V
3.6	01Q369C	50V	68	01Q680J	50V	3.6	013Q369C	500V	62	013Q620J	500V	680	013Q681J	100V
3.9	01Q399C	50V	75	01Q750J	50V	3.9	013Q399C	500V	68	013Q680J	500V	750	013Q751J	100V
4.3	01Q439C	50V	82	01Q820J	50V	4.3	013Q439C	500V	75	013Q750J	500V	820	013Q821J	100V
4.7	01Q479C	50V	91	01Q910J	50V	4.7	013Q479C	500V	82	013Q820J	500V	910	013Q911J	100V
5.1	01Q519J	50V	100	01Q101J	50V	5.1	013Q519J	500V	91	013Q910J	500V	1000	013Q102J	100V
5.6	01Q559J	50V							100	013Q101J	500V			

HOW TO ORDER

CDR13 BG 101 E G M M

STYLE
CDR11 — Chip .055″ x .055″
CDR12 — Tinned Chip .055″ x .055″
CDR13 — Chip .110″ x .110″
CDR14 — Tinned Chip .110″ x .110″
CDR21 — Micro Strip .135″ x .110″
CDR22 — Axial Ribbon .135″ x .110″
CDR23 — Radial Wire .135″ x .110″
CDR24 — Radial Ribbon .135″ x .110″
CDR25 — Axial Wire .135″ x .110″

CAPACITANCE
Nominal capacitance expressed in picofarads (pF) by three-digit number, first two digits represent significant figures, last digit specifies number of zeros to follow. When the nominal value is less than 10 pF, the letter 'R' indicates the decimal point and the succeeding digit(s) represent significant figure(s). For example: 1R0 indicates 1.0 pF; R75 indicates 0.75 pF and 0R5 indicates 0.5 pF.

WVDC
A = 50
B = 100
C = 200
D = 300
E = 500

CAPACITANCE TOLERANCE
B = ±.1 pF
C = ±.25 pF
D = ±.5 pF
F = ±1%
G = ±2%
J = ±5%
K = ±10%
M = ±20%

FINISH
CDR11 = M
CDR12 = S
CDR13 = M
CDR14 = S
CDR21 = T
CDR22 = T
CDR23 = S
CDR24 = T
CDR25 = S

FAILURE RATE LEVEL
Expressed in % per 1000 hours
M = 1.0%
P = .1%
R = .01%

Metuchen Capacitors Inc. / 420 Park Avenue, Perth Amboy, NJ 08861 / (201) 442-0500 / TWX 710-998-0892

METUCHEN CAPACITORS INC.

Molded Precision Radial-Leaded NPO Capacitors TIGHT TOLERANCES (AS CLOSE AS ±0.5%)

GENERAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE: −55°C to +125°C

DISSIPATION FACTOR: For 30 pF to and including 1000 pF .1% Max. at 1 MHz. Less than 30 pF per MIL-C-20. Above 1000 pF. 15% Max. at 1 kHz. All measurements at 1 VAC

INSULATION RESISTANCE: 1000 megohms — microfarads but need not exceed 100,000 megohms at ±25°C

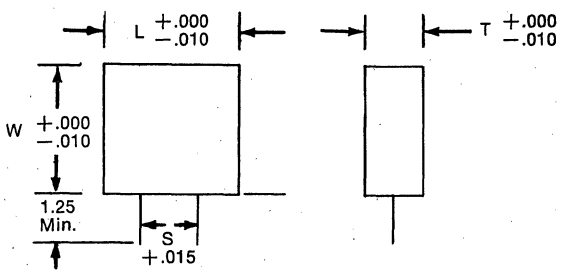
FLASH TEST: 3 times WVDC

LIFE TEST: 2 times WVDC

LEADS: #22 AWG (.025 Dia.) except CR04 #24 AWG (.020 Dia.) Tinned Copper

CAPACITANCE TOLERANCE AVAILABLE: Greater than 10 pF, ±0.5%, ±1%, ±2%, ±5%, ±10% and ±20%; Less than or equal to 10 pF, ±.25 pF and ±.5 pF

Will meet or exceed latest revision of MIL-C-20



DIMENSIONS

Style	CR04	CR05	CR06	CR08	CR20
L	.150 (3.81)	.200 (5.08)	.300 (7.62)	.300 (7.62)	.500 (12.70)
W	.150 (3.81)	.200 (5.08)	.300 (7.62)	.300 (7.62)	.500 (12.70)
T	.100 (2.54)	.100 (2.54)	.100 (2.54)	.150 (3.81)	.150 (3.81)
S	.100 (2.54)	.200 (5.08)	.200 (5.08)	.200 (5.08)	.400 (10.16)

mm are in parentheses

HOW TO ORDER

CR04 B CG 101 K

SIZE:

WVDC:
B = 50, D = 100, F = 200

DIELECTRIC TYPE:
CG = NPO ±30 ppm/°C

CAPACITANCE:

TOLERANCE:
C = ±.25 pF, D = ±.5 pF (10 pF and below)
E = 0.5%, F = ±1%, G = ±2% (10 pF and above)
J = ±5%, K = ±10%, M = ±20%

Style	CR04			CR05			CR06			CR08			CR20		Cap. Char. EIA
Cap. value	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	200	WVDC 50	100	
1.0pF															109
1.2															129
1.5															159
1.8															189
2.2															229
2.7															279
3.3															339
3.9															399
4.7															479
5.6															569
6.8															689
8.2															829
9.1															919
10															100
12															120
15															150
18															180
20															200
22															220
24															240
27															270
30															300
33															330
36															360
39															390
43															430
47															470
51															510
56															560
62															620
68															680
75															750
82															820
91															910
100															101
110															111
120															121
130															131
150															151
160															161
180															181
200															201
220															221
240															241
270															271
300															301
330															331
360															361
390															391
430															431
470															471
510															511
560															561
620															621
680															681
750															751
820															821
910															911
1000															102
1200															122
1500															152
1800															182
2000															202
2200															222
2400															242
2700															272
3000															302
3300															332
3600															362
3900															392
4300															432
4700															472
5100															512
5600															562
6200															622
6800															682
7500															752
8200															822
9100															912
.010uF															103
.012															123
.015															153
.018															183
.020															203
.022															223
.024															243
.027															273
.030															303
.033															333
.036															363
.039															393
.043															433
.047															473
.051															513
.056															563
.062															623
.068															683
.075															753
.082															823
.091															913
.100															104

Metuchen Capacitors Inc. / 420 Park Avenue, Perth Amboy, NJ 08861 / (201) 442-0500 / TWX 710-998-0892

MP International
MULTI PRODUCTS INTERNATIONAL
Dept. EM, 218 Little Falls Road, P.O. Box 238, Cedar Grove, New Jersey 07009
(201) 239-8183 • Telex 130430 • Cable Address MUPRINUSA — CEDG

SPECIALISTS IN CERAMIC CAPACITORS

DISC CERAMIC CAPACITORS

SPECIFICATIONS

Temperature Characteristics: Available in characteristics shown in table (below-right) as standard.

Operating Temperature: −55°C to +85°C.

Test Voltage: 2.5 times working voltage for 1 second.

Insulation Resistance:
7500 Megohms or an RC product of 75-ohms F, whichever is less.
RC product of .04-ohms F for 12 VDCW Y5T.
RC product of .1-ohm F for 16 VDCW Y5T.
10,000 Megohms for NPO.

Q (Ratio of Reactance to Equivalent Series Resistance):
Capacitance ≤ 30 pf Q ≥ 400 + 20 x Cpf
Capacitance > 30 pf Q ≥ 1000

Dissipation Factor:
For Z5F, X5R, Z5U, Z5P (@ 1 KC and 25°C) 2.5%
For Z4V, Z5V 5% For Y5U 8.0%
For S2L, S3N 0.6% For NPO, N750, N1500: 0.2%

Encapsulation: Phenolic coated, wax impregnated.

Marking: MP, Value, Tolerance, Voltage.

HOW TO ORDER

Type CF-104Z4

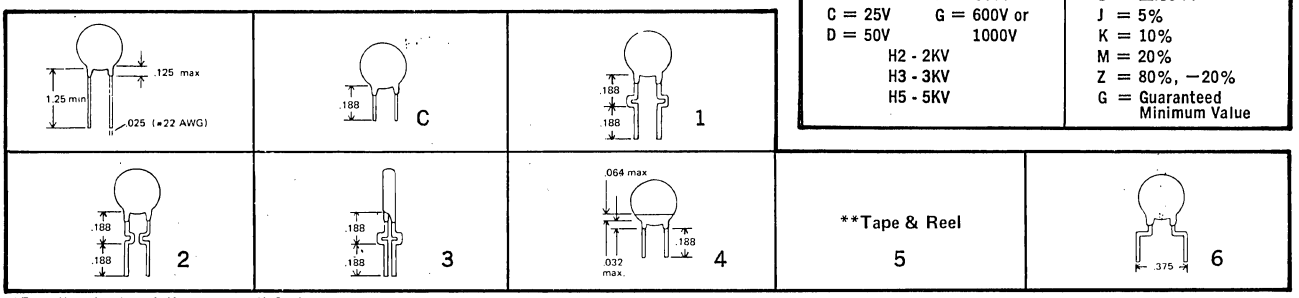
Voltage Rating
Temperature Characteristic
Capacitance
(In picofarads.) The 1st two digits indicate significant digits. The 3rd digit indicates the number of zeroes following. R denotes decimal.
Tolerance
Lead Variation

Note: The digit "4" representing lead variation may be 1, 2, 3 or 6 as shown in the diagrams below. The letter "C" and a blank space may also represent lead variations as shown in the diagrams.

TEMPERATURE CHARACTERISTIC			
A = Y5U	F = Z5V	M = P100	S = N470
B = Z5F	G = S2L	N = NPO	T = N750
C = Z5R	H = S3N	P = N150	V = N1500
D = Z5P	J = Z4V	Q = N220	W = N2200
E = Z5U	K = Z5T	R = N330	X = N3300
Other temp. char. available.			

VOLTAGE RATING (WDC)	TOLERANCE
A = 12V	C = ±.25 PF
B = 16V	D = ±.50 PF
C = 25V	J = 5%
D = 50V	K = 10%
E = 100V	M = 20%
F = 500V	Z = 80%, −20%
G = 600V or 1000V	G = Guaranteed Minimum Value
H2 - 2KV	
H3 - 3KV	
H5 - 5KV	

*LEAD VARIATIONS



*For other lead variations, consult factory.
**Disc Ceramic Capacitors can be mounted on continuous tape for automatic board insertion. These may be supplied for use in machines such as Matsushita, "Panasert", TDK "Avisert", or Universal 6341. Check the specifications of the particular capacitor(s) required by your application. To order tape and reel packaging, add numeral "5" to part number. Consult factory for details.

MULTILAYER CHIPS

SPECIFICATIONS

- **Temperaure Characteristics: NPO/COG** — 0 ±30ppm/°C, −55°C to +125°C; **BX/X7R** — △C 0 ± 15% Max. over −55°C to +125°C; **Z5U** — △C +22, −56% Max. over +10°C to +85°C
- **Capacitance: NPO/COG** — Measured at 1 Vrms Max., 1MHz ±50KHz, 25°C, below 100PF — 1 Vrms Max., 1KHz ±50Hz, 25°C, above 100PF; **BX/X7R** — Measured at 1KHz ±50Hz, 1.0 ±0.2V, 25°C; **Z5U** — Measured at 1KHz ±50Hz, 0.5V Max., 25°C
- **Dielectric Withstanding Voltage: NPO/COG, BX/X7R, Z5U** — 200% rated voltage for 5 seconds, 50mA Max. charging current, 25°C
- **Insulation Resistance: — NPO/COG** — Greater than 100 G Ω below .01 UF, 25°C, VDCW — Greater than 1000 Ω F above .01 UF, 25°C, VDCW; **BX/X7R** — Greater than 100 G Ω for capacitance below .01 UF, 25°C, VDCW; **Z5U** — Greater than 10,000M Ω for capacitance below .05 UF,25°C, VDCW — Greater than 500 Ω F for capacitance above .05 UF, 25°C, VDCW
- **Dissipation Factor (D.F.): NPO/COG** — 0.1% Max., at 1 Vrms Max., 1KHz, 25°C; **BX/X7R** — .025 (2.5%) Max. at 1KHz ±50Hz, 1.0 ±0.2V, 25°C; **Z5U** — .025 (2.5%) Max., at 1KHz ±50Hz, 0.5V Max., 25°C

ORDERING TERMINOLOGY:

MA — SERIES CODE

R30 — SIZE CODE see chart

CG — TEMPERATURE COEFFICIENT CODE
CG = NPO/COG
XR = X7R
ZU = Z5U

331 — CAPACITANCE CODE
For example:
331 = 330 PF
561 = 560 PF
102 = 1000 PF
223 = 22,000 PF = .022 UF
154 = 150,000 PF = .15 UF
8R2 = 8.2 PF
3R3 = 3.3 PF

J — TOLERANCE CODE
*B = ±0.1 PF
*C = ±0.25 PF
*D = ±0.5 PF
F = ±1%
G = ±2%
J = ±5%
K = ±10%
M = ±20%
*For Capacitance value below 10 PF only.

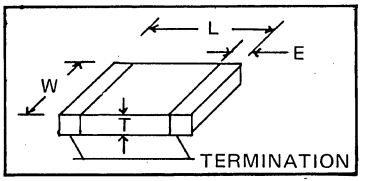
S — TERMINATION CODE
S = Silver
G = Gold
P = Palladium — Silver
T = Palladium — Gold

201 — RATED VOLTAGE
6R0 = 6 VDCW
120 = 12 VDCW
250 = 25 VDCW
500 = 50 VDCW
101 = 100 VDCW
201 = 200 VDCW

SIZE CODE

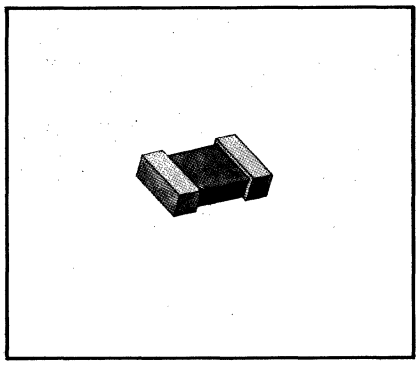
SIZE (in.)	R01	R03	R05	R07	R09	R11	R13	L01	S02	L02	L05	S04	L07
*L	.055	.080	.100	.110	.125	.130	.150	.175	.175	.180	.185	.200	.225
*W	.050	.050	.050	.105	.095	.095	.055	.065	.130	.080	.080	.260	.075
**T (max.)	.050	.050	.050	.070	.070	.070	.060	.070	.070	.060	.070	.070	.070
E	.005	.015	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020

*Tolerance ±0.010, ±7%, whichever is greater, +0.030-0.010 for soldered units.
**For soldered units allow +0.020.



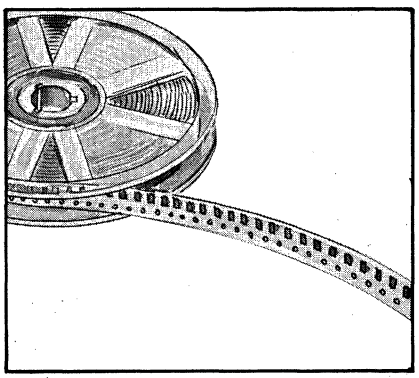
monolithic ceramic capacitors

MURATA ERIE NORTH AMERICA, INC.



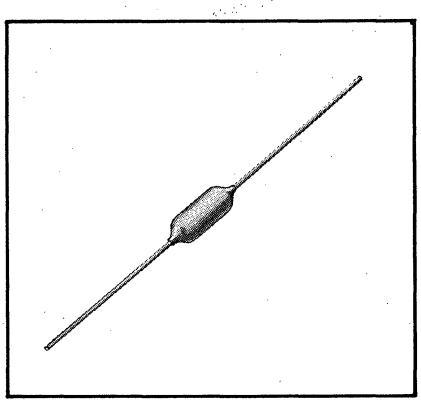
Chips

Capacitance Range:	1pF to .47mF
Voltage Ratings:	50 and 100 VDC
Temperature Characteristics:	NPO, X7F, X7R, Z5U
Dimensions:	.060″ x .030″ to .220″ x .200″



Chips for Tape and Reel

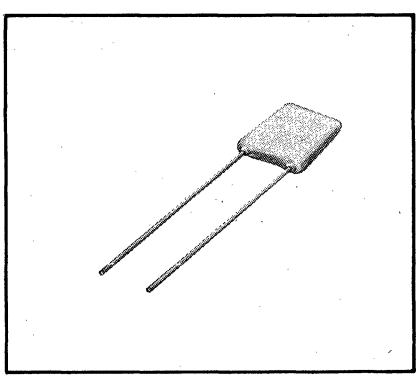
Capacitance Range:	1pF to .1mF
Voltage Ratings:	25 and 50 VDC
Temperature Characteristics:	NPO, X7R, Y5V
Dimensions:	.080″ x .050″, .125″ x .060″ and .125″ x .100″
Carrier Tape:	Standard 8MM



Axial Leaded Conformal Epoxy Coated

Capacitance Range:	1pF to 1mF
Voltage Ratings:	50 and 100 VDC
Temperature Characteristics:	NPO, X7R, Z5U
Dimensions:	.170″ x .100″ to .400″ x .150″

Available in standard packaging for auto-insertion



Radial Leaded Conformal Epoxy Coated

Capacitance Range:	1pF to 4.7mF
Voltage Ratings:	50 and 100 VDC
Temperature Characteristics:	NPO, X7F, X7R, Z5U
Dimensions:	.138″ x .100″ to .500″ x .500″

Available taped and reeled for auto-insertion

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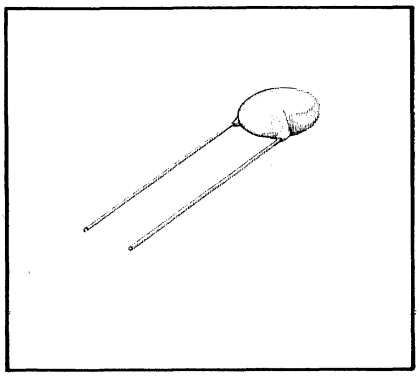
disc ceramic capacitors

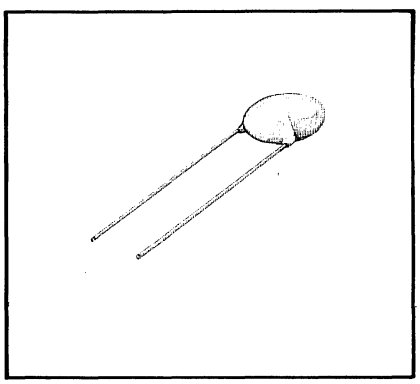
MURATA ERIE NORTH AMERICA, INC.



Low Voltage

Capacitance Range:	1pF to .5mF
Voltage Ratings:	12 VDC to 100 VDC
Temperature Characteristics:	Y5R, Y5P, Y5U, Y5V, Z5U NPO thru N750
Dimensions:	.157″ to .690″ Dia.

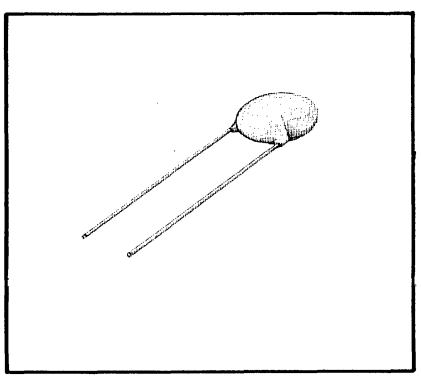
Available in standard packaging for auto-insertion



Medium Voltage

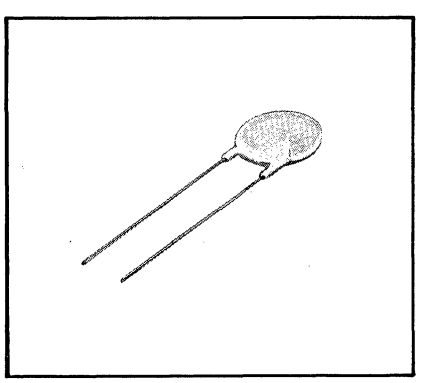
Capacitance Range:	1pF to .02mF
Voltage Ratings:	500; 1,000; 2,000; 3,000, 6,000 VDC
Temperature Characteristics:	Y5F, Y5P, Y5U, Z5U NPO, N220, N750, N1500
Dimensions:	.197″ to .708″ Dia.

Available in standard packaging for auto-insertion



High Voltage

Capacitance Range:	100pF to 2,200pF
Voltage Ratings:	7,500; 10,000; 15,000 VDC
Temperature Characteristics:	Y5P, Z5U, N4700
Dimensions:	.354″ to .788″ Dia.



Safety Recognized UL, CSA, etc.

Capacitance Range:	100pF to .01mF
Voltage Ratings:	400 VAC
Temperature Characteristics:	B, F, FZ
Dimensions:	.394″ to .669″ Dia.
Approval Types:	UL, CSA, VDE, SEMKO, BS, SEV

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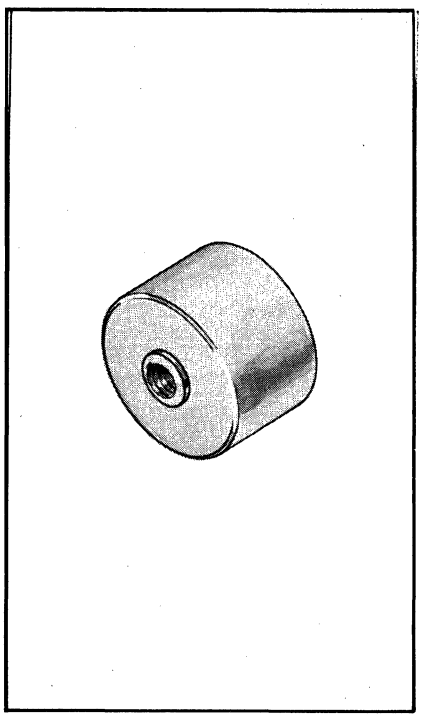
high voltage ceramic capacitors

MURATA ERIE NORTH AMERICA, INC.



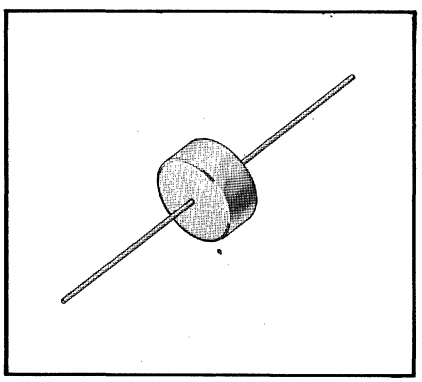
10 to 40 KVDC, DHS Series

For AC and DC Pulse Applications

Capacitance Ranges:	190pF to 8000pF
Voltage Ratings:	10, 15, 20, 30, 40 KVDC
Temperature Characteristics:	N4700
Size:	.63″ x .79″ Dia. to 1.42″ x 2.36″ Dia.

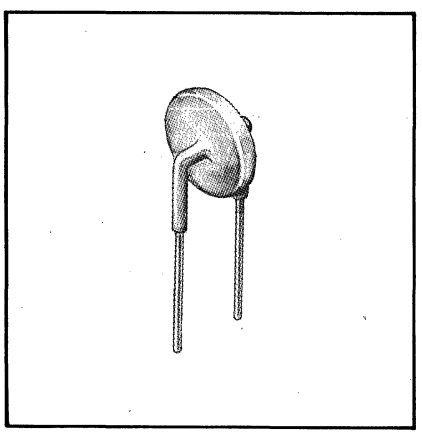
For General Purpose Applications

Capacitance Ranges:	180pF to 9300pF
Voltage Ratings:	10, 15, 20, 30, 40 KVDC
Temperature Characteristics:	Z5U
Size:	.75″ x .79″ Dia. to 1.61″ x 2.36″ Dia.



10 and 15 KVDC—DHL Series

Capacitance Ranges:	750pF and 1000pF
Voltage Ratings:	10 and 15 KVDC
Temperature Characteristics:	Y5P
Size:	.39″ x .79″ Dia. to .47″ x .79″ Dia.



10 and 15 KVDC—DHD Series

Capacitance Ranges:	500pF and 2000pF
Voltage Ratings:	10 and 15 KVDC
Temperature Characteristics:	Y5P
Size:	.295″ x .630″ Dia. to .295″ x .945″ Dia.

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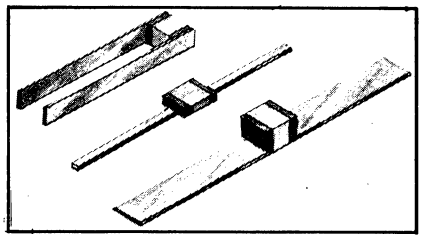
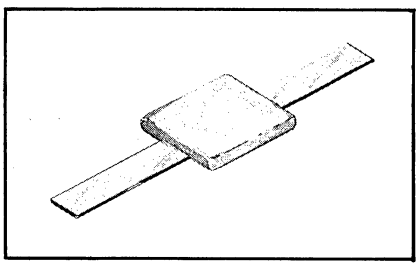
fixed and variable capacitors for microwave applications

MURATA ERIE NORTH AMERICA, INC.



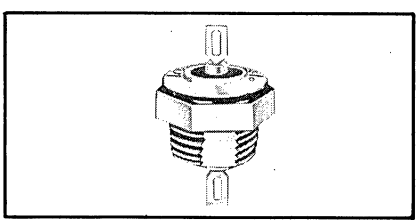
Monolithic Chips — MA Series

Capacitance Ranges:	0.3pF to 1000pF
Voltage Ratings:	50, 100, 200, 300, 500 VDC
Tolerances:	B, ±0.1pF thru M, ±20%
Q:	10,000 @ 1 MHz
Temperature Characteristics:	P90, ±20ppm/°C
Size:	.055″ x .055″ and .135″ x .110″



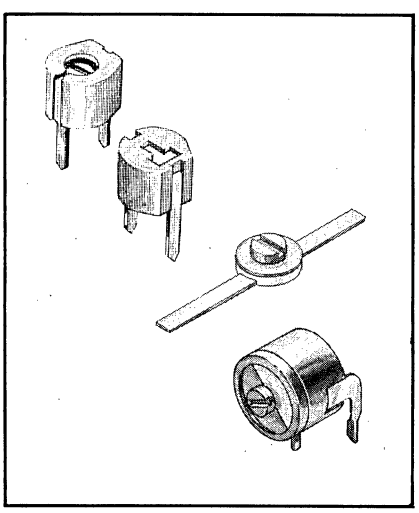
Glass Encapsulated Monolithic RF Power — UFP Series

Capacitance Ranges:	10pF to 3000pF
Voltage Ratings:	300 to 3600 VDC
Q:	5000 @ 1 MHz
RF Current Ratings:	8 Amperes
Temperature Characteristics:	P90, ±20ppm/°C
Size:	37/64″ x 35/64″ to 1 1/16″ x 1 1/16″



Button Mica

Capacitance Ranges:	15pF to 1000pF
Voltage Ratings:	500 VDC
Q:	Per MIL-C-10950
Configurations:	Stand-off and Feed-thru
Size:	.457″ Dia. x .730″ and .515″ Dia x .815″



Ceramic Trimmers

TZ03

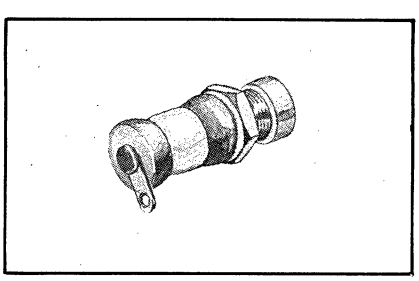
Capacitance Ranges:	1.25pF — 2.3pF to 10pF to 120pF
Voltage Ratings:	50 and 100 VDC
Temperature Characteristics:	NPO thru N1200
Size:	.236 Dia.

DVS3

Capacitance Ranges:	1.5pF — 6pF to 5pF to 35pF
Voltage Ratings:	25 VDC
Temperature Characteristics:	NPO and N750
Size:	.126″ Dia.

DV11

Capacitance Ranges:	2pF — 8pF to 15pF — 60pF
Voltage Ratings:	200 and 350 VDC
Temperature Characteristics:	NPO thru N1500
Size:	3/8″ Dia.



Air Trimmers

MVM

Capacitance Ranges:	0.8pF — 10pF to 1pF — 20pF
Voltage Ratings:	250 VDC
Temperature Characteristics:	0, ±15 and 0, ±25ppm/°C
Size:	.281″ Dia. x .484″ to .281″ Dia. x .900″

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

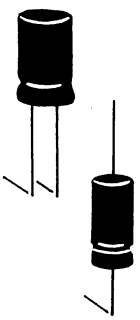
W

WPS word processing software

Y

YIG yttrium iron garnet

NIC COMPONENTS CORPORATION
CAPACITORS FOR HIGH TECHNOLOGY



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ALUMINUM ELECTROLYTIC CAPACITORS
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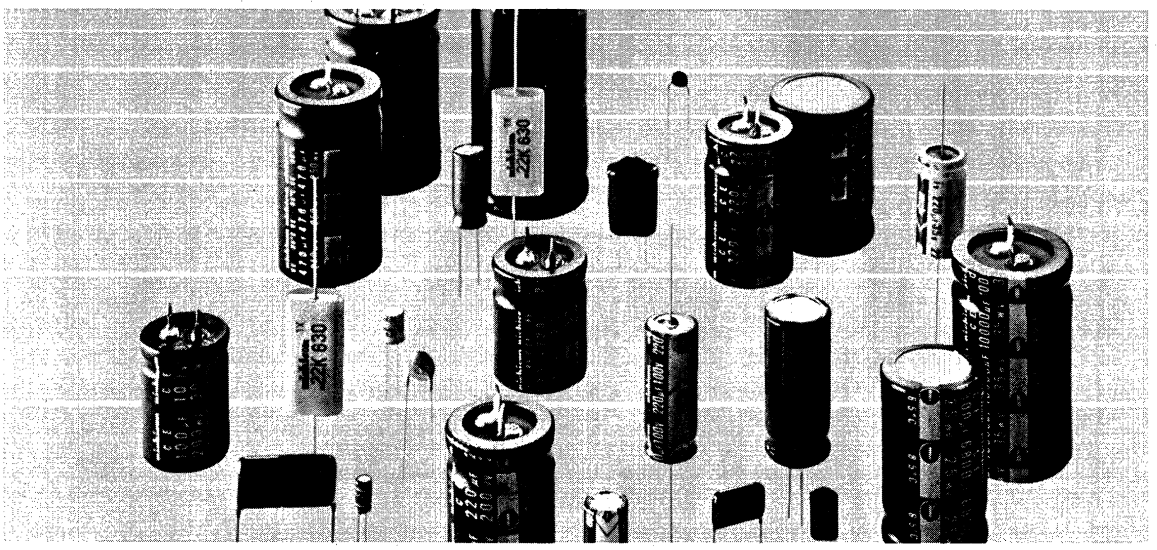
CAT. NAC-SF043

SHORT FORM CATALOG



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Nichicon is one of the world's largest manufacturers of miniature and can type aluminum electrolytic, semi-conductive ceramic disc, polyester film and metallized polyester film capacitors.

For catalogs and pricing contact your local Nichicon representative or distributor. You can also call or write Nichicon (America) Corporation, 927 E. State Parkway, Schaumburg, Illinois 60195. (312) 843-7500.

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IMPORTANT INFORMATION IN THE APPLICATION OF ALUMINUM ELECTROLYTIC CAPACITORS

1. DC electrolytic capacitors have polarity. The polarity is marked on the body of the capacitors. This type of capacitor must not be used with polarity reversed.
2. Voltage in excess of the rated voltage and/or the rated surge voltage must not be applied.
3. The capacitors should not be used at temperatures exceeding the range of the specified operating temperature.
4. In general, capacitance values decrease as the frequency increases.
5. If the capacitors are stored or left unused for more than three (3) years at normal storage temperature (−40°C ~ +40°C), aging should be conducted at the rated working voltage before application.
6. Soldering irons should not come in contact with the vinyl insulating sleeves of the capacitors.
7. Dip-soldering of the capacitors should not exceed ten (10) seconds at 260°C.
8. The capacitors may be damaged with some cleaning solvents such as Chlorothine, Triclene, Methyl Chloride, etc.

When requesting more information or data sheets, reference the series type number.

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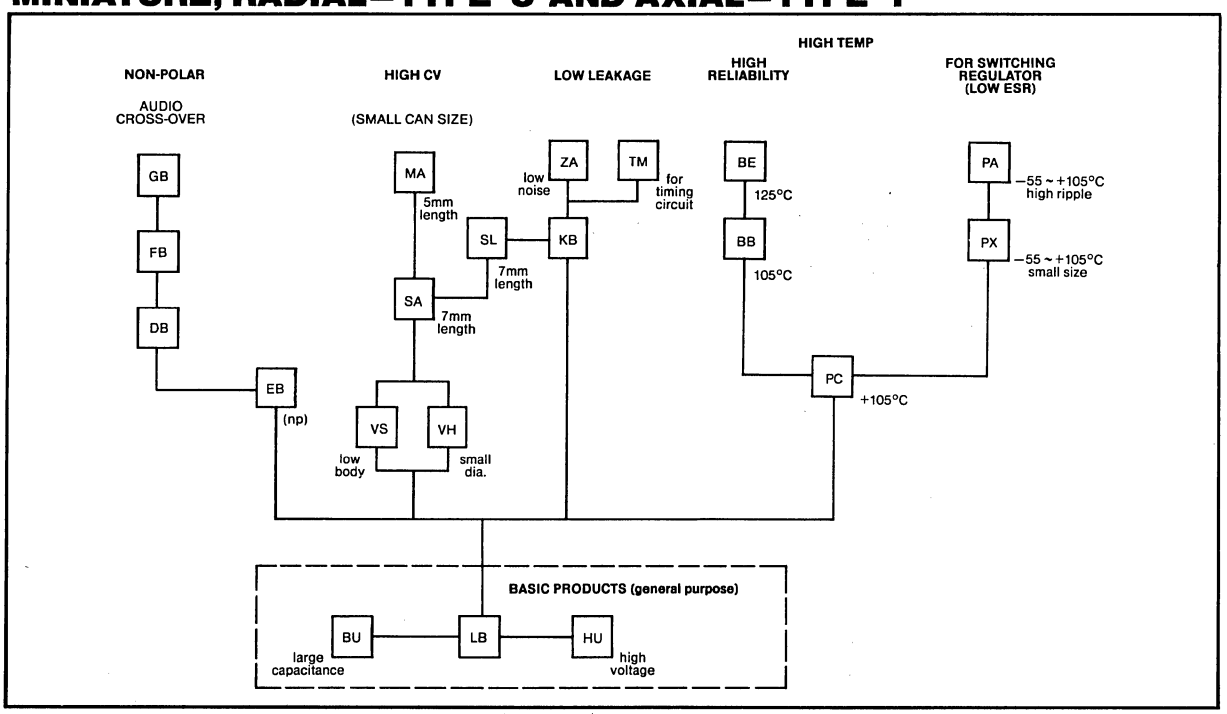
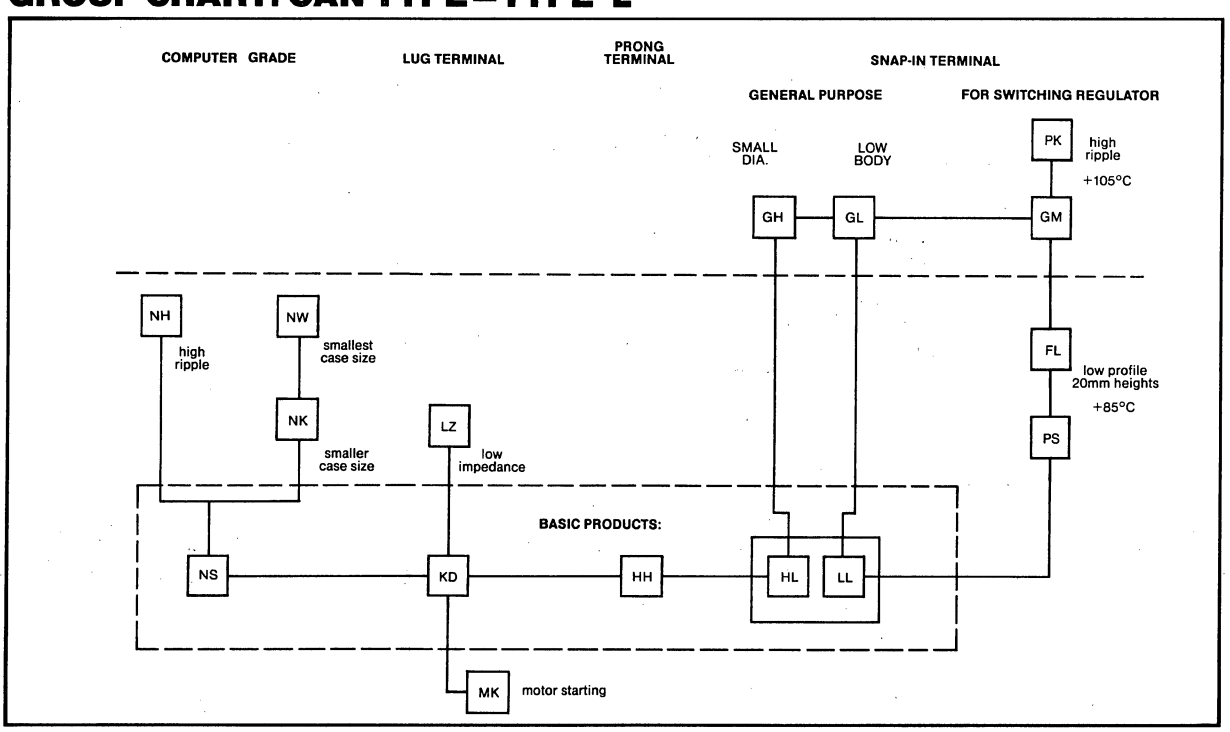
ALUMINUM ELECTROLYTIC CAPACITORS GROUP CHART: MINIATURE, RADIAL—TYPE 'U' AND AXIAL—TYPE 'T'



GROUP CHART: CAN TYPE—TYPE 'L'



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MINIATURE ALUMINUM ELECTROLYTICS— RADIAL LEAD—TYPE 'U' AND AXIAL LEAD—TYPE 'T'

Item No.	Series Type	Features	Operating Temp (°C)	Construction	Rated Voltage Range (V. DC)	Capacitance Range (μF)	Capacitance Tol. (%)	D.C. Leakage Current (μA)
1	LB	• Smaller Standard Size • Greater CV Density	−40 ~ +85	Radial (U)	6.3 ~ 100	0.1 ~ 10,000	±20(M)	0.03 CV (4μA Min.) After 1 Minute
				Axial (T)	6.3 ~ 100	0.47 ~ 33,000	±20(M)	0.03CV (3μA Min.) After 5 Minutes
2	VS/VH	• Low Profile Design (VS) • Small Diameter (VH)	−40 ~ +85	Radial (U)	6.3 ~ 50	0.1 ~ 3,300	±20(M)	0.01CV (2μA Min.) After 2 Minutes
3	BU	• Large Capacitance in Compact Size • 3-Lead Construction or Conventional 2 Lead Type	−40 ~ +85	Radial (U)	6.3 ~ 100	680 ~ 33,000	±20(M)	0.03CV After 5 Minutes
4	HU	• High Voltage	−25 ~ +85	Radial (U)	160 ~ 450	1 ~ 100	−10 ~ +50(T)	0.06CV +10 After 5 Minutes
				Axial (T)	160 ~ 450	1 ~ 470	−10 ~ +50(T)	
5	KB	• Low Leakage • Good for Tantalum Replacement	−40 ~ +85	Radial (U)	6.3 ~ 100	0.1 ~ 4,700	±20(M) ±10(K)	0.002CV (0.4μA Min.) After 2 Minutes
				Axial (T)	6.3 ~ 100	0.47 ~ 3,300	±20(M) ±10(K)	0.002CV (1μA Min.) After 2 Minutes
6	ZA	• Low Noise • Epoxy End Seal	−40 ~ +85	Radial (U)	6.3 ~ 100	0.47 ~ 47	±20(M)	0.004CV (0.2μ A Min.) After 30 Sec.
7	SA	• Super Miniature, Body Height (7mm for full line) • For Tantalum Replacement	−40 ~ +85	Radial (U)	6.3 ~ 63	0.1 ~ 100	±20(M)	0.01CV (3μ A Min.) After 2 Minutes
8	SL	• Super Miniature, Body Height (7mm for full line) • Low Leakage • For Tantalum Replacement	−40 ~ +85	Radial (U)	6.3 ~ 63	0.1 ~ 100	±20(M)	0.002CV (0.4μ A Min.) After 2 Minutes
9	MA	• Ultra Miniature, Body Height (5mm for full line) • For Tantalum Replacement	−40 ~ +85	Radial (U)	4 ~ 50	0.1 ~ 100	±20(M)	0.01CV (3μ A Min.) After 2 Minutes
10	PC	• Similar Case Size as LB Series • Plus Extended Temperature Range	−55 ~ +105	Radial (U)	6.3 ~ 100	0.1 ~ 10,000	±20(M)	0.03CV (4μ A Min.) After 1 Minute
			−40 ~ +105	Axial (T)	6.3 ~ 100	0.47 ~ 4,700	±20(M)	
11	BB	• High Temp. • High Reliability (+105°C, 3,000 hours)	−40 ~ +105	Radial (U)	10 ~ 100	0.47 ~ 1,000	±20(M)	0.002CV (2μ A Min.) After 5 Minutes
				Axial (T)	10 ~ 100	0.47 ~ 1,000	±20(M)	
12	BE	• High Temp. • High Reliability (+125°C, 2,000 hours)	−40 ~ +125	Radial (U)	10 ~ 50	0.47 ~ 470	±20(M)	0.002CV (2μ A Min.) After 5 Minutes
				Axial (T)	10 ~ 50	0.47 ~ 470	±20(M)	
13	TM	• For Timing Circuits • Very Stable at High Temp.	−40 ~ +85	Radial (U)	10 ~ 50	1 ~ 470	±20(M) ±10(K)	0.001CV +1 After 2 Minutes
14	EB	• Non-Polarized	−40 ~ +85	Radial (U)	6.3 ~ 100	0.47 ~ 6,800	±20(M)	0.03CV (3μA Min.) After 5 Minutes
				Axial (T)	6.3 ~ 100	0.47 ~ 10,000	±20(M)	
15	DB	• Bi-Polar For Audio Crossover • Standard of Bi-Polar Series	−40 ~ +85	Radial (U)	50	1 ~ 68	±20(M)	0.03 A (3μ A Min.) After 5 Minutes
				Axial (T)	50	1 ~ 68	±20(M)	
16	FB	• Bi-Polar For Audio Crossover • Small Case and Wider Capacitance Range	−40 ~ +85	Radial (U)	50	1 ~ 100	±20(M)	0.03CV (3μ A Min.) After 5 Minutes
17	GB	• Bi-Polar For Audio Crossover • Highest Performance of Bi-Polar Series	−40 ~ +85	Radial (U)	50	1 ~ 39	±10(K)	0.03CV (3μ A Min.) After 5 Minutes

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MINIATURE ALUMINUM ELECTROLYTICS— FOR SWITCHING REGULATORS

Item No.	Series Type	Features	Operating Temp (°C)	Construction	Rated Voltage Range (V. DC)	Capacitance Range (μF)	Capacitance Tol. (%)	D.C. Leakage Current (μA)
18	PA	• Low-ESR For Switching Regulators • High Ripple at High Frequency	−55 ~ +105	Radial (U)	6.3 ~ 200	1 ~ 1,000	±20(M)	0.002CV (3μ A Min.) After 5 Minutes
19	PX	• Low-ESR For Switching Regulators • Compact Case Size	−55 ~ +105	Radial (U)	6.3 ~ 63	22 ~ 2,200	±20(M)	0.03CV After 5 Minutes

CAN-TYPE ELECTROLYTICS—TYPE L

Item No.	Series Type	Features	Operating Temp. (°C)	Rated Voltage Range (V. DC)	Capacitance Range (μF)	Capacitance Tol.(%)	D.C. Leakage Current (μA)
20	KD	• Lug Terminal (LA)	−40 ~ +85 (16 ~ 100V) −25 ~ +85 (160 ~ 500V)	16 ~ 500	22 ~ 68,000	−10 ~ +50(T)	$3\sqrt{CV}$ After 5 Minutes
21	HH	• Prong Terminal (HH) for P.C.B. Mount	−40 ~ +85 (16 ~ 100V) −25 ~ +85 (160 ~ 500V)	16 ~ 500	150 ~ 47,000	−10 ~ +50(T)	$3\sqrt{CV}$ After 5 Minutes
22	HL	• Snap-in Terminal (HS) • for P.C.B Mount	−40 ~ +85 (16 ~ 100V) −25 ~ +85 (160 ~ 500V)	16 ~ 500	22 ~ 22,000	−10 ~ +30(Q)	$3\sqrt{CV}$ After 5 Minutes
23	LL	• Snap-in Terminal (HS) for P.C.B. Mount • Low Profile of HL Series	−40 ~ +85 (16 ~ 100V) −25 ~ +85 (160 ~ 200V)	16 ~ 200	220 ~ 15,000	−10 ~ +30(Q)	$3\sqrt{CV}$ After 5 Minutes
24	GH	• Snap-in Terminal (HS) • Higher Temp. (105°C)	−40 ~ +105	10 ~ 100	470 ~ 15,000	±20(M)	$3\sqrt{CV}$ After 5 Minutes
25	GL	• Snap-in Terminal (HS) • Higher Temp. (105°C) • Low Profile of GH Series	−40 ~ +105	10 ~ 100	1,000 ~ 10,000	±20(M)	$3\sqrt{CV}$ After 5 Minutes
26	LZ	• P.C. Mount Terminal (LM) • Low Impedance • Low Profile	−40 ~ +85	16 ~ 100	2,200 ~ 22,000	−10 ~ +30(Q)	$3\sqrt{CV}$ After 5 Minutes
27	NW	• Computer Grade— Screw Terminal (SM) • Smallest Size of Computer Grade	−25 ~ +85	6.3 ~ 450	120 ~ 1,000,000 (1F)	−10 ~ +50(T)	$3\sqrt{CV}$ After 5 Minutes
28	NK	• Computer Grade— Screw Terminal (SM) • Smaller Case Size Than 'NS' and Higher Ripple than 'NW'	−25 ~ +85	6.3 ~ 450	150 ~ 470,000	−10 ~ +50(T)	$3\sqrt{CV}$ After 5 Minutes
29	NS	• Computer Grade— Screw Terminal (SM) • Standard Size and Ripple	−25 ~ +85	6.3 ~ 450	220 ~ 470,000	−10 ~ +50(T)	$3\sqrt{CV}$ After 5 Minutes
30	NH	• Computer Grade— Screw Terminal (SM) • For High Ripple Current Applications	−25 ~ +85	6.3 ~ 450	220 ~ 220,000	−10 ~ +100(W) (63 ~ 80V) −10 ~ +75(U) (100 ~ 350V) −10 ~ +50(T) (400 ~ 450V)	$3\sqrt{CV}$ After 5 Minutes
31	MK	• For Motor Starting • Lug Terminal (LA)	−25 ~ +65	110 ~ 250 V. AC	20 ~ 400	−0 ~ +20(A)	—

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CAN TYPE ELECTROLYTICS—TYPE 'L' FOR SWITCHING REGULATORS

Item No.	Series Type	Features	Operating Temp. (°C)	Rated Voltage Range (V. DC)	Capacitance Range (μF)	Capacitance Tol.(%)	D.C Leakage Current (μA)
32	PS	• Snap-in Terminal (HS) • Provides Several Case Size for Each Rating	−40 ~ +85 (160 ~ 250V) −25 ~ +85 (350 ~ 450V)	160 ~ 450	47 1,000	±20(M)	$3\sqrt{CV}$ After 5 Minutes
33	FL	• Snap-in Terminal (HS) • Low Profile	−40 ~ +85	160 ~ 250	82 270	±20(M)	$3\sqrt{CV}$ After 5 Minutes
34	GM	• Snap-in Terminal (HS) • Higher Temp. (105°C) • Provides Several Case Size for Each Rating	−40 ~ +105 (160 ~ 250V) −25 ~ +105 (400V)	160 ~ 400	47 1,000	±20(M)	$3\sqrt{CV}$ After 5 Minutes
35	PK	• Snap-in Terminal (HS) • Higher Temp (105°C) • Highest Ripple Current Capability	−40 ~ 105	200,250	150 1,000	±20(M)	$3\sqrt{CV}$ After 5 Minutes

SEMI-CONDUCTIVE CERAMIC CAPACITOR

Item No.	Series Type	Rated Voltage (V. DC)	T. C.	Capacitance (μF)	Capacitance Tolerance	Insulation Resistance (MΩ)
36	RSB	12	Y5S	0.022 ~ 0.47	±20% (M), +80-20% (Z)	0.022-0.1μF—1 Min. at 12V 0.33μF—0.33 Min. at 12 V 0.22μF—0.5 Min. at 12V 0.47μF—0.25 Min. at 12 V
37	RSB	25	Y5T	0.01 ~ 0.1	±20% (M), +80-20% (Z)	1,000 Min. at 25V
38	RSB	50	Y5V Y5T	0.01 ~ 0.1	Y5V: +80-20% (Z) Y5T ±20% (M), +80-20% (Z)	1,000 Min. at 50V

POLYESTER FILM CAPACITOR

Item No.	Series Type	Rated Voltage (V. DC)	Capacitance (μF)	Capacitance Tolerance	Insulation Resistance	D. F.
39	TDY	100	0.001 ~ 0.47	±5% (J), ±10% (K), ±20% (M)	9,000 MΩ Min.	1.0% Max. at 1kHz

METALLIZED POLYESTER FILM CAPACITOR

Item No.	Series Type	Rated Voltage (V. DC)	Capacitance (μF)	Capacitance Tolerance	Insulation Resistance	D. F.
40	TDXM (Radial)	250, 400, 630	0.01 ~ 2.2	±5% (J), ±10% (K), ±20% (M)	≤0.33μF—9,000 MΩ Min.	1.0% Max.
41	TTAM (Axial)	250, 400, 630	0.15 ~ 10	±5% (J), ±10% (K), ±20% (M)	>0.33μF—3,000 MΩ Min.	at 1kHz

UL LISTED METALLIZED FILM CAPACITOR—RADIAL—MOLDED RESIN CASE

Item No.	Series Type	Rated Voltage	Capacitance (μF)	Capacitance Tolerance	Insulation Resistance	D. F.
42	AL	125 V. AC	0.0047 ~ 0.22	±10% (K), ±20% (M)	9,000 MΩ Min. at 100 V. DC 1 Min.	1.0% Max. at 1kHz

Note: The following features for ceramic disc and film capacitors are available upon your request:
1. Radial lead taping is available in 11mm diameter and less products for all ceramic series and TDY film capacitors
2. Axial lead taping is available in 11mm diameter and less products for all ceramic series
3. Lead cut and forming are available for all series

Nichicon also manufactures:
Oil filled paper capacitors (without P.C.B.'s)
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Hybrid I.C.'s
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SPECIAL ORDERING SPECIFICATIONS

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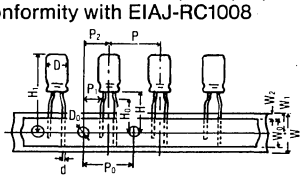
TAPED CAPACITORS FOR AUTOMATIC INSERTION

Taped Nichicon aluminum electrolytic capacitors of Axial Lead type and Radial Lead type designs are available in a choice of two packaging methods: reel packaging and ammunition box.

TAPED RADIAL LEADS

Available for capacitors with diameters of 4 (.157"); 5 (.196"); 6 (.236"); and 8mm (.314"). In conformity with EIAJ-RC1008

Units of up to φ10 (φ10x16L) can be supplied in taped form on request.



Code	D	d	P	P_0	P_1	P_2	F	H	H_0	H_1	D_0	W	W_0	W_1	W_2
Nominal Value	*	*	12.7	12.7	3.85	6.35	5.0	H+A≤H_1	16.0	MAX 32.25	4.0	18.0	MIN 12.5	9.0	MAX 3.0
Tolerance	MAX +0.5	±0.05	±1.0	±0.2	±0.7	±1.3	+0.8 −0.2	–	±0.5	–	±0.2	±0.5	–	±0.5	–

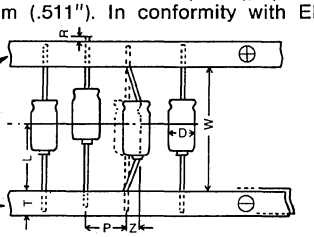
* For capacitors of φ4, units with F dimension of 3.5 are also available.
* "φd" depends on capacitor specification.

TAPED AXIAL LEADS

Available for capacitors with diameters of 5 (.196"); 6 (.236"); 8 (.314"); 10 (.394") and 13mm (.511"). In conformity with EIAJ-RC1008 and IEC-Pub 286

White tape for positive polarity

Blue or yellow tape for negative polarity



Code	W	R	P	Z	L	T
Nominal Value	52.4, 63.5, 73	2 MAX.	*	1.2 MAX.	W/2	6.0
Tolerance	±1.5	–	±0.5	–	±1.2	±1

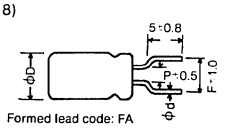
* P = 10 for φ5, 6 and 8 capacitors P = 15 for φ10 and 13 capacitors

LEAD FORMING (Capacitors with trimmed or formed leads—radial lead type)

Capacitors with their leads formed or trimmed allow for easier insertion of the units into PC boards. Thus, higher mounting efficiency can be gained.

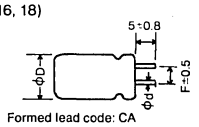
Formed leads and trimmed leads

Shape (1) (φ4, 5, 6, 8)



Formed lead code: FA

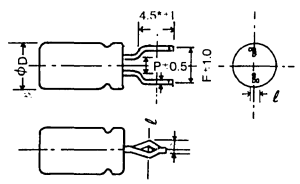
Shape (2) (φ10, 13, 16, 18)



Formed lead code: CA

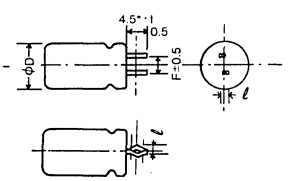
Snap-in type lead

Shape (3) (φ4, 5, 6, 8)



Formed lead code: AA

Shape (4) (φ10, 13, 16, 18)



Formed lead code: AA

Forming method Code	Shape No.	Dimensions φD	F	P	L
Forming and cutting FA	①	4	5	1.5	–
		5	5	2.0	–
		6(6.3)	5	2.5	–
		8	5	3.5	–
Cutting CA	②	10	5	–	–
		13	5	–	–
		16	7.5	–	–
		18	7.5	–	–
Snap-in type forming AA	③	4	5	1.5	1.1
		5	5	2.0	1.1
		6(6.3)	5	2.5	1.1
		8	5	3.5	1.3
	④	10	5	–	1.3
		13	5	–	1.3
		16	7.5	–	1.3
		18	7.5	–	1.3

*For φ4 capacitors with formed or trimmed leads, they can also be supplied with F dimension of 3.5 mm.
*Lead diameter φd depends on capacitor specification.

SAFETY VENT (Miniature Aluminum Electrolytic Capacitors)

Diameters ≥ 10mm	Safety Vent Standard
Diameters ≤ 8mm	Safety Vent Optional (Except SA, SL, and MA Series,)

ANTI-SOLVENT FEATURE

Clean and simple. Nichicon anti-solvent aluminum electrolytic capacitors withstand unfriendly cleaning agents for up to 5 minutes. And even though they perform better than epoxy end-sealed capacitors, their maximum seated height and cost have been reduced.

Series	Cleaning Agent	Cleaning Condition	Cleaning Time
LB† SA	Freon® TE, TES TMS	• ultrasonic (28kHz, 10 W/L Max. output) • vapor • immersion	5 minutes
SL EB VS/VH BU	I. I. I. Trichloroethane Triclene Freon® TF & TMC	• vapor • immersion	5 minutes

†LB Series capacitors with capacitance ratings ≥ 1μF, except: 100 volt "T" type axials and 100 volt/470μF radial types.

nichicon The capacitor choice.

The capacitor choice.

NICHICON (AMERICA) CORPORATION

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

POLYESTER FILM CAPACITORS

POLYESTER FILM CAPACITORS EXTENDED FOIL/FILM WRAP/EPOXY END FILL STYLE 107 −55°C TO +125°C

ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

CAPACITANCE MEASUREMENTS

Capacitors of 1.0 μF or less shall be measured at a frequency of 1000 Hz. Capacitors greater than 1.0 μF shall be measured at 60 Hz. The standard capacitance tolerance is 20%. Other tolerances are available upon request.

Reference: MIL-STD-202, Method 305.

TEMPERATURE CHARACTERISTICS

The maximum change in capacitance from the measured value at +25°C shall be −6% at −55°C, and +15% at +125°C.

DISSIPATION FACTOR

When measured as specified in Paragraph 1, the dissipation factor at +25°C shall not exceed 0.6% for values up to 1.0 μF and shall not exceed 1.0% for greater capacitance values.

INSULATION RESISTANCE

When measured at +25°C, and rated voltage (or 500 VDC, whichever is less), the insulation resistance shall be a minimum of 50,000 megohm-microfarads, but need not exceed 100,000 megohms. The period of electrification shall not exceed two minutes.

Reference: MIL-STD-202, Method 302.

VOLTAGE DERATING

The capacitors may be operated at full rated voltage from −55°C to +85°C, or with linear derating to 50% of rated voltage above +85°C with a maximum temperature of +125°C.

VOLTAGE TEST

When tested at +25°C, the capacitors shall withstand the indicated DC test voltages for a period of one minute:

Terminal to terminal	200% of DC rating
Terminal to case (less than .235 diameter)	200% of DC rating
Terminal to case (greater than .235 diameter)	400% of DC rating or 2,000 VDC, whichever is less

Reference: MIL-STD-202, Method 301.

LIFE TESTING

When tested for 1000 hours at 150% of the appropriate rated voltage for the test temperature, the capacitors shall exhibit no more than one failure in twelve pieces tested. Alternatively, an accelerated +125°C test may be performed at the +85°C voltage rating for a period of 250 hours. A failure is defined as:

a) A capacitance change of more than 10% of its initial value;
b) A dissipation factor greater than that specified in Paragraph 3;
c) An insulation resistance less than ⅓ that specified in Paragraph 4; or
d) A permanent open or short.

VIBRATION

The capacitors will meet or exceed in the vibration requirements of MIL-STD-202, Method 201.

NYTRONICS CATALOG NUMBERING SYSTEM

107 B 103 M

- **107** — Nytronics Style
- **B** — D.C. Voltage Rating: B = 100V, C = 200V, E = 400V, F = 600V
- **103** — Capacitance: In μμf. The first two digits are the significant figures, the third is the number of zeros.
- **M** — Capacitance Tolerance: F = ±1%, P = ±2%, J = ±5%, K = ±10%, M = ±20%

Note: Special capacitance values, voltage ratings and sizes available to customer requirements.

PHYSICAL SIZE TOLERANCES

	100 Volts DC & 200 Volts DC		400 Volts DC	
DIAMETER	Up to .158	+.032 −.000	Up to .218	±.032
	.159 to .200	+.040 −.000	.219 to .500	±.046
	Over .200	+.050 −.000	Over .500	±.062
LENGTH		+1/16 −0		+3/32 −1/16

TINNED COPPERWELD LEADS

No. 22 AWG. (.025) for cases up to .325 Dia.
No. 20 AWG. (.032) for cases .326 thru 1.0 Dia.
No. 18 AWG. (.040) for cases above 1.0 Dia.

Lead Length: 1⅝" Min.

Also available are the following styles with characteristics similar to Type 107.

STYLE 103
Flat Press with Axial Leads
Extended Foil Construction
Polyester Film Dielectric
Film Wrap-Epoxy Endfill
−55°C to +125°C Operation

STYLE 118
Round Body with Axial Leads
Extended Foil Construction
Polyester Film Dielectric
Polyethylene Case-Epoxy Endfill
−55°C to +100°C Operation

STANDARD RATINGS

Capacitance μf	Dia. x Length		Cat. No.
100 VOLTS DC WORKING			
.001	.138	3/8	107B102M
.0015	.138	3/8	107B152M
.0022	.138	3/8	107B222M
.0033	.138	3/8	107B332M
.0047	.138	3/8	107B472M
.0068	.138	3/8	107B682M
.0082	.138	3/8	107B822M
.01	.158	3/8	107B103M
.015	.158	21/32	107B153M
.022	.158	21/32	107B223M
.027	.158	21/32	107B273M
.033	.158	21/32	107B333M
.047	.190	21/32	107B473M
.068	.220	21/32	107B683M
.082	.265	21/32	107B823M
.1	.265	1 1/16	107B104M
.12	.300	3/4	107B124M
.15	.330	3/4	107B154M
.22	.350	15/16	107B224M
.27	.350	1 1/16	107B274M
.33	.385	1 1/16	107B334M
.39	.415	1 1/16	107B394M
.47	.450	1 1/16	107B474M
.56	.490	1 1/16	107B564M
.68	.540	1 1/16	107B684M
.82	.570	1 1/16	107B824M
1.	.590	1 3/16	107B105M
1.5	.670	1 3/16	107B155M
1.8	.730	1 3/16	107B185M
2.0	.700	1 1/2	107B205M
200 VOLTS DC WORKING			
.001	.138	3/8	107C102M
.0015	.138	3/8	107C152M
.0022	.138	3/8	107C222M
.0033	.138	3/8	107C332M
.0047	.138	3/8	107C472M
.0068	.138	3/8	107C682M
.0082	.138	3/8	107C822M
.01	.158	3/8	107C103M
.015	.158	21/32	107C153M
.022	.158	21/32	107C223M
.027	.158	21/32	107C273M
.033	.158	21/32	107C333M
.047	.190	21/32	107C473M
.068	.220	21/32	107C683M
.082	.265	21/32	107C823M
.1	.265	1 1/16	107C104M
.12	.285	13/16	107C124M
.15	.315	13/16	107C154
.22	.325	1 1/16	107C224M
.27	.330	1 3/16	107C274M
.33	.360	1 3/16	107C334M
.39	.395	1 3/16	107C394M
.47	.430	1 3/16	107C474M
.56	.465	1 3/16	107C564M
.68	.510	1 3/16	107C684M
.82	.580	1 3/16	107C824M
1.	.590	1 5/16	107C105M
1.5	.680	1 7/16	107C155M
1.8	.740	1 7/16	107C185M
2.0	.750	1 7/16	107C205M
400 VOLTS DC WORKING			
.001	.156	5/8	107E102M
.0015	.156	5/8	107E152M
.0022	.156	5/8	107E222M
.0033	.156	5/8	107E332M
.0047	.187	5/8	107E472M
.0068	.218	5/8	107E682M
.0082	.234	5/8	107E822M
.01	.250	5/8	107E103M
.015	.296	5/8	107E153M
.022	.312	3/4	107E223M
.027	.281	7/8	107E273M
.033	.312	7/8	107E333M
.047	.343	7/8	107E473M
.068	.375	1	107E683M
.082	.406	1	107E823M
.1	.421	1	107E104M
.12	.468	1	107E124M
.15	.468	1 1/4	107E154M
.22	.546	1 3/8	107E224M
.27	.609	1 3/8	107E274M
.33	.593	1 5/8	107E334M
.39	.625	1 5/8	107E394M
.47	.671	1 5/8	107E474M
.56	.718	1 3/4	107E564M
.68	.796	1 3/4	107E684M
.82	.812	1 7/8	107E824M
1.	.812	2	107E105M
1.5	.921	2 1/4	107E155M
1.8	1.015	2 1/4	107E185M
2.0	1.093	2 1/4	107E205M

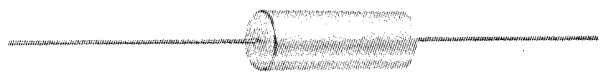
Special capacitance values, tolerances and sizes are available on request.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

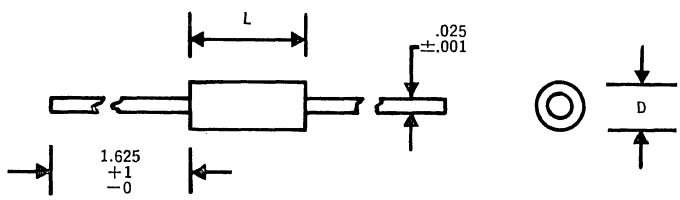
MOLDED MYLAR CAPACITORS

TYPE 111 MOLDED MYLAR* CAPACITORS

MOLDED IN RUGGED FLAME-RETARDANT MOLDING COMPOUND



Nytronics Type 111 Capacitors were developed for applications requiring excellent capacitance stability, superior humidity resistance and high insulation resistance. The capacitor element is non-inductively wound with mylar dielectric and extended foil.



Size	D, Max	L, Max
A	.188	.440
B	.188	.697
C	.219	.697
A-B	.219	.572

**

ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

CAPACITANCE
Shall be within the specified limits when measured at a frequency of 1 KHz at +25°C.

DISSIPATION FACTOR
Shall not exceed 1% when measured as above.

INSULATION RESISTANCE
When measured at +25°C and with rated voltage applied for 2 minutes, shall be a minimum of 50,000 megohms.

DIELECTRIC STRENGTH
Shall withstand 2.5X rated voltage for one minute.

OPERATING TEMPERATURE
−55°C to +85°C at full rated voltage; derated linearly to 50% of rated voltage at 125°C.

LIFE TEST
250 hours, at +85°C and 150% of rated voltage or, at +125°C with 85°C rated voltage applied. One failure in twelve allowed.

MOISTURE RESISTANCE
Capacitors shall meet the humidity requirements of MIL-STD-202E, Method 106D, 5 cycles.

Capacity MFD	100 VDC	Case Size	200 VDC	Case Size
.001	111B102K	A	111C102K	A
.0012	111B122K	A	111C122K	A
.0015	111B152K	A	111C152K	A
.0018	111B182K	A	111C182K	A
.0022	111B222K	A	111C222K	A
.0027	111B272K	A	111C272K	A
.0033	111B332K	A	111C332K	A
.0039	111B392K	A	111C392K	A
.0047	111B472K	A	111C472K	A
.0056	111B562K	A	111C562K	A
.0068	111B682K	A	111C682K	A
.0082	111B822K	A	111C822K	A
.01	111B103K	A	111C103K	B
.012**	111B123K	B	111C123K	B
.015**	111B153K	B	111C153K	B
.018**	111B183K	B	111C183K	B
.022**	111B223K	B	111C223K	B
.027**	111B273K	C	111C273K	C
.033**	111B333K	C	111C333K	C
.039	111B393K	C		
.047	111B473K	C		

** Available in alternate A-B size. To order prefix number with AB — Example AB111B123, 100 VDC only.

NYTRONICS CATALOG NUMBERING SYSTEM

111 B 103 K

Nytronics Type

D.C. Rated Voltage
B = 100V
C = 200V

Capacitance
In Picofarads. The 1st 2 digits are the significant figures. The 3rd is the number of zeroes.

Capacitance Tolerance
J = ±5%
K = ±10%
M = ±20%
Other tolerances available on request.

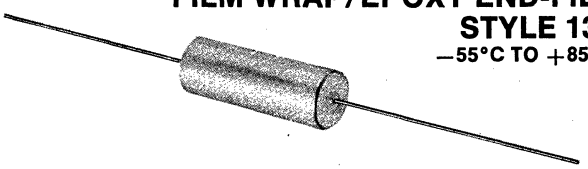
Intermediate capacitance values available
* Dupont Trade Name
† Other values and sizes available soon; inquiries invited

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

POLYSTYRENE CAPACITORS

POLYSTYRENE CAPACITORS

EXTENDED FOIL
FILM WRAP/EPOXY END-FILL
STYLE 133
—55°C TO +85°C



ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

CAPACITANCE MEASUREMENTS
Capacitors of 1.0 μF or less shall be measured at a frequency of 1000 Hz.

Capacitors greater than 1.0 μF shall be measured at 60 Hz.

The standard capacitance tolerance is 20%. Other tolerances are available upon request.

Reference: MIL-STD-202, Method 305.

TEMPERATURE CHARACTERISTICS AND STABILITY
When measured over the full operating range, the Temperature Coefficient shall be −120ppm/°C ±30ppm/°C.

There shall be less than 0.1% change per year in capacitance when operated between +20°C and +50°C.

After cycling from −55°C to +75°C, the capacitance shall not vary more than 0.2% from its initial measurement at +25°C.

DISSIPATION FACTOR
When measured as specified in Paragraph 1, the dissipation factor at +25°C shall not exceed 0.1%.

INSULATION RESISTANCE
When measured at +25°C, and rated voltage (or 500 VDC, whichever is less), the insulation resistance shall be a minimum of 200,000 megohm-microfarads, but need not exceed 500,000 megohms. The period of electrification shall not exceed two minutes.

Reference: MIL-STD-202, Method 302.

VOLTAGE DERATING
The capacitors may be operated at full rated voltage from −55°C to +65°C, or with linear derating to 60% of rated voltage above +65°C to the maximum operating temperature of +85°C.

VOLTAGE TEST
When tested at +25°C, the capacitors shall withstand the indicated DC test voltages for a period of one minute:

Terminal to terminal	200% of DC rating
Terminal to case (less than .235 diameter)	200% of DC rating
Terminal to case (greater than .235 diameter)	400% of DC rating or 2.000 VDC, whichever is less

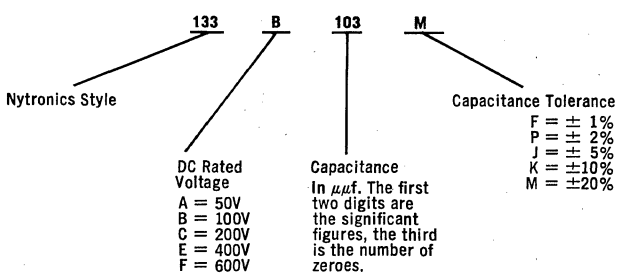
Reference: MIL-STD-202, Method 301.

LIFE TESTING
When tested at 85°C for 250 hours at full 65°C rated voltage, the capacitors shall exhibit no more than one failure in twelve pieces tested. A failure is defined as:

a) A capacitance change of more than 6% of its initial value;
b) A dissipation factor greater than that specified in Paragraph 3;
c) An insulation resistance less than 60% that specified in Paragraph 4; or
d) A permanent open or short.

VIBRATION
The capacitors will meet or exceed the vibration requirements of MIL-STD-202, Method 201.

NYTRONICS CATALOG NUMBERING SYSTEM



Note: Special capacitance values, voltage ratings and sizes available to customer requirement.

Intermediate value available.

STANDARD RATINGS AT 85°C

50 VOLTS DC WORKING

Capacitance MFD	Diameter	Length	Cat. No.
.001	.218	.625	133A102M
.0015	.218	.625	133A152M
.0022	.218	.625	133A222M
.0033	.218	.625	133A332M
.0039	.218	.625	133A392M
.0047	.218	.625	133A472M
.0068	.218	.625	133A682M
.0082	.218	.625	133A822M
.01	.218	.625	133A103M
.015	.260	.625	133A153M
.022	.260	.750	133A223M
.027	.290	.750	133A273M
.033	.325	.750	133A333M
.039	.350	.812	133A393M
.047	.375	.812	133A473M
.068	.390	.937	133A683M
.082	.420	.937	133A823M
.1	.420	.937	133A104M
.12	.460	1.000	133A124M
.15	.460	1.125	133A154M
.18	.500	1.125	133A184M
.22	.600	1.125	133A224M
.27	.655	1.437	133A274M
.39	.703	1.437	133A394M
.47	.734	1.562	133A474M

100 VOLTS DC WORKING

Capacitance μf	Diameter	Length	Cat. No.
.001	.218	.750	133B102M
.0015	.218	.750	133B152M
.0022	.218	.750	133B222M
.0033	.218	.750	133B332M
.0039	.218	.750	133B392M
.0047	.218	.750	133B472M
.0068	.234	.750	133B682M
.0082	.234	.750	133B822M
.01	.296	.750	133B103M
.012	.296	.750	133B123M
.015	.296	.750	133B153M
.022	.318	.875	133B223M
.027	.328	.875	133B273M
.033	.343	.875	133B333M
.039	.359	.875	133B393M
.047	.375	.875	133B473M
.068	.406	1.000	133B683M
.082	.460	1.000	133B823M
.1	.460	1.000	133B104M
.15	.460	1.125	133B154M
.18	.500	1.125	133B184M
.22	.600	1.125	133B224M
.27	.655	1.437	133B274M
.39	.703	1.437	133B394M
.47	.734	1.562	133B474M

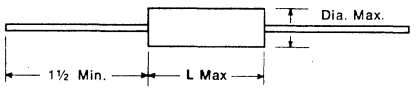
200 VOLTS DC WORKING

Capacitance μf	Diameter	Length	Cat. No.
.001	.218	.750	133C102M
.0015	.218	.750	133C152M
.0022	.218	.750	133C222M
.0033	.218	.750	133C332M
.0039	.218	.750	133C392M
.0047	.218	.750	133C472M
.0068	.234	.750	133C682M
.0082	.234	.750	133C822M
.01	.296	1.000	133C103M
.012	.296	1.000	133C123M
.015	.296	1.000	133C153M
.022	.318	1.000	133C223M
.027	.375	1.000	133C273M
.033	.375	1.000	133C333M
.039	.437	1.125	133C393M
.047	.437	1.125	133C473M
.068	.500	1.125	133C683M
.082	.562	1.375	133C823M
.1	.500	1.375	133C104M
.15	.625	1.375	133C154M
.18	.687	1.375	133C184M
.22	.687	1.812	133C224M
.27	.687	1.812	133C274M
.39	.875	1.812	133C394M
.47	1.000	1.812	133C474M

400 VOLTS DC WORKING

Capacitance μf	Diameter	Length	Cat. No.
.001	.218	.750	133E102M
.0015	.218	.750	133E152M
.0022	.218	.750	133E222M
.0033	.218	.750	133E332M
.0039	.218	.750	133E392M
.0047	.218	.750	133E472M
.0068	.234	.750	133E682M
.0082	.234	.750	133E822M
.01	.320	1.000	133E103M
.012	.320	1.000	133E123M
.015	.400	1.000	133E153M
.022	.400	1.000	133E223M
.027	.450	1.125	133E273M
.033	.450	1.125	133E333M
.039	.515	1.125	133E393M
.047	.515	1.125	133E473M
.068	.562	1.125	133E683M
.082	.562	1.375	133E823M
.1	.640	1.375	133E104M
.15	.640	1.812	133E154M
.18	.700	1.812	133E184M
.22	.750	1.812	133E224M
.27	.750	1.812	133E274M
.39	1.000	1.812	133E474M
.47	1.000	1.812	133E474M

CONFIGURATIONS



LEAD WIRE SIZE

No. 22 AWG. (.025) for cases up to .325 Dia.

No. 20 AWG. (.032) for cases .326 thru 1.0 Dia.

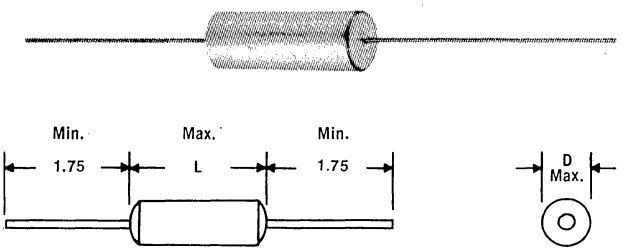
No. 18 AWG. (.040) for cases above 1.0 Dia.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

POLYPROPLYENE CAPACITORS

TYPE 187 POLYPROPYLENE CAPACITORS

EXTENDED FOIL/FILM WRAP/ EPOXY ENDFILL



ELECTRICAL SPECIFICATIONS

CAPACITANCE
Shall be within the specified limits when measured at 1 kHz at +25°C.

DISSIPATION FACTOR
Shall not exceed .1% when measured as above.

INSULATION RESISTANCE
When measured at +25°C and with rated voltage applied for 2 minutes, shall be a minimum 250,000 megohms/mfd; need not exceed 500,000 megohms.

DIELECTRIC STRENGTH
Shall withstand 200% of rated voltage for 1 minute.

OPERATING TEMPERATURE
−55°C to +105°C at full rated voltage.

LIFE TEST
250 hours, at 105°C with 140% of rated voltage applied. One failure in twelve shall be permitted.

HUMIDITY RESISTANCE
Meets the requirements of MIL-STD-202, Method 103B, Test Condition B. After test the I.R. will be equal to or greater than 1/3 of the initial requirement.

LEAD PULL & BEND TEST
Capacitors will withstand a 5 pound pull test and bend test as described in RS-164.

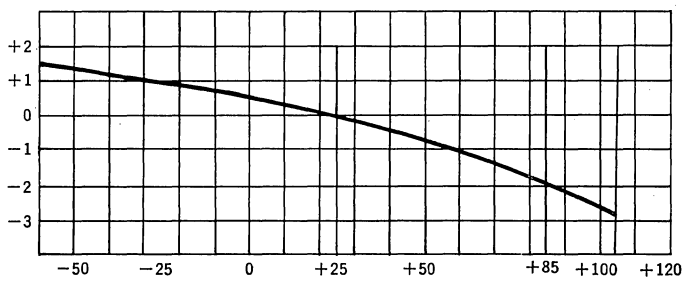
LEAD WIRE SIZE

AWG	DIAMETER MAX.
#22	.40 & Under
#20	.401 Thru 1.0
#18	Above 1.0

CAPACITY TOLERANCE SUFFIX

F = ± 1%
P = ± 2%
J = ± 5%
K = ±10%
M = ±20%

TYPICAL CAPACITANCE CHANGE WITH TEMPERATURE IN PERCENT



TEMPERATURE IN DEGREES CENTIGRADE

Other capacitance values and voltage ratings available upon request.

CAPACITY MFD.	100 VDC CATALOG NO.	D MAX.	L MAX.	200 VDC CATALOG NO.	D MAX.	L MAX.	400 VDC CATALOG NO.	D MAX.	L MAX.
.001	187B102___	.218	.625	187C102___	.218	.625	187E102___	.218	.625
.0012	187B122___	.218	.625	187C122___	.218	.625	187E122___	.218	.625
.0015	187B152___	.218	.625	187C152___	.218	.625	187E152___	.218	.625
.0018	187B182___	.218	.625	187C182___	.218	.625	187E182___	.218	.625
.0022	187B222___	.218	.625	187C222___	.218	.625	187E222___	.218	.625
.0027	187B272___	.218	.625	187C272___	.218	.625	187E272___	.218	.625
.0033	187B332___	.218	.625	187C332___	.218	.625	187E332___	.218	.625
.0039	187B392___	.218	.625	187C392___	.218	.625	187E392___	.218	.625
.0047	187B472___	.218	.625	187C472___	.218	.625	187E472___	.218	.625
.0056	187B562___	.218	.625	187C562___	.218	.625	187E562___	.240	.625
.0068	187B682___	.218	.625	187C682___	.218	.625	187E682___	.255	.625
.0082	187B822___	.218	.625	187C822___	.218	.625	187E822___	.235	.687
.01	187B103___	.218	.625	187C103___	.232	.625	187E103___	.255	.687
.012	187B123___	.218	.625	187C123___	.245	.625	187E123___	.280	.687
.015	187B153___	.235	.625	187C153___	.242	.687	187E153___	.310	.687
.018	187B183___	.250	.625	187C183___	.255	.687	187E183___	.340	.687
.022	187B223___	.265	.625	187C223___	.265	.687	187E223___	.360	.687
.027	187B273___	.285	.625	187C273___	.316	.687	187E273___	.395	.687
.033	187B333___	.320	.625	187C333___	.320	.687	187E333___	.370	.812
.039	187B393___	.345	.625	187C393___	.358	.687	187E393___	.395	.812
.047	187B473___	.300	.750	187C473___	.330	.812	187E473___	.435	.812
.056	187B563___	.325	.750	187C563___	.354	.812	187E563___	.465	.812
.068	187B683___	.345	.812	187C683___	.385	.812	187E683___	.450	.937
.082	187B823___	.345	.812	187C823___	.415	.812	187E823___	.480	.937
.1	187B104___	.410	.812	187C104___	.415	.937	187E104___	.530	.937
.12	187B124___	.425	.812	187C124___	.450	.937	187E124___	.495	1.250
.15	187B154___	.425	.937	187C154___	.495	.937	187E154___	.545	1.250
.18	187B184___	.425	.937	187C184___	.530	.937	187C184___	.605	1.250
.22	187B224___	.450	.937	187C224___	.520	1.125	187E224___	.655	1.250
.27	187B274___	.460	1.125	187C274___	.575	1.125	187E274___	.630	1.500
.33	187B334___	.490	1.125	187C334___	.635	1.125	187E334___	.690	1.500
.39	187B394___	.490	1.250	187C394___	.635	1.250	187E394___	.740	1.500
.47	187B474___	.540	1.250	187C474___	.690	1.250	187E474___	.810	1.500
.56	187B564___	.585	1.250	187C564___	.660	1.500	187E564___	.870	1.500
.68	187B684___	.635	1.250	187C684___	.720	1.500	187E684___	.860	1.750
.82	187B824___	.685	1.250	187C824___	.720	1.750	187E824___	.950	1.750
1.	187B105___	.760	1.250	187C105___	.770	1.750	187E105___	1.040	1.750

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

METALLIZED POLYPROPYLENE CAPACITOR TYPE 192

POLYESTER TAPE WRAP CASE/EPOXY ENDFILL

Type 192 Capacitors feature small size, excellent stability, high insulation resistance, low dissipation factor and good humidity resistance. These properties make them ideal for use in timing and integrating circuitry.

CAPACITANCE
Shall be within specified tolerance when measured at 1 KHz for values thru 1 MFD and at 60 Hz for values above 1 MFD.

DISSIPATION FACTOR
Less than .1% when measured as above at 25°C.

DIELECTRIC STRENGTH
1.5 X rated voltage for one minute through a limiting resistance of 100 ohms/volt.

INSULATION RESISTANCE
Minimum values.

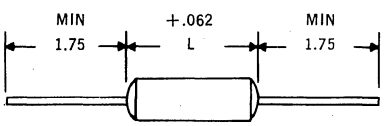
Temperature	+25°C	+85°C	+105°C
Megohms X Microfarads	100,000	5,000	500
Need Not Exceed (Megohms)	200,000	10,000	1000

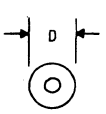
Measured After Two Minutes Electrification At Rated Voltage

TEMPERATURE RANGE
−55°C to +85°C at rated voltage to 105°C with 50% voltage derating.

HUMIDITY
Will meet the test requirements of MIL-STD-202, Method 103B, Test Condition B. After testing the I.R. will be equal to or greater than ⅓ of the initial requirements. One failure in 12 permitted.

LIFE TEST
250 hours at 85°C with 140% of rated voltage applied. A resistance of one ohm per volt shall be inserted in series with each capacitor. One failure in 12 shall be permitted.





D TOLERANCE

.249 and Under	+.032
.250 thru .500	+.046
.501 thru 1.000	+.062

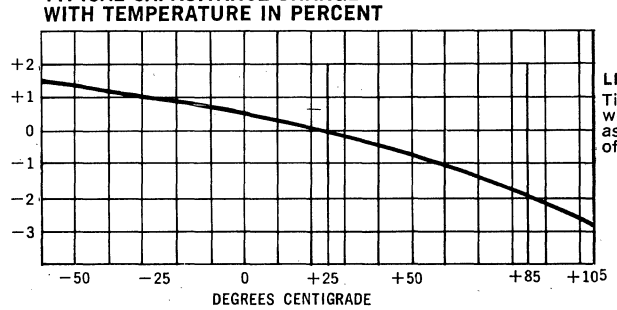
LEAD GAUGE

Body Length	AWG
.530 and Less	24
.650 thru 1.062	22
1.187 thru 2.00	20
Greater Than 2.00	18

CAPACITY TOLERANCE SUFFIX

F = ± 1%
P = ± 2%
J = ± 5%
K = ±10%
M = ±20%

TYPICAL CAPACITANCE CHANGE WITH TEMPERATURE IN PERCENT



LEAD MATERIAL:
Tinned copperweld wire shall withstand mechanical test as specified in Paragraph 3.4 of EIA Standard RS-164A

CAP MFD	CAT. No.	DIA.	LENGTH
150 VOLTS DC WORKING			
.010	192V103	.160	.400
.012	192V123	.170	.400
.015	192V153	.190	.400
.018	192V183	.165	.470
.022	192V223	.180	.470
.027	192V273	.188	.470
.033	192V333	.178	.470
.039	192V393	.188	.470
.047	192V473	.203	.470
.056	192V563	.190	.530
.068	192V683	.205	.530
.082	192V823	.225	.530
.10	192V104	.245	.530
.12	192V124	.265	.530
.15	192V154	.240	.650
.18	192V184	.260	.650
.22	192V224	.285	.650
.27	192V274	.315	.650
.33	192V334	.315	.780
.39	192V394	.325	.780
.47	192V474	.355	.780
.56	192V564	.385	.780
.68	192V684	.380	.900
.82	192V824	.380	1.062
1.0	192V105	.415	1.062
1.2	192V125	.450	1.062
1.5	192V155	.500	1.062
2.0	192V205	.535	1.187
3.0	192V305	.575	1.437
4.0	192V405	.660	1.437
5.0	192V505	.665	1.750
6.0	192V605	.725	1.750
8.0	192V805	.770	2.000
10.0	192V106	.860	2.000
200 VOLTS DC WORKING			
.010	192C103	.160	.400
.012	192C123	.170	.400
.015	192C153	.190	.400
.018	192C183	.165	.470
.022	192C223	.180	.470
.027	192C273	.195	.470
.033	192C333	.210	.470
.039	192C393	.195	.530
.047	192C473	.215	.530
.056	192C563	.230	.530
.068	192C683	.250	.530
.082	192C823	.225	.650
.10	192C104	.245	.650
.12	192C124	.265	.650
.15	192C154	.295	.650
.18	192C184	.285	.780
.22	192C224	.310	.780
.27	192C274	.340	.780
.33	192C334	.370	.780
.39	192C394	.360	.900
.47	192C474	.395	.900
.56	192C564	.425	.900
.68	192C684	.465	.900
.82	192C824	.440	1.187
1.0	192C105	.480	1.187
1.2	192C125	.525	1.187
1.5	192C155	.580	1.187
2.0	192C205	.670	1.187
3.0	192C305	.720	1.500
4.0	192C405	.825	1.500
5.0	192C505	.830	1.750
6.0	192C605	1.000	1.750
8.0	192C805	.960	2.000
10.0	192C106	1.070	2.000
400 VOLTS DC WORKING			
.010	192E103	.205	.400
.012	192E123	.220	.400
.015	192E153	.195	.470
.018	192E183	.210	.470
.022	192E223	.230	.470
.027	192E273	.220	.530
.033	192E333	.240	.530
.039	192E393	.255	.530
.047	192E473	.230	.650
.056	192E563	.245	.650
.068	192E683	.270	.650
.082	192E823	.290	.650
.10	192E104	.285	.780
.12	192E124	.305	.780
.15	192E154	.340	.780
.18	192E184	.370	.780
.22	192E224	.365	.900
.27	192E274	.400	.900
.33	192E334	.440	.900
.39	192E394	.475	.900
.47	192E474	.440	1.187
.56	192E564	.475	1.187
.68	192E684	.525	1.187
.82	192E824	.570	1.187
1.0	192E105	.560	1.500
1.2	192E125	.610	1.500
1.5	192E155	.680	1.500
2.0	192E205	.710	1.750
3.0	192E305	.860	1.750
4.0	192E405	.860	2.250
5.0	192E505	.950	2.250

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

POLYESTER CAPACITORS

METALLIZED POLYESTER CAPACITORS TYPE 188 FILM WRAP / EPOXY END FILL −55°C TO +125°C

Type 188 Capacitors features extremely small size, light weight and self clearing metallized construction which virtually eliminates catastrophic failures. Well suited for Voltage Multiplier Circuits in TV power supplies and Electrostatic copiers. Also ideal for Potting or encapsulating in Electronic Sub assemblies, Power supplies, etc.

CAPACITANCE
Measurements shall be made at 1000 cycles per second for capacitance values thru 1. MFD and at 60 cycles per second for values over 1. MFD.

CAPACITANCE TOLERANCE
Standard capacitance tolerance is ±20% (M). Closer tolerances available upon request.

DISSIPATION FACTOR
The dissipation factor shall not exceed 1% when measured at 25°C. Measurements shall be made at 1000 Hz for capacitance values thru 1. MF and at 60 Hz for higher values.

TEST VOLTAGE
Capacitors shall withstand 200% of rated DC voltage for one minute at 25°, with the charging and discharge current limited to a maximum of 1. Ampere.

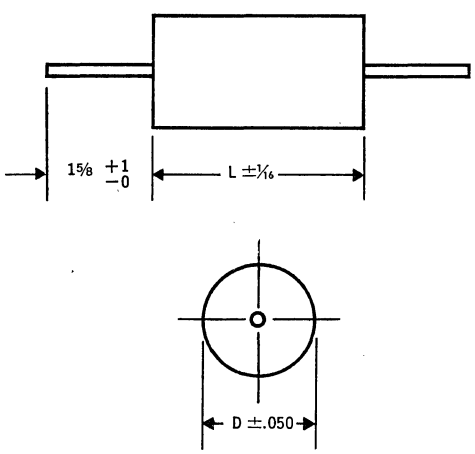
OPERATING TEMPERATURES
−55°C to +125°C.

LIFE TEST
Capacitors shall withstand a life test of 250 hours at 125°C, with 140% of the 125°C rated DC voltage applied. A resistance of one ohm per volt of applied voltage shall be inserted in series with the capacitor.

VOLTAGE DERATING
These capacitors will operate as full DC voltage ratings at 85°C. For operation at temperatures above 85°C, see Figure 4.

VIBRATION
Capacitors shall withstand a vibration test per Method 204, Test condition B of MIL-STD-202B as modified by MIL-C-27287. After test, the I.R. will be equal to or greater than ⅓ of the initial requirement.

HUMIDITY TEST
These capacitors shall meet the humidity test requirements of MIL-STD-202 Method 103B, test condition B. After testing the I.R. will be equal to or greater than ⅓ of the initial requirement.



Lead Sizes
.160 dia. — .250 = .020
.251 dia. — .500 = .025
.501 dia. & over = .032

Capacitance	Diameter	Length	Cat. No.
600 VOLTS DC WORKING			
.010	.20	.53	188F103M
.012	.18	.65	188F123M
.015	.20	.65	188F153M
.018	.22	.65	188F183M
.022	.23	.65	188F223M
.027	.25	.65	188F273M
.033	.28	.65	188F333M
.039	.26	.78	188F393M
.047	.28	.78	188F473M
.056	.30	.78	188F563M
.068	.32	.78	188F683M
.082	.35	.78	188F823M
.10	.33	.97	188F104M
.12	.35	.97	188F124M
.15	.39	.97	188F154M
.18	.44	.97	188F184M
.22	.42	1.17	188F224M
.27	.45	1.17	188F274M
.33	.50	1.17	188F334M
.39	.55	1.17	188F394M
.47	.54	1.45	188F474M
.56	.58	1.45	188F564M
.68	.63	1.45	188F684M
.82	.63	1.68	188F824M
1.0	.69	1.68	188F105M
1.2	.75	1.68	188F125M
1.5	.84	1.68	188F155M
2.0	.83	2.25	188F205M
2.5	.92	2.25	188F255M
3.0	1.00	2.25	188F305M

Capacitance	Diameter	Length	Cat. No.
100 VOLTS DC WORKING			
.010	.16	.40	188B103M
.012	.16	.40	188B123M
.015	.16	.40	188B153M
.018	.16	.40	188B183M
.022	.16	.40	188B223M
.027	.16	.40	188B273M
.033	.16	.40	188B333M
.039	.18	.40	188B393M
.047	.20	.40	188B473M
.056	.16	.53	188B563M
.068	.16	.53	188B683M
.082	.17	.53	188B823M
.10	.19	.53	188B104M
.12	.20	.53	188B124M
.15	.19	.65	188B154M
.18	.21	.65	188B184M
.22	.23	.65	188B224M
.27	.25	.65	188B274M
.33	.27	.65	188B334M
.39	.29	.65	188B394M
.47	.26	.78	188B474M
.56	.28	.78	188B564M
.68	.30	.78	188B684M
.82	.33	.78	188B824M
1.0	.36	.78	188B105M
1.2	.34	.97	188B125M
1.5	.37	.97	188B155M
2.0	.42	.97	188B205M
2.5	.42	1.17	188B255M
3.0	.45	1.17	188B305M
3.5	.49	1.17	188B355M
4.0	.52	1.17	188B405M
4.5	.49	1.45	188B455M
5.0	.52	1.45	188B505M
200 VOLTS DC WORKING			
.010	.16	.40	188C103M
.012	.17	.40	188B123M
.015	.19	.40	188C153M
.018	.21	.40	188C183M
.022	.16	.53	188C223M
.027	.17	.53	188C273M
.033	.19	.53	188C333M
.039	.20	.53	188C393M
.047	.18	.65	188C473M
.056	.20	.65	188C563M
.068	.21	.65	188C683M
.082	.23	.65	188C823M
.10	.25	.65	188C104M
.12	.27	.65	188C124M
.15	.30	.65	188C154M
.18	.27	.78	188C184M
.22	.30	.78	188C224M
.27	.32	.78	188C274M
.33	.35	.78	188C334M
.39	.33	.97	188C394M
.47	.35	.97	188C474M
.56	.38	.97	188C564M
.68	.42	.97	188C684M
.82	.46	.97	188C824M
1.0	.45	1.17	188C105M
1.2	.49	1.17	188C125M
1.5	.54	1.17	188C155M
2.0	.56	1.45	188C205M
2.5	.61	1.45	188C255M
3.0	.67	1.45	188C305M
3.5	.65	1.68	188C355M
4.0	.69	1.68	188C405M
4.5	.73	1.68	188C455M
5.0	.77	1.68	188C505M
400 VOLTS DC WORKING			
.010	.20	.40	188E103M
.012	.16	.53	188E123M
.015	.17	.53	188E153M
.018	.19	.53	188E183M
.022	.20	.53	188E223M
.027	.18	.65	188E273M
.033	.20	.65	188E333M
.039	.21	.65	188E393M
.047	.23	.65	188E473M
.056	.25	.65	188E563M
.068	.27	.65	188E683M
.082	.25	.78	188E823M
.10	.27	.78	188E104M
.12	.29	.78	188E124M
.15	.32	.78	188E154M
.18	.35	.78	188E184M
.22	.33	.97	188E224M
.27	.36	.97	188E274M
.33	.39	.97	188E334M
.39	.42	.97	188E394M
.47	.46	.97	188E474M
.56	.44	1.17	188E564M
.68	.48	1.17	188E684M
.82	.54	1.17	188E824M
1.0	.53	1.45	188E105M
1.2	.57	1.45	188E125M
1.5	.63	1.45	188E155M
2.0	.65	1.68	188E205M
2.5	.73	1.68	188E255M
3.0	.79	1.68	188E305M
3.5	.85	1.68	188E355M
4.0	.78	2.25	188E405M
4.5	.83	2.25	188E455M
5.0	.87	2.25	188E505M

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POLYESTER CAPACITORS

METALLIZED POLYESTER CAPACITORS TYPE 189 FILM WRAP / EPOXY END FILL −55°C TO +125°C

Type 189 Capacitors features extremely small size, light weight and self clearing metallized construction which virtually eliminates catastrophic failures. Well suited for Voltage Multiplier Circuits in TV power supplies and Electrostatic copiers. Also ideal for Potting or encapsulating in Electronic Sub assemblies, Power supplies, etc.

CAPACITANCE
Measurements shall be made at 1000 cycles per second for capacitance values thru 1. MFD and at 60 cycles per second for values over 1. MFD.

CAPACITANCE TOLERANCE
Standard capacitance tolerance is ±20% (M). Closer tolerances available upon request.

DISSIPATION FACTOR
The dissipation factor shall not exceed 1% when measured at 25°C. Measurements shall be made at 1000 Hz for capacitance values thru 1. MF and at 60 Hz for higher values.

TEST VOLTAGE
Capacitors shall withstand 200% of rated DC voltage for one minute at 25°, with the charging and discharge current limited to a maximum of 1. Ampere.

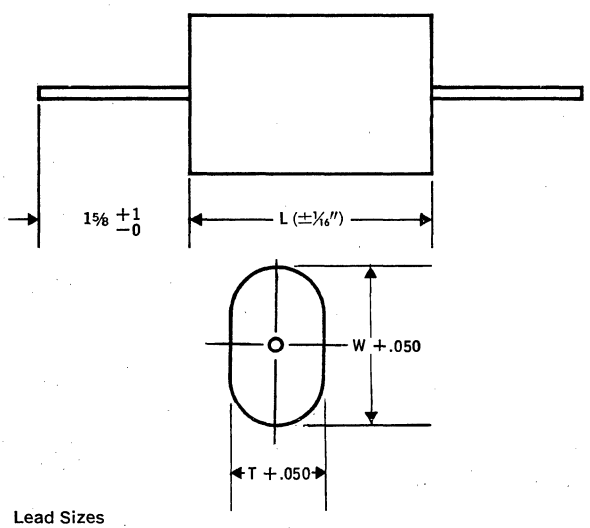
OPERATING TEMPERATURES
−55°C to +125°C.

LIFE TEST
Capacitors shall withstand a life test of 250 hours at 125°C, with 140% of the 125°C rated DC voltage applied. A resistance of one ohm per volt of applied voltage shall be inserted in series with the capacitor.

VOLTAGE DERATING
These capacitors will operate as full DC voltage ratings at 85°C. For operation at temperatures above 85°C, see Figure 4.

VIBRATION
Capacitors shall withstand a vibration test per Method 204, Test condition B of MIL-STD-202B as modified by MIL-C-27287.

HUMIDITY TEST
These capacitors shall meet the humidity test requirements of MIL-STD-202 Method 103B, test condition B. After testing the I.R. will be equal to or greater than ⅓ of the initial requirement.



Lead Sizes

Nom. Body Length	Lead Dia.
Thru .530	.020
.650 thru .970	.025
Above .970	.032

Capacitance	Thickness	Width	Length	Cat. No.
600 VOLTS DC WORKING				
.010	.12	.25	.53	189F103M
.012	.13	.26	.53	189F123M
.015	.15	.28	.53	189F153M
.018	.17	.30	.53	189F183M
.022	.19	.32	.53	189F223M
.027	.21	.34	.53	189F273M
.033	.24	.37	.53	189F333M
.039	.21	.34	.65	189F393M
.047	.24	.37	.65	189F473M
.056	.22	.35	.78	189F563M
.068	.25	.38	.78	189F683M
.082	.27	.40	.78	189F823M
.10	.30	.43	.78	189F104M
.12	.32	.48	.78	189F124M
.15	.36	.52	.78	189F154M
.18	.33	.49	.97	189F184M
.22	.37	.53	.97	189F224M
.27	.36	.52	1.17	189F274M
.33	.40	.56	1.17	189F334M
.39	.44	.60	1.17	189F394M
.47	.49	.65	1.17	189F474M
.56	.41	.57	1.68	189F564M
.68	.45	.61	1.68	189F684M
.82	.51	.67	1.68	189F824M
1.0	.58	.74	1.68	189F105M
1.2	.64	.80	1.68	189F125M
1.5	.73	.89	1.68	189F155M
2.0	.69	.89	2.25	189F205M
2.5	.80	1.00	2.25	189F225M
3.0	.87	1.07	2.25	189F305M

INTERMEDIATE VALUES AVAILABLE.

Capacitance	Thickness	Width	Length	Cat. No.
100 VOLTS DC WORKING				
.010	.10	.20	.40	189B103M
.012	.10	.20	.40	189B123M
.015	.10	.20	.40	189B153M
.018	.10	.20	.40	189B183M
.022	.10	.20	.40	189B223M
.027	.10	.20	.40	189B273M
.033	.10	.20	.40	189B333M
.039	.10	.20	.40	189B393M
.047	.10	.22	.40	189B473M
.056	.11	.24	.40	189B563M
.068	.10	.20	.53	189B683M
.082	.10	.20	.53	189B823M
.10	.10	.20	.53	189B104M
.12	.10	.23	.53	189B124M
.15	.12	.25	.53	189B154M
.18	.14	.27	.53	189B184M
.22	.17	.30	.53	189B224M
.27	.19	.32	.53	189B274M
.33	.21	.34	.53	189B334M
.39	.24	.37	.53	189B394M
.47	.21	.34	.65	189B474M
.56	.23	.36	.65	189B564M
.68	.27	.40	.65	189B684M
.82	.24	.37	.78	189B824M
1.0	.26	.42	.78	189B105M
1.2	.29	.45	.78	189B125M
1.5	.33	.49	.78	189B155M
2.0	.32	.48	.97	189B205M
2.5	.36	.52	.97	189B255M
3.0	.35	.51	1.17	189B305M
3.5	.38	.54	1.17	189B355M
4.0	.41	.57	1.17	189B405M
4.5	.44	.60	1.17	189B455M
5.0	.47	.63	1.17	189B505M
6.0	.52	.68	1.17	189B605M
8.0	.46	.62	1.68	189B805M
10.0	.53	.69	1.68	189B106M
200 VOLTS DC WORKING				
.010	.10	.20	.40	189C103M
.012	.10	.20	.40	189C123M
.012	.10	.20	.40	189C153M
.018	.13	.23	.40	189B183M
.022	.13	.26	.40	189C223M
.027	.10	.20	.53	189C273M
.033	.12	.22	.53	189C333M
.039	.12	.25	.53	189C393M
.047	.13	.26	.53	189C473M
.056	.14	.27	.53	189C563M
.068	.16	.29	.53	189C683M
.082	.18	.31	.53	189C823M
.10	.20	.33	.53	189C104M
.12	.22	.35	.53	189C124M
.15	.26	.39	.53	189C154M
.18	.24	.37	.65	189C184M
.22	.26	.39	.65	189C224M
.27	.24	.37	.78	189C274M
.33	.27	.40	.78	189C334M
.39	.30	.43	.78	189C394M
.47	.33	.46	.78	189C474M
.56	.37	.50	.78	189C564M
.68	.32	.48	.97	189C684M
.82	.35	.51	.97	189C824M
1.0	.35	.51	1.17	189C105M
1.2	.38	.54	1.17	189C125M
1.5	.43	.59	1.17	189C155M
2.0	.52	.68	1.17	189C205M
2.5	.46	.62	1.68	189C255M
3.0	.49	.65	1.68	189C305M
3.5	.54	.70	1.68	189C355M
4.0	.58	.74	1.68	189C405M
4.5	.62	.78	1.68	189C455M
5.0	.64	.84	1.68	189C505M
6.0	.70	.90	1.68	189C605M
8.0	.84	1.04	1.68	189C805M
10.0	.75	.95	2.25	189C106M
400 VOLTS DC WORKING				
.010	.14	.24	.40	189E103M
.012	.10	.23	.53	189E123M
.015	.11	.21	.53	189E153M
.018	.12	.22	.53	189E183M
.022	.12	.25	.53	189E223M
.027	.13	.26	.53	189E273M
.033	.15	.28	.53	189E333M
.039	.17	.30	.53	189E393M
.047	.19	.32	.53	189E473M
.056	.21	.34	.53	189E563M
.068	.23	.36	.53	189E683M
.082	.26	.39	.53	189E823M
.10	.23	.36	.65	189E104M
.12	.25	.38	.65	189E124M
.15	.24	.37	.78	189E154M
.18	.26	.39	.78	189E184M
.22	.30	.43	.78	189E224M
.27	.33	.46	.78	189E274M
.33	.36	.52	.78	189E334M
.39	.33	.49	.97	189E394M
.47	.33	.53	.97	189E474M
.56	.34	.50	1.17	189E564M
.68	.38	.54	1.17	189E684M
.82	.43	.59	1.17	189E824M
1.0	.48	.64	1.17	189E105M
1.2	.54	.70	1.17	189E125M
1.5	.46	.62	1.68	189E155M
2.0	.54	.70	1.68	189E205M
2.5	.60	.80	1.68	189E255M
3.0	.67	.87	1.68	189E305M
3.5	.73	.93	1.68	189E355M
4.0	.78	.98	1.68	189E405M
4.5	.69	.89	2.25	189E455M
5.0	.75	.95	2.25	189E505M

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

TUBULAR CAPACITORS

HIGH VOLTAGE TUBULAR CAPACITORS DUAL DIELECTRIC/OIL IMPREGNATED PHENOLIC CASED/EPOXY END FILL/TYPE 161

RECOMMENDED APPLICATIONS

Nytronics Type 161 Capacitors are well-suited for use in Oscilloscopes, Electronic Air Cleaners, Power Supplies of industrial devices, and related equipment. The design of these capacitors employs a Paper/Polyester Film Section, oil impregnated, incased in a phenolic tube designed specifically for high voltage application. A unique epoxy endfill process precludes oil seepage which occasionally occurs in similar designs.

TYPICAL RATINGS

CAP/MFD	3000 VDC	5000 VDC	8000 VDC	10,000 VDC
.005	½ x 1½	5/16 x 1⅞	¾ x 2	¾ x 2½
.01	5/16 x 1⅞	¾ x 1⅞	¾ x 2¼	⅞ x 2½
.05	¾ x 2 1/16	1 x 2½	1 x 4¼	1½ x 3⅛

NOTE: Other Ratings can be designed to your specifications.

OPERATING TEMPERATURE

−55°C to +85°C at full rated voltage.

DISSIPATION FACTOR

Will not exceed 1% at 25°C.

MEASUREMENTS

Capacitance up to 1 microfarad are measured at a frequency of 1000 cycles per second and capacitances over 1 microfarad at 60 cps.

DIELECTRIC STRENGTH TEST

Units will withstand a potential of 150% of rated voltage applied for one minute at 25°C.

STANDARD TOLERANCE

±20%. Other tolerances available on request.

STANDARD MARKING

Nytronics, Part No., Capacitance, Voltage, and Date Code.

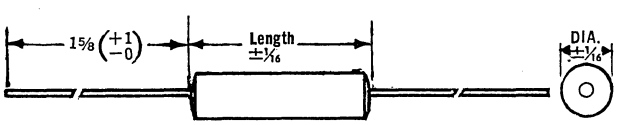
INSULATION RESISTANCE

When measured at the applicable test temperature with an electrification time of two minutes at 500 volts shall be equal to or greater than the values listed below:

Test Temperature	25°C	85°C
Megohms X Microfarads	2000	10
except that the insulation resistance in megohms need not exceed	25000	250

MOISTURE RESISTANCE

These capacitors will meet the moisture resistance requirements of EIA Specification RS-164, which requires units to withstand a 95% Relative Humidity at 40°C, except time of exposure may be increased to 500 hours. After exposure and subsequent drying periods, the insulation resistance will not be less than ⅓ of the initial requirement.



Tinned Copperweld Leads #20 AWG (.032) for sizes to 5/8" Dia.
#18 AWG (.040) for sizes 5/8" Dia. and over.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
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POLYSTYRENE FILM CAPACITORS

POLYSTYRENE FILM CAPACITORS HERMETICALLY SEALED TYPE 231 −65°C to +85°C

ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS

1. CAPACITANCE MEASUREMENTS

Capacitors of 1.0 μF or less shall be measured at a frequency of 1000 Hz. Capacitors greater than 1.0 μF measured at 60 Hz.
Tolerances of ±20%, ±10%, ±5%, ±2%, ±1% are standard. Tolerances closer than ±1% are available upon request.
Reference: MIL-STD-202, Method 305.

2. TEMPERATURE/CHARACTERISTICS AND STABILITY

When measured over the full operating range, the Temperature Coefficient shall be −120 ppm/°C ±30 ppm/°C.
There shall be less than 0.1% change per year in capacitance when operated between +20°C and +50°C.
When cycled from −55°C to +75°C, the capacitance shall not vary more than 0.2% from its initial measurement.

3. DISSIPATION FACTOR

When measured as specified in Paragraph 1, the dissipation factor at +25°C shall not exceed 0.1%.

4. INSULATION RESISTANCE

When measured at +25°C, and rated voltage (or 500 VDC, whichever is less), the insulation resistance shall be a minimum of 200,000 megohm-microfarads, but need not exceed 500,000 megohms. The period of electrification shall not exceed two minutes.
Reference: MIL-STD-202, Method 302.

5. VOLTAGE DERATING

The capacitors may be operated at full rated voltage from −55°C to +85°C.

6. VOLTAGE TEST

When tested at +25°C, the capacitors shall withstand the indicated DC test voltages for a period of one minute:

Terminal to terminal	200% of DC rating
Terminal to case	200% of DC rating

Reference: MIL-STD-202, Method 301.

7. LIFE TESTING

When tested at 85°C for 250 hours at 140% of the rated voltage, the capacitors shall exhibit no more than one failure in twelve pieces tested. A failure is defined as:
a) A capacitance change of more than 6% of its initial value;
b) A dissipation factor greater than that specified in Paragraph 3;
c) An insulation resistance less than 60% that specified in Paragraph 4; or
d) A permanent open or short.

8. VIBRATION

The capacitors will meet or exceed the vibration requirements of MIL-STD-202, METHOD 201.

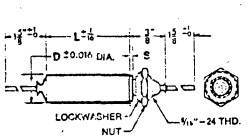
NYTRONICS CATALOG NUMBERING SYSTEM

231 A 3 E 104 M 2

- **231** — NYTRONICS TYPE: 231 Polystyrene
- **A** — TERMINALS: Wire Leads; No. 22 AWG. (.025) for case Dia. .312 and under; No. 20 AWG. (.032) for case Dia. over .312
- **3** — CIRCUIT: Circuit 1, Circuit 3
- **E** — DC RATED VOLTAGE: B = 100, C = 200, E = 400, F = 600
- **104** — CAPACITANCE: In uuf. The first two digits are the significant figures, the third is the number of zeroes.
- **M** — CAPACITANCE TOLERANCE: M = ±20%, K = ±10%, J = ±5%, G = ±2%, F = ±1%
- **2** — STYLE

CONFIGURATIONS

Circuit 1

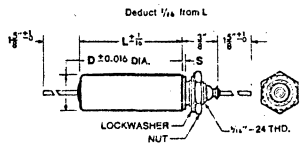


STYLE 3

D	S
.400	.020
.562	.031

and up
Minimum D=.400".

Circuit 3



STANDARD RATINGS

Nytronics Part No.	Capacitance μf	Dia. ±.016	Length ±1/16
100 VOLTS DC WORKING			
231A1B822K	.0082	.235	15/16
231A1B103K	.01	.235	15/16
231A1B123K	.012	.235	15/16
231A1B153K	.015	.235	15/16
231A1B183K	.018	.312	15/16
231A1B223K	.022	.312	15/16
231A1B273K	.027	.312	15/16
231A1B333K	.033	.312	15/16
231A1B393K	.039	.312	15/16
231A1B473K	.047	.400	15/16
231A1B563K	.056	.400	15/16
231A1B683K	.068	.400	15/16
231A1B823K	.082	.562	15/16
231A1B104K	.10	.562	15/16
231A1B124K	.12	.562	15/16
231A1B154K	.15	.562	15/16
231A1B184K	.18	.562	15/16
231A1B224K	.22	.562	15/16
231A1B274K	.27	.670	15/16
231A1B334K	.33	.670	15/16
231A1B394K	.39	.670	1 1/16
231A1B474K	.47	.670	1 1/16
231A1B564K	.56	.670	1 1/16
231A1B684K	.68	.750	1 1/16
231A1B824K	.82	1.000	1 1/16
231A1B105K	1.0	1.000	1 1/16
231A1B125K	1.2	1.000	1 1/16
200 VOLTS DC WORKING			
231A1C472K	.0047	.235	15/16
231A1C562K	.0056	.235	15/16
231A1C682K	.0068	.235	15/16
231A1C822K	.0082	.312	15/16
231A1C103K	.01	.312	15/16
231A1C123K	.012	.312	15/16
231A1C153K	.015	.312	15/16
231A1C183K	.018	.312	15/16
231A1C223K	.022	.400	15/16
231A1C273K	.027	.400	15/16
231A1C333K	.033	.400	15/16
231A1C393K	.039	.400	15/16
231A1C473K	.047	.562	15/16
231A1C563K	.056	.562	15/16
231A1C683K	.068	.562	15/16
231A1C823K	.082	.562	15/16
231A1C104K	.10	.562	15/16
231A1C124K	.12	.562	15/16
231A1C154K	.15	.670	15/16
231A1C184K	.18	.670	15/16
231A1C224K	.22	.670	1 1/16
231A1C274K	.27	.670	1 1/16
231A1C334K	.33	.750	1 1/16
231A1C394K	.39	1.000	1 1/16
231A1C474K	.47	1.000	1 1/16
231A1C564K	.56	1.000	1 1/16
400 VOLTS DC WORKING			
231A1E222K	.0022	.235	15/16
231A1E272K	.0027	.235	15/16
231A1E332K	.0033	.235	15/16
231A1E392K	.0039	.235	15/16
231A1E472K	.0047	.312	15/16
231A1E562K	.0056	.312	15/16
231A1E682K	.0068	.312	15/16
231A1E822K	.0082	.312	15/16
231A1E103K	.01	.312	15/16
231A1E123K	.012	.312	15/16
231A1E153K	.015	.400	15/16
231A1E183K	.018	.400	15/16
231A1E223K	.022	.400	15/16
231A1E273K	.027	.562	15/16
231A1E333K	.033	.562	15/16
231A1E393K	.039	.562	15/16
231A1E473K	.047	.562	15/16
231A1E563K	.056	.562	15/16
231A1E683K	.068	.562	15/16
231A1E823K	.082	.670	15/16
231A1E104K	.10	.670	15/16
231A1E124K	.12	.562	1 1/16
231A1E154K	.15	.670	1 1/16
231A1E184K	.18	.670	1 1/16
231A1E224K	.22	.750	1 1/16
231A1E274K	.27	.750	1 1/16
231A1E334K	.33	1.000	1 1/16
231A1E394K	.39	1.000	1 1/16
231A1E474K	.47	1.000	1 1/16
600 VOLTS DC WORKING			
231A1F102K	.001	.235	15/16
231A1F122K	.0012	.235	15/16
231A1F152K	.0015	.235	15/16
231A1F182K	.0018	.235	15/16
231A1F222K	.0022	.312	15/16
231A1F272K	.0027	.312	15/16
231A1F332K	.0033	.312	15/16
231A1F392K	.0039	.312	15/16
231A1F472K	.0047	.312	15/16
231A1F562K	.0056	.312	15/16
231A1F682K	.0068	.312	15/16
231A1F822K	.0082	.312	15/16
231A1F103K	.01	.400	15/16
231A1F123K	.012	.400	15/16
231A1F153K	.015	.562	15/16
231A1F183K	.018	.562	15/16
231A1F223K	.022	.562	15/16
231A1F273K	.027	.562	15/16
231A1F333K	.033	.562	15/16
231A1F393K	.039	.562	15/16
231A1F473K	.047	.670	15/16
231A1F563K	.056	.670	15/16
231A1F683K	.068	.562	1 1/16
231A1F823K	.082	.670	1 1/16
231A1F104K	.10	.670	1 1/16
231A1F124K	.12	.750	1 1/16
231A1F154K	.15	1.000	1 1/16
231A1F184K	.18	1.000	1 1/16
231A1F224K	.22	1.000	1 1/16

FOR OTHER STYLES SEE PAGE 44

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

HERMETICALLY SEALED CAPACITORS

HERMETICALLY SEALED CAPACITORS CP04 THRU CP09 TO MIL-C-25

μF	WVDC	CP04A1 — (Uninsulated) CP05A1 (Insulated) Char. K −55°C to +125°C	Size* D. x L.
.001	600	CP04A1KF102K3	.235 x ¾
.0015	600	CP04A1KF152K3	.235 x ¾
.0022	600	CP04A1KF222K3	.235 x ¾
.0033	600	CP04A1KF332K3	.235 x ¾
.0047	600	CP04A1KF472K3	.235 x ¾
.0068	600	CP04A1KF682K3	.235 x ¾
.01	400	CP04A1KE103K3	.235 x ¾
	600	CP04A1KF103K3	.312 x ⅞
.015	200	CP04A1KC153K3	.235 x ¾
	600	CP04A1KF153K3	.312 x ⅞
.022	200	CP04A1KF223K3	.235 x ¾
	600	CP04A1KF223K3	.312 x ⅞
.033	100	CP04A1KB333K3	.235 x ¾
	400	CP04A1KE333K3	.312 x ⅞
	600	CP04A1KF333K3	.400 x ⅞
.047	200	CP04A1KC473K3	.312 x ⅞
	400	CP04A1KE473K3	.400 x ⅞
	600	CP04A1KF473K3	.400 x 1⅛
.068	200	CP04A1KC683K3	.312 x ⅞
	400	CP04A1KE683K3	.400 x 1⅛
	600	CP04A1KF683K3	.400 x 1⅜
.1	100	CP04A1KB104K3	.312 x ⅞
	200	CP04A1KC104K3	.400 x ⅞
	400	CP04A1KE104K3	.400 x 1⅜
	600	CP04A1KF104K3	.562 x 1⅛
.15	100	CP04A1KB154K3	.400 x ⅞
	200	CP04A1KC154K3	.400 x 1⅛
	400	CP04A1KE154K3	.562 x 1⅛
	600	CP04A1KF154K3	.562 x 1⅜
.22	100	CP04A1KB224K3	.400 x 1⅜
	200	CP04A1KC224K3	.400 x 1⅜
	400	CP04A1KE224K3	.562 x 1⅜
	600	CP04A1KF224K3	.562 x 1⅞
.33	100	CP04A1KB334K3	.400 x 1⅜
	200	CP04A1KC334K3	.562 x 1⅛
	400	CP04A1KE334K3	.562 x 1⅞
	600	CP04A1KF334K3	.670 x 1⅞
.47	100	CP04A1KB474K3	.562 x 1⅛
	200	CP04A1KC474K3	.562 x 1⅜
	400	CP04A1KE474K3	.670 x 1⅞
	600	CP04A1KF474K3	.750 x 2⅛
.68	100	CP04A1KB684K3	.562 x 1⅜
	200	CP04A1KC684K3	.562 x 1⅞
	400	CP04A1KE684K3	.750 x 2⅛
	600	CP04A1KF684K3	1.0 x 1⅞
1.0	100	CP04A1KB105K3	.562 x 1⅞
	200	CP04A1KC105K3	.670 x 1⅞
	400	CP04A1KE105K3	1.0 x 1⅞

μF	WVDC	CP08A1 — (Uninsulated) CP09A1 (Insulated) Char. K −55°C to +125°C	Size* D. x L.
.001	600	CP08A1KF102K3	.235 x ¾
.0015	600	CP08A1KF152K3	.235 x ¾
.0022	600	CP08A1KF222K3	.235 x ¾
.0033	400	CP08A1KE332K3	.235 x ¾
	600	CP08A1KF332K3	.312 x ⅞
.0047	200	CP08A1KC472K3	.235 x ¾
	600	CP08A1KF472K3	.312 x ⅞
.0068	200	CP08A1KC682K3	.235 x ¾
	600	CP08A1KF682K3	.312 x ⅞
.01	100	CP08A1KB103K3	.235 x ¾
	600	CP08A1KF103K3	.312 x ⅞
.015	100	CP08A1KB153K3	.235 x ¾
	400	CP08A1KE153K3	.312 x ⅞
	600	CP08A1KF153K3	.400 x ⅞
.022	200	CP08A1KC223K3	.312 x ⅞
	600	CP08A1KF223K3	.400 x ⅞
.033	200	CP08A1KC333K3	.312 x ⅞
	400	CP08A1KE333K3	.400 x ⅞
	600	CP08A1KF333K3	.400 x 1⅛
.047	100	CP08A1KB473K3	.312 x ⅞
	200	CP08A1KC473K3	.400 x ⅞
	400	CP08A1KE473K3	.400 x 1⅛
	600	CP08A1KF473K3	.400 x 1⅜
.068	200	CP08A1KC683K3	.400 x ⅞
	400	CP08A1KE683K3	.400 x 1⅜
	600	CP08A1KF683K3	.562 x 1⅛
.1	100	CP08A7KB104K3	.400 x ⅞
	200	CP08A1KC104K3	.400 x 1⅛
	400	CP08A1KE104K3	.562 x 1⅛
	600	CP08A1KF104K3	.562 x 1⅜
.15	100	CP08A1KB154K3	.400 x 1⅛
	200	CP08A1KC154K3	.400 x 1⅜
	400	CP08A1KE154K3	.562 x 1⅜
	600	CP08A1KF154K3	.562 x 1⅝
.22	100	CP08A1KB224K3	.400 x 1⅜
	200	CP08A1KC224K3	.562 x 1⅛
	400	CP08A1KE224K3	.562 x 1⅝
	600	CP08A1KF224K3	.670 x 1⅝
.33	100	CP08A1KB334K3	.562 x 1⅛
	200	CP08A1KC334K3	.562 x 1⅜
	400	CP08A1KE334K3	.670 x 1⅝
	600	CP08A1KF334K3	.750 x 2⅛
.47	100	CP08A1KB474K3	.562 x 1⅜
	200	CP08A1KC474K3	.562 x 1⅝
	400	CP08A1KE474K3	.750 x 2⅛
	600	CP08A1KF474K3	.750 x 2⅜
.68	100	CP08A1KB684K3	.562 x 1⅝
	200	CP08A1KC684K3	.670 x 1⅝
1.0	100	CP08A1KB105K3	.670 x 1⅝
	200	CP08A1KC105K3	.750 x 2⅛

NOTE: The capacitors listed in this table have a capacitance tolerance of ±10%.
* For case grounded reduce L dimension by 1/16". Above listing are ratings listed in Mil-C-25C. Other values are available in Nytronics Commercial Equivalents.
** For CP05 and CP09 add .0625 to Diameter and 1/16" to Length.

NYTRONICS CATALOG NUMBERING SYSTEM

CP — MILITARY TYPE CAPACITORS Fixed, Paper dielectric, Direct current, Hermetically sealed in metallic cases

04 — SUBMINIATURE CAPACITORS CP05 CP09 CP10 CP12 CP11 CP13

A — TERMINALS A = axial leads

1 — CIRCUIT 1 = 3 =

K — CHARACTERISTIC K = −55°C to +125°C

B — DC VOLTAGE RATING

273 — CAPACITANCE In uuf. The first two digits are the significant figures, the third is the number of zeros.

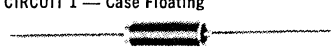
K — CAPACITANCE TOLERANCE K = ±10%

1 — VIBRATION GRADE 1 = 10 to 55 cps 3 = 10 to 2000 cps

RATED VOLTAGE DESIGNATIONS
(DC working at 40°C, except for characteristic K which is 85°C)
B = 100 C = 200 E = 400 F = 600 G = 1000

BASIC STYLE

CP04A1/CP08A1
CIRCUIT 1 — Case Floating



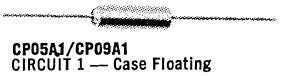
CP04A3/CP08A3
CIRCUIT 3 — Case Grounded

STYLE 3

CP11A1/CP13A1
CIRCUIT 1 — Case Floating

CP11A3/CP13A3
CIRCUIT 3 — Case Grounded

STYLE V (Insulated)



CP05A1/CP09A1
CIRCUIT 1 — Case Floating

CP05A3/CP09A3
CIRCUIT 3 — Case Grounded

STYLE 7

CP10A1/CP12A1
CIRCUIT 1 — Case Floating

CP10A3/CP12A3
CIRCUIT 3 — Case Grounded

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(803) 393-5421 — TWX 810-665-2182

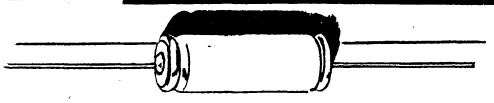
MIL TYPE CP25 - CP29 MIL-C-25

MIL-C-25 (LATEST REVISION) CP25 TO CP29

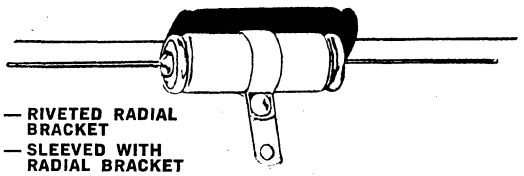
Available in capacitances from .003 thru 0.1 mf and voltages of 1500 VDC.

Type Designation[1]	Rated Voltage	Capacitance μf
CP2-A-EC104-	200	.1
CP2-A-EC254-	200	.25
CP2-A-EC504-	200	.5
CP2-A-EF302-	600	.003
CP2-A-EF602-	600	.006
CP2-A-EF103-	600	.01
CP2-A-EF203-	600	.02
CP2-A-EF503-	600	.05
CP2-A-EF104-	600	.1
CP2-A-EF254-	600	.25
CP2-A-EF504-	600	.5
CP2-A-EG302-	1,000	.003
CP2-A-EG602-	1,000	.006
CP2-A-EG103-	1,000	.01
CP2-A-EG203-	1,000	.02
CP2-A-EG503-	1,000	.05
CP2-A-EG104-	1,000	.1
CP2-A-EG254-	1,000	.25
CP2-A-EH302-	1,500	.003
CP2-A-EH602-	1,500	.006
CP2-A-EH103-	1,500	.01
CP2-A-EH203-	1,500	.02
CP2-A-EH503-	1,500	.05
CP2-A-EH104-	1,500	.1

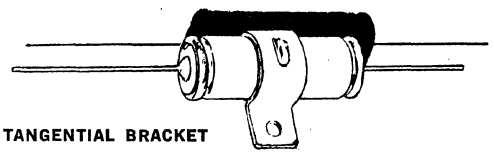
[1] Complete type designation will include additional symbols to complete style designation and to indicate circuit and capacitance tolerance.



CP25 — UNINSULATED BODY
CP26 — INSULATED BODY

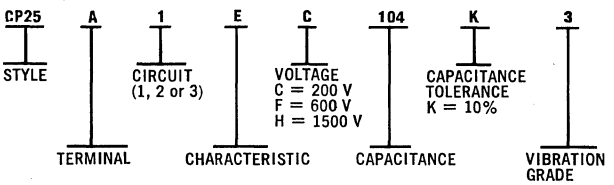


CP27 — RIVETED RADIAL BRACKET
CP28 — SLEEVED WITH RADIAL BRACKET



CP29 — TANGENTIAL BRACKET

TYPE - DESIGNATION EXAMPLE (CP25A1EC104K)

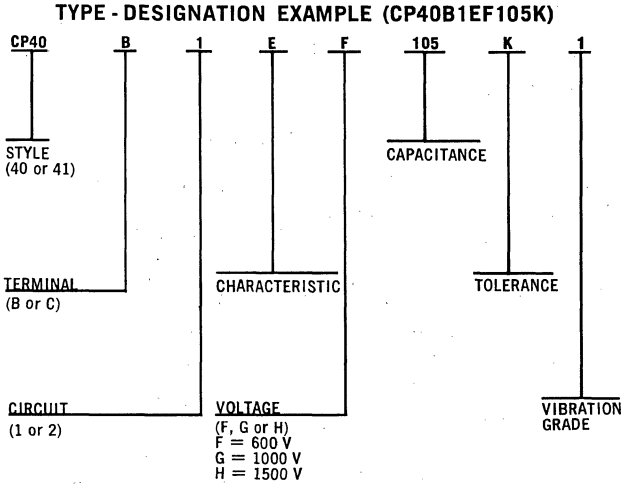


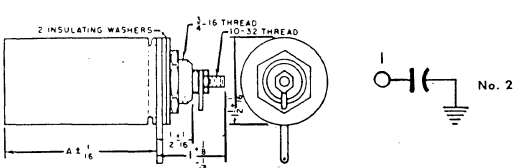
CP40, CP41 (TYPES PCM, PCIM)

Available in capacitances from .25 mf thru 4.0 mf and voltages of 600 VDC thru 1500 VDC.

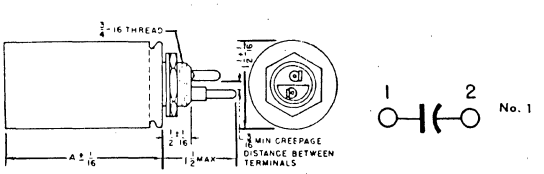
Type Designation 1/	DC Voltage Rating (see fig. 2) Volts	Capacitance μf
CP4 - - - - F105K1	600	1
CP4 - - - - F205K1	600	2
CP4 - - - - F405K1	600	4
CP4 - - - - G105K1	1,000	1
CP4 - - - - G205K1	1,000	2
CP4 - - - - H254K1	1,500 3/	0.25
CP4 - - - - H504K1	1,500	0.5
CP4 - - - - H105K1	1,500	1

TYPE - DESIGNATION EXAMPLE (CP40B1EF105K)





CIRCUIT DIAGRAM — CP40
Available with (C) or (B) Terminals



CIRCUIT DIAGRAM — CP41
Available only with (B) Terminal

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(803) 393-5421 — TWX 810-665-2182

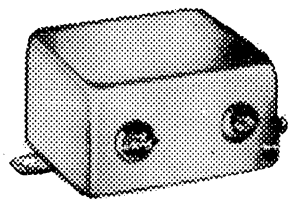
MIL TYPE CP53, CP54, CP55 MIL-C-25

CAPACITORS MIL TYPE CP53, CP54, CP55

Section assembled in hermetically sealed tin-coated drawn-shell container. Mineral-oil impregnated and filled. Lug-type terminal seals. Meets requirements of MIL-C-25.

Temperature Rating: −55°C to +85°C.

Standard Tolerance: −10% to +20%.



CP53

PDM VARIATIONS

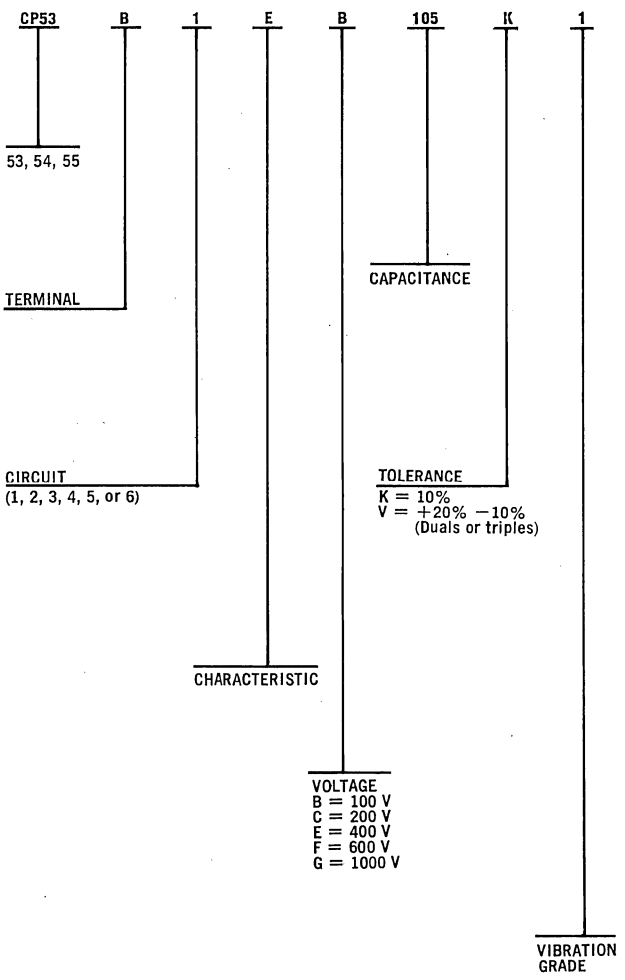
MIL Type CP53, with terminals on side.

PDMT (CP54) With terminals on top.

PDMB (CP55) With terminals on the bottom.

Type Designation	DC Voltage Rating Volts	Capacitance μf
CP5-B- - B105K1	100	1
CP5-B-EB205K1	100	2
CP5-B- - B405K1	100	4
CP5-B-FC504K1	200	0.5
CP5-B-EC105K1	200	1
CP5-B-EC205K1	200	2
CP5-B-EF254K1	600	0.25
CP5-B- - F504K1	600	0.5
CP5-B- - F105K1	600	1
CP5-B-EF205K1	600	2
CP5-B-EG503K1	1,000	0.05
CP5-B-EG104K1	1,000	0.1
CP5-B- - G254K1	1,000	0.25
CP5-B-EG504K1	1,000	0.5
CP5-B-EG105K1	1,000	1
CP5-B-EF503V1	600	0.05-0.05
CP5-B-EF104V1	600	0.1 -0.1
CP5-B- - F254V1	600	0.25-0.25
CP5-B- - F504V1	600	0.5 -0.5
CP5-B-EF105V1	600	1 -1
CP5-B-EG503V1	1,000	0.05-0.05
CP5-B- - G104V1	1,000	0.1 -0.1
CP5-B-EG254V1	1,000	0.25-0.25
CP5-B-EG504V1	1,000	0.5 -0.5
CP5-B5-E504V1	400	0.5 -0.5 -0.5
CP5-B5-F104V1	600	0.1 -0.1 -0.1
CP5-B5EF254V1	600	0.25-0.25-0.25
CP5-B5EF504V1	600	0.5 -0.5 -0.5
CP5-B5EG503V1	1,000	0.05-0.05-0.05
CP5-B5EG104V1	1,000	0.1 -0.1 -0.1
CP5-B5EG254V1	1,000	0.25-0.25-0.25

TYPE-DESIGNATION EXAMPLE (CP53B1EB105K)



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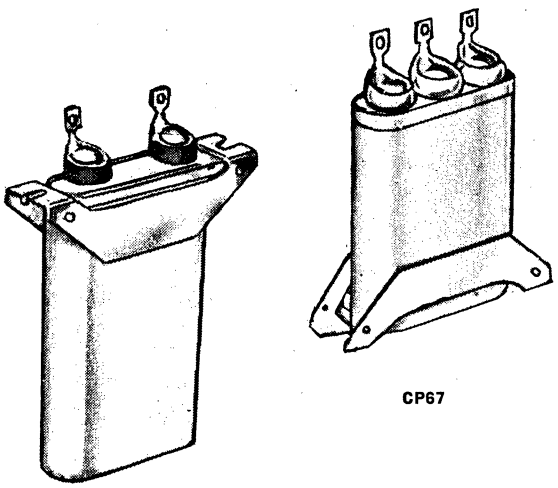
(803) 393-5421 — TWX 810-665-2182

MIL TYPE
CP69, CP67, CP91
MIL-C-25

CAPACITORS MIL TYPE CP67, CP69

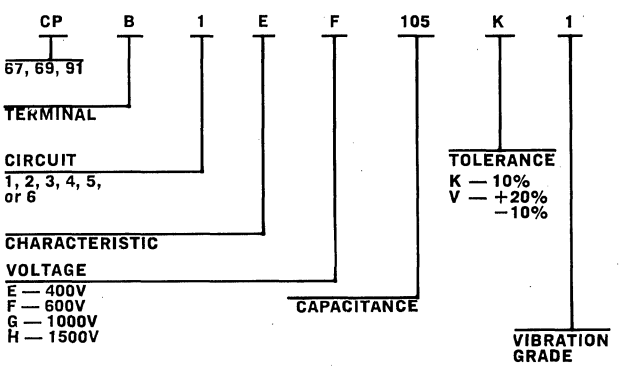
Type Designation	DC Voltage Rating Volts	Capacitance μf
CP6-B-EF503K1	600	0.05
CP6-B-EF104K1	600	0.1
CP6-B-EF254K1	600	0.25
CP6-B-EF504K1	600	0.5
CP6-B--F105K1	600	1
CP6-B-EG103K1	1,000	0.01
CP6-B-EG203K1	1,000	0.02
CP6-B-EG503K1	1,000	0.05
CP6-B--G104K1	1,000	0.1
CP6-B-EG254K1	1,000	0.25
CP6-B--G504K1	1,000	0.5
CP6-B-EF503V1	600	0.05-0.05
CP6-B-EF104V1	600	0.1 -0.1
CP6-B-EF254V1	600	0.25-0.25
CP6-B--F504K1	600	0.5 -0.5
CP6-B-EG103V1	1,000	0.01-0.01
CP6-B-EG203V1	1,000	0.02-0.02
CP6-B--G503V1	1,000	0.05-0.05
CP6-B--G104V1	1,000	0.1 -0.1
CP6-B--G254V1	1,000	0.25-0.25
CP6-B-5-F503V1	600	0.05-0.05-0.05
CP6-B5EFP04V1	600	0.1 -0.1 -0.1
CP6-B5-F254V1	600	0.25-0.25-0.25
CP6-B5EG103V1	1,000	0.01-0.01-0.01
CP6-B5EG203V1	1,000	0.02-0.02-0.02
CP6-B5EG503V1	1,000	0.05-0.05-0.05
CP6-B5EG104V1	1,000	0.1 -0.1 -0.1



CP67

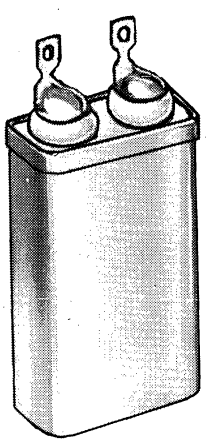
CP69

TYPE DESIGNATION EXAMPLE



CAPACITORS MIL TYPE CP91 SERIES

Type Designation	DC Voltage Rating Volts	Capacitance μf	Capacitance Tolerance
CP91B-E105K1	400	1	K
CP91B-EF503K1	600	0.05	K
CP91B-EF254K1	600	0.25	K
CP91B-EF504K1	600	0.5	K
CP91B-F105K1	600	1	K
CP91B-EG103K1	1,000	0.01	K
CP91B-EG203K1	1,000	0.02	K
CP91B-EG503K1	1,000	0.05	K
CP91B-EG104K1	1,000	0.1	K
CP91B-EG254K1	1,000	0.25	K
CP91B-G504K1	1,000	0.5	K
CP91B6EE503V1	400	0.05-0.05	V
CP91B6EE104V1	400	0.1 -0.1	V
CP91B6EE504V1	400	0.5 -0.5	V
CP91B6EF503V1	600	0.05-0.05	V
CP91B6-F104V1	600	0.1 -01	V
CP91B6EF254V1	600	0.25-0.25	V
CP91B6-F504V1	600	0.5 -0.5	V
CP91B6EG103V1	1,000	0.01-0.01	V
CP91B6EG203V1	1,000	0.02-0.02	V
CP91B6EG503V1	1,000	0.05-0.05	V
CP91B6-G104V1	1,000	0.1 -0.1	V
CP91B6-G254V1	1,000	0.25-0.25	V
CP91B6EH103V1	1,500	0.01-0.01	V
CP91B6EH503V1	1,500	0.05-0.05	V



CP91

NOTE: AVAILABLE WITH SPADE-LUG OR FOOTED BRACKET

Take a close look at PPD film capacitors... the best quality, most economical film capacitors you can buy.

Flame retardant polypropylene and polyester, film foil and metallized film capacitors.

PPD manufactures a complete line of polypropylene and polyester, film foil and metallized film capacitors.

- Coatings are flame retardant conforming to UL 94 V-O
- Laser markings available
- Tolerances to ±1%
- Markings and coatings impervious to industry-standard cleaning procedures
- Axial and radial capacitors available on tape and reel for automatic insertion

Our low-cost, ultra-miniature conformal coated axials are ideally suited for high-density applications. Radial-lead box configurations are available down to 5mm (.2") lead spacing.

Made in the U.S.A.

PPD's state-of-the-art automated manufacturing and testing assures you of consistent quality every time. And quality is just one thing we don't charge extra for.

Look at our quality for yourself. Just write us on your company letterhead, and we'll send you a sample of our product.

PPD

P.O. Box 31347
Raleigh, N.C. 27622
919/781-3955

MINIGLOSSARY BASIC CAPACITOR FORMULAS

I. Capacitance (farads)

English: $C = \frac{.224\ K\ A}{t_D}$

Metric: $C = \frac{.0884\ K\ A}{t_D}$

II. Energy stored in capacitors (Joules, watt-sec)

$E = \frac{1}{2}\ CV^2$

III. Linear charge of a capacitor (Amperes)

$I = C\frac{dV}{dt}$

IV. Total Impedance of a capacitor (ohms)

$Z = \sqrt{R_s^2 + (X_C - X_L)^2}$

Where Rs = ESR

V. Capacitive Reactance (ohms)

$X_C = \frac{1}{2\pi fC}$

VI. Inductive Reactance (ohms)

$X_L = 2\pi fL$

VII. Phase Angles:

Ideal Capacitors: Current leads voltage 90°
Ideal Inductors: Current lags voltage 90°
Ideal Resistors: Current in phase with voltage

VIII. Dissipation Factor

$DF = \tan\delta\ (\text{loss angle}) = \frac{ESR}{X_c} = (2\pi fC)\ (ESR)$

IX. Power Factor

PF = Sine δ (loss angle) = Cos ϕ (phase angle)
PF = DF (when less than 10%)

X. Quality Factor (dimensionless)

$Q = \text{Cotan}\ \delta\ (\text{loss angle}) = \frac{1}{DF}$

XI. Equivalent Series Resistance (ohms)

$ESR = (DF)\ (Xc) = (DF)\ (\frac{1}{2}\pi fC)$

XII. Power Loss (watts)

Power loss = $(2\pi fCV^2)\ (DF)$

XIII. KVA (Kilowatts)

$KVA = 2\pi fCV^2 \times 10^{-3}$

XIV. Temperature Characteristic (ppm/°C)

$TC = \frac{Ct - C_{25}}{C_{25}\ (T_t - 25)} \times 10^6$

XV. Cap Drift (%)

$C.D. = \frac{C_1 - C_2}{C_1} \times 100$

XVI. Reliability of Ceramic Capacitors

$\frac{L_O}{L_t} = \left(\frac{V_t}{V_O}\right)^x \left(\frac{T_t}{T_O}\right)^\tau$

XVII. Capacitors in Series (current the same)

Any number: $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} \cdots + \frac{1}{C_N}$

Two: $C_T = \frac{C_1 C_2}{C_1 + C_2}$

XVIII. Capacitors in Parallel (voltage the same)

$C_T = C_1 + C_2 \cdots + C_N$

XIX. Aging Rate

A.R. = % Δ C/decade of time

XX. Decibels

$db = 20 \log \frac{V_1}{V_2}$

Metric prefixes:

Pico	X 10^{-12}
Nano	X 10^{-9}
Micro	X 10^{-6}
Milli	X 10^{-3}
Deci	X 10^{-1}
Deca	X 10
Kilo	X 10^3
Mega	X 10^6
Giga	X 10^9
Tera	X 10^{12}

Symbols:

K = Dielectric Constant
A = Area
t_D = Dielectric thickness
V = Voltage
t = time
R_s = Series Resistance
f = frequency
L = Inductance
δ = Loss angle
ϕ = Phase angle
x + y = Exponent effect of voltage and temp
L_O = Operating life
L_t = Test life
V_t = Test voltage
V_O = Operating voltage
T_t = Test temperature
T_O = Operating temperature

QPL
MIL-C-55681B
(M-LEVEL)
ESTABLISHED RELIABILITY
CDR11 thru CDR14
CDR21 thru CDR25

MIL-C-11272C
CY81 thru CY89

QPL
MIL-C-20G
(R-LEVEL)
ESTABLISHED RELIABILITY
CCR05 thru CCR09
CCR75 thru CCR79
CC05 thru CC09 CC75 thru CC79

ULTRA-STABLE
NPO MU-CAPS®
MOST STABLE MINIATURE CAPACITOR AVAILABLE
T.C.--ZERO ±30 PPM/°C
AXIAL RADIAL
SQUARE... from 1 PF. to .22 MF.
TUBULAR ... from 1 PF. to .22 MF.

REPUBLIC
SUBMINIATURE CERAMIC CAPACITORS

ULTRA-Q MICROWAVE FREQUENCIES

Pd. SILVER or TINNED

MS MICRO STRIP
AR AXIAL RIBBON
RR RADIAL RIBBON
RW RADIAL WIRE
AW AXIAL WIRE

SPECIFICATIONS
Capac. Range: .1 Pf thru 1000 Pf
WVDC: 50 thru 500 VDC
Q @ 1 MHZ: 10,000 minimum
Temp. Coeff.: +90 ±20ppm/°C

CHIPS SINGLE LAYER

Sizes: .030" Sq. and up
Capacitance: SUPER-K Ceramic 150 PF. to 10,000 PF.
HIGH-K " 100 PF. to 5,000 PF.
STABLE-K " 50 PF. to 2,700 PF.
LOW-VAR " 20 PF. to 1,000 PF.
TEMP. COMP. " 1 PF. to 330 PF.
Electrodes: Normally silver. Other precious metals on request
Voltage: 50 WVDC

CHIPS MONOLITHIC MULTILAYER

Sizes: From .050" x .050" x .050" to .610" x .310" x .080"
Capacitance: STABLE-K Ceramic 10 PF. to 2 MF.
NPO " 1 PF. to .027 MF.
Electrodes: Normally silver. Other precious metals on request
Voltage: 50 WVDC

TEMPERATURE COMPENSATING NPO thru N5600 AND GENERAL PURPOSE

M-CAPS
NPO ULTRA-STABLE

are monolithic capacitors with maximum capacitance/volume ratio in a choice of 3 dielectrics to cover all requirements. From .100" square to .300" square.

NPO	STABLE-K	HIGH-K
2.2-33,000 PF.	120 PF.-1MF.	470 PF. -1MF.

RIBBON LEADS
Style RLA

Size and specifications same as "Thinline" capacitors shown above, except radial and axial tinned copper ribbon leads, approximately .006" thick x 3/32" wide for units with max. size of .150" and up; .045" wide for smaller units.

SEND FOR FREE CATALOG

REPUBLIC ELECTRONICS CORP. 176 E. 7th St., PATERSON, N.J. 07524
201-279-0300 TWX 710-988-5908

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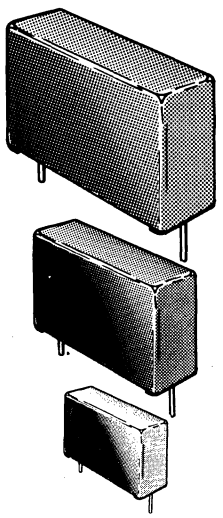
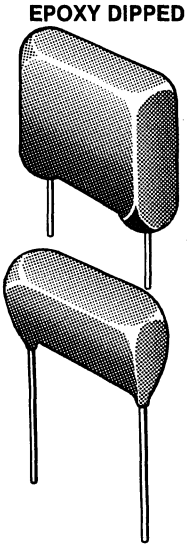
FILM and METALLIZED

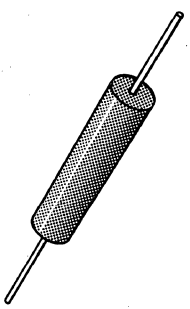
MOLDED BOX



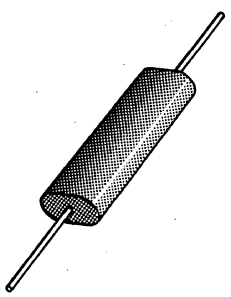
EPOXY DIPPED



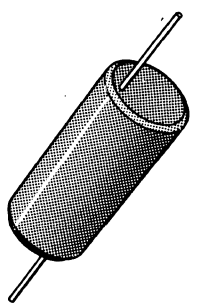
AXIAL WRAP and FILL



OVAL AXIAL WRAP and FILL

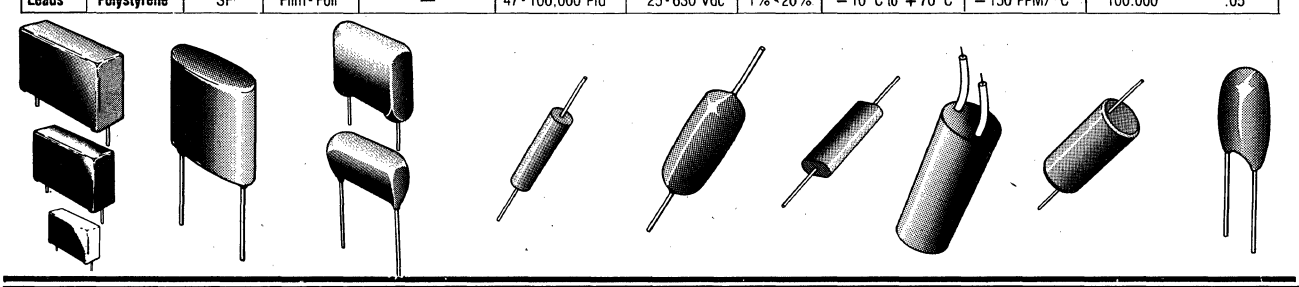


POLYESTER WRAP OFFSET LEADS

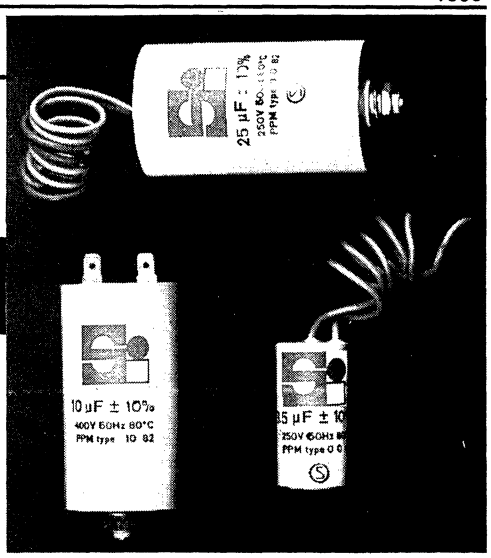


Configuration Dielectric

		Seacor Series#	Film-Foil or Metallized	Taped & Reeled Available	Capacitance Range	Voltage Range VDC	Standard Tolerance Range	Temperature Range	Approximate Temperature Coefficient	Insulation Resistance Minimum	Dissipation Factor at 1K Hz. 25°C
Molded Box	Polyester	MMKO	Metallized	—	.0027 - 6.8 Mfd	63 - 630 Vdc	5% - 20%	−40°C to +100°C	+400 PPM/°C	15Km/ohm	.8
		SMMKO	Metallized	T&R Available	.001 - 1.0 Mfd	63 - 400	5% - 20%	−40°C to +100°C	+400 PPM/°C	15Km/ohm	.8
		MMK-5	Metallized	T&R Available	.001 - .47 Mfd	63 - 100 Vdc	5% - 20%	−55°C to +100°C	+400 PPM/°C	15Khn/ohm	.8
	Polycarbonate	CMK	Metallized	—	.0027 - 6.8 Mfd	100 - 400 Vdc	1% - 20%	−55°C to +125°C	+150 PPM/°C	30.000	.4
		CMK-7.5	Metallized	T&R Available	.001 - .33 Mfd	100 - 400 Vdc	1% - 20%	−55°C to +125°C	+150 PPM/°C	30.000	.4
		CMK-5	Metallized	T&R Available	.001 - .47 Mfd	63 - 100 Vdc	1% - 20%	−55°C to +125°C	+150 PPM/°C	30.000	.4
	Polypropylene	PMR	Metallized	—	.001 - 2.2 Mfd	250 - 630 Vdc	1% - 10%	−55°C to +85°C	−300 PPM/°C	100.000	.1
		PMR-7.5	Metallized	T&R Available	.001 - .047 Mfd	250 - 400 Vdc	1% - 10%	−55°C to +85°C	−300 PPM/°C	100.000	.1
	Polystyrene	SFR	Film - Foil	—	47 - 100,000 Pfd	100 - 500 Vdc	1% - 10%	−40°C to +85°C	+150 PPM/°C	100.000	.05
Epoxy Dipped	Polyester	MFDR	Film - Foil	—	.001 - .47 Mfd	100 - 600 Vdc	5% - 20%	−40°C to +85°C	+400 PPM/°C	50.000	.75
		MMDR	Metallized	—	.01 - 2.2 Mfd	250 - 630 Vdc	5% - 20%	−40°C to +85°C	+400 PPM/°C	30.000	1.0
		MFDS	Film - Foil	T&R Available	.001 - .47 Mfd	100 Vdc	5% - 20%	−40°C to +85°C	+500 PPM/°C	30.000	1.0
	Polypropylene	PFDS/R	Film - Foil	—	.001 - .18 Mfd	160 - 630 Vdc	1% - 20%	−40°C to +85°C	−300 PPM/°C	100.000	.1
Axial Wrap & Fill	Polyester	MFWA	Film - Foil	T&R Available	.001 - 1.0 Mfd	100 - 630 Vdc	5% - 20%	−55°C to +85°C	+400 PPM/°C	50.000	.75
		MMWA	Metallized	T&R Available	.01 - 10.0 Mfd	100 - 630 Vdc	5% - 20%	−40°C to +85°C	+400 PPM/°C	15.000	.75
	Polycarbonate	CMWA	Metallized	T&R Available	.01 - 10.0 Mfd	100 - 630 Vdc	1% - 20%	−40°C to +85°C	+150 PPM/°C	30.000	.2
	Polypropylene	PMWA	Metallized	T&R Available	.01 - 10.0 Mfd	250 - 1000 Vdc	1% - 20%	−40°C to +70°C	−100 PPM/°C	100.000	.1
		PFWA	Film - Foil	T&R Available	.001 - .12 Mfd	63 - 250 Vdc	1% - 20%	−40°C to +85°C	−290 PPM/°C	10.000	.2
	Polystyrene	SFWA	Film - Foil	T&R Available	100 - 603,000 Pfd	63 - 1000 Vdc	1% - 5%	−10°C to +70°C	−100 PPM/°C	50.000	.05
Oval Wrap & Fill	Polycarbonate	CMWF	Metallized	—	.001 - 22.0 Mfd	100 - 630 Vdc	5% - 20%	−55°C to +85°C	+150 PPM/°C	30.000	.2
Polyester Wrap Offset Leads	**Polystyrene**	SF	Film - Foil	—	47 - 100,000 Pfd	25 - 630 Vdc	1% - 20%	−10°C to +70°C	−150 PPM/°C	100.000	.05



FILM CAPACITORS



MOTOR RUN CAPACITORS

NEW from SEACOR

Seacor announces a new series of miniature, self-healing, dry, metallized polypropylene capacitors for motor run or other AC or DC applications. The PNP capacitor series is encapsulated in flame retardant epoxy filled plastic cases. The polypropylene design features excellent electrical life expectancy, normally 40,000 hours and 500 hours during accelerated testing at 125% of rated voltage at 80°C. End terminations are available as insulated leads or AMP push on terminals. The capacitance variation over temperature is uniquely low, less than 3% from −25°C to 80°C.

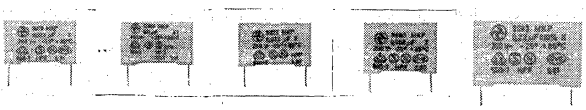
APPROVALS:

- VDE (Germany)
- SEMKO (Sweden)
- SEV (Switzerland)
- NEMKO (Norway)
- DEMKO (Denmark)

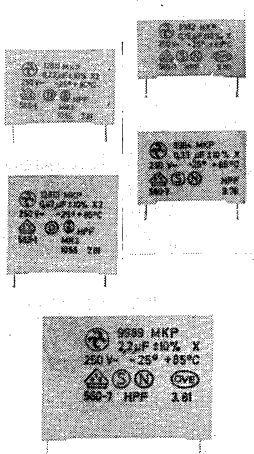
Electrical Characteristics Include:

- Capacitance Valves: 1 MFD to 65 MFD
- Tolerances: 10%, 5%
- Working Voltages: AC 115, 250, 400, 450 @ 60 Hz.
- Dissipation Factor: .1% Max
- Insulation Resistance: 10,000 Megohms X MFD
- Operating Temperature: −50°C to +90°C

SUPPRESSOR CAPACITORS



This two pole noise suppressor and X capacitor series is constructed of metallized polypropylene foil. The outer case is of flame retardant plastic with moisture proof epoxy and seals. This molded case allows for uniformity and space savings. Noise suppressor capacitors have been developed for the interference elimination of any tool, machinery, and minor equipment supplied by 2-phase a.c. mains. Electrical Characteristics include:



- Capacitance Values: .015 MFD to 2.2 MFD
- Tolerances: 20% ≤ .1 MFD, 10% > .1 MFD
- Working Voltage: 250 Vac
- Dissipation Factor: .05% @ 1 KHz @ 20°C
- Insulation Resistance: 100,000 Megohms ≤ .33 MFD 33,000 SEC > .33 MFD
- Operating Temperature Range: −25°C to +85°C

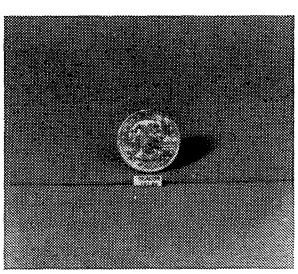
APPROVALS:

- VDE (Germany)
- SEMKO (Sweden)
- SEV (Switzerland)
- IEC (European)

The NEW SEACOR SPECIAL PRODUCTS DIVISION

SPECIAL PRODUCTS

If you can't meet your much needed requirements in a standard capacitor, contact Seacor's Special Products Division, Non-standard capacitances, tolerances, and voltages, are just a few of our capabilities. Special lead configurations, sub-miniature sizes, special designs, as well as unique marking requirements are also features of our newly developed department. Our capabilities also include special capacitance sorting and matching abilities and MANY, MANY OTHERS. A good place to start or before giving up, check Seacor's Special Products Division!



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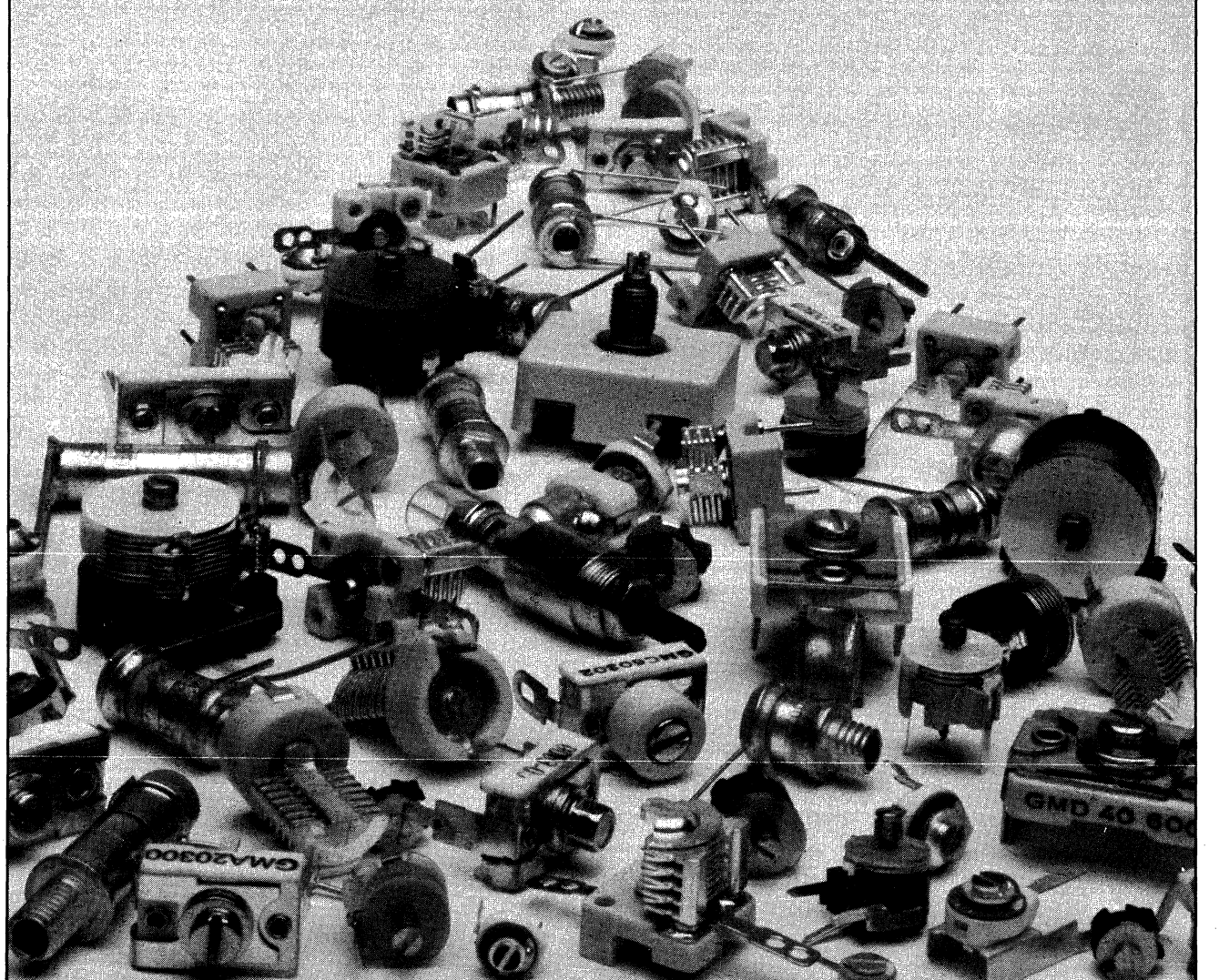
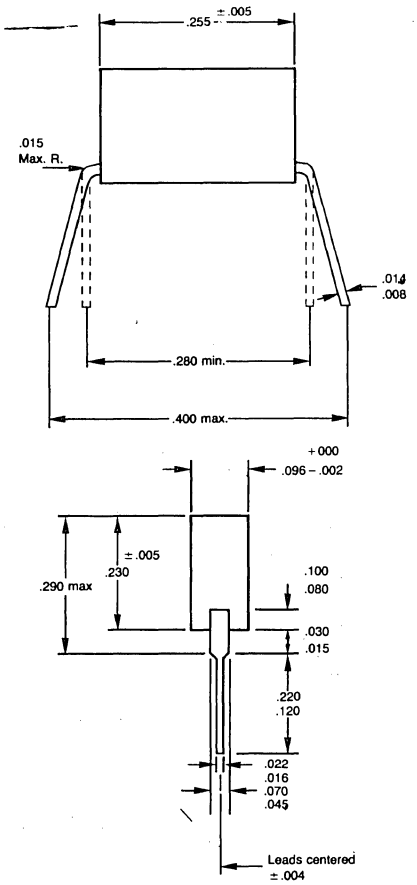


Metallized Polyester DIP

Type TRW-81

- **High IR**
- **Low DF**
- **Self-Healing**
- **Low ESR**
- **Flame Retardant Molded Epoxy Case**
- **2-pin DIP Leads**



The TRW-80 series embodies the latest in thin gauge technology. The use of ultra-thin gauge metallized polyester packaged in a small molded case with short 2 pin-dip leads provides near-ideal performance. The reliability of self-healing gives long catastrophic failure-free operation while the small package affords the low-inductance and low ESR so vital in future designs. The consistant size, low weight, precise lead placement and radial lead packaging make the TRW-80 series ideal for low cost high speed manufacturing.

SPECIFICATIONS

Insulation Resistance: Measured after 60 seconds at 25°C and rated voltage. See Table below.

Dissipation Factor: Shall be less than 1.0% when measured at 1000 ±20 Hz and at 25°C for values up to and including .12 MFD.

Dielectric Strength: Shall withstand a test of 1.6 times rated voltage for two seconds at 25°C without catastrophic failure.

Capacitance: Shall be within specified tolerance when measured at 1000 ±20 Hz at 25°C for values up to and including .12 MFD.

Equivalent Series Resistance (ESR): Less than the value shown in ESR graph when measured at 100 KHz using a Clark Hess Model 273A ESR bridge or equivalent.

Noise Factor: The pulsed ESR shall be measured with a pulse having a rise time of 5 nanoseconds to a steady state current of 100 milliamps. Typical values are shown in ESR graph. The measurement is taken after the inductive spike.

Construction: Non inductive metallized polyester winding.

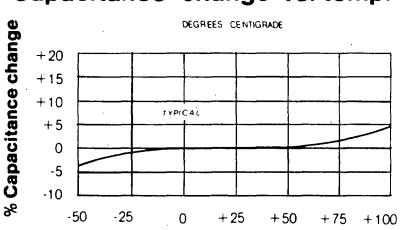
Encasement: Red molded epoxy.

Lead Material: .010 Copper-Olin C194, ¾ to full hard with 50/150 microinches 60/40 of tin. 2 pin DIP configuration.

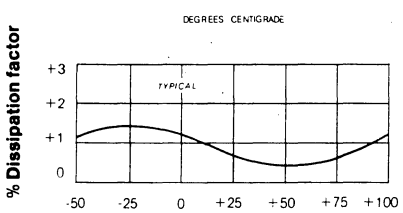
Standard Capacitance Values 50 VDC

Capacitance in MFD		
.001	.01	.1
.0012	.012	.12
.0015	.015	—
.0018	.018	—
.0022	.022	—
.0027	.027	—
.0033	.033	—
.0039	.039	—
.0047	.047	—
.0056	.056	—
.0068	.068	—
.0082	.082	—

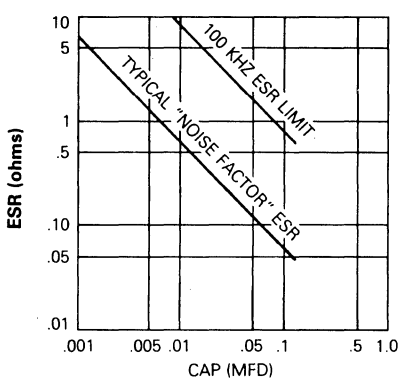
Capacitance change vs. temp.



Dissipation factor vs. temp.



ESR vs. Capacitance



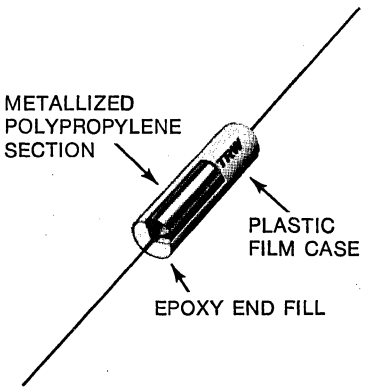
Metallized Polypropylene Dielectric

Type X363UW

Subminiature... Instrument Grade

- **Long stable life**
- **Very high insulation resistance**
- **Lowest dissipation factor**
- **Humidity resistant**
- **Saves on size and weight**
- **Capacitance tolerance to 1%**

CUT-AWAY SHOWS CONSTRUCTION



Used for a number of years in the non-precision power capacitor field, polypropylene has now been developed by TRW Capacitors as a dielectric for miniaturized precision capacitors exhibiting unique and outstanding electrical and environmental characteristics. Particularly worthy of note is its stability. The X363UW exhibits negligible shift in capacitance under long term exposure to humidity, operating life, and temperature cycling. Insulation resistance, dielectric absorption and dissipation factor properties are all the equivalent of or superior to those of polystyrene.

SPECIFICATIONS

Insulation Resistance: Minimum values.

Temperature	+25°C	+85°C	+105°C
Megohms X Microfarads	300,000	30,000	3,000
Need Not Exceed (Megohms)	500,000	50,000	5,000

Measured after two minutes electrification at 200 volts.

Capacitance Range: 0.010 thru 15.0 mfd.

Voltage Range: 100, 200, 400 VDC.

Dielectric Strength: Twice rated voltage for one minute through a limiting resistance of 100 ohms/volt.

Dissipation Factor: Less than 0.1% at 25°C when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 10.0 mfd.

Dielectric Absorption: When tested per MIL-C-19978 the dielectric absorption shall not exceed 0.05%. Shorter test methods produce lower results. For further information, consult TRW Engineering.

Capacitance: Shall be within specified tolerance when measured at or referred to 1000 ±20 Hz for values up to and including 15.0 mfd at 25° ±5°C.

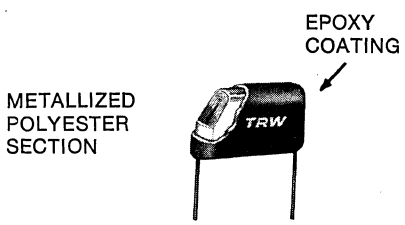
Temperature Range: −55°C to +105°C with no voltage derating.

Metallized Polyester

Type X601PE-X601CPE

Dipped Epoxy Coating

- **Ultra miniature, lightweight**
- **Tough, Rugged Case**
- **Styled for maximum packaging efficiency**
- **Capacitance values to 10 mfd**
- **Tolerances to ±5%**



CUT-AWAY SHOWS CONSTRUCTION

The X601PE was designed for quality capacitor applications utilizing the advance technology of TRW. It is ideally designed for "Space Age" applications requiring the best the industry has to offer in minimum size and weight, consistent with maximum reliability. The X601PE line is now available in a full range of value from 0.01 to 10.0 mfd in 100 and 200 VDC. The unit is excellent in electrical and environmental performance throughout this range.

SPECIFICATIONS

Insulation Resistance: Table 1, minimum values.

Temperature	+25°C	+85°C	+125°C
Megohms X Microfarads	20,000	2,000	20
Need Not Exceed (Megohms)	30,000	5,000	50

Measured after 2 minutes electrification at rated voltage

Dissipation Factor: Less than 1.0% when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 1.0 mfd at 25°C ±5°C. Capacitance values greater than 1.0 mfd measured at 60 ±6 Hz.

Dielectric Strength: Twice rated voltage for 1 minute through 100 ohms per volt limiting resistance.

Humidity Resistance: Tested as outlined in MIL-STD-202, Method 103, Condition B, no voltage applied. After final conditioning, IR no less than ⅓ minimum values listed in Table 1.

Life Test: 500 hours at +100°C and 125% of rated volts.

Temperature Range: −55°C to +100°C, to 125°C with 50% derating.

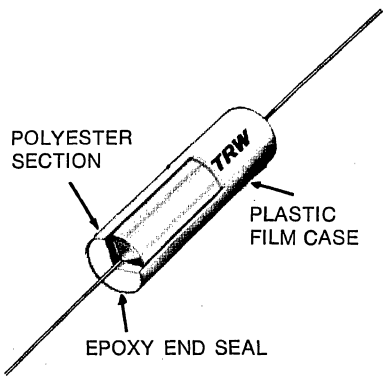
Construction: Metallized Polyester, non-inductive winding.

Polyester Dielectric

Type 663UW

- **For maximum space saving**
- **"Instrument" quality**
- **Tough, moisture resisting case**
- **Conservatively rated**
- **Tolerances to ±1%**
- **Capacitance Range 0.001 thru 2.0 mfd**

CUT-AWAY SHOWS CONSTRUCTION



Type 663UW capacitors are compatible in size with other subminiature transistor components. In addition, they are conservatively designed and rated for long life and reliable service in high quality equipment and instrument applications. The Polyester winding is covered with a thin, tough plastic case adding less than 1/64" to the body diameter. The dense thermosetting epoxy endfill bonds securely to the lead and case. This line is designed and rated for long life and reliable service.

SPECIFICATIONS

Insulation Resistance: Greater than 70,000 megohms-microfarads at 25°C, but the IR need not exceed 140,000 megohms.

Dissipation Factor: Less than 1.0% when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 1.0 mfd at 25°C ±5°C. Capacitance values greater than 1.0 mfd measured at 60 ±6 Hz.

Life Test: 250 hours at 85°C and 125% of Rated Voltage. No more than one failure allowed of 18 units tested.

Dielectric Strength: 2 times rated voltage for one minute through a limiting resistance of 100 ohms/volt.

Lead Pull Test: Steady force of 4 lbs. applied axially for 60 sec. on diameters up to 0.359 — 8 lbs. on diameters over 0.359.

Humidity Resistance: Will meet or exceed requirements of MIL-C-27287, Paragraph 3.12, when tested in accordance with MIL-STD-202, Method 103, Condition B. One failure allowed of 18 units tested.

Temperature Range: May be operated at rated voltage from −55°C to +85°C and to +125°C with 50% derating.

Voltage Range: 100 thru 1000 VDC.

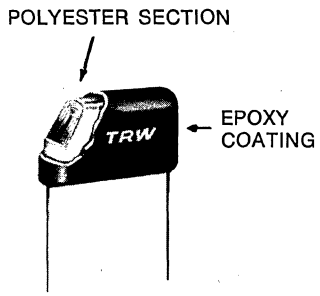
Winding Design: Extended foil construction.

Polyester Dielectric

Type 601PE-601CPE

Dipped Epoxy Coating

- **Styled for "High Density" packaging**
- **Extremely stable**
- **Ideal replacement for ceramic discs**
- **High insulation resistance**
- **Full range of values**
- **Tolerances to ±5%**



Now available in the full range from 35V to 600V and 0.001 to 1.0 mfd, the "slim" 601 series is even more valuable in high density applications. Thin, modular packaging provides maximum capacitance for minimum chassis area. It is engineered to replace ceramic discs where stability with temperature change is important.

SPECIFICATIONS

Insulation Resistance: Minimum values according to Table 1. (Refer to graph for IR at other temperatures.)

Temperature	+25°C	+85°C	+125°C
Megohms X Microfarads	50,000	2,000	20
Need Not Exceed (Megohms)	100,000	5,000	100

Measured after 2 minutes electrification at 100 VDC or rated voltage, whichever is greater.

Dissipation Factor: Less than 1.0% when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 1.0 mfd at 25°C ±5°C. Capacitance values greater than 1.0 mfd measured at 60 ±6 Hz.

Dielectric Strength: Twice rated voltage for 1 minute through 100 ohms per volt limiting resistance.

Humidity Resistance: These designs comply with test requirements per MIL-STD-202, Method 103, Condition B, no voltage applied. Minimum resistance after test, 15,000 megohms.

Life Test: 1000 hrs. @ +85°C and 125% of rated voltage. No more than one failure allowed of 24 units tested.

Temperature Cycling: MIL-STD-202, Method 102, Condition D, no voltage applied. Minimum insulation resistance after test 25,000 megohms. Less than 1% change in capacitance.

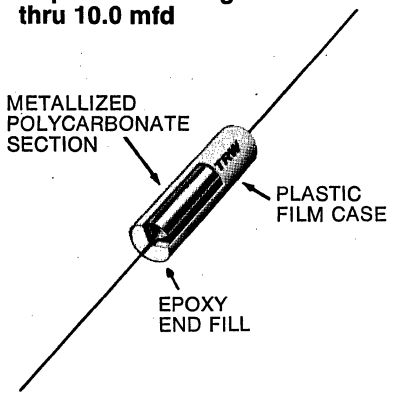
Capacitance Tolerance: Within specified tolerance when measured at 1000 ±20 Hz, 25°C ±5°C (standard is 20%).

Temperature Range: May be operated at rated voltage from −55°C to +85°C. Derate to 50% when operating at 125°C.

Metallized Polycarbonate

Type X463UW

- **Small size — Lightweight**
- **Very low temperature coefficient**
- **Fully rated from −55°C to +125°C**
- **High insulation resistance**
- **Excellent retrace**
- **Tolerances to ±1%**
- **Capacitance range from 0.001 thru 10.0 mfd**



The increasing demand for reduction in size and weight coupled with requirements for enhanced circuit performance, requires capacitors which incorporate the latest developments in component technology. TRW has now introduced a capacitor which combines the improved electrical performance of polycarbonate and the size and weight reductions associated with a metallized dielectric.

SPECIFICATIONS

Insulation Resistance: Table 1, minimum values.

Temperature	+25°C	+85°C	+125°C
Megohms X Microfarads	60,000	6,000	600
Need Not Exceed (Megohms)	200,000	50,000	5,000

Measured after 2 minutes electrification at rated voltage

Dissipation Factor: Less than 0.3% at 25°C when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 10 mfd.

Dielectric Strength: Twice rated voltage for one minute through a limiting resistance of 100 ohms/volt.

Life Test: 250 hours at 125°C and 140% rated voltage with no more than one failure out of 12 units tested.

Temperature Range: −55°C to +125°C with no voltage derating.

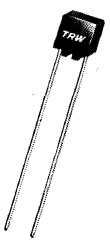
Humidity Resistance: No more than one failure allowed of 12 units tested when tested as outlined in MIL-STD-202, Method 103, Condition B, with 100 volts or rated voltage applied, whichever is less.

Voltage Ranges: 50, 100, 200, 400 VDC.

Metallized Dielectric

Type X440

- **Minimum possible size — Lightweight**
- **Very low temperature coefficient**
- **Fully rated from −55°C to +125°C**
- **High insulation resistance**
- **Tolerances to ±1%**
- **Capacitance Range 0.001 thru 0.10 mfd**



The X440 has been specifically designed to be a real help in the ever increasing problem of fitting components in today's miniaturized designs. Its absolute minimum size, precision dimensions, and the close tolerance lead spacing permit space savings impossible before. Additionally, the highly impressive electrical properties of polycarbonate are of immense value in modern high performance circuitry.

Standoffs on the bottom of the premolded case provide for rigid, secure mounting and facilitate cleaning of the printed circuit boards. Leads are uniformly and accurately spaced on 0.0200″ centers.

SPECIFICATIONS

Voltage Rating: 50 VDC from −55°C to +125°C.

Insulation Resistance: Greater than 500,000 megohms @ 25°C.

Dissipation Factor: Less than 0.3% at 1K Hz @ 25°C.

Capacitance Change with Temperature:
a. Between 0°C and 125°C, as referenced to 25°C, capacitance change will not exceed +½ −1½%.
b. TC of capacitance characteristic is 0 +50 −150 PPM/°C between 0°C and 125°C.

Dielectric Strength: 200% of rated voltage applied for 2 minutes through limiting resistance of 100 ohm/volt.

Life Test: Tested in accordance with MIL-C-27287, 250 hrs., 125°C @ 1.4 RV. IR greater than 70% of original requirement, DF less than 0.3%, cap. change less than 1%.

Humidity Resistance: Tested in accordance with MIL-C-27287, 40°C, 95% RH, 240 hours. IR greater than 10 gigaohms @ 25°C. DF less than 0.3%.

Lead Pull Test: 5 lbs. in any direction.

Construction: Metallized polycarbonate dielectric, non-inductive winding. Epoxy case with standoffs.

Leads: 24 gauge tinned solid wire on 0.2″ centers.

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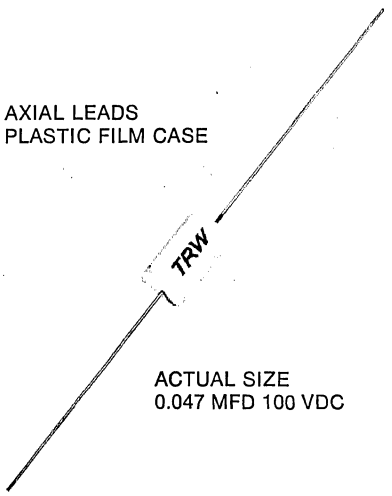
Metallized Polyester Flattened

Type X659F

- **Smallest possible size**
- **High insulation resistance**
- **Self-healing — Long stable life**
- **Full voltage range — 50 thru 400W VDC**
- **Capacitance values to 20.0 mfd**



TRW Type X659F adds a complete new dimension to circuit board layout by providing a metallized polyester, wound flattened capacitor, in sizes never before available. This advance design which utilizes the very thin gauges of metallized polyester, coupled with TRW's advanced manufacturing technology and in-house metallizing capability and control, offers the same rugged durability and reliability as all TRW Capacitors.

This basic reliability and the proven performance record of metallized polyester makes the X659F the ideal choice where freedom in equipment design and durability is required.

SPECIFICATIONS

Insulation Resistance: Minimum values.

Temperature	+25°C	+85°C	+125°C
Megohms X Microfarads	30,000	3,000	50
Need Not Exceed (Megohms)	30,000	3,000	50

Measured after 2 minutes electrification at rated voltage.

Dissipation Factor: Less than 1.0% when measured at or referred to 1000 ±20 cps for capacitance values up to and including 1.0 mfd at 25°C ±5°C except for units having a thickness dimension of 0.170 or less, the DF shall not exceed 1.5%. Capacitance values greater than 1.0 mfd measured at 60 ±6 cps.

Temperature Range: −55°C to 100°C; to +125°C with 50% derating.

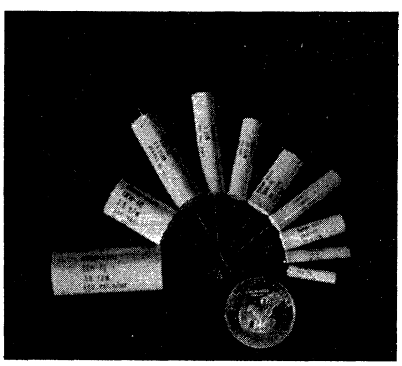
Humidity Resistance: Tested as outlined in MIL-STD-202C, Method 103B, Condition A. After final conditioning IR, no less than ⅓ minimum values listed in Table 1. Dielectric strength to withstand test as outlined in Para. 3.4. One failure allowed of 18 units tested.

Dielectric Strength: 200% rated voltage for one minute through a limiting resistance of 100 ohms/volts.

Metallized Polyester Dielectric

Types TRW-40, -41 and -42

- **AC voltage ratings from 330 to 460 volts, 50/60 Hz**
- **Capacitance values to 2.0 mfd**
- **Flame-retardant tape wrap case**



PERFORMANCE

Type TRW-40, -41 and -42 capacitors are constructed from metallized polyester film and offer small size, less weight and long reliable life without the use of impregnants. The flame retardant tape wrap and end fill provides both physical and environmental protection.

The full range of capacitance values available gives these capacitors broad usage in the electrical and electronic fields.

APPLICATIONS

Type TRW-40, -41 and -42 capacitors can be utilized for applications such as motor run, motor speed control, and noise filtering, as found in computer peripherals such as terminals, printers and disc drives; in large and small cooling fans and small motors of all types. Special terminals such as stranded insulated leads or quick disconnects are available on a customized basis. Consult the factory for details.

SPECIFICATIONS

Type	TRW-40	TRW-41	TRW-42
Capacitance Range	0.047 to 2.0 mfd	0.047 to 2.0 mfd	0.01 to 2.0 mfd
Dielectric Strength*	900 VDC	1500 VDC	2100 VDC
AC Voltage Rating	330 Vrms, 50/60 Hz	370 Vrms, 50/60 Hz	460 Vrms, 50/60 Hz
Corona Onset (min.)	480 Vrms, 60 Hz	460 Vrms, 60 Hz	600 Vrms, 60 Hz

* For one minute through a limiting resistance of 100 ohms/volt

Insulation Resistance:

Temperature	+25°C	+85°C
Megohms x Micorfarads	30,000	3,000
Need Not Exceed (Megohms)	30,000	3,000

Measured after two minutes electrification at 400 VDC

Dissipation Factor: Less than 1.0% when measured or referred to 1000 ±20 Hz for capacitance values up to and including 1.0 mfd at 25 ±5°C. Capacitance values larger than 1.0 mfd shall be measured at 60 ±6 Hz.

Capacitance: Shall be within specified tolerance when measured at or referred to 1000 ±20 Hz for capacitance values up to and including 1.0 mfd. Capacitance values larger than 1.0 mfd shall be measured at 60 ±6 Hz.

Humidity Resistance: When tested as in MIL-STD-202E, Method 103B, Condition B no more than one failure allowed of eighteen units tested.

Life Test: 1000 hours at +85°C and 125% of rated AC voltage (50-60 cps).

Temperature Range: −55°C to +85°C.

Construction: Metallized construction.

Case: Flame retardant polyester tape wrap with flame retardant epoxy endfill.

Lead Material: Tinned copperweld wire.

Lead Pull Test: Will withstand for one minute a steady force of the following magnitude:

4 lbs. — Diameters up to and including 0.465 dia.

8 lbs. — Diameters over 0.466

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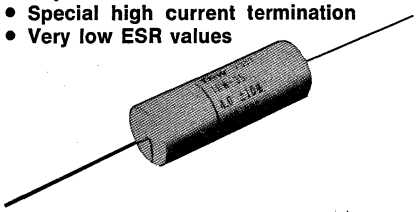
Metallized Polypropylene Dielectric

Type TRW-35

- **Designed for switching power supply applications**
- **Rated for 20 KHz usage**
- **High current — up to 9A rms**
- **Capacitance to 30 mfd**
- **Special high current termination**
- **Very low ESR values**



PERFORMANCE

The TRW-35 is designed specifically for switching power supply applications where high current, high capacitance range and low ESR values are important.

The Metallized polypropylene TRW-35 shows negligible shift in capacitance under long term exposure to humidity, operating life and temperature cycling. Insulation resistance, dielectric absorption and dissipation factor properties are all superior to those of electrolytic capacitors presently used by switching power supply manufacturers. Added to these features are size and weight savings.

APPLICATIONS

The TRW-35 is used for input filtering, hi-frequency transformer D.C. blocking, and output filtering. As an input filter it provides EMI protection back into the line (generated by the switch) and serves as a quasi-constant current source (turn on for the switch). As a D.C. blocking capacitor it prevents D.C. saturation of the hi-frequency transformer caused by switch unbalance while passing the AC square wave with little loss. As an output filter it provides a low impedance path for high frequency ripple filtering.

Unlike the electrolytic capacitor often used for such applications, the TRW-35 exhibits little or no capacitance roll-off with increasing frequency. The TRW-35 features ESR typically an order of magnitude or more under the ESR of equivalent electrolytic capacitance values.

In filter designs where capacitance values of 30 mfd or smaller are adequate for system performance, the TRW-35 offers impedance characteristics that can significantly enhance the overall system design.

SPECIFICATIONS

Dissipation Factor: Shall be less than 0.1% when measured at or referred to 1000 Hz ±20 Hz. Typical value is 0.05%.

Capacitance: Shall be within specified tolerance when measured at or referred to 1000 Hz ±20 Hz.

Insulation Resistance: Shall be greater than 100,000 megohms – Micro Farads but need not exceed 500,000 megohms when tested at 25°C and electrified at 100 VDC for 2 minutes.

ESR: The 100 KHz ESR values shall not exceed the values shown.

Construction: Non-inductive winding, polypropylene dielectric, metallized electrodes with special high current termination.

Case: Polyester tape wrap with epoxy endseals.

Lead Material: Tinned copper wire.

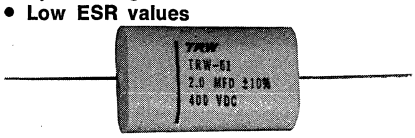
Temperature Rating: 55°C to 105°C with no voltage derating.

Voltage: 100 thru 400 VDC.

Metallized Polyester

Type TRW-61

- **Rated for 60 KHz usage**
- **High current — up to 4A rms**
- **Capacitance to 4.7 mfd**
- **White polyester tape wrap case**
- **Special high current termination**
- **Low ESR values**



PERFORMANCE

The TRW-61 is designed specifically for switching power supply applications where current and low ESR Values are important. The metallized polyester TRW-61 shows negligible shift in capacitance under long exposure to humidity, operating life and temperature cycling. Insulation resistance, dielectric absorption and dissipation factor properties are all superior to those of electrolytic capacitors presently used by switching power supply manufacturers.

These features, plus size and weight savings in SPS designs, make the TRW-61 the logical capacitor for performance and design of switching power supplies requiring medium current ratings.

SPECIFICATIONS

Insulation Resistance: Table 1, minimum values.

Insulation Resistance	+25°C	+85°C
Megohms & Microfarads	30,000	3,000
Need not Exceed (Megohms)	30,000	3,000

Measured after 2 minutes electrification at rated voltage.

Dissipation Factor: Less than 1.0% when measured at or referred to 1000 ±20 Hz at 25°C.

Temperature Range: −55°C to +100°C.

Humidity Resistance: Tested as outlined in MIL-STD-202C, Method 103B, Condition A. After final conditioning IR, no less than ⅓ minimum values listed in Table 1. Dielectric strength to withstand test as outlined in Para. 3.4. One failure allowed of 18 units tested.

Capacitance: Shall be within specified tolerance when measured at or referred to 1000 ±20 Hz at 25°C.

Capacitor Tolerance: Standard Tolerance ±20%; also available in ±10% and ±5%.

Equivalent Series Resistance (ESR): Shall be less than shown when measured at 100 KHz.

Case: Polyester tape wrap with epoxy end seals.

Lead Material: Tinned solid copper wire.

DIMENSIONS

Capacitance In Mfds.	T Max	W Max	L Max	Lead Gauge	I RMS	I Peak amps	100 KHz ESR Max Milliohms
	250 VDC						
1	0.360	0.560	1.125	20	2	7	41
1.5	0.450	0.650	1.125	20	2	11	34
2.2	0.500	0.800	1.125	20	3	16	28
3.3	0.550	0.840	1.250	20	4	19	23
4.7	0.620	1.010	1.250	18	4	26	19
	400 VDC						
1	0.550	0.850	1.200	20	2	10	41
1.5	0.690	0.990	1.200	18	3	14	34
2.2	0.630	1.020	1.560	18	4	16	28
3.3	0.790	1.180	1.560	18	4	23	23
4.7	0.960	1.350	1.560	18	4	33	19

RC Snubber Network

Type TRW-39A

- **Resistor: 3.9 ohm ½ watt ±10% carbon composition**
- **Capacitor: 0.1 mfd ±20%, 50 VDC**
- **White polyester tape wrap case**
- **Low inductance, extended foil construction**
- **Rugged polyester-foil design**
- **RC = 0.39 micro second nominal**

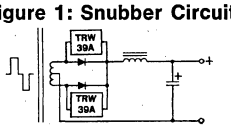
PERFORMANCE

This rugged RC network is designed for snubber applications across Schottky diodes operating in 20 KHz switching power supplies and provides critical damping of the ringing encountered in many circuits.

APPLICATIONS

Specifically designed for applications in 20 KHz switching power supplies, the TRW-39A provides critical damping and reverse voltage protection for the Schottky diode. The leakage inductance of the high frequency power transformer causes ringing of the reverse voltage when diode conduction abruptly ceases. This can cause Schottky diode failure. Figure 1 shows the snubber used across each diode. For other RC values contact TRW Capacitors, Application Engineering.

Figure 1: Snubber Circuit



SPECIFICATIONS

Insulation Resistance: Greater than 140K megohms when measured at 25°C after 2 minute electrification at 50 VDC.

Dissipation Factor: Less than 1.8% at 1000 Hz.

Dielectric Strength: Greater than 150 VDC.

Leads: Tin plated solid wire. 0.025/0.035 dia.

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Wound Film-Foil Capacitors

GENERAL-PURPOSE, WELDED TAB CONSTRUCTION

Polystyrene Film-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Rated Voltage (VDC)	Temperature Range (°C)	Lead Configuration	Case Style
Type 611	20-100,000 pF	1 through 20	33-630	−40 to +70	Axial Offset Leads	Tubular, Heat Shrunk
Type 616	20-100,000 pF	1 through 20	33-630	−40 to +70	Axial Centered Leads	Tubular, Heat Shrunk
Type 619	20-30,000 pF	1 through 20	33-630	−40 to +70	Preformed	Tubular, Heat Shrunk

Polypropylene Film-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Rated Voltage (VDC)	Temperature Range (°C)	Lead Configuration	Case Style
Type 636	220-27,000 pF	1 through 20	160 and 630	−40 to +85	Axial Centered Leads	Tubular, Heat Shrunk
Type 639	220-27,000 pF	1 through 20	160 and 630	−40 to +85	Preformed	Tubular, Heat Shrunk

Polyester Film-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Rated Voltage (VDC)	Temperature Range (°C)	Lead Configuration	Case Style
Type 641	0.001-0.1 μF	10, 20	160, 400 and 630	−40 to +85	Axial Offset Leads	Tubular, Heat Shrunk

PROFESSIONAL STYLE, EXTENDED FOIL CONSTRUCTION

Polystyrene Film-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Rated Voltage (VDC)	Temperature Range (°C)	Lead Configuration	Case Style
Type 602	100 pF to 600 nF	0.625 through 5.0	63-1000	−40 to +70	Radial	Epoxy-filled Tubular Plastic
Type 604	47 to 250,000 pF	1.0, 2.5, 5.0	100, 200, 500	−40 to +85	Radial	Epoxy-filled Rect. Plastic
Type 605	100 pF to 30 nF	0.625 through 5.0	63	−40 to +70	Radial	Epoxy-filled Square Plastic
Type 607	100 pF to 680 nF	0.625 through 5.0	63-750	−40 to +70	Radial	Tubular Tape Wrap

Wound Capacitors

Metallized Polycarbonate

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Series H	.01-15.0 μF	5, 10, 20	50-600	−55 to +125	axial	oval tape wrap
Series HE	.01- 5.0 μF	5, 10, 20	100-600	−55 to +125	axial	rect. epoxy case
Series H2E	.01- 5.0 μF	5, 10, 20	100-600	−55 to +125	radial	rect. epoxy case
Series HL	.01-15.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed tubular metal case
Series HG	.01-10.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed rect. metal case

Metallized Polyester

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Series D	.01-15.0 μF	5, 10, 20	50-600	−55 to +125	axial	oval tape wrap
Series DE	.01-10.0 μF	5, 10, 20	100-600	−55 to +125	axial	rect. epoxy case
Series D2E	.01- 8.0 μF	5, 10, 20	100-600	−55 to +125	radial	rect. epoxy case
Series DL	.01-15.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed tubular metal case
Series DG	.01-15.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed rect. metal case

Polyester-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Series E	.001-5.0 μF	5, 10, 20	100-600	−55 to +125	axial	oval tape wrap
Series EE	.001-2.0 μF	5, 10, 20	100-600	−55 to +125	axial	rect. epoxy case
Series EL	.001-5.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed tubular metal case
Series EG	.001-3.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed rect. metal case
Series EBC	.001-1.0 μF	5, 10, 20	100-600	−55 to +125	axial	tubular tape wrap meets MIL-C-27287

Polystyrene-Foil

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Type 602	100 pF-.60 μF	0.625-5.0	63-1000	−40 to +70	radial	tubular epoxy case
Type 605	100 pF-.03 μF	0.625-5.0	63	−40 to +70	radial	rect. epoxy case
Type 607	100 pF-.68 μF	0.625-5.0	63-750	−40 to +70	axial	tubular tape wrap
Series X	.001-2.0 μF	5, 10, 20	50-400	−55 to +85	axial	oval tape wrap
Series XL	.001-2.0 μF	5, 10, 20	50-400	−55 to +85	axial	hermetically sealed tubular metal case
Series XG	.001-.82 μF	5, 10, 20	50-400	−55 to +85	axial	hermetically sealed rect. metal case

Metallized Polypropylene

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Style EPYC4	.01-15.0 μF	1.0-20	100-400	−55 to +105	axial	tubular tape wrap

Paper/Polyester Dielectric

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Series BW	.001-.20 μF	5, 10, 20	2000-30,000	−55 to +125	axial	oval tape wrap
Series BWE	.001-.20 μF	5, 10, 20	2000-30,000	−55 to +125	axial	rect. epoxy case

Metallized Paper, Epoxy Impregnated

TRW Designation	Capacitance Range	Standard Tolerances (±%)	Voltage Range (V dc)	Temperature Range (°C)	Lead Configuration	Case Style
Series M	.01-10.0 μF	5, 10, 20	100-600	−55 to +125	axial	oval tape wrap
Series ME	.01- 8.0 μF	5, 10, 20	100-600	−55 to +125	axial	rect. epoxy case
Series M2E	.01- 8.0 μF	5, 10, 20	100-600	−55 to +125	radial	rect. epoxy case
Series ML	.01-15.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed tubular metal case
Series MG	.01-15.0 μF	5, 10, 20	100-600	−55 to +125	axial	hermetically sealed rect. metal case

Note: These metallized paper capacitors are also available with wax impregnation instead of epoxy. Specifications are similar, but maximum operating temperature is limited to +85°C. To order, substitute "W" for "M" in series number (e.g., Series WL).

Ceramic Disc Capacitors

Type 501 Class 1
Medium Voltage
- Suitable for use in high-frequency, high-Q, and temperature-compensated circuits
- Recommended for both UHF and VHF applications
- High capacitance stability coupled with long life
- Capacitance range of .82 to 470 pF
- Voltage ratings of 250 and 500 VDC
- Temperature characteristics of NPO to N5250

Type 502 Class 1
High Voltage
- Ideal for temperature compensation in high-power circuits
- Controlled temperature coefficient, low dissipation factor, high dielectric strength and large dissipation area
- Capacitance range of 2.2 to 620 pF
- Voltage ratings of 1000 to 6000 VDC
- Temperature characteristics of NP0 to N5250

Type 506 Class 2
Medium Voltage
- Suitable for radio frequency coupling circuits and other printed circuit board applications
- Extended frequency range of 100 MHz, extreme temperature stability, long life and small size
- Capacitance range of 100 to 4700 pF
- Voltage ratings of 250 and 500 volts
- Temperature characteristics of X5D to X5S

Type 507 Class 2
High Voltage
- Recommended for high-power circuits in TV applications
- Stable at high frequency, extremely resistant to high humidity conditions
- Capacitance range of 56 to 6200 pF
- Voltage ratings of 1000 to 6000 VDC
- Temperature characteristics of X5D to X5T

Type 509 Class 2
Medium Voltage
- Designed for coupling and bypass circuits where supply voltage is 500 VDC or less
- Offers small size in a medium voltage rating
- Capacitance range of 250 to 10,000 pF
- Voltage ratings of 250 and 500 VDC
- Temperature characteristics of X5U, Y5U

Type 511 Class 2
Medium Voltage
- Exhibits excellent electrical characteristics in transistorized circuits in bypass networks
- Ideal where space is at a premium and high capacitance value is required
- Capacitance range of 470 to 15,000 pF
- Voltage ratings of 250 and 500 VDC
- Temperature characteristics of X5V and Z5U

Type 512 Class 2
High Voltage
- Well-suited for TV and computer deflection systems
- Used also in bypass and decoupling circuits where high voltage capacitors are required
- Features high voltage performance, small size, high K, and excellent resistance to humidity
- Capacitance range of 470 to 10,000 pF
- Voltage ratings of 1000 and 2000 VDC
- Temperature characteristics of Y5V and Z5U

Type 516 Class 2
Low Voltage
- Designed for radio frequency bypass circuits in auto and home radios, TVs and computers
- Combines small size with superior performance characteristics
- Capacitance range of .0033 to .047 mfd
- Voltage ratings of 50 and 100 VDC
- Temperature characteristic of Z5U

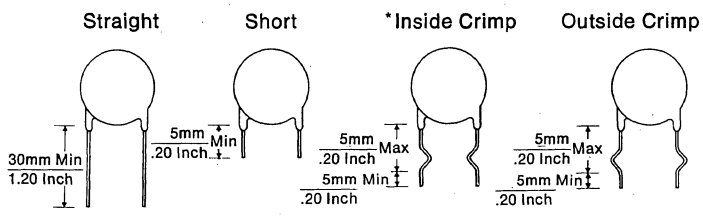
NOTE: The listed ceramic disc capacitors are standard catalog devices. However, variations in electrical characteristics are available in most cases. Please contact TRW Universal Capacitors for assistance in your design applications.

Electrical Specifications

TRW Part No.	Dissipation Factor	Min. Insulation Resistance	Dielectric Strength
Type 501	0.1% max. for C=50 pF and above, 0.8% max. for others; at 5 V_{rms}	10 x 10^9 ohms at 100 VDC	250% of rated voltage, max. I=50 mA
Type 502	0.2% max. for C=50 pF and above, 0.8% max. for others; at 5 V_{rms}	10 x 10^9 ohms at 100 VDC	170% of rated voltage, max. I=50 mA
Type 506	2.5% max. at 1 V_{rms}	10 x 10^9 ohms at 100 VDC	250% of rated voltage, max. I=50 mA
Type 507	2.5% max. at 1 V_{rms}	10 x 10^9 ohms at 100 VDC	170% of rated voltage, max. I=50 mA
Type 509	2.5% max. at 1 V_{rms}	10 x 10^9 ohms at 100 VDC	250% of rated voltage, max. I=50 mA
Type 511	3.0% max. at 1 V_{rms}	10 x 10^9 ohms at 100 VDC	250% of rated voltage, max. I=50 mA
Type 512	3.0% max. at 1 V_{rms}	10 x 10^9 ohms at 100 VDC	200% of rated voltage, max. I=50 mA
Type 516	3.0% max. at 0.1 V_{rms}	5 x 10^9 ohms at 10 VDC	250% of rated voltage, max. I=50 mA

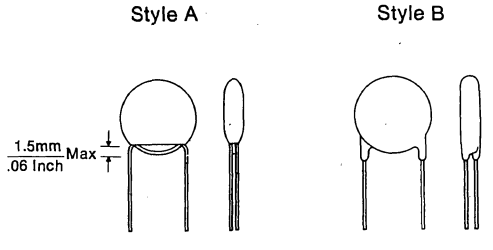
Reference Conditions: T=25° ± 1°C, F=1.0 ± 0.2 kHz, RH=63 to 67%.

Lead Configurations:



* Not available on .250 spacing

Phenolic Dipped Encapsulation:



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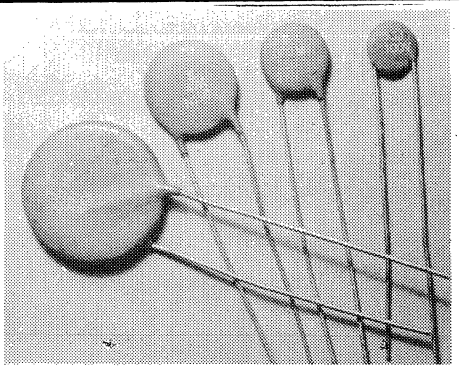


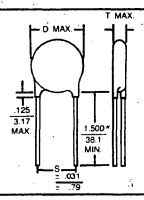
TUSONIX SLC™ *

Ceramic Capacitors—Disc

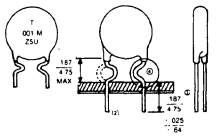
Applications and Features

TUSONIX Ceramic Disc Capacitors offer high performance in a complete range of ratings, values, and sizes. The complete line of voltage ratings offers the designer the convenience of selecting the exact capacitor rating required for his application. TUSONIX Discs are available in 100-200-500 VDC; 1-2-3-4-5 and 6 KV. Capacity increases per size for voltages less than 500 volts and decreases per size for voltages greater than 500 volts. Where voltage rating is not critical, we recommend our standard 500 volt line. (For complete details, consult our Ceramic Disc Capacitor catalog.)

Standard Leads



Kink Type Leads



TUSONIX STYLE NUMBER	831	801	851	871	811	841	821	3841	3851	3871	3881
MAXIMUM DIAMETER (D)	.290/7.37	.360/9.14	.437/11.10	.490/12.45	.593/15.06	.675/17.15	.750/19.05	.800/20.32	.875/22.23	.937/23.80	1.100/27.94
LEAD SPACING (S)	.250/6.35	.250/6.35	.250/6.35	.250/6.35	.375/9.52	.375/9.52	.375/9.52	.375/9.52	.375/9.52	.375/9.52	.375/9.52
WIRE GAUGE (AWG)	22	22	22	22	22	22	22	22	22	22	22

General Electrical Specifications

Ceramic Disc Capacitors are available in a broad range of dielectric constants. This allows a wide selection of capacitance values.

Temperature Compensating

Ceramic Capacitors (NPO thru N750) are ideal for applications requiring very precisely controlled capacitance change with temperature, high Q and very small capacitance tolerance.

Extended Temperature Compensating

Disc Capacitors (1500 thru N5600) are capacity sensitive to temperature in varying degrees, and are useful as temperature compensating elements for stabilization over a wide temperature range.

General Purpose or Hi-K

Specials

Special disc products are available from TUSONIX upon request, including details on TUSONIX's approval for U.L. line by-pass capacitors and approval to Mil-C-20 and Mil-C-11015.

Physical Characteristics

Leads—All values up to and including 2 KV are available with 20, 22 and 24 AWG leads, except body sizes. 655" max. and larger available with 20 or 22 AWG only. All values up to and including 6 kV are available with 20 or 22 AWG leads.

Body insulation—conformal coating.

Standard max. coating on leads is .125"; closer control is optional at extra cost.

Marking—Trademark, Cap, Tol., T.C., and Voltage (Voltage omitted on 500V).

TUSONIX also offers inside kink leads, outside kink leads and short pin leads to the electronic industry for use in printed wiring board applications.

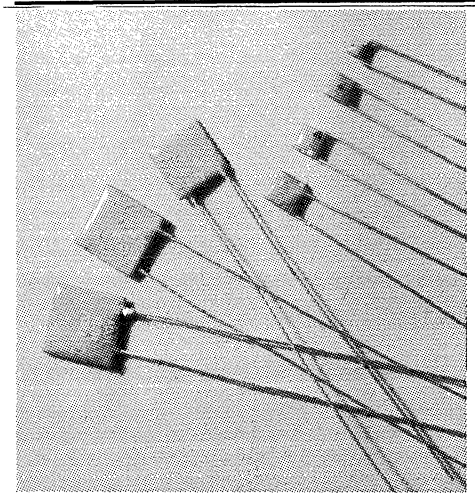
Special physical requirements are also available. Special lead spacing requirements are optional upon request, in addition to standard nominal lead spacings.

	TEMP. CHAR. CODE		MIN CAP TOL (%)	MIN TC TOL	MAX DF (%)	MIN Q	500 V MAXIMUM NOMINAL CAPACITANCE (pF) THICKNESS .156" MAX. 831	801	851	871	811	841	821	3841	3851	3871	3881
GENERAL PURPOSE (Hi-K)	Z5D Y5E X5F X7F		±5		2		200	350	500	720	1000	1300	1400	1450	1500	1600	1700
	Z5D Y5E X5F X7R		±5		2		680	1100	1800	2400	3400	4600	4700	4800	5300	5400	5600
	Z5F Y5F X5F X7F		±10		2		900	1500	2500	3500	5000	6500	7000	7400	8000	8200	8500
	Z5F Y5F X5R X7S		±10		2		1300	2300	3500	4700	7000	9000	10000	10300	11000	11500	12000
	Z5U Y5U X5U X7V		±20		2		2000	3500	5400	7300	12000	16000	18000	19000	20000	21000	22000
	Z5U Y5V X5W X7W		±20		3		3300	5600	8600	11000	20000	22000	25000	30000	32000	34000	35000
	GP7		±20		3		4400	7500	11000	15000	25000	35000	43000	52000	55000	58000	60000
TEMPERATURE COMPENSATING EXTENDED TEMPERATURE COMPENSATING	NP0	C0G	±1	±30		1000	1-30	60	90	120	150	210	240	250	270	280	290
	N030	S1G	±1	±30		1000	1.6-18	31	48	64	80	110	120	130	135	140	150
	N080	U1G	±1	±30		1000	1.8-21	36	55	75	95	120	135	150	155	160	180
	N150	P2G	±1	±30		1000	1.9-24	40	60	85	100	140	155	170	175	180	200
	N220	R2G	±1	±30		1000	2-26	45	65	90	110	160	175	190	195	200	220
	N330	S2H	±1	±60		1000	2.2-29	50	75	100	130	170	185	200	220	230	240
	N470	T2H	±1	±60		1000	2.6-35	60	90	125	150	210	230	250	260	270	290
	N750	U2J	±2	±120		1000	3.5-60	110	170	230	340	450	470	480	520	540	560
	N1500	P3K	±2	±250		1000	6-82	140	210	290	360	490	550	580	600	640	690
	N2200	R3A	±2	±400		500	7-90	160	240	330	410	560	630	670	700	730	790
	N3300	S3B	±5	±650		500	12-160	280	430	580	720	990	1050	1100	1200	1300	1400
	N4200	G3C	±5	±850		500	23-170	300	460	620	1000	1400	1600	2000	2200	2300	2500
	N4700	T3D	±5	±900		200	25-210	360	550	750	1200	1600	2000	2500	2700	2800	3000
	N5600	H3M	±5	±1000		200	40-310	540	830	1100	1800	2500	3000	3700	3900	4100	4500

TUSONIX

For complete ordering information, write or call TUSONIX, Inc., 2155 N. Forbes Boulevard, Tucson, Arizona 85745. (602) 624-8231. TLX 666-470.

*SLC stands for Single-layer Ceramic Capacitors.



TUSONIX SLC™*

Ceramic Capacitors—WEECON® Plate

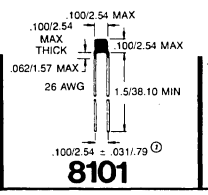
Applications and Features

TUSONIX WEECON Plate Ceramic Capacitors offer the broadest selection of ceramic formulations and package sizes available. Capacitance values range from 1 pF through .082 uF; a variety of TC materials and tolerances is available. The range of temperature characteristics adapts these capacitors from the ultra stable requirements of tuned circuits to the general purpose needs for coupling and by-pass applications. Voltages are from 25V to 500V. (For complete details, consult our WEECON® Ceramic Capacitor catalog.)

Physical Characteristics

Weecon **Temperature Compensating** Ceramic Capacitors are ideal for applications demanding precisely controlled capacitance changes with temperature variation. They are well suited for high Q circuits requiring optimum frequency stability and have excellent retrace characteristics. **Extended Temperature Compensating** Weecons are indicated where large controlled capacitance change with temperature variation is a factor. For applications where volumetric efficiency is of prime importance, **Stable** Weecons will provide higher capacitance values, in smaller packages with better reliability. TUSONIX **General Purpose** Weecons are ideal for circuits requiring the utmost in volumetric efficiency at rated temperatures.

inches / mm	inches/mm



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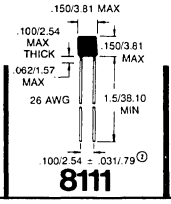

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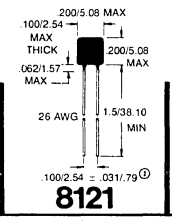

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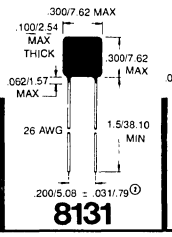

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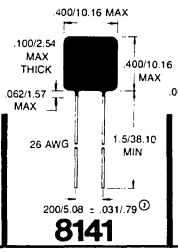

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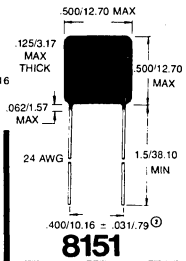


8151

			MAXIMUM CAPACITANCE																			
	EIA Code	Dielectric	Min.* Tol.	Min. Cap.	50/100V	200V	500V ①	50/100V	200V	500V ①	50/100V	200V	500V ①	50/100V	200V	500V ①	50/100V	200V	500V ①	50/100V	200V	500V ①
TEMP. COMP. TYPES	COG	NPO	1%	1.0	20	10	N/A	51	24	11	100	51	20	240	120	47	430	220	91	680	360	130
	BIG	N0030	1%	1.6	10	5.1	N/A	27	13	5.6	51	24	11	130	62	24	220	110	47	360	180	75
	UIG	N0080	1%	1.8	12	6.2	N/A	30	15	6.2	56	27	12	130	68	27	240	130	51	390	200	82
	P2G	N0150	1%	2.2	13	6.2	N/A	33	16	6.8	62	30	13	160	75	30	270	130	56	430	220	91
	R2G	N0220	1%	2.4	13	6.8	N/A	36	18	7.5	68	36	13	160	82	33	300	150	62	510	240	100
	S2H	N0330	1%	2.7	16	8.2	N/A	43	20	8.2	82	39	16	200	100	39	360	180	68	560	270	110
	T2H	N0470	1%	3.3	18	9.1	N/A	51	24	10	91	47	18	220	110	43	390	200	82	620	330	130
	U2J	N0750	2%	4.7	24	13	N/A	68	36	13	130	68	27	300	150	62	560	300	110	910	470	180
	P3K	N1500	2%	10	47	24	N/A	130	68	27	240	120	51	560	300	110	1000	510	220	1600	820	330
EXTEND. TEMP. COMP. TYPES	R3A	N2200	2%	13	62	30	N/A	160	82	33	300	150	62	750	360	150	1300	680	270	2000	1000	430
	S3B	N3300	5%	22	100	51	N/A	270	130	56	560	270	110	1200	680	270	2200	1100	510	3600	1800	750
	G3C	N4200	5%	33	160	82	N/A	430	200	91	820	390	160	1800	910	390	3300	1600	750	5600	2700	1200
	T3D	N4700	5%	39	180	91	N/A	510	240	100	910	470	200	2200	1100	430	3900	2000	820	6200	3000	1300
	H3M	N5600	5%	56	270	130	N/A	750	360	150	1300	680	270	3300	1600	680	5600	2700	1200	9100	4700	1800
STABLE TYPES	Z5D Y5F X5F X7F	—	5%	20	100	51	N/A	270	130	51	510	270	100	1200	620	240	2200	1100	470	3600	1800	750
	Z5D Y5D X5E X7R	—	5%	51	270	130	N/A	680	360	130	1300	620	270	3000	1500	620	5600	2700	1100	9100	4700	1800
	Z5E Y5F X5R X7R	—	5%	62	300	160	N/A	820	390	160	1600	820	300	3600	1800	750	6800	3300	1300	10,000	5100	2200
	Z5F Y5F X5F X7R	—	5%	68	360	180	N/A	910	470	180	1800	910	360	4300	2000	820	7500	3900	1500	12,000	6200	2400
	Z5P Y5P X5P X7R	—	10%	130	680	330	N/A	1800	910	360	3300	1600	680	7500	3900	1500	15,000	7500	3000	24,000	12,000	4700
	Z5F Y5T X5T X7T	—	10%	150	750	390	N/A	2000	1000	390	3900	1800	750	9100	4300	1800	16,000	8200	3300	27,000	13,000	5100
GENERAL PURPOSE TYPES	Z5U Y5U X5U X7V	—	20%	240	1300	620	N/A	3300	1600	680	6800	3300	1300	15,000	7500	3000	27,000	13,000	5600	47,000	22,000	9100
	Z5U Y5V X5V 651	—	20%	300	1600	820	N/A	3900	2000	820	10,000	3900	1600	18,000	9100	3600	36,000	18,000	6800	56,000	27,000	10,000

*Tolerances shown in table are minimum for 10 pF and above. ±0.1 pF is closest tolerance available for 10 pF and less.

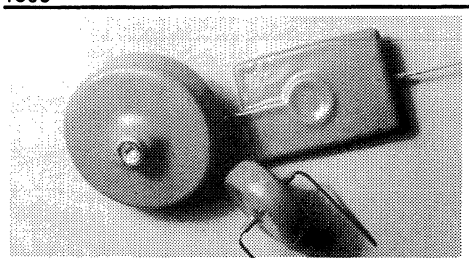
NOTES: ① When ordering 500 Volt parts, allow additional .050" thickness. ② Other lead spacings and wire diameter available upon request.

TO ORDER – Specify Tusonix Style, Voltage, T.C. Code, Capacitance and Tolerance. Example: 8101-200-Z5U-620, ± 20%* For more data, call 602-624-8231.

TUSONIX

For complete ordering information, write or call TUSONIX, Inc., 2155 N. Forbes Boulevard, Tucson, Arizona 85745. (602) 624-8231. TLX 666-470.

*SLC stands for Single-layer Ceramic Capacitors.



TUSONIX SLC™ *

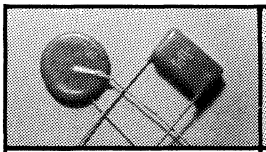
Ceramic Capacitors—High Voltage

Applications and Features

High Voltage Ceramic Capacitors have been one of TUSONIX outstanding component capabilities for many years. These high quality components are used in a broad variety of applications: electric utility transformers, power supplies and voltage multipliers for CRT displays, navigation equipment, electro-optic equipment, and image intensifiers for night vision apparatus.

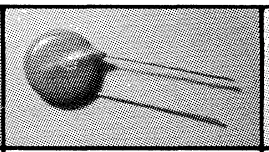
This page details only a few of our high voltage capabilities. The styles shown can be adapted to specific mechanical and electrical requirements of our customers . . . certainly one of the inherent advantages of ceramic capacitors. Custom designs are our specialty.

Disc, Cylindrical, Rectangular Ceramic Capacitors

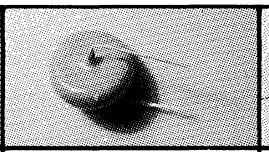


Radial wire leads, 20 ga., 1.25" (31.75) min. length

Available in:
3, 5, 10kV
in both disc and rectangular

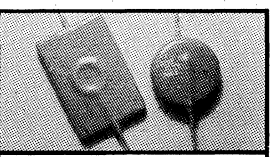


Offset wire leads, 20 ga., 1.25" (31.75) min. length
Available in:
3, 5, 10KV



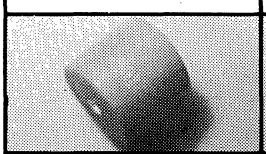
Radial formed leads attached axially, 20 ga., 2.0" (50.80) min. length
Available in:
3, 5, 10, 15kV
1" min. lead spacing required for 15kV

Axial wire leads, 20 ga., 2.0" (50.80) min. length
Available in:
3, 5, 10, 15, 20, 25, 30kV
1.250" max. dia. for over 10kV



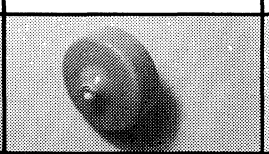
Opposed radial wire leads, 20 ga., 2.0" (50.80) min. length

Available in:
3, 5, 10kV
In both disc and rectangular



Potted female threaded stud terminals, 8-32 threads

Available in:
3, 5, 10, 15 20, 25, 30kV



Female threaded stud terminals, 8-32 threads

Available in:
3, 5, 10, 15, 20, 25, 30kV

Male stud terminals, no threads, varnish coating standard.

Available in:
3, 5, 10, 15, 20, 25, 30kV

Electrode with no terminals (single pattern), or specify if tinning is required.
Available in:
Rectangular: **3,5, 10kV** and limited capacitance values for **15, 20, 25, 30kV**
Disc: **3, 5, 10, 15, 20, 25, 30kV**

SPECIALS

Nonstandard or special design part
Available in:
3, 5, 10, 15, 20, 25, 30kV
Note: Can be manufactured with virtually any special terminal to meet specific needs.

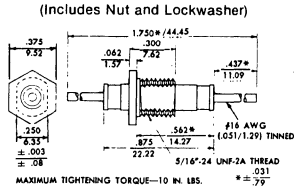
Feed-thru Ceramic Capacitors

STANDARD SPECIFICATIONS
Finish — Silver Plated except 2416 (tinned)
Marking — EIA Color Code except 320 (Capacitance Value-Stamped)

Dimension tolerance ±.015" unless otherwise specified

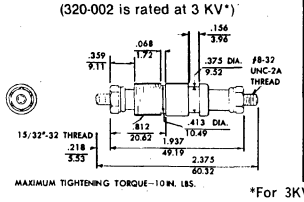
inches / mm	inches/mm

TUSONIX PART NO. 2432-002
(Includes Nut and Lockwasher)



EIA Code	Voltage (WVdc)	Max. Cap. (pF)	Tol. %	Min. IR G Ω	Max. DF %
S2L	2KV	90	± 10	50	.1
U2M	2KV	160	± 10	50	.1
X5U	2KV	5000	± 20	10	3
X5W	2KV	7500	+ 80—20	10	3
X7R	1KV	1100	± 20	10	3

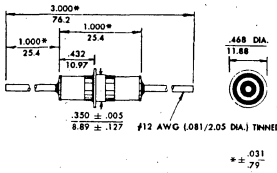
TUSONIX PART NO. 320-005
(320-002 is rated at 3 KV*)



EIA Code	Voltage (WVdc)	Max. Cap. (pF)	Tol. %	Min. IR G Ω	Max. DF %
S2L	2KV & 3KV*	234	± 20	50	.1
U2M	2KV & 3KV*	332	± 20	50	.1
X5U	2KV & 3KV*	10000	+ 80—20	10	3
X5W	2KV & 3KV*	15000	+ 80—20	10	3
X7R	1KV & 2KV*	2800	+ 80—20	10	3

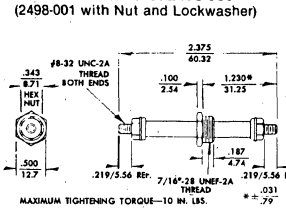
*For 3KV (and X7R, 2KV) rating, overall length is increased to 2.625/66.67.

TUSONIX PART NO. 2416-000



EIA Code	Voltage (WVdc)	Max. Cap. (pF)	Tol. %	Min. IR G Ω	Max. DF %
S2L	3KV	96	± 20	50	.1
U2M	3KV	136	± 20	50	.1
X5U	3KV	5000	± 20	10	3
X5W	3KV	8000	+ 80—20	10	3
X7R	1.5KV	1000	+ 80—20	10	3

TUSONIX PART NO. 2498-000
(2498-001 with Nut and Lockwasher)



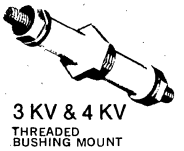
EIA Code	Voltage WVDC	Voltage Flash	MAX. Cap. (pF)	Tol. %	MIN. IR G	Max. DF %
S2L	4KV	6KV	156	± 20	50	.1
U2M	4KV	6KV	222	± 20	50	.1
X5R	4KV	6KV	4000	± 20	50	3
X5U	3KV	4.5KV	7000	± 20	10	3
X5W	3KV	4.5KV	10000	+80 -20	10	3
X7R	3KV	4.5KV	1800	+80 -20	10	3

TUSONIX

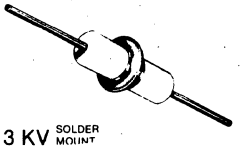
For complete ordering information, write or call TUSONIX, Inc., 2155 N. Forbes Boulevard, Tucson, Arizona 85745. (602) 624-8231. TLX 666-470.

2 KV THREADED BUSHING MOUNT
PART NO. 2432-002

2 KV THREADED BUSHING MOUNT
PART NO. 320-005

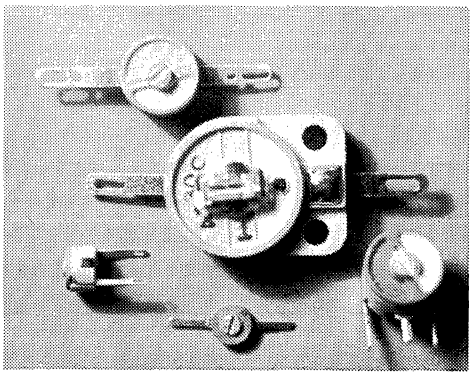


3 KV & 4 KV THREADED BUSHING MOUNT
PART NO. 2416-000



3 KV SOLDER MOUNT
PART NO. 2498-000

*SLC stands for Single-layer Ceramic Capacitors.



TUSONIX SLC™*

Ceramic Capacitors—Trimmers

Applications and Features

TUSONIX leads the way in the miniaturization of trimmers, or variable ceramic capacitors. Developments such as those illustrated below have established TUSONIX as a leader in the state of the art. More than 30 years of experience in Trimmer design and technology have enabled TUSONIX to offer engineers the world's most complete line of ceramic trimmer capacitors.

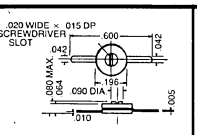
During the past 10 years the ceramic trimmer capacitor has become the most popular trimmer in the electronics industry. The inherent reliability, small size, low cost and wide selection of available electrical characteristics are major factors in the ceramic capacitor's continuing popularity among design engineers.

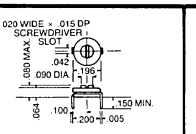
TUSONIX produces a broad range of fixed and variable (trimmer) ceramic capacitors. Complete research, development and manufacturing of the ceramic dielectric itself and the finished capacitor is performed by TUSONIX. Today TUSONIX is recognized as one of the world's leading suppliers of quality ceramic capacitors.

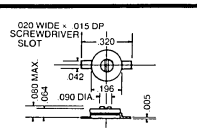
(For complete details consult Trimmer catalog.)

Series 513—
First True Ultraminiature Quality Trimmer

Working Voltage ..... A: 100 WVdc to 85°C.
G: 25 WVdc to 85°C.
Dielectric Strength ..... 2 times WVDC for 1 to 5 seconds
Operating Temperature Range ..... -55°C. to +85°C.
Q Factor @ 1MHz ..... 500 Min. (Dielectric Code A)
200 Min. (Dielectric Code G)
Torque ..... 0.3 to 2.0 oz. in.
Qualification Specification ..... TUSONIX Spec. 513
Dimensions in inches ..... For dimensions <.125" tol. is ±.005
For dimensions >.126" tol. is ±.015



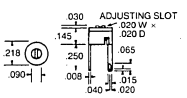


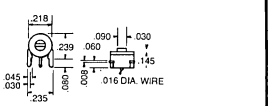


TUSONIX Part No.	TUSONIX Part No.	TUSONIX Part No.	Working Voltage (Vdc) 85°	CAPACITANCE RANGE IN pF
513-010 A 1-5	513-011 A 1-5	513-012 A 1-5	100	1-5
513-010 A 2-10	513-011 A 2-10	513-012 A 2-10	100	2-10
513-010 A 3.5-20	513-011 A 3.5-20	513-012 A 3.5-20	100	3.5-20
513-010 A 5-30	513-011 A 5-30	513-012 A 5-30	100	5-30
513-010 G 7-40	513 011 G 7-40	513-012 G 7-40	25	7-40

Series 518—
First Small Size Quality Trimmer

Working Voltage ..... A: 100 WVdc to 85°C.; 50 WVdc to 125°C.
G: 25 WVdc to 85°C.
Dielectric Strength ..... 2 times WVdc for 1-5 sec.
Operating Temperature Range ..... -55°C. to 125°C.
Torque ..... 3-3 oz. in.
Q Factor @ 1 MHz ..... 500 Minimum (Dielectric Code A)
200 Minimum (Dielectric Code F)

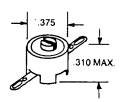


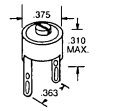


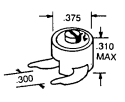
TUSONIX Part No.	MIL-C-81 Desig. 518-016	CAPACITANCE RANGE IN pF	TUSONIX Part No.	MIL-C-81 Desig. 518-017	CAPACITANCE RANGE IN pF
518-000 A 1-3	CV35 A 030	1-3	518-002 A 1.25-3	CV36 A 030	1.25-3
518-000 A 2-5	CV35 A 050	2-5	518-002 A 2-5	CV36 A 050	2-5
518-000 A 2.5-9	CV35 A 090	2.5-9	518-002 A 2.5-9	CV36 A 090	2.5-9
518-000 A 3.5-20	CV35 A 200	3.5-20	518-002 A 3.5-20	CV36 A 200	3.5-20
518-000 A 5-15	CV35 A 150	5-15	518-002 A 5-15	CV36 A 150	5-15
518-000 A 5-25	CV35 A 250	5-25	518-002 A 5-25	CV36 A 250	5-25
518-000 G 7-40	CV35 G 400	7-40	518-002 G 7-40	CV36 G 400	7-40

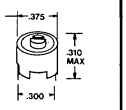
Series 538—
First ⅜" Dia. Trimmer in the Industry

Working Voltage ..... A, B, C: 350 WVdc @ 85°C.; 200 WVdc @ 125°C.
D & F: 200 WVdc @ 85°C.; 100 WVdc @ 125°C.
Dielectric Strength ..... 500 Vdc for 1-5 sec.
Operating Temperature Range ..... -55°C. to +125°C.
Q Factor @ 1 MHz ..... 500 Minimum
Torque ..... 1-6 oz. in.
Qualification Specification ..... TUSONIX Spec. 500
For dimensions ..... <.125", tolerance is ±.005
For dimensions ..... ≥.126", tolerance is ± 015
Except where noted.





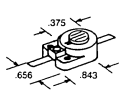




TUSONIX Part No.	TUSONIX Part No.	TUSONIX Part No.	TUSONIX Part No.	MIL-C-81 Desig. 538-054	CAPACITANCE RANGE IN pF
538-000 A 2-8	538-002 A 2-8	538-006 A 2-8	538-011 A 2-8	CV31 A 080	2 to 8
538-000 A 5.5-18	538-002 A 5.5-18	538-006 A 5.5-18	538-011 A 5.5-18	CV31 A 180	5.5 to 18
538-000 B 2.5-11	538-002 B 2.5-11	538-006 B 2.5-11	538-011 B 2.5-11	CV31 B 110	2.5 to 11
538-000 B 7-25	538-002 B 7-25	538-006 B 7-25	538-011 B 7-25	CV31 B 250	7 to 25
538-000 C 3-10	538-002 C 3-10	538-006 C 3-10	538-011 C 3-10	CV31 C 100	3 to 10
538-000 C 8-25	538-002 C 8-25	538-006 C 8-25	538-011 C 8-25	CV31 C 250	8 to 25
538-000 D 3-15	538-002 D 3-15	538-006 D 3-15	538-011 D 3-15	CV31 D 150	3 to 15
538-000 D 9-35	538-002 D 9-35	538-006 D 9-35	538-011 D 9-35	CV31 D 350	9 to 35
538-000 F 15-60	538-002 F 15-60	538-006 F 15-60	538-011 F 15-60	CV31 E 600	15 to 60

Series 503—
First Ceramic Trimmer in the United States

Working Voltage ..... **A, C: 500 WVdc @ 125°C**
... D and F: 500 WVdc @ 85°C; 250 WVdc @ 125°C
Dielectric Strength ..... 1250 Vdc for 1-5 sec.
Operating Temperature Range ..... **-55°C to +125°C**
Q Factor @ 1 MHz ..... **500 Minimum; A, C, D**
400 Minimum: F
Torque ..... **4-20 oz. in.**
Qualification Specification ..... TUSONIX Spec. 500



503-001 Same as 503-000 except terminals bent down

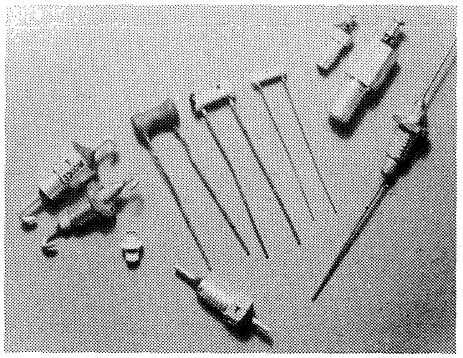
TUSONIX Part No.	TUSONIX Part No.	MIL-C-81 Desig. 503-041	CAPACITANCE RANGE IN pF
503-000 A 1.5-7	503-001 A 1.5-7	CV11 C 300	4 to 30
503-000 A 3-12	503-001 A 3-12	CV11 C 450	7 to 45
503-000 A 4.5-25	503-001 A 4.5-25	CV11 D 060	2 to 6
503-000 C 7-45	503-001 C 7-45	CV11 D 300	4 to 30
503-000 D 4-30	503-001 D 4-30	CV11 D 450	7 to 45
503-000 D 7-45	503-001 D 7-45	CV11 A 070	1.5 to 7
503-000 D 5-50	503-001 D 5-50	CV11 A 120	1 to 12
503-000 F 11-110	503-001 F 11-110	CV11 A 250	4.5 to 25

Marking: All units will be marked with TUSONIX trademark, capacitance range and dielectric type code.
Example: T 2 6 D

TUSONIX

For complete ordering information, write or call TUSONIX, Inc., 2155 N. Forbes Boulevard, Tucson, Arizona 85745. (602) 624-8231. TLX 666-470

*SLC stands for Single-layer Ceramic Capacitors.

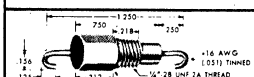
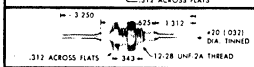
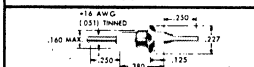
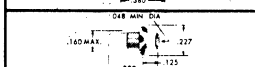
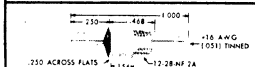
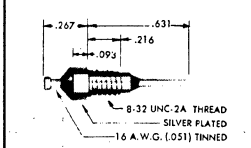


TUSONIX SLC™*

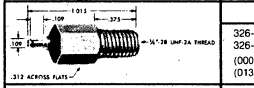
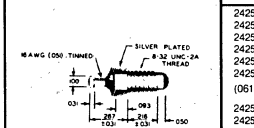
Ceramic Capacitors—Tubular, Feed-thru, Stand-off

Applications and Features

TUSONiX offers a complete line of ceramic tubular, feed-thru, and stand-off capacitors for general purpose, temperature compensation, and high stability applications. All forms feature compact package sizes, many different lead and mounting options, rugged construction, and proven high reliability in a variety of demanding applications such as RF by-passing and filtering. MIL types are also available in each form. (For complete details, consult our Ceramic Tubular, Feed-thru, and Stand-off Capacitor Catalog.)

Physical Dimensions	TUSONIX Part No.	Char.	Cap. (pF)	% Tol.
	500 WVdc (Derate 50% at 125° C.)			
	321-000 X5U0 102M (000 Nut Only) (010 Nut and Washer) (Straight Leads)	X5U	1000	±20
	357-000 X5U0 102M	X5U	1000	±20
	357-000 X5U0 152M (000 Nut Only) (001 Nut and Washer) (Curved Leads)	X5U	1500	±20
	327-000 X5U0 102M	X5U	1000	±20
	327-000 X5U0 152M (000 No Hardware) (005 Nut Only) (010 Nut and Washer)	X5U	1500	±20
	362-000 X5U0 102M	X5U	1000	±20
	362-000 X5U0 152M (000 Nut Only) (013 Nut and Washer)	X5U	1500	±20
	2404-000 U2M0 500M	U2M	50	±20
	2404-000 X5U0 101M	X5U	100	±20
	2404-000 X5U0 102P	X5U	1000	+100 −0
	2404-014 X5U0 501M	X5U	500	±20
	2404-014 X5U0 102P	X5U	1000	+100 −0
	500 WVdc (Derate 50% at 125° C.)			
	2443-000 X5S0 102M	X5S	1000	±20
	2443-000 X5S0 152M (000 No Hardware) (008 Nut and Washer) (Straight Leads)	X5S	1500	±20
	2443-001 X5S0 102M	X5S	1000	±20
	2443-001 X5S0 152M (001 Nut Only) (007 Nut and Washer) (Curved Leads)	X5S	1500	±20
	2499-003 X5S0 102M	X5S	1000	±20
	2499-003 X5S0 152M (Nut and Washer)	X5S	1500	±20
	200 WVdc (Derate 50% at 125°C.)			
	2425-001 X5U0 101AA	X5U	100	GMV
	2425-001 X5U0 102AA	X5U	1000	GMV
	2425-001 X5U0 152AA	X5U	1500	GMV
	2425-001 X5U0 202AA	X5U	2000	GMV
	2425-001 X5U0 501AA	X5U	500	GMV
	2425-001 X5W0 502AA (001 Nut Only)	X5V	5000	GMV
	2425-003 W5U0 101AA	W5U	100	GMV
	2425-003 W5U0 102AA	W5U	1000	GMV
	2425-003 W5U0 152AA	W5U	1500	GMV
	2425-003 W5U0 202AA	W5U	2000	GMV
	2425-003 W5U0 501AA	W5U	500	GMV
	2425-003 W5W0 502AA (003 Nut Only)	W5W	5000	GMV

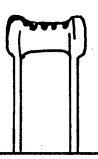
Stand-Off Ceramic Capacitors

Physical Dimensions	TUSONIX Part No.	Char.	Cap. (pF)	% Tol.
	500 WVdc (Derate 50% at 125° C.)			
	326-000 X5U0 102M	X5U	1000	±20
	326-000 X5U0 152M (000 No Hardware) (013 Nut and Washer)	X5U	1500	±20
	200 WVdc (Derate 50% at 125° C.)			
	2425-061 X5U0 101AA	X5U	100	GMV
	2425-061 X5U0 102AA	X5U	1000	GMV
	2425-061 X5U0 152AA	X5U	1500	GMV
	2425-061 X5U0 202AA	X5U	2000	GMV
	2425-061 X5U0 501AA	X5U	500	GMV
	2425-061 X5U0 502AA (061 Nut Only)	X5V	5000	GMV
	2425-063 W5U0 101AA	W5U	100	GMV
	2425-063 W5U0 102AA	W5U	1000	GMV
	2425-063 W5U0 152AA	W5U	1500	GMV
	2425-063 W5U0 202AA	W5U	2000	GMV
	2425-063 W5U0 501AA	W5U	500	GMV
	2425-063 W5U0 502AA (063 Nut Only)	W5W	5000	GMV

Qualified Products List (QPL) Approved on TUSONIX Tubular Products

MIL Specification	MIL Style	TUSONIX Style	MIL Specification	MIL Style	TUSONIX Style
MIL-C-20			**MIL-C-11015**		
/01	CC20	301-651	/01	CK21AX	315-052
/02	CC21	315-051	/02	CK22AX	331-052
/03	CC22	331-051	/04	CK27AX	332-052
/04	CC25	302-651	/13 (1000 V)	CK70AX	327-062
/06	CC27	332-051	/13 (500 V)	CK70	327-042
/07	CC30	308-651	/14	CK80	326-010
/08	CC31	338-051	/15	CK81	323-021
MIL-C-39014			/23	CK72AX	2432-012
/16	CKR75	2499-032	/29	CK74BX	2404-613
/17	CKR82	2499-035	/29	CK75BX	2404-614
/18	CKR76	2425-049	/29	CK78AW	2482-030
/19	CKR83	2425-074	/29	CK79AW	2482-029

Tubular Ceramic Capacitors

ENAMEL COATED	Style	Body Dia. Max.	Body Length Max.	Lead Space ±.060	Min. Lead Length	Lead Dia.
	301	.200 / 5.08	.400 / 10.16	.250 / 6.35	1.25 / 31.75	.025 / .64
	302	.200 / 5.08	.656 / 16.66	.375 / 9.52	1.25 / 31.75	.025 / .64
	374	.125 / 3.17	.320 / 8.12	.250 / 6.35	1.25 / 31.75	.013 / .33

CAPACITANCE RANGE (pF)

	TUSONIX STYLE		301		302		308		374		301		302	
	VOLTAGE		500 WVdc @ 85 C		500 WVdc @ 85 C		500 WVdc @ 85 C		200 WVdc @ 85°C		500 WVdc @ 125°C		500 WVdc @ 125°C	
	EIA Code	Temp. Coef. (ppm/C) T.C. Tol.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
TEMPERATURE COMPENSATING TYPES	M7G	P100 ± 30	.42	13	14	23	14	26	2.5	12	.42	9.5	10	23
	COG	NPO ± 30	.52	49	25	88	25	101	3	49	.52	49	25	88
	B1G	N030 ± 30	.63	25	26	47	26	53	5	26	.63	26	19	47
	U1G	N080 ± 30	.63	29	30	53	30	60	5.5	29	.63	29	22	53
	P2G	N150 ± 30	.63	34	35	60	35	68	6.5	33	.63	34	25	60
	R2G	N220 ± 30	.66	37	38	66	38	75	6	36	.66	37	28	66
	S2H	N330 ± 60	.66	41	42	73	42	83	7	40	.66	41	31	73
	T2H	N470 ± 60	.66	49	50	88	50	101	9.5	49	.66	36	37	88
	U2J	N750 ± 120	.66	68	69	120	69	137	13.5	67	.66	51	52	120
EXTENDED TEMPERATURE COMPENSATING TYPES	P3K	N1500 ± 250	.89	83	84	147	——		23	122	.89	83	84	147
	R3A	N2200 ± 400	1.5	133	134	235	——		24	131	1.5	52	96	170
	S3B	N3300 ± 650	2.9	208	209	368	——		39	213	2.9	81	101	200
	G3C	N4200 ± 850	3.2	330	323	588	——		61	327	——		——	
	T3D	N4700 ± 900	4.0	450	456	810	——		79	425	4.0	179	180	440
	H3M	N5600 ± 1000	5.4	660	664	1180	——		106	573	——		——	

MAXIMUM CAPACITANCE (pF)

	TUSONIX STYLE		374		301	302
	VOLTAGE		100 V	200 V	500 V	500 V
	EIA Code	Min. Cap. Tol.	Max.	Max.	Max.	Max.
STABLE TYPES (Hi-K)	Z5D Y5D	± 5%	1000 1000	1000 1000	910 910	1800 1800
	Z5F Y5F X5F X7F (W5F)	± 10%	1600 910 910 240	1600 910 910 —	1600 1300 1300 240	3000 2400 2400 430
	Z5P Y5P X5P X7P (W5P)	± 10%	1600 910 910 240	1600 910 910 —	1600 1300 1300 240	3000 2400 2400 1800
	Z5R Y5R X5R X7R (W5R)	± 10%	1600 1300 1300 240	1600 1300 1300 —	1600 1300 1300 820	3000 2400 2400 1600
	Z5S Y5S X5S X7S (W5S)	± 10%	1600 1300 1300 1000	1600 1300 1300 —	1600 1300 1300 910	3000 2400 2400 1800
	Z5T Y5T X5T X7T (W5T)	± 10%	1600 1600 1600 1600	1600 1600 1600 —	1600 1600 1600 1600	3000 3000 3000 3000
GENERAL PURPOSE TYPES	Z5U Y5U X5U X7U (W5U)	± 20%	3900 3900 3900 1600	3900 3900 3900 —	5100 3600 3600 1600	10000 6800 6800 3000
	Z5V Y5V X5V	± 20%	5600 5600 3900	5600 5600 3900	5100 5100 5100	10000 10000 10000

*SLC stands for Single-layer Ceramic Capacitors.

TUSONIX

For complete information, write or call TUSONIX, Inc., 2155 N. Forbes Boulevard, Tucson, Arizona 85745. (602) 624-8231. TLX 666-470.

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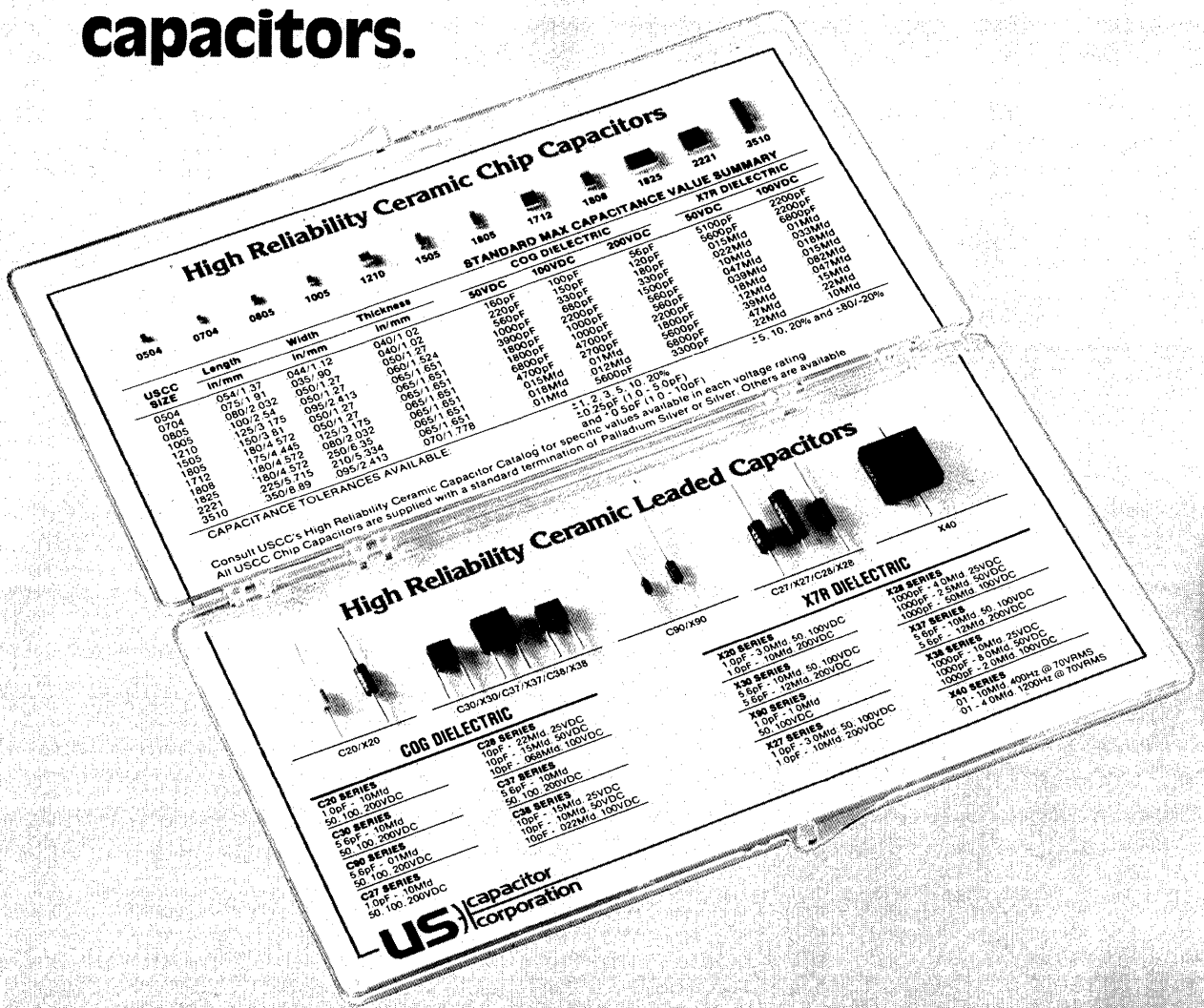

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Your first choice among the world's leading suppliers of aluminum electrolytic capacitors.

Your first choice for...

A wide range of products

- ☐ Reduced case sizes
- ☐ Low leakage current
- ☐ Extended operating temperature range
- ☐ Extended voltage and capacitance values

Service

- ☐ Local representation and inventory
  See Directory Section
- ☐ Large distribution network
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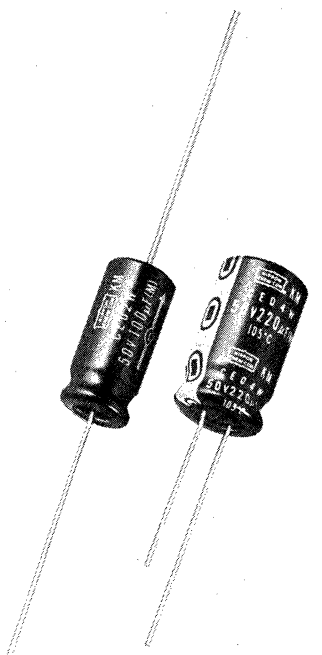
- ☐ Design engineering support

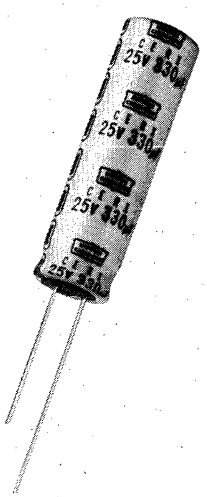
Quality

- ☐ All products are 100% tested
- ☐ All products are date coded
- ☐ All products are lot traceable

SM Series
Very high quality general purpose



KM Series
Low leakage current, extended temperature range, reduced case size



RX Series
Low leakage, high ripple current, ideal for power supply output use

SRA Series
Ultra-miniature case size (4 x 7mm) general purpose

NMHR Series
Long life, reduced case size, high ripple current, ideal for power supply input use

United Chemi-Con Series of Capacitors

United Chemi-Con manufactures capacitors in a wide variety of materials, sizes and termination styles. The table below provides a quick cross reference of the various types and their characteristics. Complete technical data is available. United Chemi-Con...since 1931, known the world over for capacitor leadership.

Series	Capacitance Range in µF	Voltage Range in Volts	Temperature Range	Leakage Current in µA	Standard Capacitance Tolerance	Minimum Case Size (mm)	Lead Configuration
SL	.47 to 3300 .47 to 10,000	6.3 to 450 6.3 to 500	−40 to +85°C	.03 CV	−10 to +50%	5 x 11 5 x 13	Radial Axial
SM	.47 to 10,000 .47 to 10,000	6.3 to 450	−40 to +85°C	.01 CV or .03 CV+15µA	±20%	5 x 11 5 x 12.5	Radial Axial
KM	.47 to 10,000	6.3 to 250	−55 to +105°C	.002 CV or .03 CV+15 µA	±20%	5 x 11 5 x 12.5	Radial Axial
KX	.47 to 3300 .47 to 2200	10 to 400	−55 to +110°C −25 to +105°C	.002 CV or .02 CV+10 µA	±20%	8 x 11.5 6.3 x 13	Radial Axial
RX	2.2 to 1000	10 to 100	−55 to +105°C	.002 CV	−10 to +100%	8 x 11.5	Radial
RZ	150 to 16,500	7.5 to 100	−55 to +105°C	$\sqrt{CV}$	−10 to +75%	19.05 x 31.75	Radial
VP	220 to 10,000	10 to 100	−25 to +85°C	.03 CV	−10 to +50%	22 x 30	Radial
BP "S" (Bipolar)	2.2 to 10	25	−25 to +70°C	100 µA Max.	±20%	16 x 25.5	Radial
SMBP "D" (Bipolar)	.47 to 2200 .47 to 2200	6.3 to 100	−40 to +85°C	.03 CV	±20%	5 x 11 6.3 x 16	Radial Axial
SMBP "P" (Bipolar)	1 to 100	25 to 63	−25 to +85°C	.03 CV	±20%	10 x 12.5 8 x 20	Radial Axial
SX	.1 to 2200	6.3 to 63	−40 to +85°C	.002 CV	±20%	5 x 11 5 x 13	Radial Axial
LL	.1 to 4700	6.3 to 100	−40 to +85°C	.002 CV	±20%	5 x 11	Radial
LR	.1 to 100	6.3 to 50	−40 to +85°C	.002 CV	±20%	5 x 14	Radial
BK	220 to 22,000	16 to 200	−40 to +85°C	.02 CV or .03 CV	±20% or −10 to +30%	25.4 x 25	P.C. Mount
NM	47 to 22,000	10 to 400	−40 to +85°C −25 to +85°C	.02 CV or .06 CV+200 µA	±20% or −10 to +30%	22 x 26	P.C. Mount
SXA	22 to 2200	6.3 to 63	−55 to +105°C	.01 CV	±20%	10 x 12.5	Radial
GX	.47 to 1000	10 to 63	−40 to +130°C	.002 CV	−10 to +50%	8 x 11.5 6.3 x 13	Radial Axial
SHA/SHB	.1 to 100	6.3 to 63	−55 to +95°C	.01/.005 CV	±20%	4 x 7/4 x 9	Radial
SRA	.1 to 100	6.3 to 63	−40 to +85°C	.01 CV	±20%	4 x 7	Radial
NMHR	100 to 1000	160 to 250	−25 to +85°C	0.02 CV	±20%	25.4 x 25	P.C. Mount

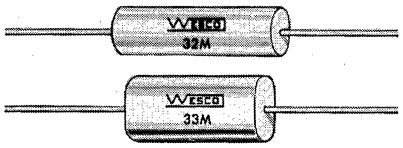
Note: These listed values are typical specifications for each series.
Please refer to the series catalog for the details.

UNITED CHEMI-CON

UNITED CHEMI-CON INC.

9801 West Higgins Road, Rosemont, Illinois 60018 Phone (312) 696-2000 TWX 910-253-2964 TELEX 28-3557

WESCO® MYLAR* FILM-FOIL CAPACITORS



SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE

200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

TEMPERATURE RANGE

−55°C to +85°C with full rated voltage applied. To +125°C with 50% of rated voltage.

INSULATION RESISTANCE

At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 100,000 megohms-microfarads, but need not exceed 100,000 megohms.

DISSIPATION FACTOR

Shall not exceed 0.75% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE

Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz ±20 Hz.

LIFE TEST

Shall withstand 140% of rated voltage at 85°C for 250 hours. One failure in twelve shall be permitted.

CAPACITANCE STABILITY (DRIFT)

Less than 0.50% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 80°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in percent.

HUMIDITY RESISTANCE

Meets requirements of Mil-C-27287,, Para. 3.12 when tested in accordance with Mil-STD.-202C, Method 103 B, Condition B.

LEAD PULL AND BEND TEST

Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

FEATURES

Wrap and fill construction.

Tubular or oval configuration for optimum space savings.

Extended foil design.

Quality control procedures per Mil-Q-9858.

Will meet or exceed Mil-C-27287.

APPLICATIONS

Computers

Data Processing Equipment

Peripheral Equipment

Aircraft and Missile Systems

Industrial Instrumentation

Navigation and Distance Measuring Equipment

Communications Equipment

Filters

TYPE 32M RATINGS AND DIMENSIONS

Capacity in Mfds.	100 VOLTS D	L	Cat. No. 32M — K-1	200 VOLTS D	L	Cat. No. 32M — K-2	400 VOLTS D	L	Cat. No. 32M — K-4	600 VOLTS D	L	Cat. No. 32M — K-6
.001	.187	.40	1001	.187	.40	1001	.187	.53	1001	.187	.53	1001
.0012	.187	.40	1201	.187	.40	1201	.187	.53	1201	.187	.53	1201
.0015	.187	.40	1501	.187	.40	1501	.187	.53	1501	.187	.53	1501
.0018	.187	.40	1801	.187	.40	1801	.187	.53	1801	.187	.53	1801
.0022	.187	.40	2201	.187	.40	2201	.187	.53	2201	.187	.53	2201
.0027	.187	.40	2701	.187	.40	2701	.187	.53	2701	.203	.53	2701
.0033	.187	.40	3301	.187	.40	3301	.187	.53	3301	.218	.53	3301
.0039	.187	.40	3901	.187	.40	3901	.187	.53	3901	.218	.53	3901
.0047	.187	.40	4701	.187	.40	4701	.187	.53	4701	.187	.65	4701
.0056	.187	.40	5601	.187	.40	5601	.187	.53	5601	.203	.65	5601
.0068	.187	.40	6801	.187	.40	6801	.187	.53	6801	.203	.65	6801
.0082	.187	.40	8201	.187	.40	8201	.203	.53	8201	.218	.65	8201
.01	.187	.40	1002	.203	.40	1002	.218	.53	1002	.234	.65	1002
.012	.187	.40	1202	.234	.40	1202	.234	.53	1202	.265	.65	1202
.015	.203	.40	1502	.250	.40	1502	.265	.53	1502	.281	.65	1502
.018	.218	.40	1802	.203	.53	1802	.218	.65	1802	.265	.78	1802
.022	.234	.40	2202	.218	.53	2202	.250	.65	2202	.281	.78	2202
.027	.265	.40	2702	.234	.53	2702	.234	.78	2702	.312	.78	2702
.033	.218	.53	3302	.218	.65	3302	.265	.78	3302	.296	.90	3302
.039	.187	.65	3902	.234	.65	3902	.281	.78	3902	.328	.90	3902
.047	.203	.65	4702	.250	.65	4702	.312	.78	4702	.359	.90	4702
.056	.218	.65	5602	.281	.65	5602	.296	.90	5602	.375	.90	5602
.068	.250	.65	6802	.312	.65	6802	.328	.90	6802	.421	.90	6802
.082	.265	.65	8202	.296	.78	8202	.343	.90	8202	.375	1.18	8202
.1	.265	.78	1003	.328	.78	1003	.390	.90	1003	.421	1.18	1003
.12	.281	.78	1203	.328	.90	1203	.359	1.18	1203	.453	1.18	1203
.15	.312	.78	1503	.359	.90	1503	.390	1.18	1503	.500	1.18	1503
.18	.312	.90	1803	.359	1.03	1803	.437	1.32	1803	.515	1.32	1803
.22	.343	.90	2203	.390	1.03	2203	.484	1.32	2203	.562	1.32	2203
.27	.343	1.03	2703	.406	1.18	2703	.468	1.56	2703	.562	1.56	2703
.33	.375	1.03	3303	.437	1.18	3303	.515	1.56	3303	.578	1.70	3303
.39	.375	1.18	3903	.468	1.18	3903	.562	1.56	3903	.625	1.70	3903
.47	.406	1.18	4703	.515	1.18	4703	.609	1.56	4703	.687	1.70	4703
.56	.437	1.18	5603	.531	1.32	5603	.640	1.70	5603	.750	1.70	5603
.68	.484	1.18	6803	.515	1.56	6803	.703	1.70	6803	.796	1.82	6803
.82	.531	1.18	8203	.578	1.56	8203	.734	1.82	8203	.828	1.94	8203
1.0	.546	1.32	1004	.593	1.70	1004	.781	1.94	1004	.921	1.94	1004
1.25	.578	1.45	1254	.671	1.70	1254	—	—	—	—	—	—
1.50	.625	1.45	1504	.734	1.70	1504	—	—	—	—	—	—
2.0	.687	1.56	2004	.812	1.82	2004	—	—	—	—	—	—

TYPE 33M RATINGS AND DIMENSIONS

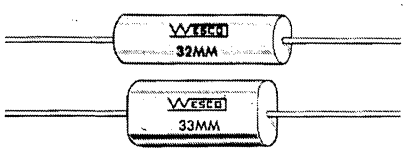
Capacity in Mfds.	100 VOLTS T	W	L	Cat. No. 33M — K1	200 VOLTS T	W	L	Cat. No. 33M — K2	400 VOLTS T	W	L	Cat. No. 33M — K4	600 VOLTS T	W	L	Cat. No. 33M — K6
.001	.125	.234	.40	1001	.125	.234	.40	1001	.109	.203	.53	1001	.109	.203	.53	1001
.0012	.125	.234	.40	1201	.125	.234	.40	1201	.109	.203	.53	1201	.109	.203	.53	1201
.0015	.125	.234	.40	1501	.125	.234	.40	1501	.125	.234	.53	1501	.125	.234	.53	1501
.0018	.125	.234	.40	1801	.125	.234	.40	1801	.125	.234	.53	1801	.125	.234	.53	1801
.0022	.125	.234	.40	2201	.125	.234	.40	2201	.125	.234	.53	2201	.125	.234	.53	2201
.0027	.125	.234	.40	2701	.125	.234	.40	2701	.125	.234	.53	2701	.125	.234	.53	2701
.0033	.125	.234	.40	3301	.125	.234	.40	3301	.125	.234	.53	3301	.140	.281	.53	3301
.0039	.125	.234	.40	3901	.125	.234	.40	3901	.125	.234	.53	3901	.140	.265	.53	3901
.0047	.125	.234	.40	4701	.125	.234	.40	4701	.125	.234	.53	4701	.125	.265	.65	4701
.0056	.125	.234	.40	5601	.125	.234	.40	5601	.125	.234	.53	5601	.125	.250	.65	5601
.0068	.125	.234	.40	6801	.125	.234	.40	6801	.125	.234	.53	6801	.125	.250	.65	6801
.0082	.125	.234	.40	8201	.125	.234	.40	8201	.140	.234	.53	8201	.140	.265	.65	8201
.01	.125	.234	.40	1002	.140	.250	.40	1002	.156	.250	.53	1002	.156	.281	.65	1002
.012	.125	.234	.40	1202	.171	.265	.40	1202	.171	.265	.53	1202	.171	.312	.65	1202
.015	.140	.234	.40	1502	.187	.281	.40	1502	.187	.312	.53	1502	.203	.328	.65	1502
.018	.156	.250	.40	1802	.140	.234	.53	1802	.140	.281	.65	1802	.171	.312	.78	1802
.022	.171	.281	.40	2202	.156	.250	.53	2202	.171	.296	.65	2202	.203	.343	.78	2202
.027	.203	.296	.40	2702	.171	.281	.53	2702	.156	.281	.78	2702	.234	.359	.78	2702
.033	.140	.250	.53	3302	.156	.250	.65	3302	.171	.312	.78	3302	.218	.343	.90	3302
.039	.125	.234	.65	3902	.171	.265	.65	3902	.203	.328	.78	3902	.250	.375	.90	3902
.047	.140	.250	.65	4702	.171	.312	.65	4702	.203	.375	.78	4702	.281	.406	.90	4702
.056	.156	.265	.65	5602	.203	.328	.65	5602	.187	.359	.90	5602	.281	.453	.90	5602
.068	.187	.281	.65	6802	.218	.359	.65	6802	.218	.390	.90	6802	.312	.500	.90	6802
.082	.187	.312	.65	8202	.218	.343	.78	8202	.250	.421	.90	8202	.281	.453	1.18	8202
.1	.187	.312	.78	1003	.234	.375	.78	1003	.281	.453	.90	1003	.312	.500	1.18	1003
.12	.203	.328	.78	1203	.218	.390	.90	1203	.250	.421	1.18	1203	.343	.515	1.18	1203
.15	.234	.359	.78	1503	.250	.421	.90	1503	.281	.484	1.18	1503	.390	.578	1.18	1503
.18	.218	.328	.90	1803	.234	.437	1.03	1803	.312	.515	1.32	1803	.406	.578	1.32	1803
.22	.250	.359	.90	2203	.265	.468	1.03	2203	.359	.562	1.32	2203	.468	.640	1.32	2203
.27	.234	.406	1.03	2703	.281	.484	1.18	2703	.343	.546	1.56	2703	.437	.640	1.56	2703
.33	.265	.437	1.03	3303	.328	.515	1.18	3303	.390	.593	1.56	3303	.468	.671	1.70	3309
.39	.265	.453	1.18	3903	.359	.562	1.18	3903	.437	.640	1.56	3903	.500	.703	1.70	3903
.47	.296	.500	1.18	4703	.406	.593	1.18	4703	.484	.687	1.56	4703	.562	.765	1.70	4703
.56	.328	.531	1.18	5603	.406	.609	1.32	5603	.515	.718	1.70	5603	.625	.828	1.70	5603
.68	.375	.562	1.18	6803	.406	.609	1.56	6803	.578	.781	1.70	6803	.656	.875	1.82	6803
.82	.421	.609	1.18	8203	.453	.656	1.56	8203	.609	.812	1.82	8203	.703	.906	1.94	8203
1.0	.437	.625	1.32	1004	.484	.687	1.70	1004	.656	.859	1.94	1004	.781	.984	1.94	1004
1.25	.453	.656	1.45	1254	.453	.859	1.70	1254	—	—	—	—	—	—	—	—
1.50	.515	.718	1.45	1504	.515	.906	1.70	1504	—	—	—	—	—	—	—	—
2.0	.468	.875	1.56	2004	.578	.984	1.82	2004	—	—	—	—	—	—	—	—

STANDARD LEAD SIZES: #24 AWG TCW: up to and including .203" Dia., #22 AWG TCW: from .204" thru .312" Dia., #20 AWG TCW : /313" Dia. and over. **CAPACITY TOLERANCE: STANDARD** . . . ±10% / OTHER . . . from ±20% to ±1%. Other values as well as voltage ratings are available on request.

*DuPONT REGISTERED TRADEMARK

WESCO® ELECTRICAL COMPANY
DEPT. EM, 201C MUNSON ST. • GREENFIELD, MASS. 01301 • PHONE: (413) 774-4358

WESCO® METALIZED MYLAR* CAPACITORS



ULTRA MINIATURE
35 VDC AND 50 VDC RATINGS

SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE
200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

TEMPERATURE RANGE
−55°C to +85°C with full rated voltage applied. To +125°C with 50% of rated volatge.

INSULATION RESISTANCE
At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 30,000 megohms-microfarads, but need not exceed 30,000 megohms.

DISSIPATION FACTOR
Shall not exceed 1.0% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE
Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz ±20 Hz.

LIFE TEST
Shall withstand 140% of rated voltage at 85°C for 250 hours. One failure in twelve shall be permitted.

CAPACITANCE STABILITY (DRIFT)
Less than 0.3% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 85°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100. yields the stability expressed in percent.

HUMIDITY RESISTANCE
Meets requirements of Mil-C-27287, Para. 3.12 when tested in accordance with Mil-STD-202, Method 103 B, Condition B.

LEAD PULL AND BEND TEST
Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

FEATURES
Wrap and fill construction
Tubular and oval configuration for optimum space savings
Extended foil design
Miniature size — lightweight
Low dissipation factor
Excellent stability
Quality control procedures per Mil-Q-9858

APPLICATIONS
Data Processing Equipment
Aircraft and Missile Systems
Industrial Instrumentation
Navigation and Distance Measuring Equipment
Communications Equipment
Tachometers
Filters
Peripheral Equipment

TYPE 32MM RATINGS AND DIMENSIONS

Capacity In Mfds.	35 VOLTS D	35 VOLTS L	35 VOLTS Cat. No. 32MM −K03.5	50 VOLTS D	50 VOLTS L	50 VOLTS Cat. No. 33MM −K05
.18	—	—	1803	.187	.40	1803
.22	—	—	2203	.203	.40	2203
.27	.171	.40	2703	.218	.40	2703
.33	.187	.40	3303	.234	.40	3303
.39	.203	.40	3903	.250	.40	3903
.47	.218	.40	4703	.187	.53	4703
.56	.250	.40	5603	.203	.53	5603
.68	.171	.53	6803	.218	.53	6803
.82	.187	.53	8203	.250	.53	8203
1.00	.203	.53	1004	.218	.65	1004
1.25	.234	.53	1254	.234	.65	1254
1.50	.250	.53	1504	.265	.65	1504
1.80	.218	.65	1804	.281	.65	1804
2.00	.234	.65	2004	.312	.65	2004
3.00	.281	.65	3004	.312	.78	3004
4.00	.343	.65	4004	.375	.78	4004
5.00	.375	.65	5004	.421	.78	5004
8.00	.390	.78	8004	.453	.90	8004
10.00	.390	.90	1005	.453	1.03	1005
15.00	.468	.90	1505	.546	1.03	1505
20.00	.546	.90	2005	.593	1.18	2005
25.00	.500	1.18	2505	.656	1.18	2505
30.00	.562	1.18	3005	.718	1.18	3005

TYPE 33MM RATINGS AND DIMENSIONS

Capacity In Mfds.	35 VOLTS T	35 VOLTS W	35 VOLTS L	35 VOLTS Cat. No. 33MM −K03.5	50 VOLTS T	50 VOLTS W	50 VOLTS L	50 VOLTS Cat. No. 32MM −K05
.18	—	—	—	1803	.125	.218	.40	1803
.22	—	—	—	2203	.140	.234	.40	2203
.27	.109	.203	.40	2703	.156	.250	.40	2703
.33	.125	.218	.40	3303	.187	.265	.40	3303
.39	.140	.234	.40	3903	.218	.296	.40	3903
.47	.156	.250	.40	4703	.125	.218	.53	4703
.56	.187	.265	.40	5603	.156	.250	.53	5603
.68	.218	.296	.53	6803	.187	.265	.53	6803
.82	.140	.234	.53	8203	.187	.296	.53	8203
1.00	.156	.250	.53	1004	.156	.250	.65	1004
1.25	.187	.265	.53	1254	.187	.281	.65	1254
1.50	.187	.281	.53	1504	.203	.296	.65	1504
1.80	.187	.250	.65	1804	.218	.312	.65	1804
2.00	.187	.265	.65	2004	.234	.343	.65	2004
3.00	.218	.312	.65	3004	.234	.359	.78	3004
4.00	.265	.359	.65	4004	.281	.406	.78	4004
5.00	.296	.406	.65	5004	.328	.453	.78	5004
8.00	.312	.437	.78	8004	.375	.500	.90	8004
10.00	.312	.437	.90	1005	.375	.500	1.03	1005
15.00	.390	.515	.90	1505	.468	.593	1.03	1505
20.00	.453	.578	.90	2005	.500	.640	1.18	2005
25.00	.437	.562	1.18	2505	.578	.703	1.18	2505
30.00	.468	.593	1.18	3005	.656	.781	1.18	3005

STANDARD LEAD SIZES FOR 32MM: #24 AWG TCW: up to and including .203″ Dia.
#22 AWG TCW: From .204″ thru .312″ Dia.
#20 AWG TCW: .313″ Dia. and over

STANDARD LEAD SIZES FOR 33MM: Refer to equivalent rating in Type 32MM

CAPACITY TOLERANCE: STANDARD ±10%/OTHER . . . FROM ±20% TO ±2%. OTHER VALUES AS WELL AS VOLTAGE RATINGS ARE AVAILABLE ON REQUEST.

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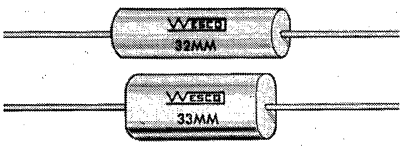
WESCO® METALIZED MYLAR* CAPACITORS



SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE

200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

TEMPERATURE RANGE

−55°C to +85°C with full rated voltage applied. To +125°C with 50% of rated voltage.

INSULATION RESISTANCE

At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 30,000 megohms-microfarads, but need not exceed 30,000 megohms.

DISSIPATION FACTOR

Shall not exceed 1.0% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE

Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz, ±20 Hz.

LIFE TEST

Shall withstand 140% of rated voltage at 85°C for 250 hours. One failure in twelve shall be permitted.

CAPACITANCE STABILITY (DRIFT)

Less than 0.3% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 85°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in percent.

HUMIDITY RESISTANCE

Meets requirements of Mil-C-27287, Para. 3.12 when tested in accordance with Mil-STD.-202C, Method 103 B, Condition B.

LEAD PULL AND BEND TEST

Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

FEATURES

Wrap and fill construction
Tubular and oval configuration for optimum space savings
Extended foil design
Miniature size — lightweight
Low dissipation factor
Excellent stability
Quality control procedures per Mil-Q-9858

APPLICATIONS

Data Processing Equipment
Aircraft and Missile Systems
Industrial Instrumentation
Navigation and Distance Measuring Equipment
Communications Equipment
Tachometers
Filters
Peripheral Equipment

TYPE 32MM RATINGS AND DIMENSIONS

Capacity in Mfds.	100 VOLTS D	L	Cat. No. 32MM — K-1	200 VOLTS D	L	Cat. No. 32MM — K-2	400 VOLTS D	L	Cat. No. 32MM — K-4	600 VOLTS D	L	Cat. No. 32MM — K-6
.0068	—	—	—	—	—	—	.218	.53	6801	.312	.53	6801
.0082	—	—	—	—	—	—	.234	.53	8201	.171	.65	8201
.01	—	—	—	—	—	—	.265	.53	1002	.250	.65	1002
.012	—	—	—	—	—	—	.203	.65	1202	.265	.65	1202
.015	—	—	—	—	—	—	.218	.65	1502	.296	.65	1502
.018	—	—	—	.203	.40	1802	.234	.65	1802	.328	.65	1802
.022	—	—	—	.218	.40	2202	.250	.65	2202	.375	.65	2202
.027	.171	.40	2702	.234	.40	2702	.265	.65	2702	.390	.65	2702
.033	.187	.40	3302	.265	.40	3302	.296	.65	3302	.437	.65	3302
.039	.187	.40	3902	.203	.53	3902	.234	.90	3902	.328	.90	3902
.047	.203	.40	4702	.218	.53	4702	.265	.90	4702	.375	.90	4702
.056	.218	.40	5602	.234	.53	5602	.265	.90	5602	.390	.90	5602
.068	.250	.40	6802	.250	.53	6802	.296	.90	6802	.437	.90	6802
.082	.187	.53	8202	.265	.53	8202	.328	.90	8202	.468	.90	8202
.1	.203	.53	1003	.281	.53	1003	.343	.90	1003	.515	.90	1003
.12	.218	.53	1203	.312	.53	1203	.328	1.18	1203	.453	1.18	1203
.15	.234	.53	1503	.343	.53	1503	.343	1.18	1503	.515	1.18	1503
.18	.250	.53	1803	.296	.65	1803	.375	1.18	1803	.562	1.18	1803
.22	.234	.65	2203	.328	.65	2203	.406	1.18	2203	.625	1.18	2203
.27	.250	.65	2703	.359	.65	2703	.453	1.18	2703	.687	1.18	2703
.33	.265	.65	3303	.406	.65	3303	.437	1.45	3303	.656	1.45	3303
.39	.281	.65	3903	.437	.65	3903	.468	1.45	3903	.703	1.45	3903
.47	.312	.65	4703	.468	.65	4703	.515	1.45	4703	.781	1.45	4703
.56	.343	.65	5603	.406	.90	5603	.546	1.45	5603	.843	1.45	5603
.68	.375	.65	6803	.437	.90	6803	.609	1.45	6803	.921	1.45	6803
.82	.359	.78	8203	.406	1.18	8203	.593	1.70	8203	.906	1.70	8203
1.0	.390	.78	1004	.437	1.18	1004	.656	1.70	1004	1.000	1.70	1004
1.25	.421	.78	1254	.500	1.18	1254	.734	1.70	1254	1.171	1.70	1254
1.50	.421	.90	1504	.531	1.18	1504	.796	1.70	1504	1.265	1.70	1504
1.80	.453	.90	1804	.593	1.18	1804	.875	1.70	1804	1.375	1.70	1804
2.0	.484	.90	2004	.625	1.18	2004	.921	1.70	2004	1.406	1.70	2004
3.0	.484	1.18	3004	.656	1.45	3004	—	—	—	—	—	—
4.0	.562	1.18	4004	.750	1.45	4004	—	—	—	—	—	—
5.0	.625	1.18	5004	.765	1.70	5004	—	—	—	—	—	—
8.0	.703	1.45	8004	.828	2.06	8004	—	—	—	—	—	—
10.0	.781	1.45	1005	.921	2.06	1005	—	—	—	—	—	—

TYPE 33MM RATINGS & DIMENSIONS

Capacity in Mfds.	100 VOLTS T	W	L	Cat. No. 33MM — K1	200 VOLTS T	W	L	Cat. No. 33MM — K2	400 VOLTS T	W	L	Cat. No. 33MM — K4	600 VOLTS T	W	L	Cat. No. 33MM — K6
.0068	—	—	—	—	—	—	—	—	.140	.281	.53	6801	.234	.359	.53	6801
.0082	—	—	—	—	—	—	—	—	.156	.296	.53	8201	.078	.218	.65	8201
.01	—	—	—	—	—	—	—	—	.187	.312	.53	1002	.171	.296	.65	1002
.012	—	—	—	—	—	—	—	—	.125	.250	.65	1202	.140	.281	.65	1202
.015	—	—	—	—	—	—	—	—	.140	.265	.65	1502	.203	.343	.65	1502
.018	—	—	—	—	—	—	—	—	.156	.281	.65	1802	.218	.421	.65	1802
.022	—	—	—	—	.140	.281	.40	2202	.171	.312	.65	2202	.250	.437	.65	2202
.027	.109	.203	.40	2702	.156	.296	.40	2702	.203	.328	.65	2702	.281	.484	.65	2702
.033	.125	.218	.40	3302	.187	.312	.40	3302	.218	.359	.65	3302	.312	.531	.65	3302
.039	.125	.234	.40	3902	.125	.250	.53	3902	.156	.296	.90	3902	.218	.421	.90	3902
.047	.140	.250	.40	4702	.140	.265	.53	4702	.171	.312	.90	4702	.250	.437	.90	4702
.056	.156	.265	.40	5602	.156	.281	.53	5602	.187	.328	.90	5602	.265	.468	.90	5602
.068	.187	.281	.40	6802	.171	.296	.53	6802	.218	.343	.90	6802	.312	.515	.90	6802
.082	.109	.234	.53	8202	.187	.312	.53	8202	.218	.390	.90	8202	.343	.562	.90	8202
.1	.125	.250	.53	1003	.203	.343	.53	1003	.250	.421	.90	1003	.390	.593	.90	1003
.12	.140	.265	.53	1203	.234	.359	.53	1203	.218	.390	1.18	1203	.343	.546	1.18	1203
.15	.156	.281	.53	1503	.265	.390	.53	1503	.250	.421	1.18	1503	.390	.596	1.18	1503
.18	.187	.312	.53	1803	.234	.359	.65	1803	.281	.453	1.18	1803	.437	.640	1.18	1803
.22	.156	.281	.65	2203	.250	.390	.65	2203	.296	.500	1.18	2203	.500	.687	1.18	2203
.27	.171	.296	.65	2703	.281	.406	.65	2703	.343	.531	1.18	2703	.562	.765	1.18	2703
.33	.187	.312	.65	3303	.281	.484	.65	3303	.312	.515	1.45	3303	.531	.734	1.45	3303
.39	.218	.343	.65	3903	.312	.515	.65	3903	.343	.546	1.45	3903	.578	.781	1.45	3903
.47	.234	.359	.65	4703	.359	.562	.65	4703	.390	.578	1.45	4703	.640	.843	1.45	4703
.56	.250	.406	.65	5603	.281	.484	.90	5603	.437	.625	1.45	5603	.718	.921	1.45	5603
.68	.281	.437	.65	6803	.328	.515	.90	6803	.484	.687	1.45	6803	.796	1.000	1.45	6803
.82	.250	.421	.78	8203	.296	.484	1.18	8203	.468	.671	1.70	8203	.781	.984	1.70	8203
1.0	.281	.453	.78	1004	.328	.531	1.18	1004	.531	.734	1.70	1004	.857	1.078	1.70	1004
1.25	.312	.515	.78	1254	.375	.578	1.18	1254	.609	.812	1.70	1254	1.062	1.265	1.70	1254
1.50	.296	.500	.90	1504	.421	.625	1.18	1504	.671	.875	1.70	1504	1.156	1.359	1.70	1504
1.80	.328	.515	.90	1804	.406	.687	1.18	1804	.750	.953	1.70	1804	1.265	1.484	1.70	1804
2.0	.359	.562	.90	2004	.421	.718	1.18	2004	.796	1.000	1.70	2004	1.281	1.484	1.70	2004
3.0	.375	.578	1.18	3004	.406	.812	1.45	3004	—	—	—	—	—	—	—	—
4.0	.406	.703	1.18	4004	.625	.828	1.45	4004	—	—	—	—	—	—	—	—
5.0	.453	.750	1.18	5004	.640	.828	1.70	5004	—	—	—	—	—	—	—	—
8.0	.531	.828	1.45	8004	.656	.953	2.06	8004	—	—	—	—	—	—	—	—
10.0	.609	.906	1.45	1005	.750	1.046	2.06	1005	—	—	—	—	—	—	—	—

STANDARD LEAD SIZES: #24 AWG TCW: up to and including .203" Dia., #22 AWG TCW: from .204" thru .312" Dia., #20 AWG TCW: .313" Dia. and over. **CAPACITY TOLERANCE:** STANDARD . . . ±10% / OTHER . . . from ±20% to ±2%. Other values as well as voltage ratings are available on request.

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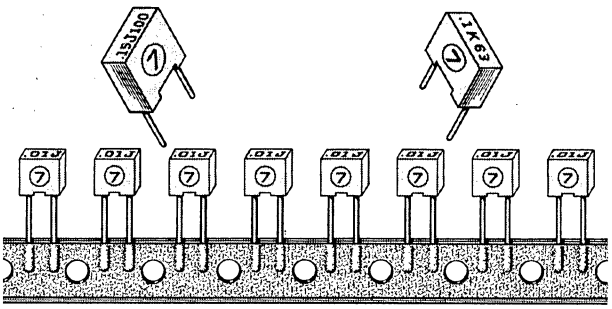
WESCO® METALIZED POLYESTER CAPACITORS "BOX" CAPACITORS



SPECIFICATIONS

TEMPERATURE RANGE
−55°C to +85°C. To +100°C with 50% voltage derating.

DIELECTRIC WITHSTANDING VOLTAGE
160% of rated voltage for 2 seconds at 25°C.

DISSIPATION FACTOR
Shall not exceed 1.0% when measured at 25°C at 1KHz ±20Hz.

CAPACITANCE TOLERANCE
Standard ±20%. ±10% and ±5% available upon request. Measurements will be made at 25°C and 1KHz ±20Hz.

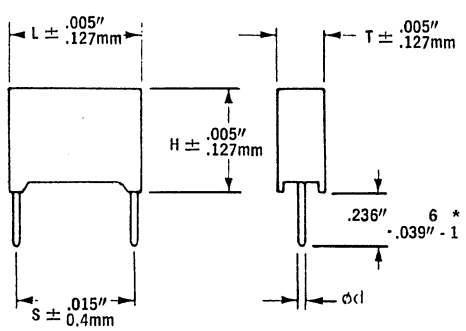
LIFE TEST
Shall withstand 125% of rated voltage at 85°C for 1000 hours.

HUMIDITY RESISTANCE
Meets requirements of MIL-STD-202, Method 103B, condition B.

TERMINALS
Tinned solid copper wire.

MARKING
Capacitance, tolerance, voltage (VDC), WESCO trademark (7).
(Exception: Certain values due to size limitation, will display capacitance, tolerance and (7) only.)
Tolerance Codings: M = ±20%, K = ±10%, J = ±5%.

RESISTANCE TO SOLDERING HEAT
During soldering operation, maximum heat of +260°C may be applied to leads for no longer than 6 seconds.



* Except for type 68MM which is: 0.157" ± .04" 4mm + 1

TYPE 60MM

Capacity in MFD.	63 VDC 40 VAC Case Code	100 VDC 63 VAC Case Code	250 VDC 160 VAC Case Code	400 VDC 200 VAC Case Code	630 VDC 220 VAC Case Code
.001-.01	—	—	—	—	G
.022	—	—	—	G	O
.047	—	—	G	L	P
.1	—	—	L	P	R
.22	G	K	L	R	W
.47	K	L	R	W	—
1.0	L	U	W	Z	—

TYPE 67MM

Capacity in MFD.	63 VDC 40 VAC Case Code	100 VDC 63 VAC Case Code	250 VDC 160 VAC Case Code	400 VDC 200 VAC Case Code	630 VDC 250 VAC Case Code
.001-.0033	—	—	—	—	C
.0047	—	—	—	C	F
.01	—	—	C	F	J
.047	—	C	F	J	—
.1	C	F	J	—	—
.22	F	J	—	—	—
.47	J	—	—	—	—
1.0	N	—	—	—	—

TYPE 68MM

Capacity in MFD.	50 VDC 30 VAC Case Code	63 VDC 40 VAC Case Code	100 VDC 63 VAC Case Code
.001-.022	—	—	A
.033-.068	—	A	—
.1	A	B	—
.22	D	E	—
.47	H	I	—
1.0	M	—	—

DIMENSIONS

Case Code	T mm	T in	H mm	H in	L mm	L in	S mm	S in	d mm	d in
A	2.5	.098	6.5	.256	7.2	.284	5	.197	0.6	.025
B	3	.118	6.5	.256	7.2	.284	5	.197	0.6	.025
C	3.5	.138	6.5	.256	10.5	.414	7.5	.295	0.6	.025
D	3.5	.138	7.5	.295	7.2	.284	5	.197	0.6	.025
E	3.5	.138	8.5	.335	7.2	.284	5	.197	0.6	.025
F	4	.158	9	.355	10.5	.414	7.5	.295	0.6	.025
G	4	.158	9	.355	13	.512	10	.394	0.8	.032
H	4.5	.177	9.5	.374	7.2	.284	5	.197	0.6	.025
I	5	.197	10	.394	7.2	.284	5	.197	0.6	.025
J	5	.197	11	.433	10.5	.414	7.5	295	0.8	.032
K	5	.197	11	.433	13	.512	10	.394	0.8	.032
L	5	.197	11	.433	18	.709	15	.591	0.8	.032
M	6	.236	11	.433	7.2	.284	5	.197	0.6	.025
N	6	.236	12	.473	10.5	.414	7.5	.295	0.8	.032
O	6	.236	12	.473	13	.512	10	.394	0.8	.032
P	6	.236	12	.473	18	.709	15	.591	0.8	.032
Q	6	.236	15	.591	26.5	1.044	20	.788	0.8	.032
R	6	.236	15	.591	26.5	1.044	22.5	.886	0.8	.032
S	7	.276	16	.630	26.5	1.044	20	.788	0.8	.032
T	7	.276	16	.630	26.5	1.044	22.5	.886	0.8	.032
U	7.5	.295	13.5	.532	18	.709	15	.591	0.8	.032
V	8.5	.335	14.5	.571	18	.709	15	.591	0.8	.032
W	8.5	.335	17	.670	26.5	1.044	22.5	.886	0.8	.032
X	9	.355	17	.670	32	1.26	27.5	1.083	0.8	.032
Y	10	.394	18.5	.729	26.5	1.044	22.5	.886	0.8	.032
Z	11	.433	20	.788	32	1.26	27.5	1.083	0.8	.032

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WESCO® POLYSTYRENE CAPACITORS

SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE
200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

INSULATION RESISTANCE
At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 500,000 megohms-microfarads, but need not exceed 500,000 megohms.

DISSIPATION FACTOR
Shall not exceed .05% when measured at 25°C and 1000 Hz, ± Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE
Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz, ±20 Hz.

LIFE TEST
Shall withstand 140% of rated voltage at 85°C for 250 hours. One failure in twelve shall be permitted.

TEMPERATURE COEFFICIENT
Capacitance shall change linearly over operating temperature range at rate of −105, ±30 parts per million/°C.

CAPACITANCE STABILITY (DRIFT)
Less than .05% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 85°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in percent.

HUMIDITY RESISTANCE
Meets requirements of Mil-C-27287, Para. 3.12 when tested in accordance with Mil-STD.-202C, Method 103 B, Condition B.

LEAD PULL AND BEND TEST
Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

TEMPERATURE RANGE
−55°C to +85°C with full rated voltage applied.

TYPE 32P RATINGS & DIMENSIONS

Capacity in Mfds.	100 VOLTS D	L	Cat. No. 32P — J-1	200 VOLTS D	L	Cat. No. 32P — J-2	400 VOLTS D	L	Cat. No. 32P — J-4
.001	.187	.53	1001	.187	.53	1001	.187	.53	1001
.0012	.187	.53	1201	.187	.53	1201	.187	.53	1201
.0015	.187	.53	1501	.187	.53	1501	.187	.53	1501
.0018	.187	.65	1801	.187	.65	1801	.187	.65	1801
.0022	.187	.65	2201	.187	.65	2201	.187	.65	2201
.0027	.187	.65	2701	.187	.65	2701	.187	.65	2701
.0033	.187	.65	3301	.187	.65	3301	.187	.65	3301
.0039	.187	.65	3901	.187	.65	3901	.187	.65	3901
.0047	.187	.65	4701	.187	.65	4701	.234	.65	4701
.0056	.187	.65	5601	.187	.65	5601	.250	.65	5601
.0068	.187	.65	6801	.187	.65	6801	.234	.78	6801
.0082	.187	.65	8201	.203	.65	8201	.250	.78	8201
.01	.203	.65	1002	.234	.65	1002	.265	.78	1002
.012	.218	.65	1202	.218	.78	1202	.296	.78	1202
.015	.234	.65	1502	.250	.78	1502	.328	.78	1502
.018	.234	.78	1802	.265	.78	1802	.359	.78	1802
.022	.250	.78	2202	.281	.78	2202	.343	.90	2202
.027	.265	.78	2702	.312	.78	2702	.375	.90	2702
.033	.296	.78	3302	.343	.78	3302	.406	.90	3302
.039	.328	.78	3902	.375	.78	3902	.453	.90	3902
.047	.343	.78	4702	.359	.90	4702	437	1.03	4702
.056	.375	.78	5602	.390	.90	5602	.484	1.03	5602
.068	.375	.90	6802	.421	.90	6802	.484	1.18	6802
.082	.406	.90	8202	.421	1.03	8202	.531	1.18	8202
.1	.453	.90	1003	.468	1.03	1003	.578	1.18	1003
.12	.484	.90	1203	.515	1.03	1203	.625	1.18	1203
.15	.500	1.03	1503	.531	1.18	1503	.656	1.32	1503
.18	.531	1.03	1803	.578	1.18	1803	.671	1.45	1803
.22	.546	1.18	2203	.640	1.18	2203	.671	1.70	2203
.27	.609	1.18	2703	.656	1.32	2703	.734	1.70	2703
.33	.625	1.32	3303	.687	1.45	3303	.812	1.70	3303
.39	.671	1.32	3903	.750	1.45	3903	—	—	—
.47	.703	1.45	4703	.734	1.70	4703	—	—	—

STANDARD LEAD SIZES: #24 AWG TCW: up to and including .203" Dia.
#22 AWG TCW: from .204" thru .312" Dia.
#20 AWG TCW: .313" Dia.and over

CAPACITY TOLERANCE: STANDARD . . . ±5% / OTHER . . . from ±20% to ±1%
Other values as well as voltage ratings are available upon request.

METALIZED POLYCARBONATE CAPACITORS

SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE
200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

TEMPERATURE RANGE
−55°C to +85°C with full rated voltage applied. To +125°C with 50% of rated voltage.

INSULATION RESISTANCE
At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 50,000 megohms-microfarads, but need not exceed 50,000 megohms.

DISSIPATION FACTOR
Shall not exceed 0.3% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE
Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz, ±20 Hz.

LIFE TEST
Shall withstand 140% of rated voltage at 85°C for 250 hours. One failure in twelve shall be permitted.

CAPACITANCE STABILITY (DRIFT)
Less than 0.3% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 85°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in percent.

HUMIDITY RESISTANCE
Meets requirements of Mil-C-27287, Para. 3.12 when tested in accordance with Mil-STD.-202C, Method 103B, Condition B.

LEAD PULL AND BEND TEST
Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90 ° in the opposite direction with no evidence of breakage.

TYPE 32MPC RATINGS & DIMENSIONS

Capacity in Mfds.	50 VOLTS D	L	Cat. No. 32MPC — K-05	100 VOLTS D	L	Cat. No. 32MPC — K-1	200 VOLTS D	L	Cat. No. 32MPC — K-2
.012	—	—	—	—	—	—	.171	.40	1202
.015	—	—	—	—	—	—	.187	.40	1502
.018	—	—	—	—	—	—	.203	.40	1802
.022	—	—	—	.156	.40	2202	.218	.40	2202
.027	—	—	—	.171	.40	2702	.234	.40	2702
.033	—	—	—	.171	.40	3302	.250	.40	3302
.039	—	—	—	.187	.40	3902	.187	.53	3902
.047	—	—	—	.203	.40	4702	.203	.53	4702
.056	—	—	—	.218	.40	5602	.218	.53	5602
.068	—	—	—	.234	.40	6802	.234	.53	6802
.082	.156	.40	8202	.187	.53	8202	.265	.53	8202
.1	.171	.40	1003	.203	.53	1003	.234	.65	1003
.12	.187	.40	1203	.218	.53	1203	.250	.65	1203
.15	.203	.40	1503	.234	.53	1503	.281	.65	1503
.18	.218	.40	1803	.250	.53	1803	.296	.65	1803
.22	.171	.53	2203	.265	.53	2203	.328	.65	2203
.27	.187	.53	2703	.250	.65	2703	.312	.78	2703
.33	.203	.53	3303	.265	.65	3303	.343	.78	3303
.39	.203	.53	3903	.281	.65	3903	.359	.78	3903
.47	.218	.53	4703	.312	.65	4703	.406	.78	4703
.56	.250	.53	5603	.328	.65	5603	.390	.90	5603
.68	.218	.65	6803	.328	.78	6803	.421	.90	6803
.82	.234	.65	8203	.343	.78	8203	.468	.90	8203
1.0	.265	.65	1004	.375	.78	1004	.515	.90	1004
1.25	.296	.65	1254	.421	.78	1254	.484	1.18	1254
1.50	.312	.65	1504	.453	.78	1504	.531	1.18	1504
1.80	.328	.78	1804	.453	.90	1804	.578	1.18	1804
2.0	.343	.78	2004	.468	.90	2004	.609	1.18	2004
3.0	.390	.78	3004	.484	1.18	3004	.656	1.45	3004
4.0	.437	.78	4004	.546	1.18	4004	.750	1.45	4004
5.0	.437	.90	5004	.531	1.45	5004	.734	1.78	5004
8.0	.468	1.18	8004	.593	1.78	8004	.859	2.06	8004
10.0	.515	1.18	1005	.656	1.78	1005	.953	2.06	1005

STANDARD LEAD SIZES: #24 AWG TCW: up to and including .203" Dia.
#22 AWG TCW: from .204" thru .312" Dia.
#20 AWG TCW: .313" Dia.and over

CAPACITY TOLERANCE: STANDARD . . . ±10% / OTHER . . . from ±20% to ±2%
Other values as well as voltage ratings are available upon request.

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METALIZED POLYPROPYLENE CAPACITORS

SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE
200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

INSULATION RESISTANCE
At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 100,000 megohms-microfarads, but need not exceed 100,000 megohms.

DISSIPATION FACTOR
Shall not exceed 0.1% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE
Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz, ±20 Hz.

LIFE TEST
Shall withstand 140% of rated voltage at 105°C for 250 hours. One failure in twelve shall be permitted.

TEMPERATURE COEFFICIENT
Capacitance shall change linearly over operating temperature range of −55°C to +85°C at rate of −290, ±75 parts per million/°C.

CAPACITANCE STABILITY (DRIFT)
Less than .2% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 105°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in precent.

HUMIDITY RESISTANCE
Meets requirements of Mil-C-27287, Para. 3.12 when tested in accordance with Mil-STD.-202C, Method 103 B, Condition B.

LEAD PULL AND BEND TEST
Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

TEMPERATURE RANGE
−55°C to +105°C with full rated voltage applied.

DIELECTRIC ABSORPTION
Shall not exceed .05% when tested in accordance with Mil-C-19978.

TYPE 32MPL RATINGS AND DIMENSIONS

Capacity in Mfds.	100 VDC D	L	Cat No. 32MPL — K-1	200 VDC D	L	Cat No. 32MPL — K-2	400 VDC D	L	Cat No. 32MPL — K-4
.01	.171	.406	1002	.171	.406	1002	.187	.531	1002
.012	.171	.406	1202	.171	.406	1202	.203	.531	1202
.015	.171	.406	1502	.187	.406	1502	.234	.531	1502
.018	.171	.406	1802	.203	.406	1802	.250	.531	1802
.022	.171	.406	2202	.171	.531	2202	.265	.531	2202
.027	.171	.406	2702	.171	.531	2702	.296	.531	2702
.033	.187	.406	3302	.187	.531	3302	.312	.531	3302
.039	.203	.406	3902	.203	.531	3902	.343	.531	3902
.047	.218	.406	4702	.218	.531	4702	.281	.656	4702
.056	.234	.406	5602	.234	.531	5602	.312	.656	5602
.068	.187	.531	6802	.250	.531	6802	.343	.656	6802
.082	.187	.531	8202	.275	.531	8202	.375	.656	8202
.1	.218	.531	1003	.250	.656	1003	.343	.781	1003
.12	.234	.531	1203	.265	.656	1203	.375	.781	1203
.15	.250	.531	1503	.296	.656	1503	.421	.781	1503
.18	.275	.531	1803	.328	.656	1803	.453	.781	1803
.22	.312	.531	2203	.359	.656	2203	.437	.906	2203
.27	.328	.531	2703	.359	.781	2703	.484	.906	2703
.33	.281	.656	3303	.375	.781	3303	.546	.906	3303
.39	.312	.656	3903	.406	.781	3903	.578	.906	3903
.47	.343	.656	4703	.390	.906	4703	.531	1.187	4703
.56	.375	.656	5603	.437	.906	5603	.578	1.187	5603
.68	.375	.781	6803	.484	.906	6803	.625	1.187	6803
.82	.390	.781	8203	.515	.906	8203	.687	1.187	8203
1.0	.421	.781	1004	.484	1.187	1004	.671	1.437	1004
1.25	.421	.906	1254	.531	1.187	1254	.750	1.437	1254
1.50	.453	.906	1504	.578	1.187	1504	.812	1.437	1504
1.80	.500	.906	1804	.640	1.187	1804	.796	1.687	1804
2.00	.515	.906	2004	.671	1.187	2004	.843	1.687	2004
3.00	.531	1.187	3004	.718	1.437	3004	1.03	1.687	3004
4.00	.609	1.187	4004	.828	1.437	4004	—	—	—
5.00	.671	1.187	5004	.828	1.687	5004	—	—	—
8.00	.750	1.437	8004	.937	2.062	8004	—	—	—
10.00	.843	1.437	1005	1.03	2.062	1005	—	—	—
12.00	.828	1.687	1205	—	—	—	—	—	—
15.00	.921	1.687	1505	—	—	—	—	—	—

STANDARD LEAD SIZES: #24 AWG: up to and including .203″ Dia.
#22 AWG: from .204″ thru .312″ Dia.
#20 AWG: .313″ Dia. and over

STANDARD LEAD MATERIAL: SOLID TINNED COPPER WIRE.

CAPACITY STANDARD: STANDARD . . . ±5%/OTHER . . . FROM ±20% TO ±1%.

OTHER VALUES AS WELL AS VOLTAGE RATINGS ARE AVAILABLE UPON REQUEST.

LIMITED WARRANTY

Seller warrants the products sold shall conform to specifications and be free from defects in material and workmanship furnished by Seller, which develop under normal and intended use. The **sole liability** of Seller, whether based upon breach of warranty or contract or negligence, shall be limited to repair or replacement, at Seller's election, of all such defective or nonconforming products, upon return f.o.b. to Seller's factory, provided Buyer has given Seller notice in writing of such defect or nonconformity within ninety days after delivery by Seller of such items to Buyer.

Seller assumes no liability for 1) incidental, collateral or consequential damages; 2) applications in combination with any electrical or electronic components other than as intended by Seller; 3) damages of any kind incurred by Buyer from modifications made to the products without written consent of Seller.

The foregoing constitutes the sole and exclusive remedy of Buyer and the exclusive liability of Seller and IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, DESCRIPTION, QUALITY OR PRODUCTIVENESS.

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WESCO® POLYPROPYLENE CAPACITORS

SPECIFICATIONS

DIELECTRIC WITHSTANDING VOLTAGE
200% of rated voltage applied through a minimum limiting resistance of 100 Ohms/Volt. Duration of voltage stress shall be 15 seconds minimum and 1 minute maximum at 25°C.

INSULATION RESISTANCE
At 25°C after 2 minutes of electrification at rated voltage or 500 VDC, whichever is less, the minimum product of Insulation Resistance and Capacitance shall be 250,000 megohms-microfarads, but need not exceed 250,000 megohms.

DISSIPATION FACTOR
Shall not exceed .05% when measured at 25°C and 1000 Hz, ±20 Hz. See characteristic curves for D.F. ratings at other temperatures.

CAPACITANCE AND TOLERANCE
Shall be measured within the tolerance limits specified. Measurements will be made at 25°C and 1000 Hz, ±20 Hz.

LIFE TEST
Shall withstand 140% of rated voltage at 105°C for 250 hours. One failure in twelve shall be permitted.

TEMPERATURE COEFFICIENT
Capacitance shall change linearly over operating temperature range of −55°C to +85°C at rate of −290, ±75 parts per million/°C.

CAPACITANCE STABILITY (DRIFT)
Less than .2% when measured in the following manner: three capacitance readings at 25°C, each made prior to and after temperature cycling from room to 105°C, and room to −55°C. The mathematical difference between the two extremes, divided by the intermediate value, and then multiplied by 100, yields the stability expressed in percent.

HUMIDITY RESISTANCE
Meets requirements of Mil-C-27287, Para 3.12 when tested in accordance with Mil-STD.-202C, Method 103 B, Condition B.

LEAD PULL AND BEND TEST
Steady pull of 5 pounds applied axially to leads for one minute. Bend test shall consist of one bend from the point of egress, first 90° in one direction, back to the original axial position, and then 90° in the opposite direction with no evidence of breakage.

TEMPERATURE RANGE
−55°C to +105°C with full rated voltage applied.

TYPE 32PL RATINGS & DIMENSIONS

Capacity in Mfds.	100 VOLTS D	L	Cat.No. 32PL — K-1	200 VOLTS D	L	Cat.No. 32PL — K-2	400 VOLTS D	L	Cat.No. 32PL — K-4
.0010	.187	.406	1001	.187	.406	1001	.187	.406	1001
.0015	.187	.406	1501	.187	.406	1501	.203	.406	1501
.0022	.187	.406	2201	.187	.406	2201	.234	.406	2201
.0033	.187	.406	3301	.187	.406	3301	.187	.531	3301
.0039	.187	.406	3901	.203	.406	3901	.187	.531	3901
.0047	.187	.406	4701	.187	.531	4701	.203	.531	4701
.0056	.187	.406	5601	.187	.531	5601	.218	.531	5601
.0068	.187	.406	6801	.187	.531	6801	.234	.531	6801
.0082	.187	.406	8201	.187	.531	8201	.203	.656	8201
.0100	.203	.406	1002	.203	.531	1002	.218	.656	1002
.015	.219	.531	1502	.203	.656	1502	.265	.656	1502
.022	.250	.531	2202	.234	.656	2202	.312	.656	2202
.027	.265	.531	2702	.265	.656	2702	.328	.656	2702
.033	.234	.656	3302	.281	.656	3302	.328	.781	3302
.039	.250	.656	3902	.312	.656	3902	.359	.781	3902
.047	.281	.656	4702	.296	.781	4702	.390	.781	4702
.056	.281	.656	5602	.312	.781	5602	.421	.781	5602
.068	.296	.656	6802	.343	.781	6802	.406	.906	6802
.082	.312	.781	8202	.375	.781	8202	.437	.906	8202
.10	.344	.781	1003	.375	.906	1003	.484	.906	1003
.12	.375	.781	1203	.406	.906	1203	.453	1.156	1203
.15	.375	.906	1503	.453	.906	1503	.500	1.156	1503
.18	.406	.906	1803	.484	.906	1803	.546	1.156	1803
.22	.437	.906	2203	.484	1.031	2203	.687	1.156	2203
.27	.437	1.031	2703	.531	1.031	2703	.578	1.406	2703
.33	.500	1.031	3303	.593	1.031	3303	.640	1.406	3303
.39	.531	1.031	3903	.593	1.156	3903	.687	1.406	3903
.47	.531	1.156	4703	.656	1.156	4703	.750	1.406	4703
.56	.578	1.156	5603	.625	1.406	5603	.825	1.406	5603
.68	.625	1.156	6803	.687	1.406	6803	.825	1.656	6803
.82	.625	1.406	8203	.687	1.656	8203	.906	1.656	8203
1.0	.687	1.406	1004	.734	1.656	1004	1.000	1.656	1004

STANDARD LEAD SIZES: #24 AWG TCW: up to and including .203" Dia.
#22 AWG TCW: from .204" thru .312" Dia.
#20 AWG TCW: .313" Dia.and over

CAPACITY TOLERANCE: STANDARD . . . ±10% / OTHER . . . from 20% to ±1%
Other values as well as voltage ratings are available upon request.

FEATURES

32P
- Wrap and fill construction
- Excellent long-term stability
- Superior "Q" for tuned circuits
- High insulation resistance
- Linear temperature coefficient
- Quality control procedures per Mil-Q-9858
- Extended foil design

32MPC
- Wrap and fill construction
- Micro-miniature — lightweight
- Low dissipation factor
- Zero TC ±50 ppm/°C from +25°C to +55°C
- Extended foil design
- Excellent stability
- Quality control procedures per Mil-Q-9858

32PL & 32MPL
- Wrap and fill construction
- Excellent long-term stability
- Superior "Q" for tuned circuits
- High insulation resistance
- Linear temperature coefficient (−55°C to +85°C)
- Quality control procedures per Mil-Q-9858
- Extended foil design

APPLICATIONS

32P, 32PL & 32MPL
- Computers
- Data Processing Equipment
- Aircraft and Missile Systems
- Industrial Instrumentation
- Navigation and Distance Measuring Equipment
- Communications Equipment
- Timing and Retrace Circuits
- Integrating Networks
- High "Q" Low Loss Filters
- Peripheral Equipment

32MPC
- Data Processing Equipment
- Aircraft and Missile Systems
- Industrial Instrumentation
- Navigation and Distance Measuring Equipment
- Communications Equipment
- Tachometers
- Filters
- Peripheral Equipment

EXPLANATION OF CATALOG NUMBER

32 M 1002 K-1

32 Round, Wrap and Fill, with epoxy seals.

M Mylar-Foil, Axial Leads*

1002 In Picofarads — first three digits are significant. Last digit specifies number of zeros, i.e., 1002 = 10,000 pfd. or 0.01 mfd.

K Capacity Tolerance:
K = ±10% H = ±3% F = ±1%
M = ±20% J = ±5% G = ±2%

1 DC Voltage Rating:
05 = 50 VDC 2 = 200 VDC 6 = 600 VDC
1 = 100 VDC 4 = 400 VDC etc.

***** For Radial Leads, add letter "R" at end of part number.

WESCO® ELECTRICAL COMPANY
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WESCO®

MINIGLOSSARY CAPACITORS

Anode: One of two plates or conductors. In polarized capacitors, the anode should be connected to the positive conductor in the circuit.

Capacitive Reactance: The measure of the opposition of a capacitor to accepting a charge and expressed in ohms. When direct current is applied under stated conditions capacitive reactance becomes a constant but, when alternating current is applied the capacitive reactance varies until an equilibrium is achieved and the capacitor appears to have only direct current present. This condition is commonly used in filter applications or in coupling circuits.

Cathode: One of two plates or conductors. In electrostatic capacitors the cathode is metallic. In electrolytic capacitors the cathode is a liquid, gel or other conductive material which is in intimate contact with a metallic cathodic connection.

Dielectric Constant: The measure of quality of the insulating materials in a capacitor. Dry air has a dielectric constant of one (1). Aluminum oxide used in aluminum electrolytic capacitors has a nominal dielectric constant of ten (10).

Electrolytic: A capacitor with one metallic conductor (generally the anode) and with a liquid or semiconductor cathode. Nonpolarized electrolytic capacitors generally have two equal anodes as well as the liquid cathode. These anodes operate alternately as anode and cathodic connection as alternating current is applied.

Electrostatic: One of two general classes of capacitors in which two or more discrete metallic conductors are present and separated by an insulating dielectric material. Examples include: mica, ceramic, film, and paper types.

Farad: The basic unit of measure in capacitors. A capacitor charged to one volt with a charge of one coulomb (one ampere flowing for one second) has a capacitance of one farad. Capacitors are generally rated at portions of a farad (microfarads or picofarads).

1 farad (F) = 1,000,000 microfarads (μF) 1 microfarad (μF) = 1,000,000 picofarads (pF)

Impedance: All capacitors exhibit impedance. It is a function of capacitor type and internal construction. This can be particularly important in certain applications such as filters for switching power supplies. Capacitors used in these applications often have special multiple tab construction to shorten current paths and to reduce internal resistance.

Leakage Current: Expressed as dcl for electrolytic capacitors, a measure of the intrinsic losses in a charged capacitor. Generally speaking, the lower the dcl, the higher quality the capacitor.

Power Factor: A measure of the overall efficiency of a capacitor. Power factor ratings take all internal losses into consideration in a complex formula. This parameter of certain capacitors is often very important in AC applications such as motor-start and/or motor-run capacitors.

Rated Voltage: The rated working voltage of a capacitor. Generally expressed in DC Volts (Vdcw). This is the voltage at which a capacitor may be safely operated at 25°C continuously within its overall parameters.

Ripple Current: The total amount of alternating and direct current that may be applied to an electrolytic capacitor under stated conditions. In general, the higher the ripple current applied, the shorter the operating life of the capacitor will be. Application of significantly higher than rated ripple currents can shorten the capacitor life dramatically and may even cause catastrophic failure (explosion).

Surge Voltage: The momentary surge voltage which may be applied for a stated length of time without doing permanent damage to the unit.

Temperature: Capacitors are generally rated at 25°C at sea level under specific humidity conditions. Operating temperature ranges are also given, along with derating (reliability) curves for operation at temperatures other than 25°C.

Temperature Coefficient: Expressed as TC in ppm (parts per million) or in percent (%) from the norm of 25°C. This is seldom a straight line and may vary widely for certain types. Most capacitors have positive TC in that the capacitance increases as temperature increases. Some types, however, have negative TC in that the capacitance decreases as temperature increases.

Ceramic Capacitor Codes
(Capacitance Given In pF)

Color	Digit	Multiplier	Tolerance			Temperature Coefficient ppm°C	Significant Figure	Multiplier
			Class 1		Class 2			
			10pF or less	Over 10pF				
Black	0	1	±2.0pF	±20%	±20%	0	0.0	−1
Brown	1	10	±0.1pF	±1%		−33		−10
Red	2	100		±2%		−75	1.0	−100
Orange	3	1000		±3%		−150	1.5	−1000
Yellow	4	10000			+100% −0%	−220	2.0	−10000
Green	5		±0.5pF	±5%	±5%	−330	3.3	+1
Blue	6					−470	4.7	+10
Violet	7					−750	7.5	+100
Gray	8	0.01	±0.25pF		+80% −20%	+150 to −1500		+1000
White	9	0.1	±1.0pF	±10%	±10%	+100 to −750		+10000
Silver								
Gold								

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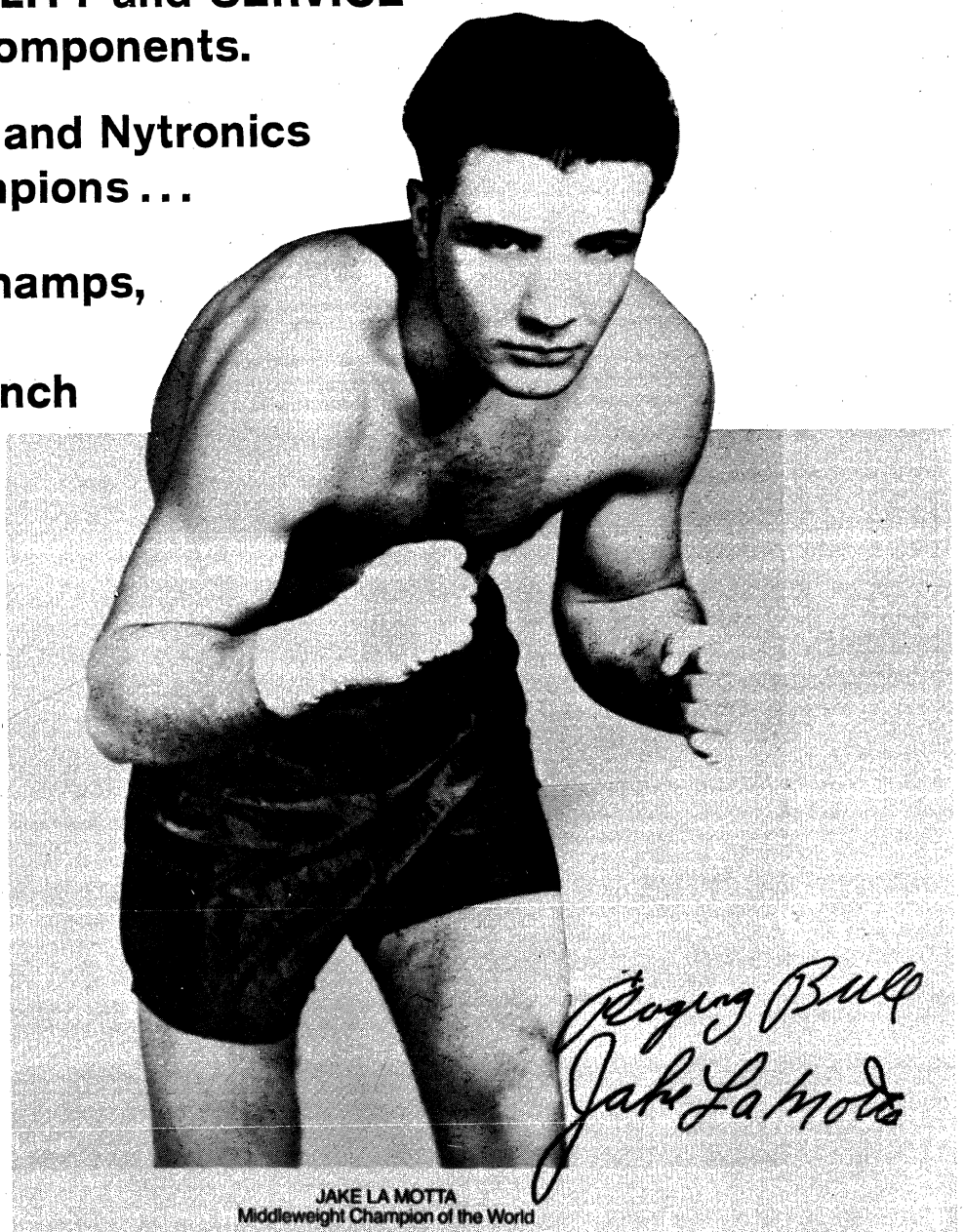

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COILS & CHOKES * Indicates MIL Part

Manufacturer	AF	RF	IF	High Q	Shielded	Variable (Adjustable)	Filter (Choke)	Chip
Caddell-Burns	1•1221*	1•1221*	1•1221*		1•1221	1•1221	1•1221	
Dale Electronics		1•1222-1•1224*			1•1222, 1•1223		1•1222, 1•1224	
Delevan		1•1225			1•1225	1•1225	1•1225	1•1225
J. W. Miller		1•1215-1•1220*	1•1218	1•1219	1•1216, 1•1218	1•1218, 1•1219	1•1219, 1•1220	
North Hills	1•1221	1•1221		1•1221	1•1221	1•1221		
Nytronics		1•1229-1•1244*			1•1229-1•1241, 1•1243	1•1243, 1•1244		
Pico	1•1245-1•1248*	1•1245-1•1248		1•1245-1•1248	1•1245-1•1248		1•1248, 1•1249	
Remco	1•1250*	1•1250*		1•1250	1•1250		1•1250*	
Torotel	1•1260-1•1267*	1•1253-1•1267*						
TRW	1•1268-1•1274*	1•1268,* 1•1270-1•1274*		1•1268, 1•1273	1•1268, 1•1269	1•1268	1•1274*	
Wilco		1•1276, 1•1277			1•1276, 1•1277		1•1276, 1•1277	

DEFLECTION & FOCUSING COILS * Indicates MIL Part

Manufacturer	Deflection Yokes			Focus Coils
	CRT	Oscilloscope Radar PPI	TV Camera	
System Instruments	1•1251*	1•1251*	1•1251*	1•1251

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.

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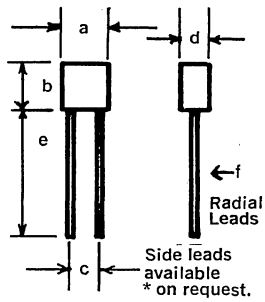

Closer inductance tolerances * available on request.

ENCAPSULATED SUBMINIATURE AND MINIATURE TOROIDAL INDUCTORS

Features

- Applications: printed circuits and modules
- Environmental: designed to meet MIL-C-15305, Grade 1, Class B (−55°C to +125°C)
- Moisture and shock resistant, immersion proof
- Powdered iron toroidal core, low external magnetic field
- Identification: part number and inductance value printed in contrasting color

General Specifications (All Series)

Maximum operating temperature: 125°C
Rated temperature rise (at 90°C): 35°C
Dielectric withstanding voltage: 700 v rms
Terminal pull: 5 pounds
Altitude rating: 70,000 feet
Overload current: 1.4 times the rated current

T1 SERIES

Part Number	Apparent Induc., uH	Max. DC Resist., Ohms	Rated DC Current mA
100066	0.01	0.02	3000
100067	0.012	0.02	3000
100068	0.015	0.02	3000
100069	0.018	0.02	3000
100070	0.022	0.02	3000
100071	0.027	0.02	3000
100072	0.033	0.02	3000
100073	0.039	0.02	3000
100074	0.047	0.02	3000
100075	0.056	0.02	3000
100076	0.068	0.03	2500
100077	0.082	0.04	2200
100078	0.10	0.04	2200
100079	0.12	0.05	2000
100080	0.15	0.06	1800
100081	0.18	0.07	1600
100082	0.22	0.08	1500
100083	0.27	0.10	1400
100084	0.33	0.12	1300
100085	0.39	0.15	1150
100086	0.47	0.20	1000
100087	0.56	0.25	900
100088	0.68	0.30	800
100089	0.82	0.35	750
100090	1.0	0.40	700

a	b	c	d	e	f
.2	.2	.1	.1	1.0	#24

Inductance Tolerances: 0.01 to 0.082 uH, ±20%; 0.10 to 1.0 uH, ±10%.

T2 SERIES

Part Number	Apparent Induc., uH	Max. DC Resist., Ohms	Rated DC Current mA
100092	0.10	0.04	2200
100093	0.12	0.05	2000
100094	0.15	0.06	1800
100095	0.18	0.07	1600
100096	0.22	0.08	1500
100097	0.27	0.10	1400
100098	0.33	0.11	1300
100099	0.39	0.14	1200
100100	0.47	0.17	1100
100101	0.56	0.22	1000
100102	0.68	0.27	900
100103	0.82	0.30	800
100104	1.0	0.35	750
100105	1.2	0.40	700
100106	1.5	0.50	630
100107	1.8	0.70	530
100108	2.2	0.90	470
100109	2.7	1.1	420
100110	3.3	1.3	390
100111	3.9	1.5	360
100112	4.7	1.8	330
100113	5.6	2.0	310
100114	6.8	2.2	300
100115	8.2	2.4	290
100116	10	2.6	280

a	b	c	d	e	f
.2	.2	.1	.1	1.0	#24

Inductance Tolerances: 0.10 to 0.82 uH, ±10%; 1.0 to 10 uH, ±5%.

T3 SERIES

Part Number	Apparent Induc., uH	Max. DC Resist., Ohms	Rated DC Current mA
100117	10	1.1	550
100118	12	1.3	500
100119	15	1.5	450
100120	18	1.9	410
100121	22	2.3	380
100122	27	2.7	350
100123	33	3.3	320
100124	39	3.9	290
100125	47	4.7	260
100126	56	5.6	240
100127	68	6.8	220
100128	82	8.1	200
100129	100	9.7	180
100130	120	12	160
100131	150	14	150
100132	180	17	140
100133	220	20	130
100134	270	24	120
100135	330	19	130
100136	390	22	120
100137	470	27	110
100138	560	32	100
100139	680	19	130
100140	820	23	120
100141	1000	27	110

a	b	c	d	e	f
.27	.27	.2	.15	1.0	#22

Inductance Tolerance: ±5%.

T4 SERIES

Part Number	Apparent Induc., uH	Max. DC Resist., Ohms	Rated DC Current mA
100142	100	6	280
100143	120	7	260
100144	150	8	240
100145	180	10	220
100146	220	12	200
100147	270	14	180
100148	330	17	160
100149	390	20	150
100150	470	24	140
100151	560	28	130
100152	680	33	120
100153	820	39	110
100154	1000	45	100
100155	1200	31	120
100156	1500	37	110
100157	1800	44	100
100158	2200	52	90
100159	2700	61	85
100160	3300	71	80
100161	3900	82	75
100162	4700	93	70
100163	5600	105	65
100164	6800	140	60
100165	8200	160	55

a	b	c	d	e	f
.375	.375	.2	.187	1.0	#22

Inductance Tolerance: ±5%.

SERIES S, M, L MOLDED R.F. CHOKES

Series	Lengths	Diameter	Lead Size	Lead Length
S	.44 max.	.188 max.	#22 AWG	1.3 min.
M	.60 max.	.25 max.	#21 AWG	1.3 min.
L	.90 max.	.31 max.	#21 AWG	1.3 min.

Physical and Environmental Characteristics
Operating temperature −55° to +125°C
terminal strength—meets five pound pull test per MIL-C-15305
All Series meet requirements of MIL-C-15305, Grade 1, Class B

Inductance Tolerance: 0.1 to 22 uH, ±10% on Q-meter / 27 uH to 10,000, ±5% 1 kHz bridge

SERIES S				SERIES M				SERIES L			
Part Number	-L- Micro-Henries	Max DC Res, Ohms	Max I mA	Part Number	-L- Micro-Henries	Max DC Res, Ohms	Max I mA	Part Number	-L- Micro-Henries	Max DC Res, Ohms	Max I mA
100170	0.10	0.02	4000	100207	1.0	0.04	2700	100244	10.0	0.15	1800
100171	0.12	0.025	3500	100208	1.2	0.04	2700	100245	12.0	0.23	1600
100172	0.15	0.03	3000	100209	1.5	0.04	2700	100246	15.0	0.3	1300
100173	0.18	0.03	3000	100210	1.8	0.05	2500	100247	18.0	0.4	1150
100174	0.22	0.03	3000	100211	2.2	0.05	2500	100248	22.0	0.5	1000
100175	0.27	0.04	2700	100212	2.7	0.05	2500	100249	27.0	0.6	900
100176	0.33	0.05	2500	100213	3.3	0.05	2500	100250	33.0	0.7	850
100177	0.39	0.08	2000	100214	3.9	0.07	2100	100251	39.0	1.1	720
100178	0.47	0.08	2000	100215	4.7	0.09	1800	100252	47.0	1.3	620
100179	0.56	0.10	1700	100216	5.6	0.14	1550	100253	56.0	1.8	540
100180	0.68	0.12	1500	100217	6.8	0.17	1300	100254	68.0	2.4	450
100181	0.82	0.18	1300	100218	8.2	0.25	1150	100255	82.0	2.8	425
100182	1.0	0.24	1100	100219	10.0	0.32	1000	100256	100.0	3.2	400
100183	1.2	0.35	1000	100220	12.0	0.47	870	100257	120.0	4.8	360
100184	1.5	0.43	850	100221	15.0	0.62	730	100258	150.0	6.4	280
100185	1.8	0.65	720	100222	18.0	0.72	660	100259	180.0	9.5	240
100186	2.2	0.80	610	100223	22.0	0.8	600	100260	220.0	12.0	200
100187	2.7	0.12	1600	100224	27.0	1.2	520	100261	270.0	13.0	195
100188	3.3	0.15	1400	100225	33.0	1.5	450	100262	330.0	14.0	190
100189	3.9	0.23	1200	100226	39.0	2.3	380	100263	390.0	15.5	180
100190	4.7	0.30	1000	100227	47.0	3.0	300	100264	470.0	17.0	170
100191	5.6	0.45	900	100228	56.0	4.2	270	100265	560.0	18.5	165
100192	6.8	0.55	800	100229	68.0	5.2	250	100266	680.0	20.0	155
100193	8.2	0.65	720	100230	82.0	6.2	220	100267	820.0	22.0	150
100194	10.0	0.73	650	100231	100.0	7.0	200	100268	1000.0	24.0	145
100195	12.0	1.1	590	100232	120.0	7.5	200	100269	1200.0	27.0	137
100196	15.0	1.4	500	100233	150.0	8.0	190	100270	1500.0	29.0	130
100197	18.0	1.6	460	100234	180.0	9.0	185	100271	1800.0	32.0	125
100198	22.0	1.8	430	100235	220.0	10.0	180	100272	2200.0	35.0	120
100199	27.0	2.7	360	100236	270.0	11.0	172	100273	2700.0	40.0	112
100200	33.0	3.5	300	100237	330.0	12.0	165	100274	3300.0	45.0	105
100201	39.0	3.8	290	100238	390.0	13.0	157	100275	3900.0	49.0	100
100202	47.0	4.0	275	100239	470.0	14.0	150	100276	4700.0	53.0	95
100203	56.0	4.4	265	100240	560.0	16.0	145	100277	5600.0	60.0	90
100204	68.0	4.7	250	100241	680.0	17.0	140	100278	6800.0	67.0	85
100205	82.0	5.3	235	100242	820.0	19.0	132	100279	8200.0	75.0	82
100206	100.0	6.0	220	100243	1000.0	21.0	125	100280	10000.0	80.0	80

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MOLDED SHIELDED MINIATURE R F CHOKES

Part Number	MS Type	Induct. Micro-henries ±10%	D.C. Resist. Max.	Milli-amp Rating Max.
9250-101	75087-1	0.10	.025	1790
9250-121	75087-2	.12	.034	1530
9250-151	75087-3	.15	.037	1470
9250-181	75087-4	.18	.047	1300
9250-221	75087-5	.22	.067	1100
9250-271	75087-6	.27	.11	855
9250-331	75087-7	.33	.13	780
9250-391	75087-8	.39	.18	670
9250-471	75087-9	.47	.25	565
9250-561	75087-10	.56	.33	490
9250-681	75087-11	.68	.45	420
9250-821	75087-12	.82	.59	370
9250-102	75088-1	1.00	.07	1070
9250-122	75088-2	1.20	.10	895
9250-152	75088-3	1.50	.12	815
9250-182	75088-4	1.80	.14	775
9250-222	75088-5	2.20	.19	650
9250-272	75088-6	2.70	.28	535
9250-332	75088-7	3.30	.35	480
9250-392	75088-8	3.90	.40	450
9250-472	75088-9	4.70	.55	380
9250-562	75088-10	5.60	.72	335
9250-682	75088-11	6.80	1.02	280
9250-822	75088-12	8.20	1.32	250
9250-103	75088-13	10.0	1.62	220
9250-123	75088-14	12.0	2.00	200
9250-153	75089-1	15.0	.80	315
9250-183	75089-2	18.0	.89	300
9250-223	75089-3	22.0	.96	290
9250-273	75089-4	27.0	1.19	260
9250-333	75089-5	33.0	1.37	240
9250-393	75089-6	39.0	1.93	205
9250-473	75089-7	47.0	2.11	195
9250-563	75089-8	56.0	2.23	190
9250-683	75089-9	68.0	2.70	170
9250-823	75089-10	82.0	2.44	180
9250-104	75089-11	100.0	3.12	160
9250-124	75089-12	120.0	3.60	150
9250-154	75089-13	150.0	4.10	140
9250-184	75089-14	180.0	4.40	135
9250-224	75089-15	220.0	5.00	125
9250-274	75089-16	270.0	5.80	115
9250-334	75089-17	330.0	6.40	110
9250-394	75089-18	390.0	7.40	105
9250-474	75089-19	470.0	9.50	92
9250-564	75089-20	560.0	10.5	90
9250-684	75089-21	680.0	11.8	80
9250-824	75089-22	820.0	13.0	80
9250-105	75089-23	1,000.0	17.5	70
9250-125	75089-24	1,200.0	22.1	60
9250-155	75089-25	1,500.0	26.5	55
9250-185	75089-26	1,800.0	29.9	50
9250-225	75089-27	2,200.0	33.8	50
9250-275	75089-28	2,700.0	47.3	40
9250-335	75089-29	3,300.0	53.0	40
9250-395	75089-30	3,900.0	73.8	35
9250-475	75089-31	4,700.0	81.6	31
9250-565	75089-32	5,600.0	98.9	28
9250-685	75089-33	6,800.0	111.0	27
9250-825	75089-34	8,200.0	119.0	26
9250-106	75089-35	10,000.0	137.0	24
9250-126	75089-36	12,000.0	143.0	23
9250-156	75089-37	15,000.0	157.0	22
9250-186	75089-38	18,000.0	175.0	21
9250-226	75089-39	22,000.0	274.0	17
9250-276	75089-40	27,000.0	308.0	16
9250-336	75089-41	33,000.0	343.0	15
9250-396	75089-42	39,000.0	376.0	15
9250-476	75089-43	47,000.0	473.0	13
9250-566	75089-44	56,000.0	512.0	13
9250-686	75089-45	68,000.0	580.0	12
9250-826	75089-46	82,000.0	618.0	11
9250-107	75089-47	100,000.0	678.0	11

0.10 thru 0.82 uh — Phenolic Core.
1.00 thru 12 uh — Iron Core.
15 + uh — Ferrite Core.
Mold Size: .162 ±.010 Diameter; .410 ±.020 length.
Leads: AWG #22TCW; 1.438±.188 Length.

See General Catalog for Complete Off The Shelf Coverage

Custom Windings A Specialty — Let Us Quote On Your Requirements

MICRO MITE MOLDED RF CHOKES

Miller Part Number	MS Type	Induct. Micro-henries ±5%	D.C. Resist. Max.	Milli-amp Rating Max.	Mold Size
9210-54	90538-01	36	2.50	180	D
9210-56	90538-02	39	2.60	176	D
9210-58	90538-03	43	2.70	172	D
9210-60	90538-04	47	2.75	170	D
9210-62	90538-05	51	2.85	167	D
9210-64	90538-06	56	3.00	164	D
9210-66	90538-07	62	3.15	160	D
9210-68	90538-08	68	3.30	156	D
9210-70	90538-09	75	3.70	147	D
9210-72	90538-10	82	3.90	143	D
9210-74	90538-11	91	4.30	136	D
9210-76	90538-12	100	4.50	133	D
9210-78	90538-13	110	4.90	128	D
9210-80	90538-14	120	5.20	124	D
9210-82	90538-15	130	5.45	121	D
9210-84	90538-16	150	6.05	114	D
9210-86	90538-17	160	6.40	111	D
9210-88	90538-18	180	6.75	108	D
9210-90	90538-19	200	7.10	106	D
9210-92	90538-20	220	7.45	103	D
9210-94	90538-21	240	7.80	101	D
9220-00	90539-01	270	8.2	110	A
9220-02	90539-02	300	8.7	107	A
9220-04	90539-03	330	9.1	105	A
9220-06	90539-04	360	9.6	102	A
9220-08	90539-05	390	10.0	100	A
9220-10	90539-06	430	10.6	97	A
9220-12	90539-07	470	11.1	95	A
9220-14	—	500	11.6	93	A
9220-15	90539-08	510	11.6	92	A
9220-16	90539-09	560	12.3	91	A
9220-18	90539-10	620	13.0	88	A
9220-20	90539-11	680	13.7	85	A
9220-22	90539-12	750	14.4	83	A
9220-24	90539-13	820	15.1	81	A
9220-26	90539-14	910	15.8	79	A
9220-28	90539-15	1000	16.5	78	A
9220-30	90540-01	1100	21.0	78	B
9220-32	90540-02	1200	22.0	76	B
9220-34	90540-03	1300	23.0	75	B
9220-36	90540-04	1500	25.0	72	B
9220-38	90540-05	1600	26.0	70	B
9220-40	90540-06	1800	28.0	68	B
9220-42	90540-07	2000	29.0	67	B
9220-44	90540-08	2200	30.0	66	B
9220-46	90540-09	2400	31.0	64	B
9220-48	90540-10	2700	33.0	62	B
9220-50	90540-11	3000	35.0	61	B
9220-52	90540-12	3300	38.0	58	B
9220-54	90540-13	3600	40.0	57	B
9220-56	90541-01	3900	44.0	61	C
9220-58	90541-02	4300	46.0	59	C
9220-60	90541-03	4700	48.0	58	C
9220-62	90541-04	5000	50.0	57	C
9220-64	90541-05	5600	53.0	56	C
9220-66	90541-06	6200	56.0	54	C
9220-68	90541-07	6800	59.0	52	C
9220-70	90541-08	7500	62.0	51	C
9220-72	90541-09	8200	65.0	50	C
9220-74	90541-10	9100	68.0	49	C
9220-76	90541-11	10000	72.0	47	C

Mold Size	Mold Diameter	Mold Length	Lead Size	Lead Length
A	.190±.010	.440±.010	AWG #22	1.44±.188
B	.215±.010	.560±.010	AWG #21	1.44±.188
C	.240±.010	.740±.010	AWG #20	1.44±.188
D	.155±.010	.375±.010	AWG #22	1.44±.188

MOLDED RF CHOKES

Part No.	MS Type	L uH	Res. Max.	mA Max.
9360-01	91189-1	1.1±20%	0.09	2800
9360-02	91189-2	2.2±20%	.20	1800
9360-03	91189-3	3.3±10%	.32	1500
9360-04	91189-4	4.7±10%	.60	1100
9360-05	91189-5	6.8±10%	1.10	800
9360-06	91189-6	10.0±10%	1.80	600
9360-07	91189-7	15.0±10%	3.00	500
9360-08	91189-8	22.0±10%	.30	1500
9360-09	91189-9	33.0±10%	.60	1100
9360-10	91189-10	47.0±10%	1.20	700
9360-11	91189-11	82.0±10%	2.20	600
9360-12	91189-12	100.0±10%	2.80	500
9360-13	91189-13	120.0±10%	4.00	400

Mold Size: .281±.031 Diameter; .937±.0625 Length.
Leads: 1.500±.125.

MOLDED RF CHOKES

Miller Part Number	MS Type	Induct. Micro-henries*	D.C. Re-sist. Max.	Milli-amp Rating Max.
9310-00	18130-1	.15*	.03	2450
9310-02	18130-2	.22*	.055	1900
9310-04	18130-3	.33*	.09	1400
9310-06	18130-4	.47*	.12	1225
9310-07	18130-5	.56	.135	1220
9310-08	18130-6	.68	.15	1100
9310-10	18130-7	.82	.22	900
9310-12	18130-8	1.00	.29	830
9310-14	18130-9	1.20	.42	650
9310-16	18130-10	1.50	.50	600
9310-18	18130-11	1.80	.65	525
9310-20	18130-12	2.20	.95	435
9310-22	18130-13	2.70	1.20	385
9310-24	18130-14	3.30	2.00	300
9310-26	18130-15	3.90	2.30	280
9310-28	18130-16	4.70	2.60	260
9310-30	18130-17	5.60	.32	750
9310-32	18130-18	6.80	.50	600
9310-34	18130-19	8.20	.60	545
9310-36	18130-20	10.0	.90	445
9310-38	18130-21	12.0	1.10	404
9310-40	18130-22	15.0	1.40	370
9310-42	18130-23	18.0	2.25	280
9310-44	18130-24	22.0	2.50	265
9310-46	—	24.0	2.50	265
9310-48	18130-25	27.0	2.60	260
9310-50	—	30.0	2.80	255
9310-52	18130-26	33.0	3.00	250

Mold Size: .156±.010 Diameter; .375±.010 Lgth. Leads: AWG #22 TCW; 1.437±.188 Lgth.

9320-00	75008-21	.15*	.030	3000
9320-02	75008-22	.22*	.035	2800
9320-04	75008-23	.33*	.065	2000
9320-06	75008-24	.47*	.085	1700
9320-07	75008-25	.56	.125	1450
9320-08	75008-26	.68	.150	1300
9320-09	75008-27	.82	.205	1100
9320-10	75008-28	1.00	.290	930
9320-11	75008-29	1.20	.400	785
9320-12	75008-30	1.50	.485	700
9320-13	75008-31	1.80	.740	580
9320-14	75008-32	2.20	.970	505
9320-16	75008-33	2.70	1.20	460
9320-18	75008-34	3.30	.140	1350
9320-20	75008-35	3.90	.155	1250
9320-22	75008-36	4.70	.210	1100
9320-24	75008-37	5.60	.280	935
9320-26	75008-38	6.80	.375	810
9320-28	75008-39	8.20	.440	750
9320-30	75008-40	10.0	.605	640
9320-32	75008-41	12.0	1.05	490
9320-34	75008-42	15.0	1.20	460
9320-35	75008-43	18.0	1.95	360
9320-36	75008-44	22.0	2.20	335
9320-38	75008-45	27.0	2.75	300

Mold Size: .188±.031 Diameter; 0.437±.031 Lgth. Leads: AWG #22 TCW; 1.437±.188 Lgth.

9330-00	90542-01	.47	.06	1970
9330-01	90542-02	.56	.08	1850
9330-02	90542-03	.68	.08	1700
9330-03	90542-04	.82	.11	1520
9330-04	90542-05	1.00	.14	1290
9330-05	90542-06	1.20	.19	1120
9330-06	90542-07	1.50	.28	925
9330-07	90542-08	1.80	.37	790
9330-08	90542-09	2.20	.50	680
9330-10	90542-10	2.70	.65	600
9330-12	90542-11	3.30	1.00	480
9330-14	90542-12	3.90	1.20	440
9330-16	90542-13	4.70	1.80	360
9330-18	90542-14	5.60	.13	1340
9330-20	90542-15	6.80	.20	1080
9330-22	90542-16	8.20	.22	1030
9330-24	90542-17	10.0	.26	950
9330-26	90542-18	12.0	.45	720
9330-28	90542-19	15.0	.52	670
9330-30	90542-20	18.0	.70	580
9330-32	90542-21	22.0	1.00	480
9330-34	90542-22	27.0	1.30	420
9330-36	90542-23	33.0	1.50	390
9330-38	90542-24	39.0	2.00	340

Mold Size: .22±.03 Diameter; 0.560±.010 Length. Leads: AWG #22 TCW; 1.437±.19 Length.
*Inductance Tolerance: ±20%.
All Others 10%.

R.F. CHOKES J. W. MILLER DIVISION, BELL INDUSTRIES / DEPT. EM, 19070 Reyes Ave., Rancho Dominguez, CA 90221 / (213) 537-5200

SUB-MINIATURE RF CHOKES

An extremely versatile series of iron core R.F. chokes designed to meet the industries' demand for high reliability, ultra-miniature components. The coils are ideally suited to network and filter design, delay lines and computer applications. The coils are impregnated with a moisture resistant lacquer and on special order they can be fungus-proofed per JAN-T-152 using varnish per MIL-V-173A. They can also be encapsulated in epoxy resin to conform to Grade 1, Class B of MIL-C-15305. Note: L measured on 260A Q Meter except120 thru 500 mH which are measured on 1 kHz Bridge.

Miller Part No.	Inductance Nominal*	D.C. Resistance Max.	Milliamp Rating Max.	Max. Winding Diam.	Form Length ±1/32
70F107AP	.10 uh★	.013	3922	.156	5/16
70F157AP	.15 uh★	.025	2828	.141	5/16
70F227AP	.22 uh★	.038	2294	.141	5/16
70F337AP	.33 uh★	.070	1690	.125	5/16
70F477AP	.47 uh★	.125	1264	.125	5/16
70F687AP	.68 uh★	.200	1000	.125	5/16
70F757AP	.75 uh★	.264	870	.125	5/16
70F827AP	.82 uh★	.290	830	.125	5/16
70F106AI	1.0 uh	.048	2041	.165	1/4
70F126AI	1.2 uh	.072	1666	.160	1/4
70F156AI	1.5 uh	.096	1443	.160	1/4
70F186AI	1.8 uh	.096	1443	.160	1/4
70F226AI	2.2 uh	.156	1132	.160	1/4
70F276AI	2.7 uh	.168	1091	.160	1/4
70F336AI	3.3 uh	.240	912	.150	1/4
70F396AI	3.9 uh	.264	870	.150	1/4
70F476AI	4.7 uh	.457	661	.150	1/4
70F566AI	5.6 uh	.492	637	.150	1/4
70F686AI	6.8 uh	.624	566	.150	1/4
70F756AI	7.5 uh	.624	566	.150	1/4
70F826AI	8.2 uh	.744	518	.150	1/4
70F916AI	9.1 uh	1.44	288	.160	1/4
70F105AI	10 uh	1.56	277	.160	1/4
70F125AI	12 uh	1.68	267	.160	1/4
70F155AI	15 uh	1.92	250	.165	1/4
70F185AI	18 uh	2.28	229	.165	1/4
70F225AI	22 uh	2.28	229	.165	1/4
70F255AI	25 uh	2.64	213	.170	1/4
70F275AI	27 uh	2.64	213	.170	1/4
70F335AI	33 uh	2.76	208	.170	1/4
70F395AI	39 uh	3.36	188	.175	1/4
70F475AI	47 uh	3.36	188	.175	1/4
70F565AI	56 uh	3.84	176	.180	1/4
70F685AI	68 uh	4.20	169	.180	1/4
70F755AI	75 uh	4.56	162	.185	1/4
70F825AI	82 uh	4.80	158	.185	1/4
70F915AI	91 uh	4.92	156	.185	1/4
70F104AI	100 uh	7.68	139	.165	1/4
70F124AI	120 uh	8.16	135	.165	1/4
70F154AI	150 uh	8.16	135	.165	1/4
70F184AI	180 uh	8.16	135	.170	1/4
70F204AI	200 uh	10.3	120	.170	1/4
70F224AI	220 uh	11.5	114	.170	1/4
70F254AI	250 uh	12.1	111	.170	1/4
70F274AI	270 uh	13.2	106	.175	1/4
70F304AI	300 uh	13.2	106	.175	1/4
70F334AI	330 uh	13.9	103	.175	1/4
70F354AI	350 uh	14.4	102	.180	1/4
70F394AI	390 uh	15.8	97	.180	1/4
70F474AI	470 uh	16.3	95	.185	1/4
70F504AI	500 uh	18.0	91	.195	1/4
70F564AI	560 uh	19.2	88	.195	1/4
70F684AI	680 uh	19.8	87	.200	1/4
70F754AI	750 uh	22.9	80	.210	1/4
70F824AI	820 uh	22.9	80	.210	1/4
70F914AI	910 uh	24.0	79	.220	1/4
70F103AI	1.00 mh	24.0	79	.225	1/4
70F123AI	1.20 mh	33.6	66	.220	1/4
70F153AI	1.50 mh	37.2	63	.225	1/4
70F183AI	1.80 mh	42.0	59	.235	1/4
70F223AI	2.20 mh	45.6	57	.240	1/4
70F253AI	2.50 mh	45.6	57	.260	3/8
70F273AI	2.70 mh	45.6	57	.260	3/8
70F333AI	3.30 mh	51.6	53	.260	3/8
70F393AI	3.90 mh	57.6	51	.275	3/8
70F473AI	4.70 mh	64.8	48	.285	3/8
70F563AI	5.60 mh	69.6	46	.300	3/8
70F683AI	6.80 mh	78.0	43	.310	3/8
70F753AI	7.50 mh	85.2	41	.310	3/8
70F823AI	8.20 mh	92.4	40	.330	3/8
70F913AI	9.10 mh	98.4	39	.330	3/8
70F102AI	10.0 mh	101	38	.335	3/8
70F122AI	12 mh	100	50	.300	1/2
70F152AI	15 mh	113	47	.300	1/2
70F182AI	18 mh	128	44	.325	1/2
70F222AI	22 mh	144	41	.330	1/2
70F252AF	25 mh	115	46	.340	5/8
70F272AF	27 mh	120	45	.353	5/8
70F332AF	33 mh	134	43	.353	5/8
70F392AF	39 mh	147	41	.370	5/8
70F472AF	47 mh	168	38	.384	5/8
70F502AF	50 mh	175	37	.400	5/8
70F562AF	56 mh	189	36	.400	5/8
70F682AF	68 mh	215	34	.415	5/8
70F752AF	75 mh	222	33	.430	5/8
70F822AF	82 mh	238	32	.430	5/8
70F912AF	91 mh	250	31	.430	5/8
70F101AF	100 mh	278	29	.446	5/8
70F121AF	120 mh	288	48	.485	7/8
70F151AF	150 mh	328	44	.505	7/8
70F181AF	180 mh	374	41	.525	7/8
70F221AF	220 mh	424	39	.540	7/8
70F251AF	250 mh	468	37	.555	7/8
70F271AF	270 mh	490	36	.570	7/8
70F331AF	330 mh	540	34	.580	7/8
70F391AF	390 mh	617	33	.600	7/8
70F471AF	470 mh	704	30	.615	7/8
70F501AF	500 mh	736	30	.635	7/8

* Tolerance 0.1 to 1.0 uh ±20%, 1.1 to 15 uh ±10%, over 15 uh ±5%. ★ Measured with leads 1/4" long from Q Meter binding posts.

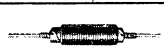
PHENOLIC CORE SINGLE LAYER WINDINGS

Dimensions of core: 3/16" diameter x 3/4" long. Leads are 1 1/2" long.

Miller Part Number	Inductance Nominal*	D. C. Resistance Maximum	Milliamp Rating Maximum	Diameter over Winding
4602	1.0 uh	.050	2000	.270
4604	1.5 uh	.093	1800	.270
4606	2.4 uh	.190	1500	.270
4608	3.9 uh	.450	1000	.270
4609	5 5 uh	.670	850	.270
4610	6.2 uh	.830	700	.270
4611	8.2 uh	1.20	600	.270
4612	10.0 uh	1.50	500	.270

*Tolerance 1.0 uh ±20%, 1.1 to 10 uh ±10%

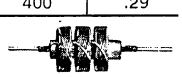
IRON CORE SINGLE LAYER WINDINGS



Dimensions of core: 7/32" diameter x 7/8" long. Leads are 1 1/2" long.

4622	10 uh ±5%	.11	1500	.29
4624	15 uh ±5%	.17	1000	.29
4626	24 uh ±5%	.34	800	.29
4628	39 uh ±5%	.65	600	.29
4629	55 uh ±5%	1.0	500	.29
4630	62 uh ±5%	1.2	475	.29
4631	82 uh ±5%	1.9	450	.29
4632	100 uh ±5%	3.0	400	.29

PHENOLIC CORE 3-SECTION WINDINGS



Dimensions of core: 3/16" diameter x 3/4" long. Leads are 1 1/2" long.

4642	.10 mh ±5%	5.4	160	.406
4644	.15 mh ±5%	6.5	160	.406
4646	.24 mh ±5%	8.5	160	.438
4648	.39 mh ±5%	11	160	.500
4649	.55 mh ±5%	13	160	.500
4650	.62 mh ±5%	15	160	.531
4651	.75 mh ±5%	16	160	.531
4652	1.0 mh ±5%	19	160	.563

IRON CORE 3-SECTION WINDINGS

Dimensions of core: 7/32" diameter x 7/8" long. Leads are 1 1/2" long.

Miller Part Number	Inductance @ 1000 Hertz	D. C. Resistance Maximum	Milliamp Rating Maximum	Diameter over Winding
4662	1.0 mh ±5%	8.6	160	.469
4664	1.5 mh ±5%	11	160	.469
4666	2.4 mh ±5%	15	160	.531
4668	3.9 mh ±5%	20	160	.563
4669	5.5 mh ±5%	25	160	.594
4670	6.2 mh ±5%	37	100	.531
4671	8.2 mh ±5%	46	100	.563
4672	10 mh ±5%	50	100	.594

FERRITE CORE 3-SECTION WINDINGS

Dimensions of core: 1/4" diameter x 7/8" long. Leads are 1 1/2" long.

6302	2.5 mh ±5%	9.0	160	.469
6304	5.0 mh ±5%	14	160	.531
6306	10 mh ±5%	31	100	.531
6308	25 mh ±5%	82	65	.531
6310	50 mh ±5%	127	65	.625

SINGLE LAYER COLOR CODED RF CHOKES

The following solenoid wound R.F. Chokes are impregnated with a thermosetting varnish and are color coded to EIA standards. Form Dimensions .156 x 1/2".

Part No.	L*	R Ohms Max.	I Ma. Max.	Part No.	L*	R Ohms Max.	I Ma. Max.
74F106AP	1.0 uh	.20	1000	74F125AP	12 uh	3.60	200
74F126AP	1.2 uh	.22	950	74F155AP	15 uh	6.00	150
74F156AP	1.5 uh	.25	900	74F185AP	18 uh	7.50	100
74F186AP	1.8 uh	.28	850	74F225AI	22 uh	2.00	500
74F226AP	2.2 uh	.30	800	74F275AI	27 uh	1.85	450
74F276AP	2.7 uh	.50	700	74F335AI	33 uh	2.00	450
74F336AP	3.3 uh	.70	600	74F395AI	39 uh	2.60	400
74F396AP	3.9 uh	.80	500	74F475AI	47 uh	3.50	350
74F476AP	4.7 uh	1.00	400	74F565AI	56 uh	3.75	300
74F566AP	5.6 uh	1.80	350	74F685AI	68 uh	4.00	250
74F686AP	6.8 uh	1.85	300	74F825AI	82 uh	5.10	200
74F826AP	8.2 uh	1.90	275	74F104AI	100 uh	6.00	150
74F105AP	10 uh	3.00	250				

* Tolerance 1.0 to 2.2 uh, ±20%, 2.7 to 100 uh, ±10%

J. W. MILLER DIVISION, BELL INDUSTRIES / DEPT. EM, 19070 Reyes Ave., Rancho Dominguez, CA 90221 / (213) 537-5200

SEE OUR INDUSTRIAL CATALOG FOR COMPLETE COVERAGE

Custom Windings — May We Quote On Your Requirements?

VLS SERIES VARIABLE INDUCTORS (SHIELDED)

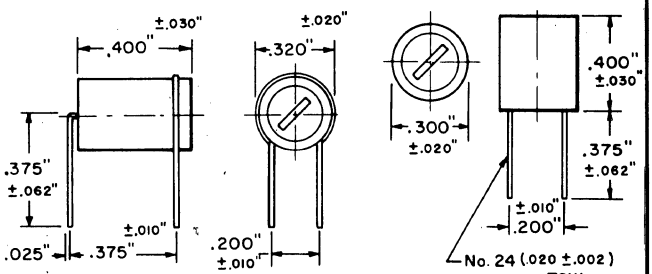
May be mounted either Vertically or Horizontally

Printed Circuit: Mil-C-15305

Tunable Range: .10 uH .12 uH ±5% — All others ±10%

Operating Temperature: −55°C to +125°C

Leads: No. 24 TCW

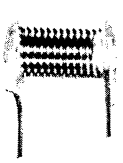


HORIZONTAL STYLE VERTICAL STYLE

Part No.	Nom. L	DCR 25°C, Max. Ohms	Max. I mA	Part No.	Nom. L	DCR 25°C, Max. Ohms	Max. I mA
VLSR10	.10	0.030	2500	VLS121	120.00	2.38	316
VLSR12	.12	0.030	2500	VLS151	150.00	2.52	306
VLSR15	.15	0.030	2500	VLS181	180.00	2.88	288
VLSR18	.18	0.035	2400	VLS221	220.00	3.18	273
VLSR22	.22	0.038	2300	VLS271	270.00	3.50	260
VLSR27	.27	0.040	2200	VLS331	330.00	4.80	222
VLSR33	.33	0.040	2200	VLS391	390.00	5.44	209
VLSR39	.39	0.045	2100	VLS471	470.00	5.90	201
VLSR47	.47	0.045	2100	VLS561	560.00	6.30	194
VLSR56	.56	0.050	2000	VLS681	680.00	7.20	181
VLSR68	.68	0.055	1900	VLS821	820.00	8.00	172
VLSR82	.82	0.060	1800	VLS102	1,000.00	12.00	141
VLS1R0	1.00	0.070	1700	VLS122	1,200.00	13.50	132
VLS1R2	1.20	0.085	1670	VLS152	1,500.00	16.50	119
VLS1R5	1.50	0.100	1540	VLS182	1,800.00	18.00	114
VLS1R8	1.80	0.110	1470	VLS222	2,200.00	20.50	107
VLS2R2	2.20	0.120	1410	VLS272	2,700.00	22.50	102
VLS2R7	2.70	0.125	1380	VLS332	3,300.00	42.00	76
VLS3R3	3.30	0.165	1200	VLS392	3,900.00	47.50	71
VLS3R9	3.90	0.180	1135	VLS472	4,700.00	53.00	67
VLS4R7	4.70	0.245	985	VLS562	5,600.00	62.50	65
VLS5R6	5.60	0.265	950	VLS682	6,800.00	69.50	58
VLS6R8	6.80	0.330	853	VLS822	8,200.00	75.00	56
VLS8R2	8.20	0.460	720	VLS103	10,000.00	100.00	49
VLS100	10.00	0.640	620	VLS123	12,000.00	64.00	60
VLS120	12.00	0.800	545	VLS153	15,000.00	84.00	52
VLS150	15.00	0.865	520	VLS183	18,000.00	93.00	50
VLS180	18.00	0.940	504	VLS223	22,000.00	104.00	45
VLS220	22.00	1.03	460	VLS273	27,000.00	173.00	35
VLS270	27.00	1.18	418	VLS333	33,000.00	187.00	32
VLS330	33.00	1.30	398	VLS393	39,000.00	220.00	30
VLS390	39.00	1.41	385	VLS473	47,000.00	253.00	28
VLS470	47.00	1.61	350	VLS563	56,000.00	285.00	26
VLS560	56.00	2.08	330	VLS683	68,000.00	311.00	24
VLS680	68.00	2.20	320	VLS823	82,000.00	385.00	22
VLS820	82.00	2.42	300	VLS104	100,000.00	420.00	20
VLS101	100.00	2.15	333				

FIXED COILS

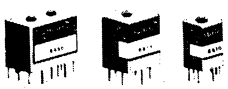
The 75F series are of Polypropylene moulded around an accurately positioned winding. Unsurpassed stability and uniformity is obtained.



Frequency range: 50 MHz to 450 MHz
Lead length: 3/16" ±1/32"
Maximum length: .38 inches
Maximum width: .23 inches

Miller Part Number	Inductance	Q Minimum	DC Current	Wire Size
75F238MPC	.023 uH	110	1A	22 AWG
75F328MPC	.032 uH	110	1A	22 AWG
75F518MPC	.051 uH	110	1A	22 AWG
75F117MPC	.110 uH	110	1A	22 AWG
75F157MPC	.150 uH	110	1A	22 AWG
75F227MPC	.270 uH	110	.5A	26 AWG
75F397MPC	.390 uH	110	.5A	26 AWG
75F477MPC	.470 uH	110	.5A	26 AWG
75F597MPC	.590 uH	110	.5A	26 AWG

I.F. COMPONENTS SUB MINIATURE



The transformers in this series represents the state of the art, as it relates to a commercial product. In both the 455 kc. and 10.7 Mc. groups there are a complete set of I.F. transformers as well as Ratio Detector and Discriminator transformers.

Dimensions: 8849, 8850, 8851, 8805, 8806, 8807 — 25/32" x 7/16" x 1/2" high • 8852, 8853 & 8854 — 13/32" sq. x 5/8" high • 8810, 8811, 8812 & 8813 — 9/32" sq. x 15/32" high

Cat. No.	Specs	Description
	10.7 Mc. Transistor Transformers	
8849	500 kc. P P	10.7 Mc. Ratio Detector
8850	300 kc. P P	10.7 Mc. Discriminator
8851-A	6 db 300 kc.	10.7 Mc. Double Tuned IF
8852	100 K-300	10.7 Mc. Single Tuned IF
8853	20 K-500	10.7 Mc. Single Tuned IF
8854	25 K-500	10.7 Mc. Single Tuned IF
	455 Kc. Transistor Transformers	
8805	20 kc. P P	455 kc. Ratio Detector
8806	20 kc. P P	455 kc. Discriminator
8807	6 db 15 kc.	455 kc. Double Tuned IF
8810	50 K-500	455 kc. Single Tuned IF
8811	30 K-500	455 kc. Single Tuned IF
8812	20 K-5 K	455 kc. Single Tuned IF
8813	Oscillator (455 kc. IF). (Tuning Cap. 78 to 110 pf. Max.)	

ADJUSTABLE R.F. COILS 9100 SERIES SHIELDED

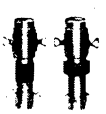
These ultra compact adjustable coils offer a good inductance range with relatively small changes in Q. Tuning is accessible from either top or bottom of the assembly. Magnetic shielding is achieved by the use of cup cores while the copper shield offers effective electro static shielding. Printed circuit terminals on base and shield.

Applications between 10 kHz and 200 MHz
Dimensions: .440" Sq. x .550" High.

Part No.	L Min.	L Max.	Max. DC Ohms	Max. Current
9101	.099	.134	0.01	4.85 A
9102	.129	.192	0.01	4.43 A
9103	.165	.258	0.02	3.97 A
9104	.246	.418	0.02	3.83 A
9105	.366	.627	0.02	3.43 A
9106	.588	.950	0.90	516.00 mA
9107	.830	1.54	1.02	485.00 mA
9108	1.44	2.94	1.38	417.00 mA
9109	2.52	5.70	1.76	368.00 mA
9110	5.35	13.49	2.92	286.00 mA
9111	12.50	29.45	4.72	225.00 mA
9112	26.25	71.25	6.97	185.00 mA
9113	64.57	163.00	9.98	155.00 mA
9114	147.00	430.00	16.32	121.00 mA
9115	422.00	1.10	27.84	92.00 mA
9116	1.05	3.74	41.06	76.00 mA
9117	3.36	11.12	78.92	55.00 mA

ECONOMY ADJUSTABLE R.F. CHOKES

Through the use of a recently developed Nylon molding process we are able to offer an inexpensive line of adjustable chokes. These items feature a wide inductance range which has been achieved through the use of a threaded ferrite core. They can be adjusted from either the top or bottom. This lends a degree of flexibility to your design. Mounting is achieved by means of a metal clip in a 5/16" round hole or a special keyed hole. Instructions supplied with each coil.

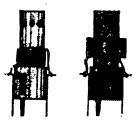


Dimensions: 3/8" x 1 3/8" long.

Miller Part Number	Inductance Minimum	Inductance Maximum	R Ohms Max.	Max. Current Ma.
4201	.300 uh	.580 uh	.04	636
4201-A	.550 uh	1.10 uh	.05	636
4202	1.00 uh	2.50 uh	.15	400
4203	2.00 uh	5.50 uh	.19	400
4204	5.00 uh	12.0 uh	1.1	126
4205	10.0 uh	25. uh	1.6	100
4206	20.0 uh	55. uh	2.3	100
4207	50.0 uh	140. uh	4.0	100
4208	120. uh	330. uh	6.6	100
4209	310. uh	860. uh	12.	100

J. W. MILLER DIVISION, BELL INDUSTRIES / DEPT. EM, 19070 Reyes Ave., Rancho Dominguez, CA 90221 / (213) 537-5200

VERTICAL MOUNTED PRINTED CIRCUIT VELVETORK ADJUSTABLE RF COILS



Dimensions (form only) Over Collar 3/8" Dia. x 3/4" long.

The coil form is Polyester impregnated Alpha Cellulose tubing with internally bonded resilient ribs which provide both thread and torque control. Coils may be adjusted from either end of form.

Miller Part No.	Inductance Min.	Inductance Max.	R Ohms Max.	Max. Current Ma.	Dia. over Winding
23A107RPC	.095 uH	.125 uH	.02	4100	.40
23A157RPC	.130 uH	.170 uH	.02	1600	.37
23A227RPC	.185 uH	.265 uH	.02	1600	.37
23A337RPC	.285 uH	.410 uH	.03	1000	.37
23A477RPC	.420 uH	.580 uH	.03	2500	.37
23A687RPC	.540 uH	.850 uH	.03	1600	.37
23A827RPC	.640 uH	1.00 uH	.03	1600	.37
23A106RPC	.760 uH	1.25 uH	.04	1600	.37
23A156RPC	1.20 uH	1.87 uH	.06	1000	.37
23A226RPC	1.65 uH	2.75 uH	.14	400	.37
23A336RPC	2.40 uH	4.10 uH	.17	400	.37
23A476RPC	3.40 uH	5.80 uH	.24	400	.37
23A686RPC	4.60 uH	8.50 uH	.39	250	.37
23A826RPC	5.60 uH	10.00 uH	.64	160	.37
23A105RPC	7.10 uH	12.50 uH	.77	160	.37
23A155RPC	10.00 uH	18.70 uH	1.68	100	.37
23A225RPC	14.80 uH	27.50 uH	1.91	100	.37
23A335RPC	22.00 uH	41.00 uH	2.34	100	.37
23A475RPC	31.00 uH	58.00 uH	2.72	100	.40
23A685RPC	43.50 uH	85.00 uH	3.30	100	.40
23A825RPC	61.00 uH	100.00 uH	3.89	100	.40
23A104RPC	76.00 uH	125.00 uH	4.39	100	.40
23A154RPC	105.00 uH	187.00 uH	5.46	100	.40
23A224RPC	160.00 uH	275.00 uH	6.70	100	.44
23A334RPC	240.00 uH	410.00 uH	8.30	100	.44
23A474RPC	360.00 uH	580.00 uH	10.50	100	.48
23A684RPC	530.00 uH	850.00 uH	12.90	100	.48
23A824RPC	700.00 uH	1.00 mH	14.90	100	.53
23A103RPC	910.00 uH	1.25 mH	17.10	100	.58
23A153RPC	990.00 uH	1.87 mH	28.20	65	.45
23A223RPC	1.60 mH	2.75 mH	34.80	65	.45
23A333RPC	2.40 mH	4.10 mH	42.90	65	.48
23A473RPC	3.40 mH	5.80 mH	51.60	65	.48
23A683RPC	5.15 mH	8.50 mH	63.60	65	.55
23A823RPC	7.40 mH	10.00 mH	75.60	65	.55
23A102RPC	9.80 mH	12.50 mH	87.30	65	.55
23A152RPC	12.00 mH	18.70 mH	111.00	65	.60
23A222RPC	12.10 mH	27.50 mH	197.00	33	.60
23A332RPC	18.20 mH	41.00 mH	244.00	33	.60
23A472RPC	27.50 mH	58.00 mH	302.00	33	.60
23A682RPC	40.00 mH	85.00 mH	378.00	33	.58
23A822RPC	50.00 mH	100.00 mH	423.00	33	.58
23A101RPC	62.00 mH	125.00 mH	468.00	33	.60

SHIELDED SUBMINIATURE ADJUSTABLE RF COILS

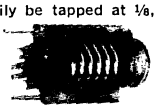
Dimensions: 1/2" sq., x 5/8" high.

These compact adjustable coils offer a minimum two-to-one inductance range with relatively small changes in Q. The tuning adjustment is accessible from either the top or bottom of the coil assembly. Magnetic shielding is achieved through the use of cup cores while the metal shield offers effective electrostatic shielding. Printed circuit terminals on base and shield.

Miller Part No.	Inductance Min.	Inductance Max.	R Ohms Max.	Max. Current Ma.
9050	1.5 uH	3.0 uH	.66	80
9051	3.0 uH	7.0 uH	.85	125
9052	7.0 uH	14.0 uH	1.38	80
9053	14.0 uH	28.0 uH	2.10	80
9054	28.0 uH	60.0 uH	3.00	100
9055	60.0 uH	120.0 uH	4.00	100
9056	120.0 uH	280.0 uH	5.75	80
9057	280.0 uH	650.0 uH	12.00	80
9058	650.0 uH	1.3 mH	15.00	100
9059	1.3 mH	3.0 mH	23.00	100
9059-1	1.8 mH	2.2 mH	10.00	141
9060	3.0 mH	10.0 mH	76.00	30
9061	8.0 mH	20.0 mH	110.00	30
9062	15.0 mH	40.0 mH	150.00	30
9063	20.0 mH	60.0 mH	175.00	25

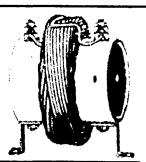
HIGH Q MOLDED ADJUSTABLE COILS

The 48A Series of coils listed below may easily be tapped at 1/8, 1/4, 3/8, 5/8, 3/4, 7/8 turn if desired.
Frequency Range: 30 MHz to 250 MHz
Wire Size: 20 AWG tinned copper
Form Length: .73 inches
Coil OD: .310 inches
Lead Spacing: .408 inches
Core: 10-32 x 3/8" Carbonyl J



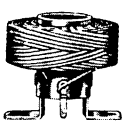
Miller Part No.	Minimum Inductance	Maximum Inductance	D.C. Current
48A518mpc	.046 uH	.055 uH	2A
48A778mpc	.071 uH	.082 uH	2A
48A117mpc	.099 uH	.122 uH	2A
48A147mpc	.118 uH	.157 uH	2A
48A187mpc	.150 uH	.207 uH	2A
48A227mpc	.181 uH	.278 uH	2A
48A257mpc	.209 uH	.283 uH	2A
48A287mpc	.241 uH	.316 uH	2A
48A317mpc	.270 uH	.351 uH	2A

MEDIUM DUTY DUO-LATERAL LINE FILTER CHOKES



Cat. No.	Amps.	Ohms	Induc.	Dimensions
7826	5	.28	570 uH	2 1/2" x 4"
7827	10	.15	370 uH	2 1/2" x 4"
7828	15	.085	200 uH	2 1/2" x 4"
7829	20	.05	135 uH	2 1/2" x 4"

LIGHT DUTY DUO-LATERAL LINE FILTER CHOKES



Single Line Filter Chokes
Dimensions: 1 7/8" x 1 3/4".

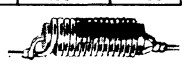
Cat. No.	Amps.	Ohms	uH
7825	2	.7	600
7825-3	3	.25	250
7825-5	5	.1	100
7825-8	8	.05	50

DUAL LINE FILTER CHOKES

Dimensions: 3 1/4" x 2 1/8".

Cat. No.	Amps.	Ohms	uH
D-7825	2	.7	600
D-7825-3	3	.25	250
D-7825-5	5	.1	100
D-7825-8	8	.05	50

HEAVY DUTY HASH CHOKES



Part No.	uH ±20%	Ohms Max.	Amps.	Dimensions
5218	3.35	.010	20	17/32" x 1 5/16"
5219	4.90	.016	15	1/2" x 1 1/4"
5220	8.80	.021	10	1/2" x 1 1/4"
5230	4.00	.012	8	5/16" x 29/32"
5240	40.00	.082	3	5/16" x 1 1/4"
5248	68.00	.054	5	17/32" x 1 1/4"
5250	100.00	.216	2	5/16" x 1 1/4"
5252	125.00	.080	3.5	1/2" x 1 1/4"
5254	250.00	.170	2.5	7/16" x 1 1/4"
5256	500.00	.260	2.0	5/16" x 1 1/4"
5258	1000.00	.550	1.0	1/2" x 1 1/4"
*5300	100.00	.087	2.5	3/4" x 1 1/32"

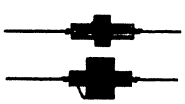
*Dual Choke:
Electrical measurements per section

DUAL LINE FILTER CHOKES

Miller Dual Duo-Lateral Line Filter Chokes are wound with two coils on one form, giving the advantage of small physical size in cases where space requirements are stringent and two single coils would occupy too much area. Identical in specifications, except for dimensions, to our single type Duo-Lateral chokes. They are wound on white ceramic forms 2" in diameter by 4 1/2" long.

Cat. No.	Amps.	Ohms	uH	Dimensions
D-7826	5	.28	570	4 1/2" x 4"
D-7827	10	.15	370	4 1/2" x 4"
D-7828	15	.085	200	4 1/2" x 4"
D-7829	20	.05	135	4 1/2" x 4"

SINGLE PI FERRITE CORE RF CHOKES



This series of single pi RF Chokes affords maximum Q with minimum resistance through the use of ferrite core material. The coils are impregnated in a fungus resistant lacquer. Form Dimensions .187" x 5/8".

Part No.	L ±5%	Max. R Ohms	Max. Ma.
73F104AF	100.0 uH	2.0	250
73F124AF	120.0 uH	2.2	250
73F154AF	150.0 uH	2.5	250
73F184AF	180.0 uH	2.9	250
73F224AF	220.0 uH	3.2	250
73F274AF	270.0 uH	3.6	250
73F334AF	330.0 uH	3.8	250
73F394AF	390.0 uH	4.2	225
73F474AF	470.0 uH	4.8	200
73F564AF	560.0 uH	5.3	200
73F684AF	680.0 uH	6.0	200
73F824AF	820.0 uH	6.8	200
73F103AF	1.0 mH	7.5	150
73F123AF	1.2 mH	7.8	150
73F153AF	1.5 mH	8.8	150
73F183AF	1.8 mH	11.0	150
73F223AF	2.2 mH	12.0	150
73F273AF	2.7 mH	13.5	125
73F333AF	3.3 mH	15.1	125
73F393AF	3.9 mH	18.0	125
73F473AF	4.7 mH	21.5	100
73F563AF	5.6 mH	25.0	80
73F683AF	6.8 mH	29.0	80
73F823AF	8.2 mH	30.0	80
73F102AF	10.0 mH	34.0	80

MICRO-MINIATURE MOLDED RF CHOKES

We are pleased to offer the following series of molded RF chokes. They represent what we believe to be the smallest package for the current rating specified. Color Coding is per MIL-C-15305.

Miller Part No.	MS Type	Inductance Micro-henries ±10%	Max. D.C. Resistance	Milli-amp Rating Max.
9230-94	75083-1	.10	.07	1100
9230-96	75083-2	.12	.08	1100
9230-00	75083-3	.15	.10	1100
9230-02	75083-4	.18	.12	1010
9230-04	75083-5	.22	.14	935
9230-06	75083-6	.27	.16	875
9230-08	75083-7	.33	.20	780
9230-10	75083-8	.39	.30	640
9230-12	75083-9	.47	.35	590
9230-14	75083-10	.56	.50	495
9230-16	75083-11	.68	.60	450
9230-18	75083-12	.82	.85	380
9230-20	75083-13	1.00	1.00	350
9230-22	75084-1	1.20	.18	825
9230-24	75084-2	1.50	.22	745
9230-26	75084-3	1.80	.30	640
9230-28	75084-4	2.20	.40	550
9230-30	75084-5	2.70	.50	495
9230-32	75084-6	3.30	.85	380
9230-34	75084-7	3.90	1.00	350
9230-36	75084-8	4.70	1.20	320
9230-38	75084-9	5.60	1.80	260
9230-40	75084-10	6.80	2.00	245
9230-42	75084-11	8.20	2.70	210
9230-44	75084-12	10.00	3.70	180
9230-46	75084-13	12.00	2.70	210
9230-48	75084-14	15.00	2.80	205
9230-50	75084-15	18.00	3.10	195
9230-52	75084-16	22.00	3.30	190
9230-54	75084-17	27.00	3.50	185
9230-56	75085-1	33.00	3.40	187
9230-58	75085-2	39.00	3.60	180
9230-60	75085-3	47.00	4.50	165
9230-62	75085-4	56.00	5.70	145
9230-64	75085-5	68.00	6.70	135
9230-66	75085-6	82.00	7.30	130
9230-68	75085-7	100.00	8.00	125
9230-70	75085-8	120.00	13.00	97
9230-72	75085-9	150.00	15.00	85
9230-74	75085-10	180.00	17.00	79
9230-76	75085-11	220.00	21.00	73
9230-78	75085-12	270.00	25.00	65
9230-80	75085-13	330.00	28.00	62
9230-82	75085-14	390.00	35.00	55
9230-84	75085-15	470.00	42.00	50
9230-86	75085-16	560.00	46.00	48
9230-88	75085-17	680.00	60.00	42
9230-90	75085-18	820.00	65.00	40
9230-92	75085-19	1000.00	72.00	38

Mold Size: .095 ±.010 Diameter; .250 ±.010 Length.
Leads: AWG #24 TCW; 1.500 ±.188 Length.

J. W. MILLER DIVISION, BELL INDUSTRIES / DEPT. EM, 19070 Reyes Ave., Rancho Dominguez, CA 90221 / (213) 537-5200

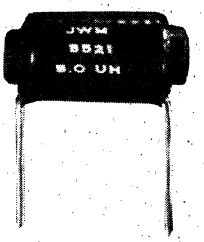
J.W. Miller 5500 & 5600
HIGH CURRENT FILTER CHOKES

Chokes are ideal for all EMI/RFI filtering applications. They are also suitable for energy storage inductors in switching power supplies.

Covered with shrink tubing and varnish impregnated.

Printed Circuit mounting.

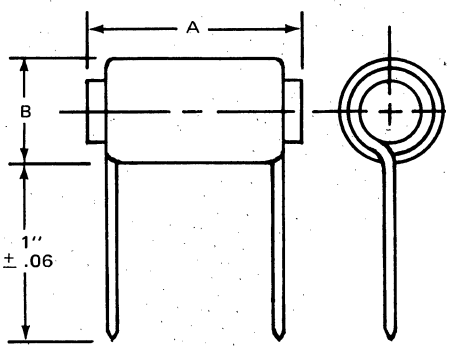
5500 SERIES — High saturation flux density ferrite rods.



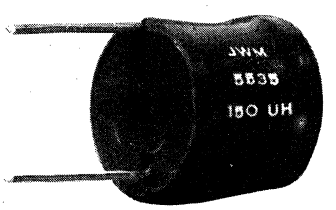
* Inductance measured @ 1 kHz with 0 Amps D.C. current.
Typical inductance change is less than 5% @ maximum rated current.

Leads: 1" long. Tinned within 1/8" of body.

Miller Number	* L uH ± 10%	R,dc Max. Ohms	I,dc Max. Amps	Dim. A Max.	Dim. B Max.
5501	5	.013	10	.88	.63
5502	10	.017	9	1.12	.63
5503	27	.030	7	.88	.81
5504	50	.045	5.6	1.12	.81
5505	100	.061	4.9	1.12	.81
5506	150	.069	4.6	1.38	.81
5507	250	.089	4	1.62	.81
5508	5	.009	14	.88	.64
5509	10	.012	12	1.12	.64
5510	27	.022	9	.88	.88
5511	50	.028	8	1.12	.88
5512	68	.034	7.3	1.12	.88
5513	100	.038	6.8	1.38	.88
5514	150	.046	6.3	1.62	.88
5515	5	.006	19	1.12	.69
5516	10	.008	16	1.38	.69
5517	27	.014	12.5	1.12	.94
5518	50	.020	10.5	1.38	.94
5519	68	.023	10	1.38	.94
5520	100	.027	10	1.62	.94
5521	5	.004	23	1.38	.72
5522	10	.006	20	1.69	.72
5523	27	.010	15	1.38	1
5524	50	.013	15	1.62	1

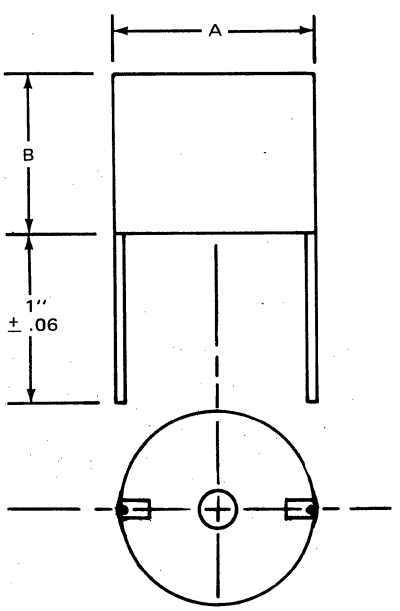


5600 SERIES — High saturation flux density ferrite bobbins.



* Inductance measured @ 1 kHz with 0 Amps D.C. current.
Typical inductance change is less than 5% @ twice rated current.

Miller Number	* L uH ± 10%	R,dc Max. Ohms	I,dc Max. Amps	Dim. A Max.	Dim. B Max.
5601	5	.007	15	.83	.91
5602	10	.008	14	.83	.91
5603	25	.023	8	.83	.91
5604	50	.034	6.6	.83	.91
5605	100	.072	4.5	.83	.91
5606	250	.173	2.9	.83	.91
5607	500	.378	2	.83	.91
5608	1,000	.801	1.3	.83	.91
5609	2,500	2.04	.85	.83	.91
5610	5	.005	20	1.22	1.11
5611	10	.006	17	1.22	1.11
5612	25	.009	14	1.22	1.11
5613	50	.017	10	1.22	1.11
5614	100	.034	7	1.22	1.11
5615	250	.083	4.6	1.22	1.11
5616	500	.129	3.7	1.22	1.11
5617	1,000	.279	2.5	1.22	1.11
5618	2,500	.690	1.6	1.22	1.11
5619	50	.012	14	1.50	1.11
5620	100	.025	9.8	1.50	1.11
5621	250	.059	6.4	1.50	1.11
5622	500	.090	5	1.50	1.11
5623	1,000	.195	3.5	1.50	1.11
5624	2,500	.499	2.2	1.50	1.11
5625	5,000	1.08	1.5	1.50	1.11
5626	100	.018	14	1.50	1.50
5627	250	.040	9	1.50	1.50
5628	500	.085	6.5	1.50	1.50
5629	1,000	.183	4.4	1.50	1.50
5630	2,500	.464	2.8	1.50	1.50
5631	5,000	.714	2.2	1.50	1.50
5632	10,000	1.55	1.5	1.50	1.50



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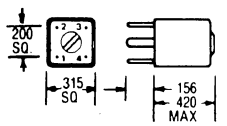
Area Code 516 746-2310

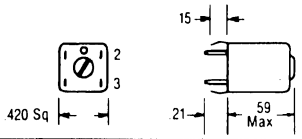
SUBMINIATURE SHIELDED VARIABLE INDUCTORS

.08 μH — 12 mH TYPE 6740



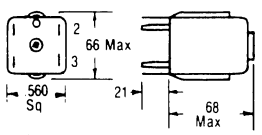
MINIATURE SHIELDED VARIABLE INDUCTORS

.25 μH — 70 μH TYPE 435



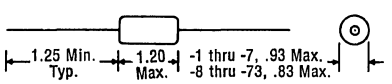
MINIATURE SHIELDED VARIABLE INDUCTORS

.55 μH — 64 μH TYPE 434



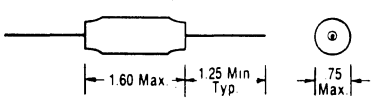
HIGH CURRENT CHOKES

10 μH — 10H TYPE 6950



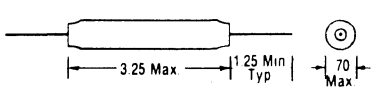
HIGH CURRENT CHOKES

10 μH — 1.0 mH TYPE 6490



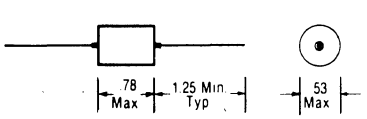
HIGH CURRENT/ HIGH VOLTAGE CHOKES

80 μH — 2.0 mH TYPE 6400



SHIELDED CHOKES

5.0 mH — 1.0 H TYPE 1662



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in the design and manufacture of coils and transformers for industry and defense. We specialize in the manufacture of coils and electronic assemblies to the most rigid military specifications.

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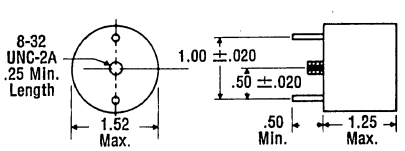
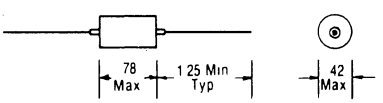
HIGH CURRENT CHOKES

10 μH — 10 mH TYPE 7000



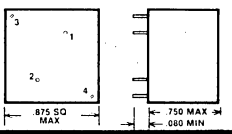
HIGH CURRENT CHOKES

10μH — 1.0H TYPE 6860



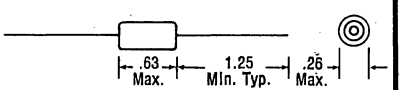
SHIELDED HIGH CURRENT CHOKES

10 μH — 1.0 H TYPE 6900



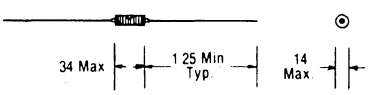
MINIATURE HIGH CURRENT CHOKES

1.0 μH — 100 mH TYPE 7070



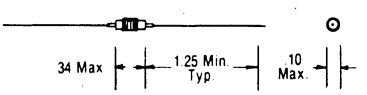
MINIATURE CHOKES

250 μH — 10.0 mH TYPE 659



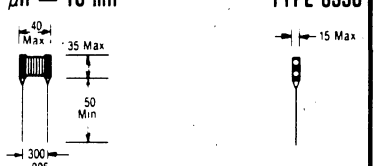
MINIATURE CHOKES

1.0 μH — 100 μH TYPE 620



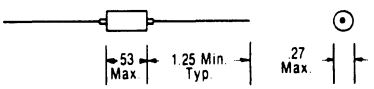
PRINTED CIRCUIT CHOKES

1 μH — 10 mH TYPE 6550



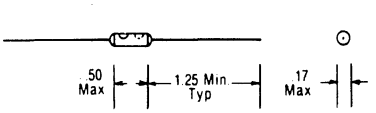
SHIELDED CHOKES

250 μH — 100 mH TYPE 1670

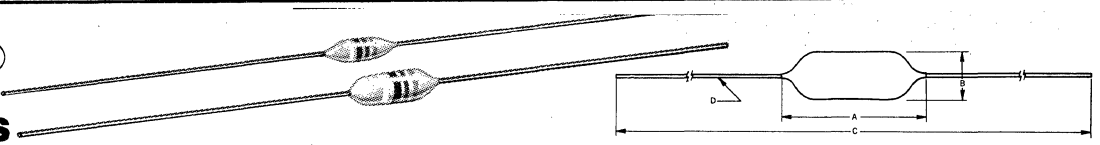


MINIATURE SHIELDED CHOKES

1.0 μH — 5.0 mH TYPES 6375/6376



DALE®



RF CHOKES

Epoxy Conformal Coated Inductors

FEATURES

- Equivalent in quality to molded chokes—at a lower price.
- Excellent for automatic insertion.

Model No.		A	B	C	D
IR-2	MAX.	.300 [7.62]	.120 [3.05]	—	.0215 [.534]
	MIN.	.270 [6.86]	.100 [2.54]	2.9202 [74.17]	.0185 [.458]
IR-4	MAX.	.440 [11.18]	.180 [4.57]	—	.027 [.686]
	MIN.	.410 [10.41]	.150 [3.81]	2.985 [75.82]	.023 [.584]

MODEL NO. IR-2

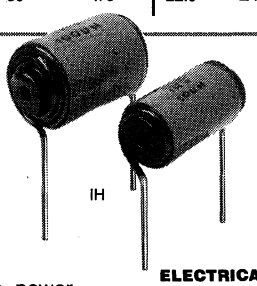
Ind. (μh)	Tol.	Q. Min.	Test Freq. L&Q (Mhz)	Ind. (μh)	Tol.	Q. Min.	Test Freq. L&Q (Mhz)
.10	±10%	40	25.0	12.0	±10%	45	2.5
.12	±10%	40	25.0	15.0	±10%	40	2.5
.15	±10%	38	25.0	18.0	±10%	50	2.5
.18	±10%	35	25.0	22.0	±10%	50	2.5
.22	±10%	33	25.0	27.0	±10%	50	2.5
.27	±10%	33	25.0	33.0	±10%	45	2.5
.33	±10%	30	25.0	39.0	±10%	45	2.5
.39	±10%	30	25.0	47.0	±10%	45	2.5
.47	±10%	30	25.0	56.0	±10%	45	2.5
.56	±10%	30	25.0	68.0	±10%	50	2.5
.68	±10%	28	25.0	82.0	±10%	50	2.5
.82	±10%	28	25.0	100.	±10%	50	2.5
1.00	±10%	25	25.0	120.	±10%	30	.79
1.20	±10%	25	7.9	150.	±10%	30	.79
1.50	±10%	28	7.9	180.	±10%	30	.79
1.80	±10%	30	7.9	220.	±10%	30	.79
2.20	±10%	30	7.9	270.	±10%	30	.79
2.70	±10%	37	7.9	330.	±10%	30	.79
3.30	±10%	45	7.9	390.	±10%	30	.79
3.90	±10%	45	7.9	470.	±10%	30	.79
4.70	±10%	45	7.9	560.	±10%	30	.79
5.60	±10%	50	7.9	680.	±10%	30	.79
6.80	±10%	50	7.9	820.	±10%	30	.79
8.20	±10%	55	7.9	1000.	±10%	30	.79
10.0	±10%	55	7.9				

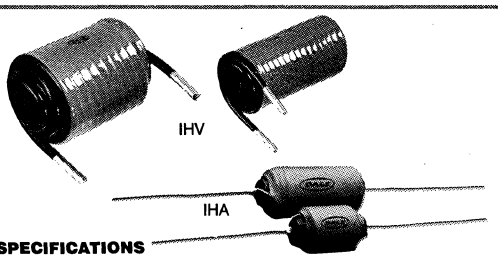
MODEL NO. IR-4

Ind. (μh)	Tol.	Q. Min.	Test Freq. L&Q (Mhz)	Ind. (μh)	Tol.	Q. Min.	Test Freq. L&Q (Mhz)
.15	±20%	50	25.0	27.0	±10%	60	2.5
.22	±20%	50	25.0	33.0	±10%	65	2.5
.33	±20%	45	25.0	36.0	± 5%	60	2.5
.47	±20%	45	25.0	39.0	± 5%	60	2.5
.56	±10%	50	25.0	43.0	± 5%	60	2.5
.68	±10%	50	25.0	47.0	± 5%	55	2.5
.82	±10%	50	25.0	51.0	± 5%	55	2.5
1.00	±10%	50	25.0	56.0	± 5%	55	2.5
1.20	±10%	33	7.9	62.0	± 5%	55	2.5
1.50	±10%	33	7.9	68.0	± 5%	55	2.5
1.80	±10%	33	7.9	75.0	± 5%	55	2.5
2.20	±10%	33	7.9	82.0	± 5%	50	2.5
2.70	±10%	33	7.9	91.0	± 5%	50	2.5
3.30	±10%	33	7.9	100.0	± 5%	50	2.5
3.90	±10%	33	7.9	110.0	± 5%	60	.79
4.70	±10%	33	7.9	120.0	± 5%	65	.79
5.60	±10%	45	7.9	130.0	± 5%	65	.79
6.80	±10%	50	7.9	150.0	± 5%	65	.79
8.20	±10%	50	7.9	160.0	± 5%	65	.79
10.0	±10%	55	7.9	180.0	± 5%	65	.79
12.0	±10%	65	2.5	200.0	± 5%	65	.79
15.0	±10%	65	2.5	220.0	± 5%	65	.79
18.0	±10%	75	2.5	240.0	± 5%	65	.79
22.0	±10%	75	2.5				

TYPE IH, IHA & IHV SERIES

High Current Filter Chokes





FEATURES

- Axial or radial leads for printed circuit mounting
- Pre-tinned leads
- Designed for noise filtering for switching regulators, power amplifiers, power supplies and SCR or Triac control circuits.

ELECTRICAL SPECIFICATIONS

Model	Ind. @ 1 KHz *±10%	Current (Max.)	DC Resistance (Max.)	Self-Resonant Frequency (Min.)
IH-3	5 μh	3 amps	.015Ω	40 MHz
IH-3	10 μh	3 amps	.018Ω	25 MHz
IH-3	27 μh	3 amps	.035Ω	8 MHz
IH-3	50 μh	3 amps	.050Ω	5 MHz
IH-3	100 μh	3 amps	.065Ω	2.5 MHz
IH-3	150 μh	3 amps	.075Ω	2.0 MHz
IH-3	250 μh	3 amps	.090Ω	1.0 MHz
IH-5	5 μh	5 amps	.012Ω	30 MHz
IH-5	10 μh	5 amps	.015Ω	20 MHz
IH-5	27 μh	5 amps	.025Ω	7 MHz
IH-5	50 μh	5 amps	.030Ω	4 MHz
IH-5	68 μh	5 amps	.035Ω	3.5 MHz
IH-5	100 μh	5 amps	.050Ω	2.5 MHz
IH-5	150 μh	5 amps	.060Ω	2.0 MHz
IH-10	5 μh	10 amps	.010Ω	30 MHz
IH-10	10 μh	10 amps	.012Ω	20 MHz
IH-10	27 μh	10 amps	.018Ω	7 MHz
IH-10	50 μh	10 amps	.025Ω	4 MHz
IH-10	68 μh	10 amps	.027Ω	3.5 MHz
IH-10	100 μh	10 amps	.030Ω	2.5 MHz
IH-15	5 μh	15 amps	.008Ω	30 MHz
IH-15	10 μh	15 amps	.010Ω	20 MHz
IH-15	27 μh	15 amps	.015Ω	7 MHz
IH-15	50 μh	15 amps	.020Ω	4 MHz

ELECTRICAL SPECIFICATIONS

Model	Ind. @ 1 KHz *±10%	Current (Max.)	DC Resistance (Max.)	Self-Resonant Frequency (Min.)
IHA-101	50 μh	1 amp	.12Ω	4.0 MHz
IHA-102	100 μh	1 amp	.18Ω	2.0 MHz
IHA-103	250 μh	1 amp	.30Ω	1.0 MHz
IHA-104	500 μh	1 amp	.50Ω	.8 MHz
IHA-105	1000 μh	1 amp	.60Ω	.5 MHz
IHA-201	27 μh	2 amps	.085Ω	5.5 MHz
IHA-202	50 μh	2 amps	.10Ω	4.0 MHz
IHA-203	100 μh	2 amps	.15Ω	2.0 MHz
IHA-204	250 μh	2 amps	.25Ω	1.0 MHz
IHA-205	500 μh	2 amps	.45Ω	.5 MHz
IHA-301	5 μh	3 amps	.025Ω	25.0 MHz
IHA-302	10 μh	3 amps	.035Ω	20.0 MHz
IHA-303	27 μh	3 amps	.05Ω	6.0 MHz
IHA-304	50 μh	3 amps	.065Ω	4.0 MHz
IHA-305	100 μh	3 amps	.075Ω	2.0 MHz
IHA-501	5 μh	5 amps	.015Ω	50.0 MHz
IHA-502	10 μh	5 amps	.025Ω	40.0 MHz
IHA-503	27 μh	5 amps	.035Ω	7.0 MHz
IHA-504	50 μh	5 amps	.05Ω	2.0 MHz
IHA-505	100 μh	5 amps	.065Ω	1.0 MHz
IHV-15-500	500 μh	15 amps	.050Ω	0.8 MHz
IHV-20-200	200 μh	20 amps	.021Ω	1.2 MHz
IHV-28-60	60 μh	28 amps	.0085Ω	1.9 MHz
IHV-30-150	150 μh	30 amps	.013Ω	2.1 MHz
IHV-40-39	39 μh	40 amps	.0048Ω	2.5 MHz
IHV-45-92	92 μh	45 amps	.0075Ω	2.9 MHz
IHV-50-50	50 μh	50 amps	.0045Ω	3.1 MHz
IHV-60-24	24 μh	60 amps	.0025Ω	5.7 MHz

*Inductance measured with zero D.C. current.

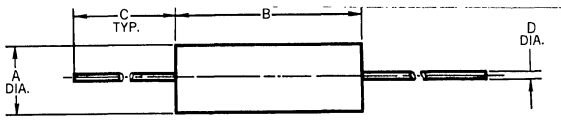
For complete information, write or phone

DALE ELECTRONICS, INC., East Highway 50, Yankton, South Dakota 57078. Phone 605-665-9301

DALE®

RF CHOKES, MIL-C-15305D

Epoxy Molded, Flame Retardant, Standard and Shielded Types



INDUCTANCE RANGE & MIL STANDARD

Model No.	INDUCTANCE RANGE From	To	CLASSIFICATION Grade	Class	Military Standard
IM-2	.10 μH	1.00 μH	1	B	MS-75083
	1.2 μH	27 μH	1	A	MS-75084
	33 μH	1000 μH	1	A	MS-75085
IM-4	.15 μH	4.7 μH	1	B	MS-18130
	5.6 μH	33 μH	1	A	MS-14046
	36 μH	240 μH	1	A	MS-90538
IM-6	270 μH	1000 μH	—	—	—
IM-8	1100 μH	3600 μH	—	—	—
IM-10	3900 μH	10,000 μH	—	—	—
IMS-5	.1 μH	100,000 μH	1	A	—

DIMENSIONS

Model No.		A	B	C	D
IM-2	Max.	.105 [2.67]	.260 [6.60]	1.626 [41.30]	.0215 [.546]
	Min.	.085 [2.16]	.240 [6.10]	1.250 [31.75]	.0185 [.470]
IM-4	Max.	.165 [4.19]	.385 [9.78]	1.625 [41.28]	.027 [.686]
	Min.	.145 [3.68]	.365 [9.27]	1.250 [31.75]	.023 [.584]
IM-6	Max.	.200 [5.08]	.450 [11.43]	1.625 [41.28]	.027 [.686]
	Min.	.180 [4.57]	.430 [10.92]	1.250 [31.75]	.023 [.584]
IM-8	Max.	.225 [5.72]	.570 [14.48]	1.625 [41.28]	.030 [.762]
	Min.	.205 [5.21]	.550 [13.97]	1.250 [31.75]	.026 [.660]
IM-10	Max.	.250 [6.35]	.750 [19.05]	1.625 [41.28]	.034 [.864]
	Min.	.230 [5.84]	.730 [18.54]	1.250 [31.75]	.030 [.762]
IMS-5	Max.	.172 [4.37]	.430 [10.92]	1.625 [41.28]	.027 [.686]
	Min.	.152 [3.86]	.390 [9.91]	1.250 [31.75]	.023 [.584]

MODEL NO. IM-2

IND. (μh)	TOL.	Q MIN.	Test Freq. L & Q (Mhz)
.10	±10%	40	25.0
.12	±10%	40	25.0
.15	±10%	38	25.0
.18	±10%	35	25.0
.22	±10%	33	25.0
.27	±10%	33	25.0
.33	±10%	30	25.0
.39	±10%	30	25.0
.47	±10%	30	25.0
.56	±10%	30	25.0
.68	±10%	28	25.0
.82	±10%	28	25.0
1.00	±10%	25	25.0
1.20	±10%	25	7.9
1.50	±10%	28	7.9
1.80	±10%	30	7.9
2.20	±10%	30	7.9
2.70	±10%	37	7.9
3.30	±10%	45	7.9
3.90	±10%	45	7.9
4.70	±10%	45	7.9
5.60	±10%	50	7.9
6.80	±10%	50	7.9
8.20	±10%	55	7.9
10.0	±10%	55	7.9
12.0	±10%	45	2.5
15.0	±10%	40	2.5
18.0	±10%	50	2.5
22.0	±10%	50	2.5
27.0	±10%	50	2.5
33.0	±10%	45	2.5
39.0	±10%	45	2.5
47.0	±10%	45	2.5
56.0	±10%	45	2.5
68.0	±10%	50	2.5
82.0	±10%	50	2.5
100.0	±10%	50	2.5
120.0	±10%	30	.79
150.0	±10%	30	.79
180.0	±10%	30	.79
220.0	±10%	30	.79
270.0	±10%	30	.79
330.0	±10%	30	.79
390.0	±10%	30	.79
470.0	±10%	30	.79
560.0	±10%	30	.79
680.0	±10%	30	.79
820.0	±10%	30	.79
1000.0	±10%	30	.79

MODEL NO. IM-4

IND. (μh)	TOL.	Q MIN.	Test Freq. L & Q (Mhz)
.15	±20%	50	25.0
.22	±20%	50	25.0
.33	±20%	45	25.0
.47	±20%	45	25.0
.56	±10%	50	25.0
.68	±10%	50	25.0
.82	±10%	50	25.0
1.00	±10%	50	25.0
1.20	±10%	33	7.9
1.50	±10%	33	7.9
1.80	±10%	33	7.9
2.20	±10%	33	7.9
2.70	±10%	33	7.9
3.30	±10%	33	7.9
3.90	±10%	33	7.9
4.70	±10%	33	7.9
5.60	±10%	45	7.9
6.80	±10%	50	7.9
8.20	±10%	50	7.9
10.0	±10%	55	7.9
12.0	±10%	65	2.5
15.0	±10%	65	2.5
18.0	±10%	75	2.5
22.0	±10%	75	2.5
27.0	±10%	60	2.5
33.0	±10%	65	2.5
36.0	± 5%	60	2.5
39.0	± 5%	60	2.5
43.0	± 5%	60	2.5
47.0	± 5%	55	2.5
51.0	± 5%	55	2.5
56.0	± 5%	55	2.5
62.0	± 5%	55	2.5
68.0	± 5%	55	2.5
75.0	± 5%	55	2.5
82.0	± 5%	50	2.5
91.0	± 5%	50	2.5
100.0	± 5%	50	2.5
110.0	± 5%	60	.79
120.0	± 5%	65	.79
130.0	± 5%	65	.79
150.0	± 5%	65	.79
160.0	± 5%	65	.79
180.0	± 5%	65	.79
200.0	± 5%	65	.79
220.0	± 5%	65	.79
240.0	± 5%	65	.79

MODEL NO. IM-6

IND. (μh)	TOL.	Q MIN.	Test Freq. L & Q (Mhz)
270.0	± 5%	65	.79
300.0	± 5%	65	.79
330.0	± 5%	65	.79
360.0	± 5%	65	.79
390.0	± 5%	65	.79
430.0	± 5%	65	.79
470.0	± 5%	65	.79
510.0	± 5%	65	.79
560.0	± 5%	65	.79
620.0	± 5%	60	.79
680.0	± 5%	60	.79
750.0	± 5%	60	.79
820.0	± 5%	60	.79
910.0	± 5%	60	.79
1000.0	± 5%	60	.79

MODEL NO. IM-8

IND. (μh)	TOL.	Q MIN.	Test Freq. L & Q (Mhz)
1100.0	± 5%	60	.25
1200.0	± 5%	60	.25
1300.0	± 5%	60	.25
1500.0	± 5%	65	.25
1600.0	± 5%	65	.25
1800.0	± 5%	65	.25
2000.0	± 5%	65	.25
2200.0	± 5%	70	.25
2400.0	± 5%	70	.25
2700.0	± 5%	70	.25
3000.0	± 5%	70	.25
3300.0	± 5%	70	.25
3600.0	± 5%	70	.25

MODEL NO. IM-10

IND. (μh)	TOL.	Q MIN.	Test Freq. L & Q (Mhz)
3900.0	± 5%	80	.25
4300.0	± 5%	80	.25
4700.0	± 5%	80	.25
5000.0	± 5%	80	.25
5600.0	± 5%	80	.25
6200.0	± 5%	80	.25
6800.0	± 5%	80	.25
7500.0	± 5%	80	.25
8200.0	± 5%	80	.25
9100.0	± 5%	80	.25
10,000.0	± 5%	80	.25

MODEL NO. IMS-5 Shielded Inductor

IND. ±10% (μH)	Q MIN.	TEST FREQ. (MHz)
.10	50	25
.12	51	25
.15	51	25
.18	50	25
.22	49	25
.27	47	25
.33	46	25
.39	44	25
.47	44	25
.56	43	25
.68	42	25
.82	40	25
1.00	44	25
1.20	44	7.9
1.50	44	7.9
1.80	44	7.9
2.20	44	7.9
2.70	44	7.9
3.30	44	7.9
3.90	44	7.9
4.70	44	7.9
5.60	44	7.9
6.80	44	7.9
8.20	44	7.9
10.0	50	7.9
12.0	55	2.5
15.0	45	2.5
18.0	45	2.5
22.0	45	2.5
27.0	45	2.5
33.0	45	2.5
39.0	50	2.5
47.0	50	2.5
56.0	50	2.5
68.0	50	2.5
82.0	50	2.5
100.0	50	2.5
120.0	55	.79
150.0	55	.79
180.0	55	.79
220.0	55	.79
270.0	55	.79
330.0	55	.79
390.0	60	.79
470.0	60	.79
560.0	60	.79
680.0	60	.79
820.0	60	.79
1,000.0	60	.79
1,200.0	45	.25
1,500.0	45	.25
1,800.0	45	.25
2,200.0	45	.25
2,700.0	45	.25
3,300.0	45	.25
3,900.0	45	.25
4,700.0	45	.25
5,600.0	44	.25
6,800.0	40	.25
8,200.0	40	.25
10,000.0	40	.25
12,000.0	30	.079
15,000.0	30	.079
18,000.0	30	.079
22,000.0	27	.079
27,000.0	27	.079
33,000.0	27	.079
39,000.0	27	.079
47,000.0	23	.079
56,000.0	23	.079
68,000.0	23	.079
82,000.0	21	.079
100,000.0	18	.079

For complete information, write or phone

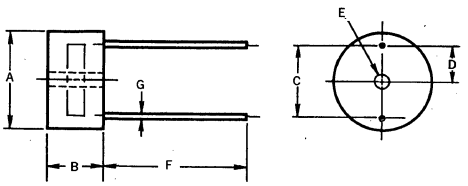
DALE ELECTRONICS, INC., East Highway 50, Yankton, South Dakota 57078. Phone 605-665-9301

DALE®

FILTER INDUCTORS, MIL-T-27
Toroidal, Encapsulated or Dipped

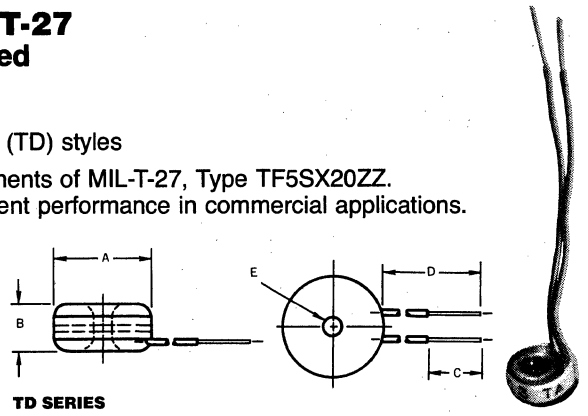
FEATURES

- Choice of encapsulated (TE) or dipped (TD) styles
- TE style designed to meet the requirements of MIL-T-27, Type TF5SX20ZZ. TD style combines low cost with excellent performance in commercial applications.



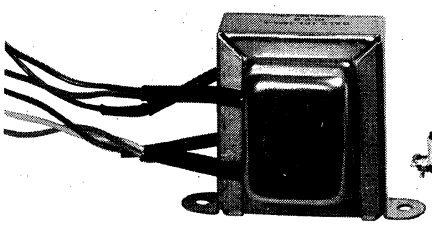
TE SERIES

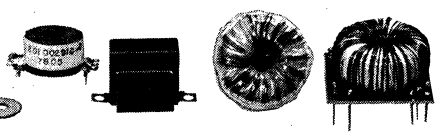
Model No.	A Max.	B Max.	C	D	E	F Min.	G	Ind. Range
TE-2	.437 [11.10]	.270 [6.86]	.300 [7.62]	—	—	1.0 [25.40]	.020 [.51]	50 μH to 250 mH
TE-3	.685 [17.40]	.385 [9.78]	.500 [12.70]	.250 [6.35]	.093 [2.36]	1.0 [25.40]	.025 [.64]	50 μH to 4 H
TE-4	1.062 [26.97]	.500 [12.70]	.900 [22.86]	.450 [11.43]	.120 [3.05]	1.0 [25.40]	.032 [.81]	150 μH to 7.5 H
TE-5	1.32 [33.53]	.725 [18.42]	1.00 [25.40]	.500 [12.70]	1.44 [3.66]	1.0 [25.40]	.032 [.81]	1000 μH to 20 H



TD SERIES

Model No.	A Max.	B Max.	C Min.	D Min.	E	Ind. Range
TD-2	.437 [11.10]	.25 [6.35]	—	2.0 [50.80]	3/8±1/8 [9.53±3.18]	50 μH to 250 mH
TD-3	.685 [17.40]	.32 [8.13]	.125 [3.18]	3.0 [76.20]	3/8±1/8 [9.53±3.18]	50 μH to 4 H
TD-4	1.062 [26.97]	.437 [11.10]	.22 [5.59]	4.0 [101.60]	3/8±1/8 [9.53±3.18]	150 μH to 7.5 H
TD-5	1.32 [33.53]	.688 [17.48]	.22 [5.59]	6.0 [152.40]	3/8±1/8 [9.53±3.18]	1000 μH to 20 H





CUSTOM INDUCTIVE PRODUCTS

TOROIDS

• Potted with case sizes to fit your specific designs • Open wound using Dale-formulated coatings for extra protection • Hermetically-sealed cans • Pulse Transformers, Inverters, RF Inductors and Transformers with or without terminal boards. Unusual shapes and sizes a specialty.

BOBBINS

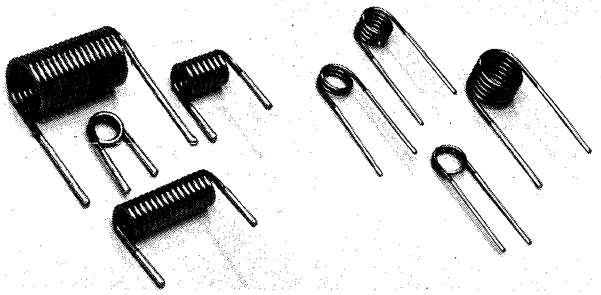
• Statistical control on high volume production items • Low initial tooling cost.

TOUGH COIL JOBS

Whether you need a hundred pieces or a million, we offer: • Complete facilities to design, engineer and produce prototype quantities • Faster turnaround on custom samples and short run production quantities • Close production coordination including cost-saving statistical control on high volume items.

AIR CORE CHOKES, INDUCTORS

Produced to your specifications for a wide range of high frequency applications including: • Television • Radio (2-way, scanners, AM/FM) • Cable TV Systems • Satellite Communication • Microwave • Test Equipment



SPECIFICATIONS

ELECTRICAL

Frequency: To 500 MHz
Current: 1 amp. max.
Temperature: To 130°C

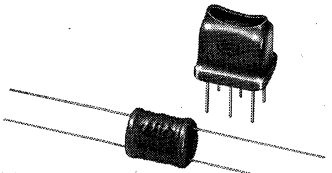
MECHANICAL

Winding: 1 to 32 turns, clockwise or counter-clockwise with variable pitch.
Wire Gauge: #18 to #32.

Leads: Automatically tinned. Various configurations available.
Coil Inside Diameter: .079″ to .354″.
Coil Length: Up to 1.26″.

PT-10, 20 & 50
Pulse Transformers

• TRIGGER-TYPE PULSE TRANSFORMERS designed for low-cost trigger source isolation in half and full wave SCR power control circuits. P.C. and bobbin styles. • PRIMARY INDUCTANCE RANGE: 200 μH to 5,000 μH.



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Delevan

COILS & INDUCTIVE COMPONENTS

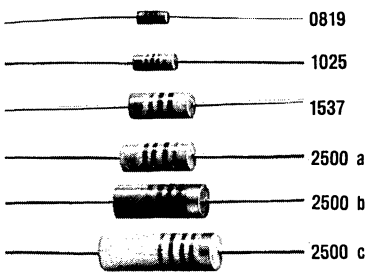
SETTING THE STANDARDS FOR OVER 30 YEARS

For over three decades, Delevan has manufactured a wide variety of inductive devices to Military and Aerospace standards of quality. This brief overview describes the basic lineup of many standard catalog items meeting rigid military or other commercial standards.

In addition to our over 800 catalog designs, Delevan manufactures a wide variety of custom magnetic components to customer specifications. Send us your requirements for a prompt quotation.

For further information call your Delevan Representative or contact the factory direct.

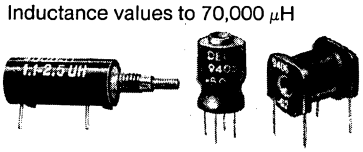
MOLDED RF COILS

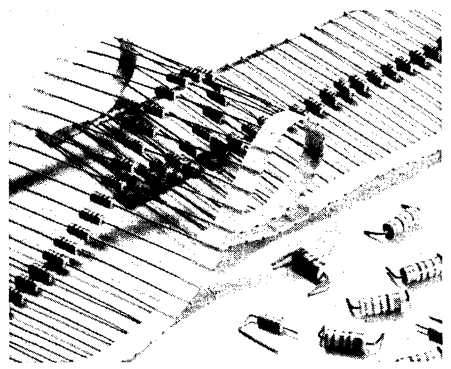


Series	Inductance Range Microhenries	Dia.		Length
0819	.10- 1,000	.078"	x	.200"
1025	.10- 1,000	.095"	x	.250"
1537	.15- 240	.156"	x	.375"
2500	270-10,000	a .190"	x	.440"
		b .215"	x	.560"
		c .240"	x	.740"

VARIABLE RF COILS

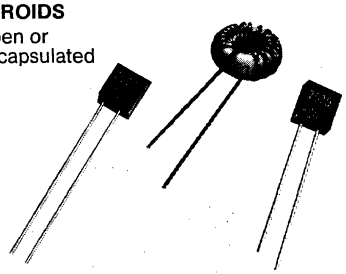
Inductance values to 70,000 μH



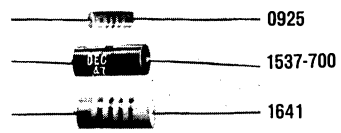


TOROIDS

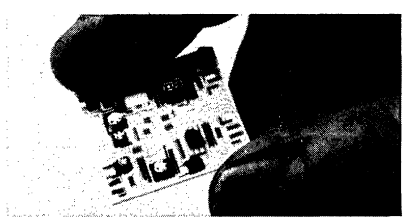
Open or encapsulated



MOLDED SHIELDED RF COILS

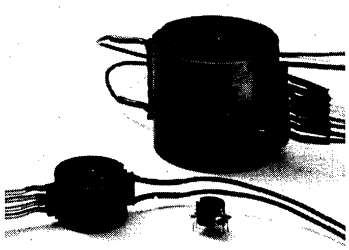


Series	Inductance Range Microhenries	Dia.		Length
0925	.10- 560	.095"	x	.250"
1537-700	.10-10,000	.156"	x	.375"
1641	.10-10,000	.162"	x	.410"



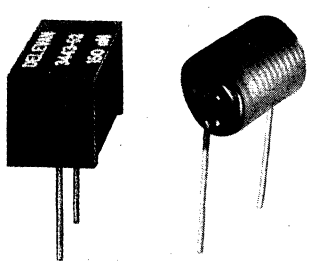
MICRO-i® CHIP INDUCTORS

- Low profile
- Ribbon leads or chip
- Gold plated or Solder coated
- Wire bondable versions
- from .010 μH to 1,000 μH



POT CORES

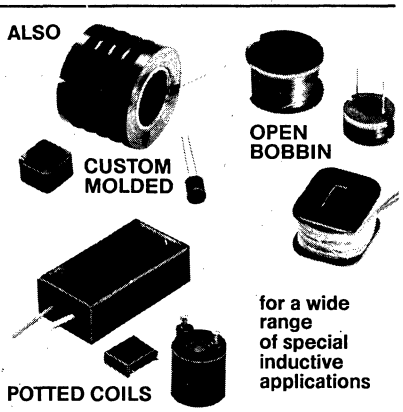
Coils & transformers in a wide range of sizes



POWER CHOKES

- for high current applications
- standard values— 1.0 μH to 15,000 μH

ALSO



for a wide range of special inductive applications

SPECIAL SERVICES

- Reel Taping
- Cut or Formed Leads
- Color Coding or Custom Marking
- Q Meter Repair or Calibration
- Environmental Testing

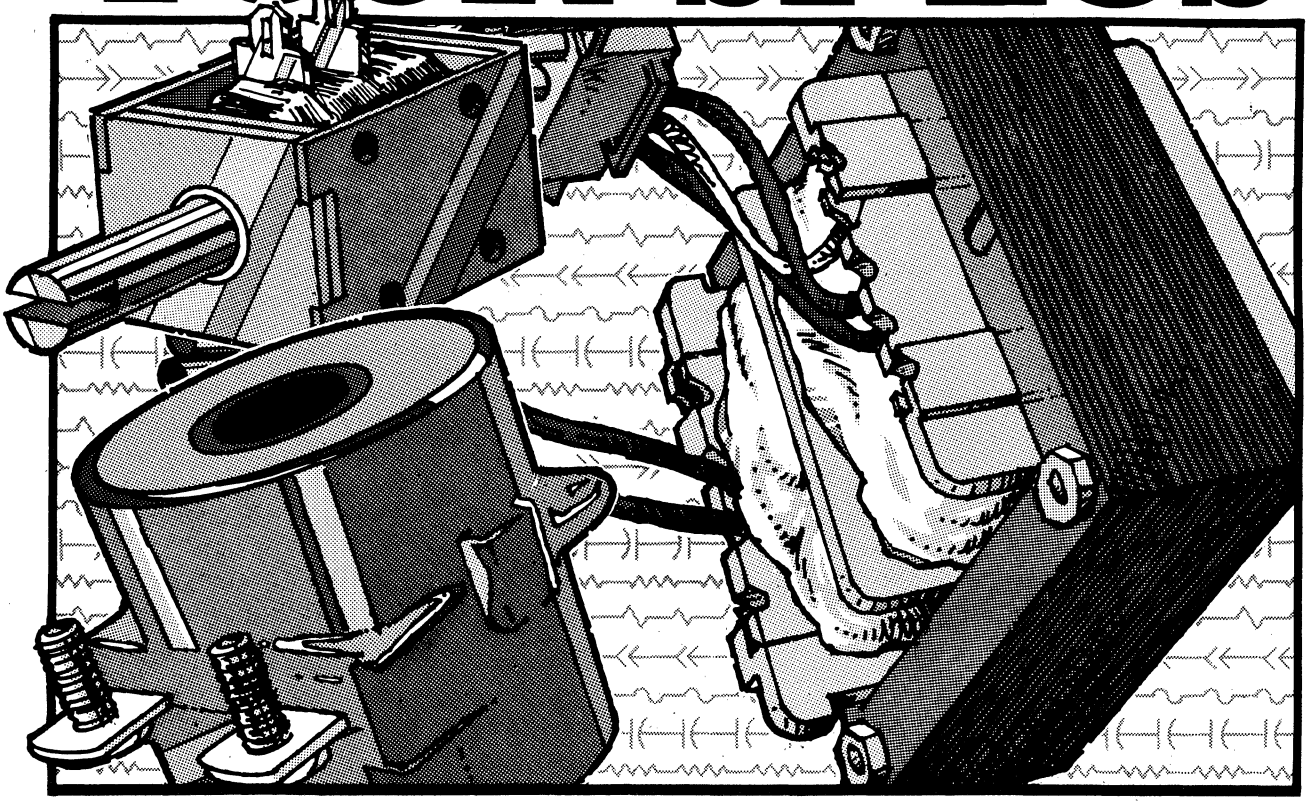
Write or call for application assistance.

Delevan Division — AMERICAN PRECISION INDUSTRIES INC.

270 QUAKER RD./EAST AURORA, N.Y. 14052
TELEPHONE 716/652-3600 TELEX 91-293

Other Divisions and Subsidiaries include: Air Quality, Basco, Deltran, A.P.I. of Florida, American Precision Industries (U.K.) Ltd., Dustex of Canada Inc.

WE WANT YOUR SPECS



If you are designing a new part, modifying an existing one, making changes brought about by industry standards, or just looking for a new supplier . . . . ENDICOTT COIL should be your Source.

For over 30 years, we have successfully met the component specifications of companies marketing a diverse range of products including: Data Processing Equipment, Time Keeping Devices, Relays, Switches, Motors, Clutches, Brakes, Office Equipment, Keyboards, Control Systems and Printing Equipment - just to mention a few.

Whether you have short run or high volume needs, Endicott Coil's modern facility and experienced personnel can deliver your parts, on time and to your specifications.

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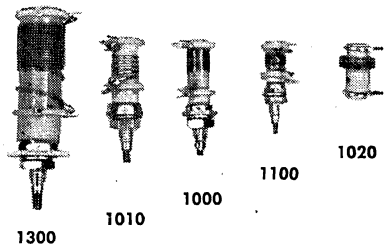
MAGNETIC COMPONENTS TO YOUR SPECIFICATIONS

NORTH HILLS • HIGH-PERFORMANCE COILS, ADJUSTABLE & FIXED

TO COVER ALL FREQUENCY RANGES FROM AUDIO TO 200 MHZ

COILS ON CERAMIC FORMS PER MIL-I-10



Series No.	Dimensions (Inches) Dia.	Length	Mtg. Hole Dia. (Inches)
1000	.50	.88	.196
1020	.50	.63	.050, .500 Apart
1100	.33	.63	.166
1300	.70	1.80	.252
1010	.43	.88	.196

Miniature 1000 Series

Part No.	Range Microhenries	Average Q
1000-A	1.0- 1.6	70 @ 7.9 MHz
1000-B	1.6- 2.7	80 @ 7.9 MHz
1000-C	2.7- 4.5	85 @ 7.9 MHz
1000-D	4.5- 8.5	85 @ 7.9 MHz
1000-E	8.5-14.5	75 @ 2.5 MHz
1000-F	14.5-22	65 @ 2.5 MHz
1000-G	22-29	65 @ 2.5 MHz
1000-H	29-55	85 @ 2.5 MHz
1000-I	55-110	80 @ 2.5 MHz
1000-J	110-185	85 @ .79 MHz
1000-K	185-305	85 @ .79 MHz
1000-L	305-515	85 @ .79 MHz
1000-M	515-820	85 @ .79 MHz
1000-N	820-1100	75 @ .79 MHz

RF Printed Circuit Coils

1020-A	0.41- 0.53	75 @ 25 MHz
1020-B	0.85- 1.15	65 @ 7.9 MHz
1020-C	1.87- 2.50	65 @ 7.9 MHz
1020-D	4.0 - 5.4	70 @ 7.9 MHz
1020-E	7.5 -12.5	70 @ 2.5 MHz
1020-F	20 -29	80 @ 2.5 MHz
1020-G	33 -61	80 @ 2.5 MHz
1020-H	80 -120	60 @ 0.79 MHz
1020-I	170 -260	70 @ 0.79 MHz

Subminiature 1100 Series

1100-A	0.9- 1.4	60 @ 7.9 MHz
1100-B	1.4- 1.9	70 @ 7.9 MHz
1100-C	1.9- 2.6	65 @ 7.9 MHz
1100-D	2.6- 3.7	65 @ 7.9 MHz
1100-E	3.7- 5.5	65 @ 7.9 MHz
1100-F	5.5- 7.4	60 @ 7.9 MHz
1100-G	7.4-12.5	70 @ 7.9 MHz
1100-H	12.5-18.0	65 @ 2.5 MHz
1100-I	18.0-28.0	70 @ 2.5 MHz
1100-J	28.0-38.0	70 @ 2.5 MHz
1100-K	38.0-55.0	70 @ 2.5 MHz

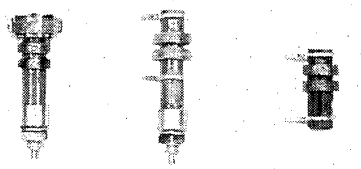
Transmitter 1300 Series

1300-A	For use from 90-200 MHz	
1300-B	For use from 40-90 MHz	
1300-C	For use from 20-40 MHz	
1300-D	0.7- 1.0	170 @ 25 MHz
1300-E	1.1- 1.6	130 @ 7.9 MHz
1300-F	1.7- 2.5	140 @ 7.9 MHz
1300-G	2.7- 4.1	140 @ 7.9 MHz
1300-H	4.4- 6.5	140 @ 7.9 MHz
1300-I	6.8-10.0	140 @ 7.9 MHz
1300-J	11.5-17.0	110 @ 2.5 MHz
1300-K	19.0-29.0	95 @ 2.5 MHz
1300-L	31.0-45.0	100 @ 2.5 MHz
1300-M	49.0-75.0	100 @ 2.5 MHz

HF Coils, Variable Approx. ±15%

1010-A	0.118	115 @ 50 MHz
1010-B	0.225	125 @ 25 MHz
1010-C	0.315	130 @ 25 MHz

WIDE ADJUSTMENT RANGE 120 SERIES



120 Series Mica-filled form .75″ O.D. x 1.3″ H. .196″ dia. mtg. hole

PCS-120 Series Phenolic form

PC-120 Series Phenolic form .5″ O.D.x1.25″ L. .05″ Pins, .70″ Apart

Part No.	Range Microhenries	Average Q
120-A	2-3	70 @ 7.9 MHz
120-B	3-5	80 @ 7.9 MHz
120-C	5-9	85 @ 7.9 MHz
120-D	9-18	65 @ 2.5 MHz
120-E	18-36	70 @ 2.5 MHz
120-F	36-64	65 @ 2.5 MHz
120-G	64-105	85 @ 2.5 MHz
120-H	105-200	80 @ .79 MHz
120-I	200-500	75 @ .79 MHz
120-J	500-1000	85 @ .79 MHz
120-K	1000-2000	50 @ .25 MHz

Subminiature 600 Series

- Variable ±10%
- Shielded
- 0.3″ O.D. x 0.4″ H
- .020″ Leads .20″ Apart

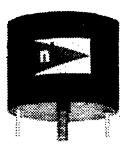
Part No.	Nominal Microhenries	Average Q
600U1X0	1.0	120 @ 7.9 MHz
600U1X5	1.5	120 @ 7.9 MHz
600U2X2	2.2	120 @ 7.9 MHz
600U3X3	3.3	130 @ 7.9 MHz
600U4X7	4.7	125 @ 7.9 MHz
600U6X8	6.8	140 @ 7.9 MHz
600U10X	10	135 @ 7.9 MHz
600U15X	15	130 @ 2.5 MHz
600U22X	22	135 @ 2.5 MHz
600U33X	33	130 @ 2.5 MHz
600U47X	47	130 @ 2.5 MHz
600U68X	68	120 @ 2.5 MHz
600MX10	100	100 @ 2.5 MHz
600MX15	150	125 @ .79 MHz
600MX22	220	130 @ .79 MHz
600MX33	330	125 @ .79 MHz
600MX47	470	120 @ .79 MHz
600MX68	680	100 @ .79 MHz
600M1X0	1000	100 @ .79 MHz

High Q RF Coils, Fixed

- .75″ O.D. x .63″ H
- Hermetically sealed
- Complete shielding
- For printed circuitry
- For standard circuitry

Part No.	Nominal Microhenries	Average Q
1219-A	0.47± 5%	90 @ 20 MHz
1219-B	1.0 ± 5%	100 @ 10 MHz
1219-C	2.2 ± 5%	130 @ 8 MHz
1219-D	4.7 ± 5%	130 @ 5 MHz
1219-E	10 ± 5%	130 @ 3 MHz
1219-F	22 ± 3%	185 @ 1.7 MHz
1219-G	47 ± 3%	185 @ 1 MHz
1219-H	100 ± 3%	200 @ 0.8 MHz
1219-I	220 ± 3%	225 @ 0.7 MHz
1219-J	470 ± 3%	250 @ 0.6 MHz
1219-K	1000 ± 3%	300 @ 0.5 MHz
1219-L	2200 ± 3%	300 @ 0.25 MHz

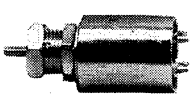
Hi Q 801, 802 Series, Adjustable ±10%



801, 802 Series 1.18″ O.D. x .93″ H

Part No.	Nominal Millihenries	Peak Q
801M1X0	1.0	100 @ 10 kHz
801M1X5	1.5	100 @ 10 kHz
801M2X2	2.2	100 @ 10 kHz
801M3X3	3.3	100 @ 10 kHz
801M4X7	4.7	100 @ 10 kHz
801M6X8	6.8	100 @ 10 kHz
801M10X	10	200 @ 20 kHz
801M15X	15	200 @ 20 kHz
801M22X	22	200 @ 20 kHz
801M33X	33	200 @ 20 kHz
801M47X	47	200 @ 20 kHz
801M68X	68	200 @ 20 kHz
801HX10	100	300 @ 30 kHz
801HX15	150	300 @ 30 kHz
801HX22	220	300 @ 30 kHz
801HX33	330	250 @ 20 kHz
801HX47	470	250 @ 20 kHz
801HX68	680	250 @ 20 kHz
801H1X0	1000	150 @ 15 kHz
802M1X0	1.0	400 @ 100 kHz
802M1X5	1.5	400 @ 100 kHz
802M2X2	2.2	400 @ 100 kHz
802M3X3	3.3	400 @ 100 kHz
802M4X7	4.7	400 @ 100 kHz
802M6X8	6.8	400 @ 100 kHz
802M10X	10	400 @ 70 kHz
802M15X	15	400 @ 70 kHz
802M22X	22	400 @ 70 kHz
802M33X	33	400 @ 70 kHz
802M47X	47	400 @ 40 kHz

SHIELDED COILS



- Shielded
- Encapsulated

- .44″ Diameter **900 Series**

Part No.	Range Microhenries	Average Q
900-A	0.5- 0.8	80 @ 25 MHz
900-B	0.8- 1.3	70 @ 18 MHz
900-C	1.3- 2.0	60 @ 15 MHz
900-D	2.0- 4.0	70 @ 8 MHz
900-E	4.0- 7.0	70 @ 5 MHz
900-F	7.0-12.0	70 @ 4 MHz
900-G	12.0-20.0	70 @ 3 MHz
900-H	20.0-35.0	70 @ 2.5 MHz
900-I	35.0-60.0	70 @ 2.0 MHz
900-J	60.0-100.0	70 @ 1.0 MHz

- .63″ Diameter **1500 Series**

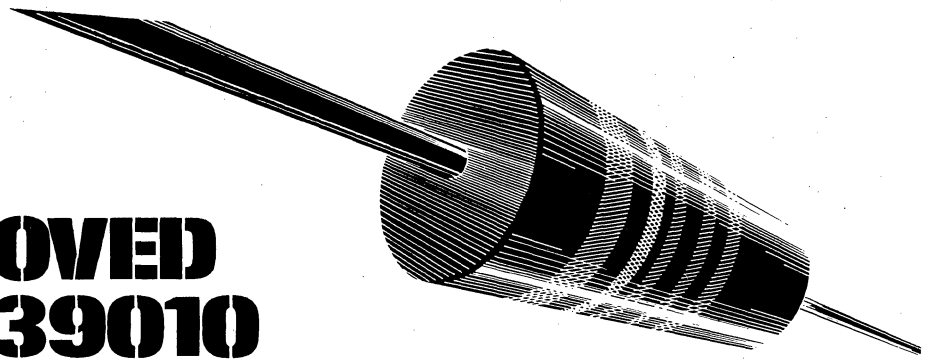
Part No.	Range Millihenries	Average Q
1500-A	.100- .175	80 @ 790 kHz
1500-B	.175- .300	80 @ 790 kHz
1500-C	.300- .500	80 @ 790 kHz
1500-D	.500- .800	75 @ 790 kHz
1500-E	.800-1.15	55 @ 500 kHz
1500-F	1.15-1.50	55 @ 250 kHz
1500-G	1.50-2.30	55 @ 250 kHz
1500-H	2.30-3.50	50 @ 250 kHz
1500-I	3.50-7.50	40 @ 250 kHz

For North Hills Wideband Transformers See Section 5600.

North Hills Electronics, INC. / GLEN COVE, N.Y. 11542 • 516-671-5700

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors



APPROVED MIL-C-39010

LATEST REVISION

MIL-C-39010/1 - /2 - /3 FAILURE RATE "R" .01%/1000 HRS.
MIL-C-39010/4 - /5 - /6 - /7 FAILURE "R" .01%/1000 HRS.
MIL-C-39010/8 - /9 - /10 FAILURE RATE "R" .01%/1000 HRS.

Nytronics' history of technical leadership in inductors has a new chapter. The first company to extend the standard line concept to variable inductors has remained ahead in every subsequent step of refinement and miniaturization.

Today, there's a new place for a familiar group of inductors under highest reliability military specifications—MIL-C-39010 (latest revision). The unique "T" lead construction eliminates fine wire consideration that has previously concerned design engineers on critical circuitry.

With sizes ranging from the world's smallest shielded inductor to the most complex variable inductor . . . shielded, unshielded and variable, in hundreds of off-the-shelf values . . . it makes good sense to check first with Nytronics or your local distributor.

Now tested and approved to highest reliability military specifications.

Nytronics Standard Inductor Part Number	Standard Military Series	New High Reliability Qualification
SWD	MS75087	MIL-C-39010-1
SWD	MS75088	MIL-C-39010-2
SWD	MS75089	MIL-C-39010-3
RFC-S	MS75008	MIL-C-39010-4
RFC-S	MS75101	MIL-C-39010-5
RFC-SS	MS18130	MIL-C-39010-6
RFC-SS	MS14046	MIL-C-39010-7
MD	MS75083	MIL-C-39010-8
MD	MS75084	MIL-C-39010-9
MD	MS75085	MIL-C-39010-10

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
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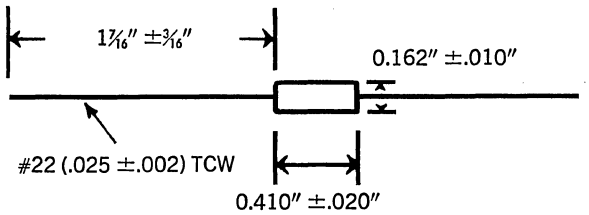
Inductors

MS-INDUCTOR SERIES 75087, 75088, 75089 MOLDED SHIELDED INDUCTOR

GRADE 1 CLASS A

Ultra-Reliable Molded Shielded Miniature Inductor.
Inductance Range: 0.1uH to 100,000uH.

The **MS-INDUCTOR SERIES** are R.F. Inductors specifically designed to meet the demanding requirements of MIL-C-15305 (latest revision). The MS-INDUCTOR Series epoxy molded envelope and shielding offers the design engineer reliability, electrical performance, and minimum coupling in high density packaging.



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: ±10% over the entire inductance range.
Dielectric Strength: 1000 volts RMS at sea level.
Self-Resonant Frequency: Measured per MIL-C-15305 (latest revision).
Q: Measured on a Q-Meter.
Maximum Current: Based on temperature rise not to exceed 15°C at 90°C ambient.

DENSITY CHARACTERISTICS

Volume: 0.0076 cubic inches **Weight:** 0.75 grams maximum
Shielding: At 1000 cycles two units assembled side by side exhibit less than 3% coupling.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +105°C.

Terminal Strength: Meets five pound pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision), Grade 1, Class B. High frequency 10 cps to 2000 cps @ 20G ±10% maximum for 12 logarithmic swings each of 20 minute duration repeated for each of three mutually perpendicular planes. Shock: 100G, 6 MS.

Marking: Color coded per MIL-C-15305 (latest revision).

All values available in Established Reliability, Level R, to MIL-C-39010.

Material	MS No.	NCG P/N	L uH	Q min		Min. SRF MHz	Max. DCR Ω	Max. I mA	Incr.† I mA
PHENOLIC	MS75087-1	SWD	0.10	50	25	250	0.025	1790	>2900
	MS75087-2	SWD	0.12	51	25	250	0.034	1530	>2800
	MS75087-3	SWD	0.15	51	25	250	0.037	1470	>2750
	MS75087-4	SWD	0.18	50	25	250	0.047	1300	>2200
	MS75087-5	SWD	0.22	49	25	250	0.067	1100	>1700
	MS75087-6	SWD	0.27	47	25	250	0.11	855	>1500
	MS75087-7	SWD	0.33	46	25	250	0.13	780	>1300
	MS75087-8	SWD	0.39	44	25	250	0.18	670	>1100
	MS75087-9	SWD	0.47	44	25	235	0.25	565	>1000
	MS75087-10	SWD	0.56	43	25	210	0.33	490	> 900
	MS75087-11	SWD	0.68	42	25	190	0.45	420	> 750
	MS75087-12	SWD	0.82	40	25	180	0.59	370	> 600
IRON	MS75088-1	SWD	1.0	44	25	140	0.070	1070	>1900
	MS75088-2	SWD	1.2	44	7.9	130	0.093	895	>1600
	MS75088-3	SWD	1.5	44	7.9	115	0.12	815	>1300
	MS75088-4	SWD	1.8	44	7.9	105	0.14	775	>1200
	MS75088-5	SWD	2.2	44	7.9	100	0.19	650	>1100
	MS75088-6	SWD	2.7	44	7.9	92	0.28	535	> 950
	MS75088-7	SWD	3.3	44	7.9	85	0.35	480	> 800
	MS75088-8	SWD	3.9	44	7.9	75	0.40	450	> 750
	MS75088-9	SWD	4.7	44	7.9	70	0.55	380	> 650
	MS75088-10	SWD	5.6	44	7.9	65	0.72	335	> 550
	MS75088-11	SWD	6.8	50	7.9	55	1.02	280	> 500
	MS75088-12	SWD	8.2	50	7.9	50	1.32	250	> 475
	MS75088-13	SWD	10	50	7.9	46	1.62	220	> 450
	MS75088-14	SWD	12	55	2.5	44	2.00	200	> 400
FERRITE	MS75089-1	SWD	15	45	2.5	49	0.80	315	250
	MS75089-2	SWD	18	45	2.5	45	0.89	300	235
	MS75089-3	SWD	22	45	2.5	41	0.96	290	220
	MS75089-4	SWD	27	45	2.5	38	1.19	260	200
	MS75089-5	SWD	33	50	2.5	34	1.37	240	190
	MS75089-6	SWD	39	50	2.5	29	1.93	205	180
	MS75089-7	SWD	47	50	2.5	27	2.11	195	175
	MS75089-8	SWD	56	50	2.5	25	2.23	190	160
	MS75089-9	SWD	68	50	2.5	21	2.70	170	150
	MS75089-10	SWD	82	50	2.5	10.5	2.44	180	140
FERRITE	MS75089-11	SWD	100	50	2.5	10.0	3.12	160	120
	MS75089-12	SWD	120	55	0.79	9.7	3.60	150	95
	MS75089-13	SWD	150	55	0.79	8.5	4.10	140	90
	MS75089-14	SWD	180	55	0.79	8.0	4.40	135	85
	MS75089-15	SWD	220	55	0.79	7.5	5.00	125	80
	MS75089-16	SWD	270	55	0.79	7.0	5.80	115	70
	MS75089-17	SWD	330	55	0.79	6.5	6.40	110	65
	MS75089-18	SWD	390	60	0.79	6.2	7.40	105	60
	MS75089-19	SWD	470	60	0.79	5.7	9.50	92	58
	MS75089-20	SWD	560	60	0.79	4.7	10.5	90	55
	MS75089-21	SWD	680	60	0.79	4.5	11.8	80	50
	MS75089-22	SWD	820	60	0.79	4.2	13.0	80	45
	MS75089-23	SWD	1000	60	0.79	3.8	17.5	70	40
	MS75089-24	SWD	1200	40	0.25	1.5	22.1	60	35
	MS75089-25	SWD	1500	45	0.25	1.2	26.5	55	33
	MS75089-26	SWD	1800	45	0.25	1.0	29.9	50	30
	MS75089-27	SWD	2200	45	0.25	0.97	33.8	50	27
	MS75089-28	SWD	2700	45	0.25	0.92	47.3	40	25
	MS75089-29	SWD	3300	45	0.25	0.84	53.0	40	22
	MS75089-30	SWD	3900	45	0.25	0.80	73.8	35	20
	MS75089-31	SWD	4700	45	0.25	0.74	81.6	31	19
	MS75089-32	SWD	5600	44	0.25	0.73	98.9	28	17
	MS75089-33	SWD	6800	40	0.25	0.66	111.0	27	16
	MS75089-34	SWD	8200	40	0.25	0.54	119.0	26	15
	MS75089-35	SWD	10,000	40	0.25	0.47	137.0	24	14
	MS75089-36	SWD	12,000	30	0.079	0.33	143.0	23	13
	MS75089-37	SWD	15,000	30	0.079	0.29	157.0	22	12
	MS75089-38	SWD	18,000	30	0.079	0.28	175.0	21	10
	MS75089-39	SWD	22,000	27	0.079	0.25	274.0	17	9
	MS75089-40	SWD	27,000	27	0.079	0.21	308.0	16	8
	MS75089-41	SWD	33,000	27	0.079	0.19	343.0	15	7.5
	MS75089-42	SWD	39,000	27	0.079	0.17	376.0	15	6.0
	MS75089-43	SWD	47,000	23	0.079	0.16	473.0	13	5.5
	MS75089-44	SWD	56,000	23	0.079	0.14	512.0	13	5.0
	MS75089-45	SWD	68,000	23	0.079	0.13	580.0	12	4.0
	MS75089-46	SWD	82,000	21	0.079	0.12	618.0	11	3.5
	MS75089-47	SWD	100,000	19	0.079	0.11	678.0	11	3.0

† INCREMENTAL CURRENT: The D.C. current required to cause a 5% reduction in the nominal inductance value.
MS No. Electricals as shown.
NCG Part No. is reference only, see page 7 for SWD electricals.

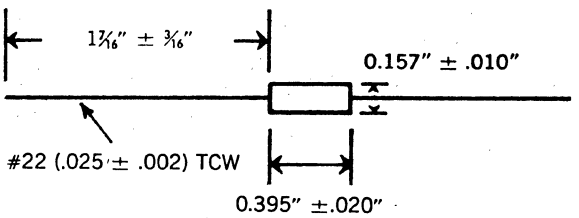
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

MS-INDUCTOR SERIES
90537
MOLDED SHIELDED INDUCTOR
(Manufactured per MS-90537)

Ultra-Reliable Molded Shielded Miniature Inductor.
Inductance Range: 0.1uH to 100,000uH.

The **MS-INDUCTOR SERIES** are R.F. Inductors specifically designed to meet the demanding requirements of MIL-C-15305 (latest revision). The MS-INDUCTOR Series epoxy molded envelope and shielding offers the design engineer reliability, electrical performance, and minimum coupling in high density packaging.



GRADE 1 CLASS B

ELECTRICAL CHARACTERISTICS

Inductance Tolerance: ±10% over the entire inductance range.
Dielectric Strength: 700 volts RMS at sea level.
Self-Resonant Frequency: Measured per MIL-C-15305 (latest revision).
Q: Measured on Q-Meter.
Maximum Current: Based on temperature rise not to exceed 35°C at 90°C ambient.

DENSITY CHARACTERISTICS

Volume: 0.0076 cubic inches **Weight:** 0.75 grams maximum
Shielding: At 1000 cycles two units assembled side by side exhibit less than 3% coupling.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: —55°C to +125°C.

Terminal Strength: Meets five pound pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305D, Grade 1, Class B. High frequency 10 cps to 2000 cps @ 20G ±10% maximum for 12 logarithmic swings each of 20 minute duration repeated for each of three mutually perpendicular planes. Shock: 100G, 6 MS.

Marking: Color coded per MIL-C-15305 (latest revision).

Material	MS Catalog No.	NCG P/N	L µH	Q Min.	Q Min. MHz	Min. SRF MHz	Max. DCR Ω	Max. I mA	Incr.** I mA
PHENOLIC	90537-1	SWD	0.10	50	25	250	0.025	2900	>2900
	90537-2	SWD	0.12	51	25	250	0.034	2800	>2800
	90537-3	SWD	0.15	51	25	250	0.037	2750	>2750
	90537-4	SWD	0.18	50	25	250	0.047	2200	>2200
	90537-5	SWD	0.22	49	25	250	0.067	1700	>1700
	90537-6	SWD	0.27	47	25	250	0.11	1500	>1500
	90537-7	SWD	0.33	46	25	250	0.13	1300	>1300
	90537-8	SWD	0.39	44	25	250	0.18	1100	>1100
	90537-9	SWD	0.47	44	25	235	0.25	1000	>1000
	90537-10	SWD	0.56	43	25	210	0.33	900	>900
	90537-11	SWD	0.68	42	25	190	0.45	750	>750
	90537-12	SWD	0.82	40	25	180	0.59	600	>600
IRON	90537-13	SWD	1.0	47	25	140	0.070	1900	>1900
	90537-14	SWD	1.2	46	7.9	130	0.093	1600	>1600
	90537-15	SWD	1.5	45	7.9	115	0.12	1300	>1300
	90537-16	SWD	1.8	43	7.9	105	0.14	1200	>1200
	90537-17	SWD	2.2	45	7.9	100	0.19	1100	>1100
	90537-18	SWD	2.7	46	7.9	92	0.28	950	>950
	90537-19	SWD	3.3	44	7.9	85	0.35	800	>800
	90537-20	SWD	3.9	44	7.9	75	0.40	750	>750
	90537-21	SWD	4.7	44	7.9	70	0.55	650	>650
	90537-22	SWD	5.6	47	7.9	65	0.72	550	>550
	90537-23	SWD	6.8	50	7.9	55	1.02	500	>500
	90537-24	SWD	8.2	50	7.9	50	1.32	475	>475
	90537-25	SWD	10	49	7.9	46	1.62	450	>450
	90537-26	SWD	12	55	2.5	44	2.00	400	>400
FERRITE	90537-27	SWD	15	44	2.5	49	0.80	620	250
	90537-28	SWD	18	45	2.5	45	0.89	610	235
	90537-29	SWD	22	46	2.5	41	0.96	600	220
	90537-30	SWD	27	49	2.5	38	1.19	500	200
	90537-31	SWD	33	45	2.5	34	1.37	490	190
	90537-32	SWD	39	53	2.5	29	1.93	410	180
	90537-33	SWD	47	52	2.5	27	2.11	400	175
	90537-34	SWD	56	49	2.5	25	2.23	380	160
	90537-35	SWD	68	51	2.5	21	2.70	370	150
	90537-36	SWD	82	45	2.5	10.5	2.44	360	140

Material	MS Catalog No.	NCG P/N	L µH	Q Min.	Q Min. MHz	Min. SRF MHz	Max. DCR Ω	Max. I mA	Incr.** I mA
FERRITE	90537-37	SWD	100	52	2.5	10.0	3.12	325	120
	90537-38	SWD	120	57	.79	9.7	3.60	290	95
	90537-39	SWD	150	56	.79	8.5	4.10	275	90
	90537-40	SWD	180	60	.70	8.0	4.40	260	85
	90537-41	SWD	220	58	.79	7.5	5.00	250	80
	90537-42	SWD	270	60	.79	7.0	5.80	240	70
	90537-43	SWD	330	54	.79	6.5	6.40	225	65
	90537-44	SWD	390	67	.79	6.2	7.40	200	60
	90537-45	SWD	470	60	.79	5.7	9.50	180	58
	90537-46	SWD	560	60	.79	4.7	10.5	174	55
	90537-47	SWD	680	60	.79	4.5	11.8	168	50
	90537-48	SWD	820	57	.79	4.2	13.0	152	45
	90537-49	SWD	1000	65	.79	3.8	17.5	135	40
	90537-50	SWD	1200	45	.25	1.5	22.1	115	35
	90537-51	SWD	1500	49	.25	1.2	26.5	110	33
	90537-52	SWD	1800	47	.25	1.0	29.9	105	30
	90537-53	SWD	2200	50	.25	0.97	33.8	99	27
	90537-54	SWD	2700	47	.25	0.92	47.3	83	25
	90537-55	SWD	3300	43	.25	0.84	53.0	80	22
	90537-56	SWD	3900	43	.25	0.80	73.8	67	20
	90537-57	SWD	4700	44	.25	0.74	81.6	63	19
	90537-58	SWD	5600	45	.25	0.73	98.9	56	17
	90537-59	SWD	6800	43	.25	0.66	111.0	54	16
	90537-60	SWD	8200	42	.25	0.54	119.0	52	15
	90537-61	SWD	10,000	39	.25	0.47	137.0	49	14
	90537-62	SWD	12,000	31	.079	0.33	143.0	46	13
	90537-63	SWD	15,000	31	.079	0.29	157.0	45	12
	90537-64	SWD	18,000	31	.079	0.28	175.0	41	10
	90537-65	SWD	22,000	27	.079	0.25	274.0	33	9
	90537-66	SWD	27,000	27	.079	0.21	308.0	31	8
	90537-67	SWD	33,000	27	.079	0.19	343.0	30	7.5
	90537-68	SWD	39,000	27	.079	0.17	376.0	27	6.0
	90537-69	SWD	47,000	23	.079	0.16	473.0	26	5.5
	90537-70	SWD	56,000	23	.079	0.14	512.0	25	5.0
	90537-71	SWD	68,000	23	.079	0.13	580.0	24	4.0
	90537-72	SWD	82,000	21	.079	0.12	618.0	23	3.5
	90537-73	SWD	100,000	18	.079	0.11	678.0	22	3.0

**INCREMENTAL CURRENT — The D.C. current required to cause a 5% reduction in the nominal inductance value.
NCG and MS Part No. electricals as shown.

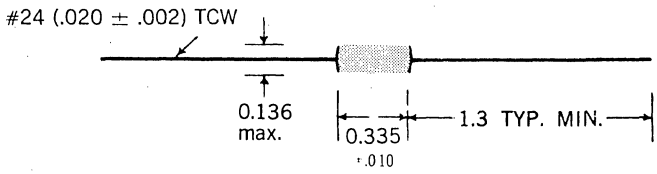
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

SUPER WEE-WEE-DUCTOR

An Ultra-Reliable molded shielded inductor. Subminiature size for high density circuits. Great Inductance-to-size ratio. .10 uH to 10,000 uH. 0.136" diameter x 0.335" length. 61 stock values.

The **SUPER WEE-WEE-DUCTOR,** a shielded miniaturized inductor, provides a greater inductance-to-size ratio in a molded epoxy envelope. Use of unique "T" lead construction on all values from 15 uH to 10,000 uH assures exceptional reliability in ranges where fine wire sizes are used. This MS inductor series is designed to meet the stringent requirements of MIL-C-15305 (latest revision). This provides the design engineer with utmost reliability, electrical performance, and minimum coupling in high density packaging.



GRADE 1 CLASS A

ELECTRICAL CHARACTERISTICS

Inductance Tolerance: ±10% (Q-Meter).
Dielectric Strength: 700 volts RMS at sea level.
Self-Resonant Frequency: Measured with full length leads on Q-Meter.
Q: Measured on Q-Meter.
Rating: maximum based on ⅓ watt dissipation.

DENSITY CHARACTERISTICS

Volume: 0.0041 cubic inches.
Weight: 0.50 grams maximum.
Shielding: Less than 3% coupling with two units mounted side by side at 1000 cycles.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +105°C.
Terminal Strength: Meets five pounds pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).
Moisture, Vibration and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision). High Frequency: 10 cps to 2000 cps @ 20G ±10% maximum for 12 logarithmic swings each of 20 minute duration repeated for each of three mutually perpendicular planes.
Shock: 100G, 6 MS.
Marking: Color coded per MIL-C-15305 (latest revision).

SUPER WEE-WEE-DUCTOR STANDARD VALUES

Material	MS No.	NCG Part No.	L µH	Q min.		min. Fo MHz	approx. Cd Pf	Max. DCR Ω	Max. I mA	Incr.* I mA
PHENOLIC	MS21399-1	SW-W- 0.10	0.10	42	25	480	.70	.087	1650	>1650
	MS21399-2	SW-W- 0.12	0.12	42	25	460	.63	.090	1630	>1630
	MS21399-3	SW-W- 0.15	0.15	42	25	400	.66	.098	1550	>1550
	MS21399-4	SW-W- 0.18	0.18	42	25	360	.62	.117	1420	>1420
	MS21399-5	SW-W- 0.22	0.22	42	25	340	.63	.141	1330	>1330
	MS21399-6	SW-W- 0.27	0.27	42	25	320	.59	.157	1230	>1230
	MS21399-7	SW-W- 0.33	0.33	42	25	295	.55	.178	1140	>1140
	MS21399-8	SW-W- 0.39	0.39	42	25	275	.55	.208	1060	>1060
	MS21399-9	SW-W- 0.47	0.47	41	25	250	.56	.257	960	> 960
	MS21399-10	SW-W- 0.56	0.56	39	25	238	.52	.283	915	> 915
	MS21399-11	SW-W- 0.68	0.68	36	25	224	.50	.337	840	> 840
	MS21399-12	SW-W- 0.82	0.82	35	25	205	.50	.470	720	> 720
IRON	MS21400-1	SW-W- 1.0	1.0	38	25	135	.87	.170	1180	>1180
	MS21400-2	SW-W- 1.2	1.2	38	7.9	124	.87	.190	1150	>1150
	MS21400-3	SW-W- 1.5	1.5	38	7.9	114	.87	.212	1050	>1050
	MS21400-4	SW-W- 1.8	1.8	38	7.9	105	.89	.242	990	> 990
	MS21400-5	SW-W- 2.2	2.2	38	7.9	95	.88	.263	950	> 950
	MS21400-6	SW-W- 2.7	2.7	38	7.9	85	.83	.320	880	> 880
	MS21400-7	SW-W- 3.3	3.3	38	7.9	78	.81	.345	820	> 820
	MS21400-8	SW-W- 3.9	3.9	42	7.9	74	.76	.411	755	> 755
	MS21400-9	SW-W- 4.7	4.7	42	7.9	68	.75	.562	650	> 650
	MS21400-10	SW-W- 5.6	5.6	42	7.9	62	.77	.742	565	> 565
	MS21400-11	SW-W- 6.8	6.8	45	7.9	55	.80	1.00	485	> 485
	MS21400-12	SW-W- 8.2	8.2	47	7.9	51	.78	1.20	440	> 440
	MS21400-13	SW-W- 10	10	51	7.9	45	.78	1.84	355	> 335
	MS21400-14	SW-W- 12	12	51	2.5	41	.85	2.60	300	> 300
FERRITE "T" LEAD	MS21401-1	SW-W- 15	15	45	2.5	48	.55	.635	610	200
	MS21401-2	SW-W- 18	18	45	2.5	44	.55	.728	570	175
	MS21401-3	SW-W- 22	22	45	2.5	37	.60	.825	530	160
	MS21401-4	SW-W- 27	27	45	2.5	32	.65	.950	500	155
	MS21401-5	SW-W- 33	33	46	2.5	30	.65	1.26	430	150
	MS21401-6	SW-W- 39	39	46	2.5	27	.66	1.42	405	145
	MS21401-7	SW-W- 47	47	46	2.5	23	.66	1.72	370	140
	MS21401-8	SW-W- 56	56	48	2.5	21	.75	2.03	340	130
	MS21401-9	SW-W- 68	68	48	2.5	18.5	.75	2.29	320	120
	MS21401-10	SW-W- 82	82	46	2.5	17.0	.75	2.55	305	115
	MS21401-11	SW-W- 100	100	46	2.5	15.5	.78	2.92	280	100
	MS21401-12	SW-W- 120	120	53	0.79	14.5	.72	3.30	235	80
	MS21401-13	SW-W- 150	150	53	0.79	13.0	.70	4.30	215	68
	MS21401-14	SW-W- 180	180	53	0.79	11.5	.70	5.40	200	64
	MS21401-15	SW-W- 220	220	55	0.79	10.0	.84	6.65	150	60
	MS21401-16	SW-W- 270	270	57	0.79	9.50	.74	7.60	140	58
	MS21401-17	SW-W- 330	330	57	0.79	8.50	.75	8.50	130	56
	MS21401-18	SW-W- 390	390	57	0.79	8.00	.74	10.0	120	54
	MS21401-19	SW-W- 470	470	57	0.79	7.20	.70	13.5	100	52
	MS21401-20	SW-W- 560	560	61	0.79	6.40	.70	14.5	95	50
	MS21401-21	SW-W- 680	680	61	0.79	5.80	.78	16.0	90	48
	MS21401-22	SW-W- 820	820	58	0.79	5.30	.78	19.0	85	47
	MS21401-23	SW-W- 1000	1000	58	0.79	4.80	.78	21.5	80	45
	MS21401-24	SW-W- 1200	1200	55	0.25	2.90	1.9	23	100	40
	MS21401-25	SW-W- 1500	1500	55	0.25	2.80	1.6	30	90	35
	MS21401-26	SW-W- 1800	1800	55	0.25	2.60	1.5	33	86	32
	MS21401-27	SW-W- 2200	2200	55	0.25	2.55	1.3	40	78	30
	MS21401-28	SW-W- 2700	2700	55	0.25	2.40	1.2	43	74	28
	MS21401-29	SW-W- 3300	3300	55	0.25	2.00	1.1	58	65	26
	MS21401-30	SW-W- 3900	3900	55	0.25	1.95	1.1	76	56	23
	MS21401-31	SW-W- 4700	4700	55	0.25	1.85	1.1	85	53	20
	MS21401-32	SW-W- 5600	5600	55	0.25	1.75	1.0	100	48	18
	MS21401-33	SW-W- 6800	6800	50	0.25	1.58	1.0	127	43	15
	MS21401-34	SW-W- 8200	8200	50	0.25	1.55	1.0	150	40	12
	MS21401-35	SW-W- 10,000	10,000	50	0.25	1.45	1.0	190	37	10

*INCREMENTAL CURRENT — The D.C. current to cause a 5% reduction in the nominal inductance value.

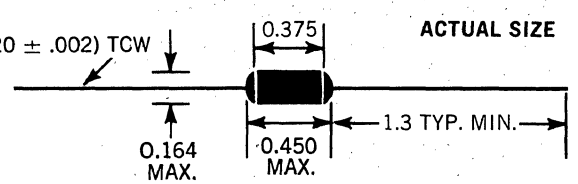
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

WEE-DUCTOR

**Miniature Shielded Inductor with high inductance-to-size ratio.
0.10uH to 180,000uH in 76 values
Designed to meet MIL-C-15305B.**

The **WEE-DUCTOR** was the first miniature shielded inductor that Nytronics standardized for stock delivery. This encapsulated non-flammable shielded unit in a 0.164" diameter by 0.450" long envelope offers the design engineer extremely high inductance for density packaging. The WEE-DUCTOR is designed to meet the environmental requirements of MIL-C-15305 Rev. B. **GRADE 2 CLASS B**



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 0.1 to 22uH ±10% (Q-Meter); 27uH to 1,000 ±5% (1KC Bridge); 1,200uH to 56,000uH ±10% (1KC Bridge) 68,000uH to 180,000uH ±20% (1KC Bridge) measured at point on leads ¼ inch from body.

Dielectric Strength: 700 volts RMS at sea level.

Self-Resonant Frequency: Minimum f_o to be not less than 80% of published data, and measured with full length leads on Q-Meter.

Q: Measured on Q-Meter.

Maximum Current: Based on temperature rise not to exceed 40°C at 85°C ambient.

DENSITY CHARACTERISTICS

Volume: 0.0087 cubic inches **Weight:** 0.75 grams maximum
Shielding: Less than 3% coupling with two units measured side by side at 1000 cycles.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: —55°C to +125°C.
Terminal Strength: Meets five pound pull test; five 360° rotations in alternate directions per MIL-C-15305B.
Marking: Printed with pertinent data.

Note: L & Q are not always tested at the same frequency.

MATERIAL	NCG PART NO.	L	Q min		Approx. SRF	approx. Cd	Max. DCR	Max. I	Incr* I
		uH		MHz	MHz	uuF	Ω	mA	mA
PHENOLIC	WEE- 0.10	0.10	63	25	>500	0.67	0.020	4000	4000
	WEE- 0.12	0.12	61	25	>500	0.67	0.029	3350	3350
	WEE- 0.15	0.15	59	25	>500	0.67	0.032	3000	3000
	WEE- 0.18	0.18	57	25	458	0.67	0.040	2850	2850
	WEE- 0.22	0.22	56	25	414	0.67	0.045	2700	2700
	WEE- 0.27	0.27	50	25	373	0.67	0.08	2000	2000
	WEE- 0.33	0.33	48	25	337	0.67	0.09	1900	1900
	WEE- 0.39	0.39	48	25	310	0.67	0.16	1420	1420
	WEE- 0.47	0.47	48	25	283	0.67	0.17	1400	1400
	WEE- 0.56	0.56	45	25	258	0.67	0.36	960	960
	WEE- 0.68	0.68	45	25	235	0.67	0.37	940	940
	WEE- 0.82	0.82	41	25	214	0.67	0.46	870	870
IRON	WEE- 1.0	1.0	42	7.9	164	0.92	0.062	2300	2300
	WEE- 1.2	1.2	43	7.9	150	0.92	0.067	2200	2200
	WEE- 1.5	1.5	41	7.9	135	0.92	0.16	1420	1420
	WEE- 1.8	1.8	42	7.9	124	0.92	0.17	1370	1370
	WEE- 2.2	2.2	42	7.9	112	0.92	0.19	1300	1300
	WEE- 2.7	2.7	41	7.9	107	0.92	0.20	1270	1270
	WEE- 3.3	3.3	40	7.9	91.5	0.92	0.31	1030	1030
	WEE- 3.9	3.9	40	7.9	84.5	0.92	0.33	1000	1000
	WEE- 4.7	4.7	40	7.9	76.5	0.92	0.58	750	750
	WEE- 5.6	5.6	40	7.9	69.5	0.92	0.64	710	710
	WEE- 6.8	6.8	40	7.9	63.5	0.92	0.68	680	680
	WEE- 8.2	8.2	45	7.9	57.5	0.92	1.3	500	500
	WEE- 10	10	46	2.5	52.5	0.92	1.4	480	480
	WEE- 12	12	47	2.5	47.5	0.92	1.5	460	460
	WEE- 15	15	47	2.5	42.5	0.92	1.7	440	440
FERRITE	WEE- 18	18	45	2.5	53.5	0.49	0.88	610	235
	WEE- 22	22	47	2.5	47.0	0.50	0.95	590	220
	WEE- 27	27	42	2.5	44.0	0.48	1.15	530	200
	WEE- 33	33	43	2.5	40.0	0.48	1.2	520	193
	WEE- 39	39	45	2.5	36.5	0.48	1.6	450	183
	WEE- 47	47	46	2.5	33.0	0.49	1.8	420	177
	WEE- 56	56	40	2.5	30.0	0.49	2.2	390	170
	WEE- 68	68	40	2.5	27.0	0.50	2.3	375	165
	WEE- 82	82	42	2.5	17.5	1.0	2.4	360	160
	WEE- 100	100	63	.79	15.0	1.0	2.6	345	157
	WEE- 120	120	62	.79	14.0	1.0	2.9	330	145

MATERIAL	NCG PART NO.	L	Q min		Approx SRF	approx. Cd	Max. DCR	Max. I	Incr* I
		uH		MHz	MHz	uuF	Ω	mA	mA
FERRITE	WEE- 150	150	63	.79	12.5	1.0	3.3	315	126
	WEE- 180	180	60	.79	11.5	1.0	3.6	300	110
	WEE- 220	220	57	.79	11.0	0.94	4.1	280	105
	WEE- 270	270	52	.79	10.0	0.92	4.8	260	91
	WEE- 330	330	50	.79	9.0	0.92	5.6	240	87
	WEE- 390	390	43	.79	8.5	0.87	6.2	230	72
	WEE- 470	470	66	.79	8.0	0.83	10.0	180	67
	WEE- 560	560	64	.79	7.5	0.82	11.5	170	65
	WEE- 680	680	71	.79	6.5	0.87	12.0	160	60
	WEE- 820	820	67	.79	6.0	0.87	13.8	150	55
	WEE- 1000	1000	62	.79	5.6	0.87	16.0	140	52
	WEE- 1200	1200	52	.250	1.490	9.0	18.2	135	50
	WEE- 1500	1500	51	.250	1.460	8.0	23.7	118	48
	WEE- 1800	1800	51	.250	1.420	6.5	30.2	105	42
	WEE- 2200	2200	50	.250	1.300	6.8	33.7	99	37
	WEE- 2700	2700	51	.250	1.180	6.8	43.1	87	33
	WEE- 3300	3300	52	.250	1.050	7.0	48.7	82	30
	WEE- 3900	3900	48	.250	.960	7.0	62.7	72	29
	WEE- 4700	4700	48	.250	.840	7.4	70.5	68	28
	WEE- 5600	5600	48	.250	.810	6.8	104	56	24
	WEE- 6800	6800	45	.250	.740	6.8	118	53	20
	WEE- 8200	8200	38	.250	.580	9.2	146	47	18
	WEE- 10,000	10,000	36	.079	.470	11.5	76.6	66	15
	WEE- 12,000	12,000	36	.079	.370	15.0	109	55	14
	WEE- 15,000	15,000	38	.079	.330	15.0	119	52	13
	WEE- 18,000	18,000	38	.079	.305	15.0	138	49	13
	WEE- 22,000	22,000	32	.079	.295	13.0	219	39	12
	WEE- 27,000	27,000	32	.079	.270	13.0	259	35	12
	WEE- 33,000	33,000	32	.079	.250	12.5	296	33	11
	WEE- 39,000	39,000	30	.079	.215	14.0	395	29	10
	WEE- 47,000	47,000	25	.079	.210	12.5	452	27	9
	WEE- 56,000	56,000	25	.079	.195	12.0	499	26	8
	WEE- 68,000	68,000	20	.079	.130	18.4	395	29	1.1
	WEE- 82,000	82,000	20	.079	.125	16.5	452	27	1.1
	WEE-100,000	100,000	20	.079	.115	16.2	499	26	1.1
	WEE-120,000	120,000	20	.070	.105	16.8	540	23	1.1
	WEE-150,000	150,000	20	.060	.098	13.4	750	20	1.0
	WEE-180,000	180,000	20	.050	.094	13.4	880	18	0.8

*INCREMENTAL CURRENT — The D.C. current to cause a 5% reduction in the nominal inductance value.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

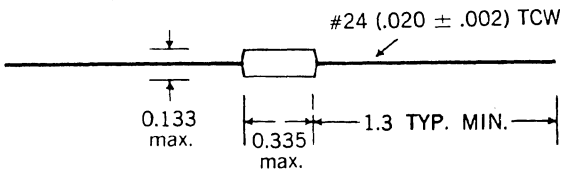
WEE-WEE-DUCTOR SERIES

The smallest shielded inductor for high density circuits 0.10 to 1,000 uh 0.133" diameter x 0.335" length. We have 49 stock values.

GRADE 2 CLASS B

The **WEE-WEE-DUCTOR** offers the Design Engineer a subminiature shielded inductor to solve special problems in density circuit application. This shielded inductor has great inductance-to-size ratio and is designed to meet the stringent requirements of MIL-C-15305 Rev. B.

0.10 to 10,000uH
0.133" diameter x 0.335" length
49 stock values



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: ±10% (Q-Meter).

Dielectric Strength: 700 volts RMS at sea level.

Self-Resonant Frequency: Minimum f_o to be not less than 80% of published data, and measured with full length leads on Q-Meter.

Rating: I maximum based on ⅓ watt dissipation.

DENSITY CHARACTERISTICS

Volume: 0.0041 cubic inches.

Weight: 0.50 grams maximum.

Shielding: Less than 3% coupling with two units mounted side by side at 1000 cycles.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +125°C.

Terminal Strength: Meets five pound pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).

Marking: Color coded per MIL-C-15305 (latest revision).

WEE-WEE-DUCTOR STANDARD VALUES

NCG PART NO.	L	Q min.		approx. SRF	Max. DCR	Max. I	Incr.* I	
	uH		MHz	MHz	Ω	mA	mA	
WEE-WEE- 0.10	0.10	42	25	500	.112	1720	>1720	PHENOLIC
WEE-WEE- 0.12	0.12	42	25	500	.126	1630	>1630	
WEE-WEE- 0.15	0.15	42	25	500	.138	1550	>1550	
WEE-WEE- 0.18	0.18	42	25	458	.165	1420	>1420	
WEE-WEE- 0.22	0.22	42	25	414	.198	1330	>1330	
WEE-WEE- 0.27	0.27	42	25	373	.220	1230	>1230	
WEE-WEE- 0.33	0.33	42	25	360	.258	1140	>1140	
WEE-WEE- 0.39	0.39	42	25	339	.292	1060	>1060	
WEE-WEE- 0.47	0.47	41	25	309	.360	960	> 960	
WEE-WEE- 0.56	0.56	39	25	295	.397	915	> 915	
WEE-WEE- 0.68	0.68	36	25	270	.472	840	> 840	
WEE-WEE- 0.82	0.82	35	25	250	.638	720	> 720	
WEE-WEE- 1.0	1.0	42	25	170	.208	1260	>1260	IRON
WEE-WEE- 1.2	1.2	38	7.9	150	.225	1210	>1210	
WEE-WEE- 1.5	1.5	38	7.9	139	.265	1120	>1120	
WEE-WEE- 1.8	1.8	38	7.9	129	.285	1080	>1080	
WEE-WEE- 2.2	2.2	36	7.9	118	.330	1000	>1000	
WEE-WEE- 2.7	2.7	38	7.9	106	.381	935	> 935	
WEE-WEE- 3.3	3.3	38	7.9	98	.432	875	> 875	
WEE-WEE- 3.9	3.9	40	7.9	91	.576	755	> 755	
WEE-WEE- 4.7	4.7	42	7.9	83	.787	650	> 650	
WEE-WEE- 5.6	5.6	42	7.9	77	1.04	565	> 565	
WEE-WEE- 6.8	6.8	45	7.9	67	1.40	485	> 485	
WEE-WEE- 8.2	8.2	47	7.9	62	1.68	440	> 440	
WEE-WEE- 10	10	51	7.9	55	2.58	355	> 355	
WEE-WEE- 12	12	51	2.5	49	3.65	300	> 300	
WEE-WEE- 15	15	45	2.5	55	.862	620	200	FERRITE
WEE-WEE- 18	18	43	2.5	50	1.02	570	175	
WEE-WEE- 22	22	42	2.5	45	1.12	545	160	
WEE-WEE- 27	27	37	2.5	41	1.28	510	155	
WEE-WEE- 33	33	46	2.5	37	1.70	440	150	
WEE-WEE- 39	39	38	2.5	33	1.99	405	145	
WEE-WEE- 47	47	42	2.5	29	2.41	370	140	
WEE-WEE- 56	56	41	2.5	27	2.85	340	130	
WEE-WEE- 68	68	46	2.5	23	3.21	320	120	
WEE-WEE- 82	82	46	2.5	21	3.57	305	115	
WEE-WEE- 100	100	43	2.5	19	4.10	280	100	
WEE-WEE- 120	120	50	0.79	16	5.97	235	80	
WEE-WEE- 150	150	49	0.79	15	7.05	215	68	
WEE-WEE- 180	180	56	0.79	14	8.12	200	64	
WEE-WEE- 220	220	53	0.79	12	14.8	150	60	
WEE-WEE- 270	270	57	0.79	11.5	16.8	140	58	
WEE-WEE- 330	330	57	0.79	10.5	18.6	130	56	
WEE-WEE- 390	390	57	0.79	10.0	21.1	120	54	
WEE-WEE- 470	470	50	0.79	8.5	32.2	100	52	
WEE-WEE- 560	560	50	0.79	7.5	36.4	95	50	
WEE-WEE- 680	680	56	0.79	7.0	41.1	90	48	
WEE-WEE- 820	820	49	0.79	6.5	45.0	85	47	
WEE-WEE-1000	1000	49	0.79	6.0	52.0	80	45	

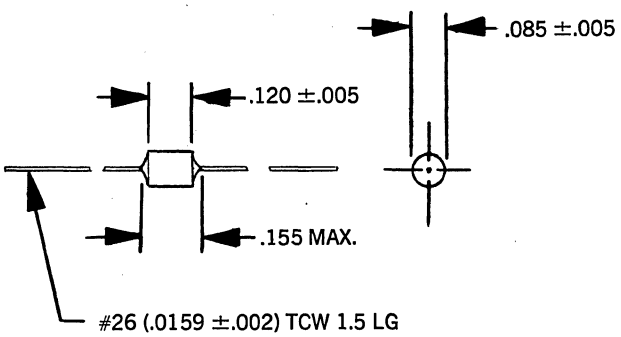
*INCREMENTAL CURRENT — The D.C. current to cause a 5% reduction in the nominal inductance value.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

PEE-WEE SERIES

The amazing **PEE-WEE DUCTOR** represents a 66% size reduction from the smallest magnetically shielded axial leaded inductor series heretofore available anywhere. Furthermore, this size reduction was obtained with negligible loss of electrical performance by employing several unique concepts in RF coil design.



ALL DIMENSIONS IN INCHES

ELECTRICAL CHARACTERISTICS:

Inductance Tolerance: ± 10% (Std).

L,Q,F, values: Measurements per MIL-C-15305. (latest revision).

Incremental Current: Incremental current in table is for 5% reduction in inductance value.

Dielectric Strength: 300 Volts RMS @ Sea Level.

*SRF minimum not less than 80% of specified values.

DENSITY CHARACTERISTICS:

Volume: .0007 Cubic Inches

Weight: 0.12 Grams

Shielding: 5% maximum coupling for two units side by side.

Marking: EIA color coded

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS:

Terminal pull: 3 lbs. minimum.

Environmental: Grade 2 Class A

PEE-WEE DUCTOR STANDARD VALUES

NCG PART NO.	L μH	Q min. @	MHz	*SRF MHz	Max. DCR Ω	Max. I mA	Incr. I mA
PW- 0.10	.10	40	25	500	.060	1500	*
PW- 0.12	.12	40	25	480	.070	1400	*
PW- 0.15	.15	40	25	450	.080	1300	*
PW- 0.18	.18	40	25	430	.090	1200	*
PW- 0.22	.22	40	25	390	.11	1100	*
PW- 0.27	.27	40	25	340	.12	1000	*
PW- 0.33	.33	40	25	310	.14	950	*
PW- 0.39	.39	40	25	280	.16	900	*
PW- 0.47	.47	40	25	250	.20	800	*
PW- 0.56	.56	40	25	220	.25	750	*
PW- 0.68	.68	35	25	200	.27	700	*
PW- 0.82	.82	35	25	180	.36	600	*
PW- 1.0	1.0	35	25	165	.40	525	*
PW- 1.2	1.2	35	7.9	150	.70	425	*
PW- 1.5	1.5	35	7.9	130	.80	400	*
PW- 1.8	1.8	35	7.9	120	.90	350	*
PW- 2.2	2.2	35	7.9	110	1.3	320	*
PW- 2.7	2.7	35	7.9	100	1.8	275	*
PW- 3.3	3.3	35	7.9	70	1.7	290	*
PW- 3.9	3.9	35	7.9	65	1.8	275	*
PW- 4.7	4.7	35	7.9	58	2.6	225	*
PW- 5.6	5.6	35	7.9	54	2.9	210	*
PW- 6.8	6.8	35	7.9	50	3.3	200	*
PW- 8.2	8.2	35	7.9	48	4.5	170	*
PW- 10	10	35	7.9	45	4.8	165	*
PW- 12	12	35	2.5	40	2.0	250	230
PW- 15	15	35	2.5	36	2.5	230	180
PW- 18	18	35	2.5	31	3.5	195	150
PW- 22	22	35	2.5	28	4.5	170	135
PW- 27	27	35	2.5	25	5.0	160	115
PW- 33	33	35	2.5	23	5.5	150	105
PW- 39	39	35	2.5	22	7.0	140	100
PW- 47	47	35	2.5	21	7.5	135	95
PW- 56	56	35	2.5	19	8.0	130	90
PW- 68	68	35	2.5	18	9.0	120	83
PW- 82	82	35	2.5	16	14	95	65
PW- 100	100	35	2.5	14	16	90	70
PW- 120	120	35	.79	9.5	10	115	40
PW- 150	150	35	.79	8.8	12	105	35
PW- 180	180	35	.79	8.1	15	90	32
PW- 220	220	35	.79	7.8	20	80	30
PW- 270	270	35	.79	7.3	23	75	27
PW- 330	330	35	.79	6.8	26	70	25
PW- 390	390	35	.79	6.0	35	65	23
PW- 470	470	35	.79	5.6	37	60	21
PW- 560	560	35	.79	5.0	40	58	20
PW- 680	680	35	.79	4.3	48	54	18
PW- 820	820	35	.79	3.8	54	47	17
PW-1000	1000	35	.79	3.5	65	43	15

* GREATER THAN MAX I

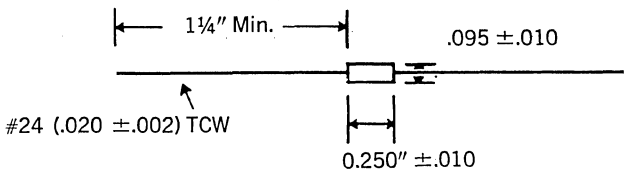
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

DECI-DUCTOR

New Subminiature Inductor 0.10uH to 1000uH Range
0.100″ diameter by 0.250″ length 49 STANDARD VALUES

The **DECI-DUCTOR** offers the design engineer epoxy-molded reliability and uniformity in a subminiature R.F. Inductor. This Nytronics R.F. Inductor line is designed to meet all the environmental specifications of MIL-C-15305 (latest revision).



GRADE 2 CLASS B

ELECTRICAL CHARACTERISTICS

Inductance Tolerance: ±10% over entire range.
Dielectric Strength: 700 volts RMS at sea level.
Self-Resonant Frequency: Measured per MIL-C-15305 (latest revision).
Rating: Maximum Current based on 35°C rise in 90°C ambient.

DENSITY CHARACTERISTICS

Volume: 0.002 cubic inches **Weight:** 0.35 grams

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: —55°C to +125°C

Terminal Strength: Meets three pound pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision), 10 cps to 2000 cps @ 15 G ±10% maximum for 12 logarithmic swings each of 20 minute duration repeated for each of three mutually perpendicular planes. Shock: 50G, 11 MS (body mounted).

Marking: Color coded per MIL-C-15305 (latest revision).

	NCG Part No.	L uH	Q Min.	MHz	Min. SRF MHz	Max. DCR Ohms	Max I. mA
PHENOLIC	DD-0.10	0.10	40	25	690	0.07	2000
	DD-0.12	0.12	40	25	650	0.08	1900
	DD-0.15	0.15	38	25	600	0.09	1750
	DD-0.18	0.18	38	25	550	0.10	1600
	DD-0.22	0.22	35	25	510	0.11	1550
	DD-0.27	0.27	35	25	470	0.15	1350
	DD-0.33	0.33	32	25	410	0.21	1150
	DD-0.39	0.39	32	25	370	0.29	970
	DD-0.47	0.47	32	25	340	0.35	820
	DD-0.56	0.56	32	25	310	0.48	700
	DD-0.68	0.68	33	25	280	0.65	600
	DD-0.82	0.82	30	25	255	0.82	500
	DD-1.00	1.00	30	25	240	1.10	475
IRON	DD-1.20	1.20	30	7.9	155	0.16	1200
	DD-1.50	1.50	32	7.9	140	0.20	1100
	DD-1.80	1.80	35	7.9	130	0.32	900
	DD-2.20	2.20	35	7.9	120	0.37	760
	DD-2.70	2.70	37	7.9	105	0.49	700
	DD-3.30	3.30	45	7.9	95	0.67	575
	DD-3.90	3.90	45	7.9	87	0.95	500
	DD-4.70	4.70	45	7.9	80	1.10	475
	DD-5.60	5.60	52	7.9	75	1.60	380
	DD-6.80	6.80	52	7.9	65	1.80	350
	DD-8.20	8.20	60	7.9	62	2.40	300
	DD-10.0	10.0	60	7.9	52	3.40	265
	DD-12.0	12.0	45	2.5	42	2.40	300
	DD-15.0	15.0	47	2.5	36	2.70	275
	DD-18.0	18.0	50	2.5	32	3.00	260
	DD-22.0	22.0	50	2.5	28	3.30	250
	DD-27.0	27.0	50	2.5	25	3.80	240
FERRITE	DD-33.0	33.0	50	2.5	30	3.80	260
	DD-39.0	39.0	50	2.5	26	4.10	240
	DD-47.0	47.0	50	2.5	24	4.40	210
	DD-56.0	56.0	50	2.5	22	5.70	205
	DD-68.0	68.0	52	2.5	19	6.50	180
	DD-82.0	82.0	52	2.5	17	7.30	175
	DD-100	100	50	2.5	15	8.20	165
	DD-120	120	28	0.79	14	14	110
	DD-150	150	28	0.79	13	16	105
	DD-180	180	28	0.79	12	18	100
	DD-220	220	26	0.79	11	25	90
	DD-270	270	26	0.79	10	33	75
	DD-330	330	26	0.79	9.0	37	70
	DD-390	390	25	0.79	8.0	51	60
	DD-470	470	27	0.79	7.0	56	58
	DD-560	560	27	0.79	6.5	61	55
	DD-680	680	28	0.79	6.0	70	50
	DD-820	820	28	0.79	5.5	91	45
	DD-1000	1000	28	0.79	5.2	102	40

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

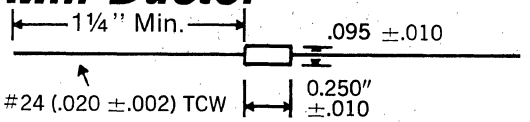
ALL VALUES AVAILABLE IN ESTABLISHED RELIABILITY, LEVEL R, TO MIL-C-39010

—MS INDUCTOR SERIES 75083, 75084, 75085 MOLDED INDUCTOR/0.100 uh to 1000 uh

Markings: Color coded per MIL-C-15305 (Latest Rev.)

The MS Inductor Series are RF Inductors specifically designed to meet the demanding requirements of MIL-C-15305 (latest revision). This MS Series is Epoxy Molded enveloped features reliability and uniformity in a Subminiature Inductor.

Mili-Ductor



ELECTRICAL CHARACTERISTICS
Inductance Tolerance: ±10% over entire range.
Dielectric Strength: 1000 volts RMS at sea level.
Self-Resonant Frequency: Measured per MIL-C-15305 (latest revision).
Rating: Maximum current based on; 35°C rise in 90° ambient for phenolic, 15°C rise in 90° ambient for iron, 35°C rise in 70° ambient for ferrite core inductors.

DENSITY CHARACTERISTICS
Volume: 0.002 cubic inches; **Weight:** 0.30 grams.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS
Operating Temperature: —55°C to +125°C phenolic core, —55°C to +105°C iron and ferrite core.
Terminal Strength: Meets five pound pull test; five 360° rotations in alternate directions per MIL-C-15305 (latest revision).
Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision), 10 cps to 2000 cps @ 20G ±10% maximum for 12 logarithmic swings each of 20 minute duration repeated for each of three mutually perpendicular planes. Shock: 100G, 6 MS (body mounted).

MS No.	NCG Part No.	±10% Inductance uh	Q Min.	Test Frequency (L & Q) MHz	Self-resonant Frequency, Min. MHz	DC Resistance Max. Ohms	Rated DC Current MA	Material
MS75083-01	MD	.10	40	25.0	680	.08	1350	PHENOLIC
MS75083-02	MD	.12	40	25.0	640	.09	1270	
MS75083-03	MD	.15	38	25.0	600	.10	1200	
MS75083-04	MD	.18	35	25.0	550	.12	1105	
MS75083-05	MD	.22	33	25.0	510	.14	1025	
MS75083-06	MD	.27	33	25.0	430	.16	960	
MS75083-07	MD	.33	30	25.0	410	.22	815	
MS75083-08	MD	.39	30	25.0	365	.30	700	
MS75083-09	MD	.47	30	25.0	330	.35	650	
MS75083-10	MD	.56	30	25.0	300	.50	545	
MS75083-11	MD	.68	28	25.0	275	.60	495	
MS75083-12	MD	.82	28	25.0	250	.85	415	
MS75083-13	MD	1.00	25	25.0	230	1.00	385	
MS75084-01	MD	1.2	25	7.9	150	.18	590	IRON
MS75084-02	MD	1.5	28	7.9	140	.22	535	
MS75084-03	MD	1.8	30	7.9	125	.30	455	
MS75084-04	MD	2.2	30	7.9	115	.40	395	
MS75084-05	MD	2.7	37	7.9	100	.55	355	
MS75084-06	MD	3.3	45	7.9	90	.85	270	
MS75084-07	MD	3.9	45	7.9	80	1.00	250	
MS75084-08	MD	4.7	45	7.9	75	1.20	230	
MS75084-09	MD	5.6	50	7.9	65	1.80	185	
MS75084-10	MD	6.8	50	7.9	60	2.00	175	
MS75084-11	MD	8.2	55	7.9	55	2.70	155	
MS75084-12	MD	10	55	7.9	50	3.70	130	
MS75084-13	MD	12	45	2.5	40	2.70	155	
MS75084-14	MD	15	40	2.5	35	2.80	150	
MS75084-15	MD	18	50	2.5	30	3.10	145	
MS75084-16	MD	22	50	2.5	25	3.30	140	
MS75084-17	MD	27	50	2.5	20	3.50	135	
MS75085-01	MD	33	45	2.5	24	3.4	130	FERRITE
MS75085-02	MD	39	45	2.5	22	3.6	125	
MS75085-03	MD	47	45	2.5	20	4.5	110	
MS75085-04	MD	56	45	2.5	18	5.7	100	
MS75085-05	MD	68	50	2.5	15	6.7	92	
MS75085-06	MD	82	50	2.5	14	7.3	88	
MS75085-07	MD	100	50	2.5	13	8	84	
MS75085-08	MD	120	30	.79	12	13	66	
MS75085-09	MD	150	30	.79	11	15	61	
MS75085-10	MD	180	30	.79	10	17	57	
MS75085-11	MD	220	30	.79	9	21	52	
MS75085-12	MD	270	30	.79	8	25	47	
MS75085-13	MD	330	30	.79	7	28	45	
MS75085-14	MD	390	30	.79	6.5	35	40	
MS75085-15	MD	470	30	.79	6	42	36	
MS75085-16	MD	560	30	.79	5	46	35	
MS75085-17	MD	680	30	.79	4	60	30	
MS75085-18	MD	820	30	.79	3.8	65	29	
MS75085-19	MD	1000	30	.79	3.4	72	28	

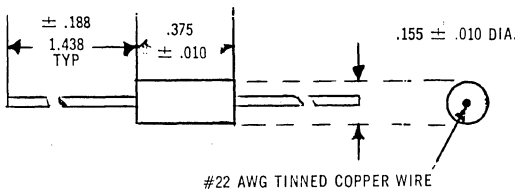
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

RFC-SS SERIES

Molded inductors specifically designed to meet MIL-C-15305 (latest revision). Inductance from 0.15 to 240uH.

GRADE 1 CLASS A (0.15-4.7)
CLASS B (5.6-240)



VALUES 0.15 μH THRU 33 μH AVAILABLE IN ESTABLISHED RELIABILITY, LEVEL R, TO MIL-C-39010

MS NO.	NCG* PART NO.	L uH	Q Min.	@ MHz	Min. SRF MHz	Max. DCR Ω	Rated DC Cur. mA	Material
MS18130-1	RFC-SS- .15	0.15	50	25	525	0.03	2450	PHENOLIC
MS18130-2	RFC-SS- .22	0.22	50	25	450	0.05	1900	
MS18130-3	RFC-SS- .33	0.33	45	25	360	0.09	1400	
MS18130-4	RFC-SS- .47	0.47	45	25	310	0.12	1225	
MS18130-5	RFC-SS- .56	0.56	50	25	280	0.13	1220	
MS18130-6	RFC-SS- .68	0.68	50	25	250	0.15	1100	
MS18130-7	RFC-SS- .82	0.82	50	25	220	0.22	900	
MS18130-8	RFC-SS- 1.00	1.00	50	25	200	0.29	830	
MS18130-9	RFC-SS- 1.20	1.20	33	7.9	180	0.42	650	
MS18130-10	RFC-SS- 1.50	1.5	33	7.9	160	0.50	600	
MS18130-11	RFC-SS- 1.80	1.8	33	7.9	150	0.65	525	
MS18130-12	RFC-SS- 2.2	2.2	33	7.9	135	0.95	435	
MS18130-13	RFC-SS- 2.7	2.7	33	7.9	120	1.20	385	
MS18130-14	RFC-SS- 3.3	3.3	33	7.9	110	2.00	300	
MS18130-15	RFC-SS- 3.9	3.9	33	7.9	100	2.30	280	
MS18130-16	RFC-SS- 4.7	4.7	33	7.9	90	2.60	260	
MS14046-1	RFC-SS- 5.6	5.6	45	7.9	60	0.32	750	IRON
MS14046-2	RFC-SS- 6.8	6.8	50	7.9	55	0.50	600	
MS14046-3	RFC-SS- 8.2	8.2	50	7.9	50	0.60	545	
MS14046-4	RFC-SS- 10	10.0	55	7.9	45	0.90	445	
MS14046-5	RFC-SS- 12	12	65	2.5	42	1.10	404	
MS14046-6	RFC-SS- 15	15	65	2.5	40	1.40	370	
MS14046-7	RFC-SS- 18	18	75	2.5	34	2.25	280	
MS14046-8	RFC-SS- 22	22	75	2.5	30	2.50	265	
MS14046-9	RFC-SS- 27	27	60	2.5	25	2.60	260	
MS14046-10	RFC-SS- 33	33	65	2.5	19	3.00	250	
MS90538-1	RFC-SS- 36	36	60	2.5	15.5	2.50	180	
MS90538-2	RFC-SS- 39	39	60	2.5	14.5	2.60	176	
MS90538-3	RFC-SS- 43	43	60	2.5	13.7	2.70	172	
MS90538-4	RFC-SS- 47	47	55	2.5	13.0	2.75	170	
MS90538-5	RFC-SS- 51	51	55	2.5	12.7	2.85	167	
MS90538-6	RFC-SS- 56	56	55	2.5	12.0	3.00	164	
MS90538-7	RFC-SS- 62	62	55	2.5	11.5	3.15	160	
MS90538-8	RFC-SS- 68	68	55	2.5	11.0	3.30	156	
MS90538-9	RFC-SS- 75	75	55	2.5	10.5	3.70	147	
MS90538-10	RFC-SS- 82	82	50	2.5	10.3	3.9	143	
MS90538-11	RFC-SS- 91	91	50	2.5	10.0	4.3	136	
MS90538-12	RFC-SS-100	100	50	2.5	9.5	4.5	133	
MS90538-13	RFC-SS-110	110	60	0.79	8.9	4.9	128	
MS90538-14	RFC-SS-120	120	65	0.79	8.7	5.2	124	
MS90538-15	RFC-SS-130	130	65	0.79	8.5	5.45	121	
MS90538-16	RFC-SS-150	150	65	0.79	8.0	6.05	114	
MS90538-17	RFS-SS-160	160	65	0.79	7.5	6.40	111	
MS90538-18	RFC-SS-180	180	65	0.79	7.0	6.75	108	
MS90538-19	RFC-SS-200	200	65	0.79	6.5	7.10	106	
MS90538-20	RFC-SS-220	220	65	0.79	6.2	7.45	103	
MS90538-21	RFC-SS-240	240	65	0.79	5.9	7.8	101	

* NCG Part No. electricals and tolerances as shown, MS No. electricals and tolerances per actual MS sheet.

ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 0.15 to 33 uH ±10%
36 to 240 uH ±5%
Measured on Q meter per MIL-C-15305 (latest revision).

Dielectric Strength: 1000 volts RMS @ sea level

Rated Current: Based on max. temp. rise of
35°C (ambient 90°C) for
RFC-SS-0.15 to 4.7
15°C (ambient 90°C) for
RFC-SS-5.6 to -240

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: Max. 125°C for
RFC-SS-0.15 to -4.7
Max. 105°C for
RFC-SS-5.6 to -240

Terminal Strength: Meets five pound pull test per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision), high frequency 10 cps

Marking: Color banded.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

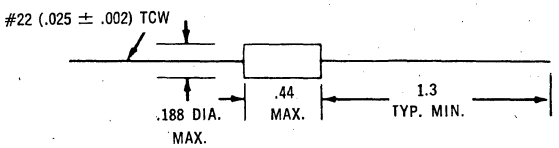
Inductors

RFC-S SERIES

Proven reliability molded inductors specifically designed to meet MIL-C-15305 (latest revision). Inductance 0.1 to 1000uH.

GRADE 1 CLASS B

ACTUAL SIZE



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 0.1 to 22uH ±10% on Q-Meter
27uH to 100 ±5%
1,000 cps bridge
120uH to 1000uH ±5% on Q-Meter

Dielectric Strength: 700 volts RMS at sea level.

Self-Resonant Frequency: Minimum f_o to be not less than 80% of published data and measured with full length leads on Grid-Dip Meter.

Q: Measured on Q-Meter.

Rating: ⅓ watt dissipation for series S

Note: L & Q are not always tested at the same frequency.

DENSITY CHARACTERISTICS

Volume: 0.012 cu. in.

Weight: 0.90 grams

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +125°C.

Terminal Strength: Meets five pound pull test per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 Grade 1, Class B. High frequency 10 cps to 2000 cps @ 30G ±10% maximum for 12 logarithmic swings, each of 20 minute duration repeated for each of three mutually perpendicular planes. (body mounted)

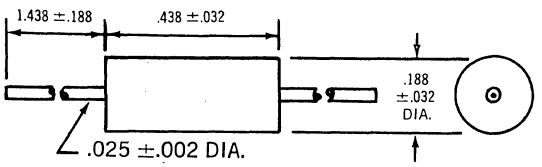
MS NO.	NCG PART NO.*	L uH	Q min		approx. SRF MHz	Max. DCR Ω	max. I mA	MATERIAL
				MHz				
MS21389-1	RFC-S- 0.10	0.10	85	50	500	.02	4000	PHENOLIC
MS21389-2	RFC-S- 0.12	0.12	85	50	500	0.25	3500	
MS21389-3	RFC-S- 0.15	0.15	85	50	500	.03	3000	
MS21389-4	RFC-S- 0.18	0.18	75	50	500	.03	3000	
MS21389-5	RFC-S- 0.22	0.22	75	50	500	.03	3000	
MS21389-6	RFC-S- 0.27	0.27	70	45	470	.04	2700	
MS21389-7	RFC-S- 0.33	0.33	70	40	440	.05	2500	
MS21389-8	RFC-S- 0.39	0.39	65	40	400	.08	2000	
MS21389-9	RFC-S- 0.47	0.47	60	25	360	.08	2000	
MS21389-10	RFC-S- 0.56	0.56	55	25	330	.10	1700	
MS21389-11	RFC-S- 0.68	0.68	55	25	300	.12	1500	
MS21389-12	RFC-S- 0.82	0.82	50	25	275	.18	1300	
MS21389-13	RFC-S- 1.0	1.0	50	20	250	.24	1100	
MS21389-14	RFC-S- 1.2	1.2	45	20	220	.35	1000	
MS21389-15	RFC-S- 1.5	1.5	45	15	200	.43	850	
MS21389-16	RFC-S- 1.8	1.8	45	15	180	.65	720	
MS21389-17	RFC-S- 2.2	2.2	45	15	165	.80	610	
MS21390-1	RFC-S- 2.7	2.7	55	10	110	.12	1600	IRON
MS21390-2	RFC-S- 3.3	3.3	55	10	100	.15	1400	
MS21390-3	RFC-S- 3.9	3.9	60	10	95	.23	1200	
MS21390-4	RFC-S- 4.7	4.7	70	7.9	90	.30	1000	
MS21390-5	RFC-S- 5.6	5.6	65	7.9	80	.45	900	
MS21390-6	RFC-S- 6.8	6.8	65	7.9	70	.55	800	
MS21390-7	RFC-S- 8.2	8.2	60	7.9	65	.65	720	
MS21390-8	RFC-S- 10	10	60	5	60	.73	650	
MS21390-9	RFC-S- 12	12	65	5	53	1.1	590	
MS21390-10	RFC-S- 15	15	80	2.5	47	1.4	500	
MS21390-11	RFC-S- 18	18	75	2.5	43	1.6	460	
MS21390-12	RFC-S- 22	22	75	2.5	40	1.8	430	
MS21390-13	RFC-S- 27	27	75	2.5	36	2.7	360	
MS21390-14	RFC-S- 33	33	85	2.5	32	3.5	300	
MS21390-15	RFC-S- 39	39	80	2.5	26	3.8	290	
MS21390-16	RFC-S- 47	47	80	2.5	22	4.0	275	
MS21390-17	RFC-S- 56	56	75	2.5	19	4.4	265	
MS21390-18	RFC-S- 68	68	75	2.5	16	4.7	250	
MS21390-19	RFC-S- 82	82	75	2.5	13	5.3	235	
MS21390-20	RFC-S- 100	100	75	1.5	10	6.0	220	
MS21390-21	RFC-S- 120	120	65	0.79	7.2	5.0	170	
MS21390-22	RFC-S- 150	150	65	0.79	6.7	5.8	164	
MS21390-23	RFC-S- 180	180	65	0.79	6.3	6.6	158	
MS21390-24	RFC-S- 220	220	65	0.79	5.9	7.4	155	
MS21390-25	RFC-S- 270	270	65	0.79	5.6	8.0	150	
MS21390-26	RFC-S- 300	300	65	0.79	5.3	8.6	145	
MS21390-27	RFC-S- 330	330	65	0.79	5.0	8.9	142	
MS21390-28	RFC-S- 360	360	65	0.79	4.7	9.6	137	
MS21390-29	RFC-S- 390	390	65	0.79	4.5	9.9	135	
MS21390-30	RFC-S- 430	430	65	0.79	4.3	10.4	131	
MS21390-31	RFC-S- 470	470	65	0.79	4.0	10.9	128	
MS21390-32	RFC-S- 510	510	65	0.79	3.8	11.6	124	
MS21390-33	RFC-S- 560	560	65	0.79	3.6	11.8	123	
MS21390-34	RFC-S- 620	620	60	0.79	3.5	12.5	120	
MS21390-35	RFC-S- 680	680	60	0.79	3.4	13.5	115	
MS21390-36	RFC-S- 750	750	60	0.79	3.3	14.0	113	
MS21390-37	RFC-S- 820	820	60	0.79	3.1	15.0	110	
MS21390-38	RFC-S- 910	910	60	0.79	3.0	15.5	107	
MS21390-39	RFC-S-1000	1000	60	0.79	2.8	16.5	104	

* NCG Part No. electricals and tolerances as shown, MS No. electricals and tolerances per actual MS sheet.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

MS-INDUCTOR SERIES
75008-75101-90539
MOLDED INDUCTOR



ALL DIMENSIONS IN INCHES

Proven reliability molded inductors designed to meet MIL-C-15305 (latest revision).
Inductance 0.15 to 1000 uh.

ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 0.15 to 0.47 uh ±20%; 0.56-27 uh ±10%; 270-1000 uH ±5%.
Dielectric Strength: 1000 Volts RMS at sea level
Max. Temp. Rise: 35°C

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: —55°C to +125°C.
Terminal Strength: Meets five pound pull test per MIL-C-15305 (latest revision).
Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision). High frequency 10 cps to 2000 cps @ 20G ±10% maximum for 12 logarithmic swings, each of 20 minute duration repeated for each of three mutually perpendicular planes. (body mounted)
Volume: S Type — 0.012 cu. in.
Weight: S Type — 0.90 grams
Marking: Color banded per MIL-C-15305 (latest revision).

VALUES 0.15 μH THRU 27 μH AVAILABLE IN ESTABLISHED RELIABILITY, LEVEL R, TO MIL-C-39010

	MS No.	NCG Part No.*	Inductance ±5% uh	Q Min.	Test Frequency MHz	Self-Resonant Frequency, Min. MHz	DC Resistance Maximum Ohms	Rated DC Current mA	Material
GRADE 1, CLASS B	MS75008-21	RFC-S	0.15 ±20%	55	25.0	510	0.030	3,000	PHENOLIC
	MS75008-22	RFC-S	0.22 ±20%	50	25.0	415	0.035	2,800	
	MS75008-23	RFC-S	0.33 ±20%	50	25.0	350	0.065	2,000	
	MS75008-24	RFC-S	0.47 ±20%	50	25.0	300	0.085	1,700	
	MS75008-25	RFC-S	0.56 ±10%	50	25.0	270	0.125	1,450	
	MS75008-26	RFC-S	0.68 ±10%	45	25.0	250	0.150	1,300	
	MS75008-27	RFC-S	0.82 ±10%	40	25.0	210	0.205	1,100	
	MS75008-28	RFC-S	1.00 ±10%	40	25.0	200	0.290	930	
	MS75008-29	RFC-S	1.20 ±10%	30	7.9	180	0.400	785	
	MS75008-30	RFC-S	1.50 ±10%	30	7.9	170	0.485	700	
	MS75008-31	RFC-S	1.80 ±10%	30	7.9	150	0.740	580	
	MS75008-32	RFC-S	2.20 ±10%	30	7.9	140	0.970	505	
	MS75008-33	RFC-S	2.70 ±10%	30	7.9	120	1.20	460	
	MS75101-1	RFC-S	3.30 ±10%	30	7.9	70	0.140	1,350	IRON
	MS75101-2	RFC-S	3.90 ±10%	30	7.9	65	0.155	1,250	
	MS75101-3	RFC-S	4.70 ±10%	30	7.9	60	0.210	1,100	
	MS75101-4	RFC-S	5.60 ±10%	30	7.9	50	0.280	935	
	MS75101-5	RFC-S	6.80 ±10%	30	7.9	50	0.375	810	
	MS75101-6	RFC-S	8.20 ±10%	30	7.9	48	0.440	750	
	MS75101-7	RFC-S	10.00 ±10%	30	7.9	42	0.605	640	
	MS75101-8	RFC-S	12.00 ±10%	50	2.5	36	1.05	490	
	MS75101-9	RFC-S	15.00 ±10%	55	2.5	30	1.20	460	
	MS75101-10	RFC-S	18.00 ±10%	60	2.5	30	1.95	360	
	MS75101-11	RFC-S	22.00 ±10%	60	2.5	24	2.20	335	
	MS75101-12	RFC-S	27.00 ±10%	65	2.5	22	2.75	300	
GRADE 1, CLASS A	MS90539-01	RFC-S	270 ±5%	65	.79	5.6	8.2	110	IRON
	MS90539-02	RFC-S	300 ±5%	65	.79	5.3	8.7	107	
	MS90539-03	RFC-S	330 ±5%	65	.79	5.0	9.1	105	
	MS90539-04	RFC-S	360 ±5%	65	.79	4.7	9.6	102	
	MS90539-05	RFC-S	390 ±5%	65	.79	4.5	10.0	100	
	MS90539-06	RFC-S	430 ±5%	65	.79	4.3	10.6	97	
	MS90539-07	RFC-S	470 ±5%	65	.79	4.0	11.1	95	
	MS90539-08	RFC-S	510 ±5%	65	.79	3.8	11.6	93	
	MS90539-09	RFC-S	560 ±5%	65	.79	3.6	12.3	91	
	MS90539-10	RFC-S	620 ±5%	60	.79	3.5	13.0	88	
	MS90539-11	RFC-S	680 ±5%	60	.79	3.4	13.7	85	
	MS90539-12	RFC-S	750 ±5%	60	.79	3.3	14.4	83	
	MS90539-13	RFC-S	820 ±5%	60	.79	3.1	15.1	81	
	MS90539-14	RFC-S	910 ±5%	60	.79	2.9	15.8	79	
	MS90539-15	RFC-S	1000 ±5%	60	.79	2.8	16.5	78	

MS No. electricals as shown,
NCG Part No. is reference only, see page 16 for RFC--S electricals.

Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

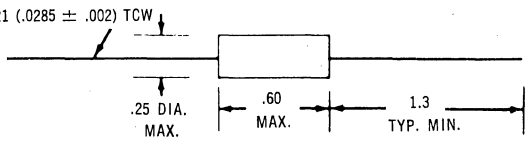
Inductors

RFC-M SERIES

Proven reliability molded inductors specifically designed to meet MIL-C-15305 (latest revision). Inductance 1.0 to 2200uH.

GRADE 1 CLASS B

ACTUAL SIZE



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 1.0 to 22uH ± 10% on Q-Meter
27uH to 2200 ± 5%
1,000 cps bridge

Dielectric Strength: 700 volts RMS at sea level.

Self-Resonant Frequency: Minimum f_0 to be not less than 80% of published data and measured with full length leads on Grid-Dip Meter.

Q: Measured on Q-Meter.

Rating: ⅓ watt dissipation for series M

Note: L & Q are not always tested at the same frequency.

DENSITY CHARACTERISTICS

Volume: 0.029 cu. in.

Weight: 2.00 grams

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +125°C.

Terminal Strength: Meets five pound pull test per MIL-C-15305.

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision). High frequency 10 cps to 2000 cps @ 30G ±10% maximum for 12 logarithmic swings, each of 20 minute duration repeated for each of three mutually perpendicular planes. (body mounted)

MS NO.	NCG PART NO.*	L	Q Min.		approx. SRF	Max. DCR	Max. I	MATERIAL
		uH		MHz	MHz	Ω	mA	
MS21388-1	RFC-M- 1.0	1.0	100	15	170	.04	2700	IRON
MS21388-2	RFC-M- 1.2	1.2	100	15	155	.04	2700	
MS21388-3	RFC-M- 1.5	1.5	100	10	140	.04	2700	
MS21388-4	RFC-M- 1.8	1.8	95	10	125	.05	2500	
MS21388-5	RFC-M- 2.2	2.2	95	10	110	.05	2500	
MS21388-6	RFC-M- 2.7	2.7	68	7.9	95	.05	2500	
MS21388-7	RFC-M- 3.3	3.3	60	7.9	90	.05	2500	
MS21388-8	RFC-M- 3.9	3.9	60	7.9	87	.07	2100	
MS21388-9	RFC-M- 4.7	4.7	60	7.9	75	.09	1800	
MS21388-10	RFC-M- 5.6	5.6	65	7.9	70	.14	1550	
MS21388-11	RFC-M- 6.8	6.8	70	7.9	65	.17	1300	
MS21388-12	RFC-M- 8.2	8.2	65	7.9	57	.25	1150	
MS21388-13	RFC-M- 10	10	65	5	50	.32	1000	
MS21388-14	RFC-M- 12	12	65	5	45	.47	870	
MS21388-15	RFC-M- 15	15	75	4	40	.62	730	
MS21388-16	RFC-M- 18	18	65	4	37	.72	660	
MS21388-17	RFC-M- 22	22	65	2.5	35	.8	600	
MS21388-18	RFC-M- 27	27	65	2.5	31	1.2	520	
MS21388-19	RFC-M- 33	33	80	2.5	27	1.5	450	
MS21388-20	RFC-M- 39	39	80	2.5	25	2.3	380	
MS21388-21	RFC-M- 47	47	100	2.5	24	3.0	300	
MS21388-22	RFC-M- 56	56	100	2.5	22	4.2	270	
MS21388-23	RFC-M- 68	68	100	2.5	20	5.2	250	
MS21388-24	RFC-M- 82	82	100	2.5	18	6.2	220	
MS21388-25	RFC-M- 100	100	100	1.5	17	7	200	
MS21388-26	RFC-M- 120	120	95	1.5	14	7.5	200	
MS21388-27	RFC-M- 150	150	90	1.0	11	8	190	
MS21388-28	RFC-M- 180	180	85	1.0	9	9	185	
MS21388-29	RFC-M- 220	220	85	1.0	7	10	180	
MS21388-30	RFC-M- 270	270	80	1.0	5.5	11	172	
MS21388-31	RFC-M- 330	330	80	.8	4.5	12	165	
MS21388-32	RFC-M- 390	390	75	.8	4.0	13	157	
MS21388-33	RFC-M- 470	470	75	.8	3.5	14	150	
MS21388-34	RFC-M- 560	560	65	.8	3.1	16	145	
MS21388-35	RFC-M- 680	680	65	.8	2.7	17	140	
MS21388-36	RFC-M- 820	820	65	.8	2.5	19	132	
MS21388-37	RFC-M-1000	1000	70	.5	2.3	21	125	
MS21388-38	RFC-M-1200	1200	60	.25	2.7	22	120	
MS21388-39	RFC-M-2200	2200	70	.25	2.0	30	100	

* NCG Part No. electricals and tolerances as shown.
MS No. electricals and tolerances per actual MS sheet.

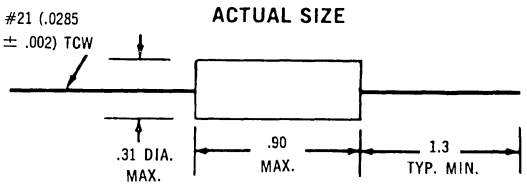
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

Inductors

RFC-L SERIES

Proven reliability molded inductors specifically designed to meet MIL-C-15305 (latest revision). Inductance 1.0 to 10,000uH.

GRADE 1 CLASS B



ELECTRICAL CHARACTERISTICS

Inductance Tolerance: 0.1 to 22uH ±10% on Q-Meter
27uH to 10,000 ±5%
1,000 cps bridge

Dielectric Strength: 700 volts RMS at sea level.

Self-Resonant Frequency: Minimum f_0 to be not less than 80% of published data and measured with full length leads on Grid-Dip Meter.

Q: Measured on Q-Meter.

Rating: ½ watt dissipation for L series.

Note: L & Q are not always tested at the same frequency.

DENSITY CHARACTERISTICS

Volume: 0.068 cu. in.

Weight: 4.10 grams

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: −55°C to +125°C.

Terminal Strength: Meets five pound pull test per MIL-C-15305 (latest revision).

Moisture, Vibration, and Shock Resistance: Meets requirements of MIL-C-15305 (latest revision). High frequency 10 cps to 2000 cps @ 30G ±10% maximum for 12 logarithmic swings, each of 20 minute duration repeated for each of three mutually perpendicular planes. (body mounted)

MS NO.	NCG PART NO.*	L	Q min		approx. SRF	Max. DCR	max. I	MAT.
		µH		MHz	MHz	Ω	mA	
MS21380-1	RFC-L- 1.0	1.0	130	15	170	.03	4000	IRON
MS21380-2	RFC-L- 1.2	1.2	130	15	155	.03	4000	
MS21380-3	RFC-L- 1.5	1.5	130	10	140	.03	4000	
MS21380-4	RFC-L- 1.8	1.8	130	10	125	.03	4000	
MS21380-5	RFC-L- 2.2	2.2	130	10	115	.04	3500	
MS21380-6	RFC-L- 2.7	2.7	100	10	102	.04	3500	
MS21380-7	RFC-L- 3.3	3.3	100	7.9	90	.04	3500	
MS21380-8	RFC-L- 3.9	3.9	80	7.9	85	.05	3100	
MS21380-9	RFC-L- 4.7	4.7	75	7.9	80	.05	3100	
MS21380-10	RFC-L- 5.6	5.6	65	7.9	72	.06	3000	
MS21380-11	RFC-L- 6.8	6.8	65	7.9	65	.06	3000	
MS21380-12	RFC-L- 8.2	8.2	65	7.9	57	.11	2400	
MS21380-13	RFC-L- 10	10	75	5	50	.15	1800	
MS21380-14	RFC-L- 12	12	75	5	45	.23	1600	
MS21380-15	RFC-L- 15	15	75	5	40	.3	1300	
MS21380-16	RFC-L- 18	18	75	5	36	.4	1150	
MS21380-17	RFC-L- 22	22	75	2.5	32	.5	1000	
MS21380-18	RFC-L- 27	27	70	2.5	30	.6	900	
MS21380-19	RFC-L- 33	33	70	2.5	28	.7	850	
MS21380-20	RFC-L- 39	39	70	2.5	26	1.1	720	
MS21380-21	RFC-L- 47	47	75	2.5	25	1.3	620	
MS21380-22	RFC-L- 56	56	80	2.5	22	1.8	540	
MS21380-23	RFC-L- 68	68	100	2.5	20	2.4	450	
MS21380-24	RFC-L- 82	82	100	2.5	18	2.8	425	
MS21380-25	RFC-L- 100	100	100	1.5	17	3.2	400	
MS21380-26	RFC-L- 120	120	100	1.5	15	4.8	360	
MS21380-27	RFC-L- 150	150	100	1.0	14	6.4	280	
MS21380-28	RFC-L- 180	180	95	1.0	12	9.5	240	
MS21380-29	RFC-L- 220	220	95	1.0	11	12	200	
MS21380-30	RFC-L- 270	270	70	1.0	9	13	195	
MS21380-31	RFC-L- 330	330	65	.79	7.5	14	190	
MS21380-32	RFC-L- 390	390	65	.79	6.5	15.5	180	
MS21380-33	RFC-L- 470	470	60	.79	5.5	17	170	
MS21380-34	RFC-L- 560	560	75	.5	4	18.5	165	
MS21380-35	RFC-L- 680	680	75	.5	3.2	20	155	
MS21380-36	RFC-L- 820	820	75	.5	2.8	22	150	
MS21380-37	RFC-L- 1000	1000	75	.5	2.4	24	145	
MS21380-38	RFC-L- 1200	1200	75	.5	2.1	27	137	
MS21380-39	RFC-L- 1500	1500	75	.4	1.9	29	130	
MS21380-40	RFC-L- 1800	1800	65	.4	1.7	32	125	
MS21380-41	RFC-L- 2200	2200	65	.25	1.5	35	120	
MS21380-42	RFC-L- 2700	2700	65	.25	1.3	40	112	
MS21380-43	RFC-L- 3300	3300	65	.25	1.2	45	105	
MS21380-44	RFC-L- 3900	3900	65	.25	1.05	49	100	
MS21380-45	RFC-L- 4700	4700	65	.25	.95	53	95	
MS21380-46	RFC-L- 5600	5600	65	.25	.85	60	90	
MS21380-47	RFC-L- 6800	6800	65	.25	.75	67	85	
MS21380-48	RFC-L- 8200	8200	65	.25	.65	75	82	
MS21380-49	RFC-L-10000	10000	65	.15	.58	80	80	

MS91189-14 THRU -28, VALUES 1.2 THRU 18uH (ON PHENOLIC CORES) ARE AVAILABLE.

MS75103-1 THRU -10, VALUES 22 THRU 120uH ARE ALSO AVAILABLE.

* NCG Part No. electricals and tolerances as shown.
MS No. electricals and tolerances per actual MS sheet.

Nytronics Components Group, Inc.
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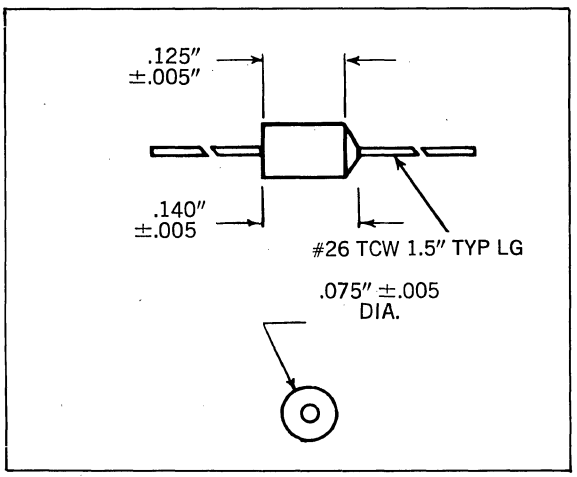
Inductors

Pee Dee Ductor Series

Marking: EIA color coded

The Pee Dee Ductor is a new, micro-miniature, axial-leaded RF inductor for hybrid circuit applications. It is significantly smaller than any unshielded inductor available anywhere. Designed to meet the requirements of MIL-C-15305 B, this reliable, high performance inductor has a standard inductance tolerance of ±10%.

GRADE 2 CLASS A



ELECTRICAL DATA

NCG Part No.	L uH	Q (Min.)	Test Freq. MHz	*F_o MHz	DCR Max. Ohms	Rated Current mA
PD-0.10	0.10	40	25	500	0.2	600
PD-0.12	0.12	40	25	450	0.2	600
PD-0.15	0.15	40	25	400	0.25	575
PD-0.18	0.18	40	25	380	0.25	575
PD-0.22	0.22	40	25	360	0.30	565
PD-0.27	0.27	40	25	300	0.30	565
PD-0.33	0.33	40	25	280	0.35	560
PD-0.39	0.39	40	25	260	0.37	550
PD-0.47	0.47	40	25	250	0.39	535
PD-0.56	0.56	40	25	240	0.40	525
PD-0.68	0.68	35	25	220	0.45	500
PD-0.82	0.82	35	25	180	0.50	480
PD-1.0	1.0	35	25	170	0.60	450
PD-1.2	1.2	35	7.9	150	0.70	425
PD-1.5	1.5	35	7.9	130	0.80	400
PD-1.8	1.8	35	7.9	120	0.90	350
PD-2.2	2.2	35	7.9	110	1.3	320
PD-2.7	2.7	35	7.9	105	1.8	275
PD-3.3	3.3	35	7.9	100	1.1	340
PD-3.9	3.9	35	7.9	90	1.4	310
PD-4.7	4.7	35	7.9	85	1.6	290
PD-5.6	5.6	35	7.9	70	1.8	275
PD-6.8	6.8	35	7.9	65	2.0	250
PD-8.2	8.2	35	7.9	62	2.2	245
PD-10	10	35	7.9	60	3.0	210
PD-12	12	35	2.5	35	2.0	250
PD-15	15	35	2.5	30	2.2	245
PD-18	18	35	2.5	25	2.5	230
PD-22	22	35	2.5	23	2.7	220
PD-27	27	35	2.5	21	3.8	195
PD-33	33	35	2.5	20	4.5	170
PD-39	39	35	2.5	16	6.0	150
PD-47	47	35	2.5	14	6.5	145
PD-56	56	35	2.5	12	7.8	135
PD-68	68	35	2.5	10	8.6	130
PD-82	82	35	2.5	9.0	9.8	120
PD-100	100	35	2.5	8.0	11.5	110
PD-120	120	28	.79	7.0	15.0	90
PD-150	150	28	.79	6.0	16.5	88
PD-180	180	25	.79	5.5	22	75
PD-220	220	24	.79	5.2	31	62
PD-270	270	24	.79	5.0	38	56
PD-330	330	24	.79	4.8	42	53
PD-390	390	24	.79	3.6	58	47
PD-470	470	24	.79	3.4	60	45
PD-560	560	24	.79	3.2	65	43
PD-680	680	22	.79	3.0	90	36
PD-820	820	23	.79	2.5	95	34
PD-1000	1000	21	.79	2.0	130	30

* F_o (self resonant frequency) minimum not less than 80% of specified value.

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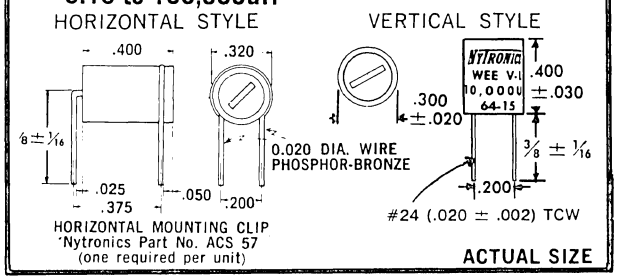
VARIABLE INDUCTORS

WEE V-L

NOW MIL APPROVED MIL-C-15305 (latest revision) — MS21381 & MS21402
Subminiature Shielded Adjustable Inductor
High Q Values
Vertical or Horizontal* Mounting
Unitized Epoxy-Molded Construction
0.400" by 0.300"
0.10 to 100,000uH



The **WEE V-L** is designed to accommodate close inductance adjustments in high-density circuits that demand exceptional stability and high "Q" in the smallest size available.
The **WEE V-L** is qualified MIL-C-15305 (latest revision). Printed board mounting is facilitated by 0.200 grid spacing and unit has shield construction to allow maximum density packaging. Standardized in 73 stock values.

ELECTRICAL CHARACTERISTICS

Adjustable Inductance Range:	±10%† over entire range as measured per MIL-C-15305 (latest revision).
Q and f_o Values:	Minimum not less than 80% of specified value at L nominal.
Dielectric Strength:	840 Volts R.M.S. at sea level.
Working Voltage:	300 Volts D.C.
Maximum Current:	Based on temperature rise not to exceed 15°C at 90°C ambient.
Incremental Current:	Defined as the DC current required to cause a five percent reduction in the nominal inductance value.

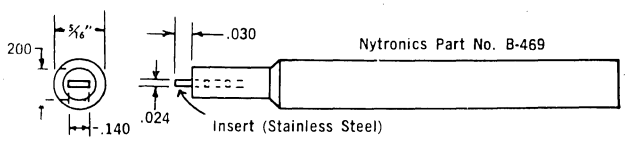
DENSITY CHARACTERISTICS

Weight:	1.5 grams maximum
Volume:	.0346 cubic inches
Shielding:	3% coupling maximum when two units are tested side by side.

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Use Nytronics Tuning Tool No. B-469 or equal.

Torque:	0.75 to 6.0 inch-oz.
Operating Temperature:	−55°C to +105°C.
Moisture, Vibration, and Shock Resistance:	Meet requirements of MIL-C-15305 (latest revision).
Marking:	Manufacturer data printed.
Terminal Pull:	Three pounds.



MS GRADE 1 CLASS A
WVL GRADE 3 CLASS A

MS No.	NCG Part No.**	L nom. uH	f MHz	Q nom.	SRF Nom. MHz	Max. BCR ohms	Max. I m.a.	Incr. I m.a.
*MS21381-1	WEE V-L† 0.10	.10	25	70	>250	0.030	1510	NA
*MS21381-2	WEE V-L† 0.12	.12	25	70	>250	0.030	1450	NA
*MS21381-3	WEE V-L 0.15	.15	25	70	>250	0.030	1400	NA
*MS21381-4	WEE V-L 0.18	.18	25	70	>250	0.035	1370	NA
*MS21381-5	WEE V-L 0.22	.22	25	70	>250	0.038	1340	NA
*MS21381-6	WEE V-L 0.27	.27	25	80	>250	0.040	1300	NA
*MS21381-7	WEE V-L 0.33	.33	25	80	>250	0.040	1260	NA
*MS21381-8	WEE V-L 0.39	.39	25	80	250	0.045	1240	NA
*MS21381-9	WEE V-L 0.47	.47	25	80	230	0.045	1200	NA
*MS21381-10	WEE V-L 0.56	.56	25	80	220	0.050	1160	NA
*MS21381-11	WEE V-L 0.68	.68	25	80	190	0.055	1100	NA
*MS21381-12	WEE V-L 0.82	.82	25	85	180	0.060	1040	NA
*MS21381-13	WEE V-L 1.00	1.00	25	85	160	0.070	986	NA
MS21381-14	WEE V-L 1.2	1.2	7.9	90	170	0.085	968	NA
MS21381-15	WEE V-L 1.5	1.5	7.9	100	155	0.100	893	NA
MS21381-16	WEE V-L 1.8	1.8	7.9	115	135	0.110	853	NA
MS21381-17	WEE V-L 2.2	2.2	7.9	110	120	0.120	817	NA
MS21381-18	WEE V-L 2.7	2.7	7.9	110	104	0.125	800	NA
MS21381-19	WEE V-L 3.3	3.3	7.9	90	93.0	0.165	696	NA
MS21381-20	WEE V-L 3.9	3.9	7.9	90	87.0	0.180	659	NA
MS21381-21	WEE V-L 4.7	4.7	7.9	95	79.0	0.245	571	NA
MS21381-22	WEE V-L 5.6	5.6	7.9	95	72.0	0.265	550	NA
MS21381-23	WEE V-L 6.8	6.8	7.9	85	63.0	0.330	493	NA
MS21381-24	WEE V-L 8.2	8.2	7.9	95	60.0	0.460	417	NA
MS21381-25	WEE V-L 10	10	7.9	90	54.0	0.640	359	NA
MS21381-26	WEE V-L 12	12	2.5	120	37.0	0.800	316	NA
MS21381-27	WEE V-L 15	15	2.5	120	28.8	0.865	301	NA
MS21381-28	WEE V-L 18	18	2.5	115	23.8	0.940	292	NA
MS21381-29	WEE V-L 22	22	2.5	125	21.3	1.03	267	NA
MS21381-30	WEE V-L 27	27	2.5	115	20.6	1.18	243	NA
MS21381-31	WEE V-L 33	33	2.5	120	18.6	1.30	231	NA
MS21381-32	WEE V-L 39	39	2.5	120	17.7	1.41	223	NA
MS21381-33	WEE V-L 47	47	2.5	110	14.9	1.61	203	NA
MS21381-34	WEE V-L 56	56	2.5	115	13.9	2.08	191	NA
MS21381-35	WEE V-L 68	68	2.5	105	12.9	2.20	185	NA
MS21381-36	WEE V-L 82	82	2.5	105	11.7	2.42	174	NA
MS21402-1	WEE V-L 100	100	2.5	95	10.5	2.15	333	333
MS21402-2	WEE V-L 120	120	0.790	95	5.60	2.38	316	190
MS21402-3	WEE V-L 150	150	0.790	90	5.20	2.52	306	175
MS21402-4	WEE V-L 180	180	0.790	95	4.90	2.88	288	150
MS21402-5	WEE V-L 220	220	0.790	95	4.60	3.18	273	125
MS21402-6	WEE V-L 270	270	0.790	100	4.20	3.50	260	120
MS21402-7	WEE V-L 330	330	0.790	100	3.55	4.80	222	110
MS21402-8	WEE V-L 390	390	0.790	100	3.45	5.44	209	105
MS21402-9	WEE V-L 470	470	0.790	100	3.20	5.90	201	100
MS21402 10	WEE V-L 560	560	0.790	95	2.90	6.30	194	90
MS21402-11	WEE V-L 680	680	0.790	100	2.70	7.20	181	80
MS21402-12	WEE V-L 820	820	0.790	90	2.50	8.00	172	70
MS21402-13	WEE V-L 1,000	1,000	0.790	100	2.35	12.0	141	65
MS21402-14	WEE V-L 1,200	1,200	0.250	95	2.20	13.5	132	60
MS21402-15	WEE V-L 1,500	1,500	0.250	90	1.90	16.5	119	55
MS21402-16	WEE V-L 1,800	1,800	0.250	100	1.80	18.0	114	47
MS21402-17	WEE V-L 2,200	2,200	0.250	100	1.70	20.5	107	43
MS21402-18	WEE V-L 2,700	2,700	0.250	95	1.50	22.5	102	39
MS21402-19	WEE V-L 3,300	3,300	0.250	90	1.40	42.0	76	36
MS21402-20	WEE V-L 3,900	3,900	0.250	85	1.27	47.5	71	35
MS21402-21	WEE V-L 4,700	4,700	0.250	85	1.24	53.0	67	34
MS21402-22	WEE V-L 5,600	5,600	0.250	85	0.93	62.5	65	31
MS21402-23	WEE V-L 6,800	6,800	0.250	75	0.79	69.5	58	27
MS21402-24	WEE V-L 8,200	8,200	0.250	80	0.75	75.0	56	26
MS21402-25	WEE V-L 10,000	10,000	0.250	70	0.70	100.0	49	24
MS21402-26	WEE V-L 12,000	12,000	0.079	70	0.50	64	60	40
MS21402-27	WEE V-L 15,000	15,000	0.079	70	0.38	84	52	34
MS21402-28	WEE V-L 18,000	18,000	0.079	70	0.36	93	50	30
MS21402-29	WEE V-L 22,000	22,000	0.079	70	0.32	104	45	28
MS21402-30	WEE V-L 27,000	27,000	0.079	70	0.30	173	35	26
MS21402-31	WEE V-L 33,000	33,000	0.079	70	0.27	187	32	24
MS21402-32	WEE V-L 39,000	39,000	0.079	70	0.26	220	30	22
MS21402-33	WEE V-L 47,000	47,000	0.079	70	0.25	253	28	20
MS21402-34	WEE V-L 56,000	56,000	0.079	70	0.24	285	26	19
MS21402-35	WEE V-L 68,000	68,000	0.079	60	0.20	311	24	18
MS21402-36	WEE V-L 82,000	82,000	0.079	60	0.19	385	22	16
MS21402-37	WEE V-L 100,000	100,000	0.079	60	0.17	420	20	15

*Turntable range on MS2138-1 thru -13 and -74 thru -85 is ±5%.

*For horizontal mounting use Nytronics mounting clip No. ACS-57 or order with prefix H (i.e. H WEE V-L 0.10).

†Tunable range ±5.0% on 0.10uH thru 1.0uH.

**NCG Part No. cannot be used as the MS number.

NOTE: Min. Q on MIL version not less than 80% of Q min. of commercial version.

NOTE: MS 21381 -74 thru -85 are available.

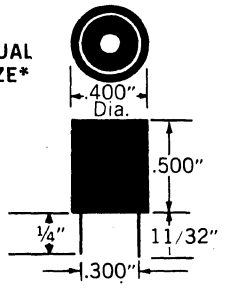
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

VARIABLE INDUCTORS

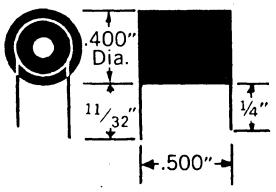
VIV-VIH

Miniature with inductance range of 0.10 to 4700uH in 29 values.
Encapsulated in epoxy resin for reliability.
Designed to meet MIL-C-15305B

ACTUAL SIZE*



ACTUAL SIZE



Terminal Leads #22 (.025 ± .002) VCW

VERTICAL STYLE HORIZONTAL STYLE

The **VARIABLE INDUCTOR** offers high reliability and exceptional stability over extreme temperature variations. This small lightweight unit is furnished in vertical and horizontal styles to facilitate mounting on printed circuit boards. The unit is designed to meet the requirements of MIL-C-15305B.

GRADE 2 CLASS B

ELECTRICAL CHARACTERISTICS

Inductance Range: 0.33 to 4700uH Tunable Range ±20%
0.15 to 0.22uH Tunable Range ±15%
0.1 Tunable Range ±10%
All measurements at 25°C on Q-Meter using miniature alligator clips mounted 1/32" from body.
Q values min. not less than 80% of specified value.

Self-Resonant Frequency: Minimum f_o to be not less than 80% of published data as measured with Grid-Dip Meter.

DENSITY CHARACTERISTICS

Volume: 0.063 cubic inches
Weight: 2.6 grams

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Torque: 0.75 to 5.0 inch-ounces
Use Nytronics Tuning Tool No. B-305 or equal.

Operating Temperature: −55°C to +125°C

Terminal Strength: Meets five pound pull tests.

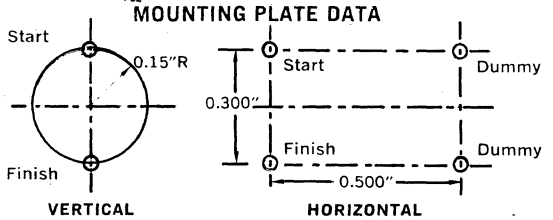
Core Material: Iron

Marking: Manufactured data printed.

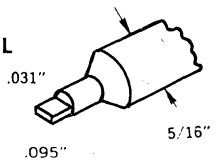
NCG PART NOS.		L nom.	Q at L Nom.		Approx. SRF, L nom.	Max. DCR	Max. I
VIV	VIH	μH		MHz	MHz	Ω	mA
VIV-0.10	VIH-0.10	0.10	85	25.	>500.	0.02	3500
VIV-0.15	VIH-0.15	0.15	100	25.	>500.	0.035	2600
VIV-0.22	VIH-0.22	0.22	100	25.	>500.	0.04	2500
VIV-0.33	VIH-0.33	0.33	100	25.	334.	0.04	2500
VIV-0.47	VIH-0.47	0.47	100	25.	285.	0.05	2200
VIV-0.68	VIH-0.68	0.68	100	25.	237.	0.07	1850
VIV-1.00	VIH-1.00	1.00	90	25.	205.	0.13	1350
VIV-1.50	VIH-1.50	1.50	70	7.9	168.	0.24	1000
VIV-2.20	VIH-2.20	2.20	73	7.9	135.	0.30	890
VIV-3.30	VIH-3.30	3.30	80	7.9	112.	0.45	730
VIV-4.70	VIH-4.70	4.70	75	7.9	100.0	0.80	550
VIV-6.80	VIH-6.80	6.80	80	7.9	80.0	1.1	460
VIV-10.0	VIH-10.0	10.0	82	7.9	67.0	1.9	355
VIV-15.0	VIH-15.0	15.0	65	2.5	54.2	3.2	270
VIV-22.0	VIH-22.0	22.0	55	2.5	17.5	3.4	265
VIV-33.0	VIH-33.0	33.0	54	2.5	15.0	3.6	255
VIV-47.0	VIH-47.0	47.0	51	2.5	13.2	4.5	230
VIV-68.0	VIH-68.0	68.0	55	2.5	12.0	5.5	210
VIV-100	VIH-100	100.0	50	2.5	10.5	6.7	190
VIV-150	VIH-150	150.	50	.79	3.0	11.0	150
VIV-220	VIH-220	220.	50	.79	2.70	13.0	135
VIV-330	VIH-330	330.	48	.79	2.24	16.0	120
VIV-470	VIH-470	470.	45	.79	1.90	18.0	115
VIV-680	VIH-680	680.	42	.79	1.70	21.0	105
VIV-1000	VIH-1000	1000.	40	.79	1.40	38.0	80
VIV-1500	VIH-1500	1500.	40	.25	1.14	54.0	65
VIV-2200	VIH-2200	2200.	44	.25	0.96	66.0	60
VIV-3300	VIH-3300	3300.	46	.25	0.86	85.0	54
VIV-4700	VIH-4700	4700.	48	.25	0.76	99.0	49

* All dimensions ±1/32 inch.

MOUNTING PLATE DATA

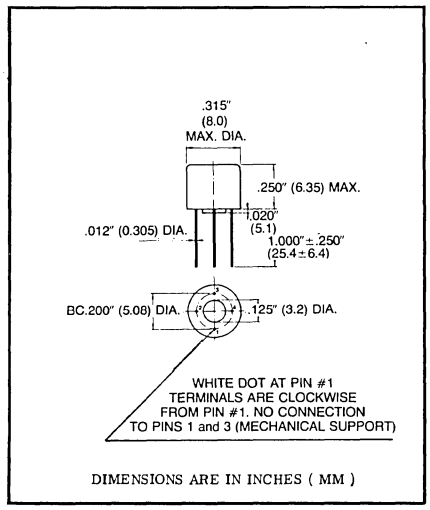


TYPICAL ALIGNING TOOL
B-305



PICO's ultra-miniature HIGH "Q" INDUCTORS

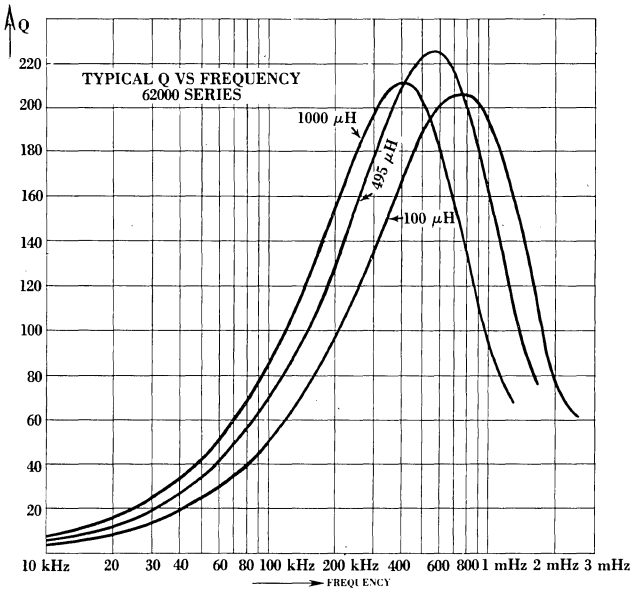
- ± 2% inductance stability vs temperature
- Smallest possible size
- Extreme resistance to thermal shock
- Meets Mil-T-27D (TF5R20ZZ)
- All units are magnetically shielded
- Non-standard inductance values available at 10% higher or lower than nearest standard inductor.



Delivery— stock to one week

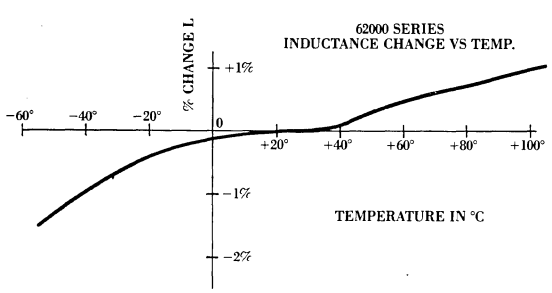
"62000" SERIES

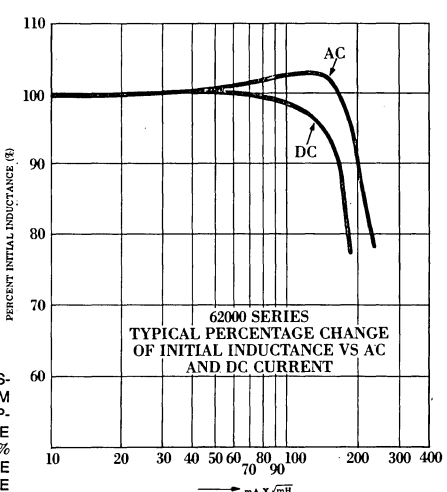
PART NUMBER	INDUCTANCE (MICRO-HENRYS)	D.C. RESISTANCE (OHMS)	APPROXIMATE SELF RESONANT FREQUENCY (MHz)	MAXIMUM DC CURRENT (mA)	MINIMUM Q	PRICE (1-9)
62112	2500	18	1.15	80	180 at (400 kHz)	14.25
62132	1500	10	1.5	100	180 at (400 kHz)	14.25
62152	992	7	1.8	125	200 at (400 kHz)	14.25
62172	900	6.5	1.9	130	200 at (400 kHz)	14.25
62192	800	6.0	2.1	140	200 at (400 kHz)	14.25
62212	742	5.7	2.3	150	200 at (500 kHz)	14.25
62232	702	5.5	2.5	155	200 at (500 kHz)	14.25
62252	600	5.0	2.7	160	200 at (500 kHz)	14.25
62272	495	4.5	3	170	200 at (500 kHz)	14.25
62292	400	3.7	3.3	185	180 at (500 kHz)	14.25
62312	298	2.8	3.8	215	170 at (500 kHz)	14.25
62332	248	2.3	4.2	235	170 at (500 kHz)	14.25
62352	196	1.8	4.75	265	160 at (500 kHz)	14.25
62372	150	1.4	5.5	300	160 at (500 kHz)	14.25
62392	100	1.2	6.8	330	150 at (500 kHz)	14.25



SPECIFICATIONS:

- INDUCTANCE TOLERANCE ±3% AT 0.1V-100KHZ
- INDUCTANCE STABILITY VS TEMPERATURE ±2% -55°C TO 105°C
- MEETS MIL-T-27D TF5R20ZZ
- WEIGHT 1 GRAM
- THERMAL SHOCK 100 CYCLES, METHOD 107D MIL-STD 202E TEST CONDITION A3
- UNIT HAS MAGNETIC SHIELD





ALL INDUCTORS ARE MEASURED AT 0 DC. THE MAXIMUM DC LISTINGS ARE FOR APPROXIMATELY 30°C HEAT RISE AND APPROXIMATELY 2% DROP IN INDUCTANCE. THE CHANGE OF INDUCTANCE WITH AC OR DC CURRENTS IS ILLUSTRATED BY THE CURVES. THE EXCITATION IS PLOTTED IN mA $\times\sqrt{mHy}$. FOR EXAMPLE THE 0.495 mH INDUCTOR (62272) WITH 170 mA DC FLOWING WILL HAVE AN EXCITATION OF mA $\times\sqrt{mHy}$ = 120, AND THE INDUCTANCE WILL DROP FROM 495 uH to 485 uH. IF THE 170 mA WAS AC, THE INDUCTANCE WOULD BE 510 uH.

For immediate engineering assistance or to place an order—
Call Toll Free 800-431-1064

PICO Electronics, Inc.

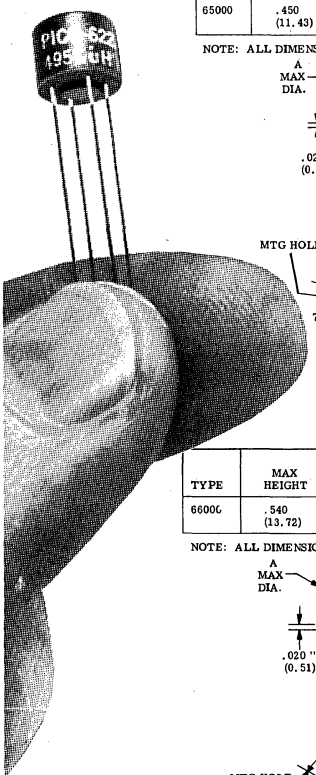
453 North MacQuesten Pkwy., Mt. Vernon, N.Y. 10552
Telephone 914-699-5514

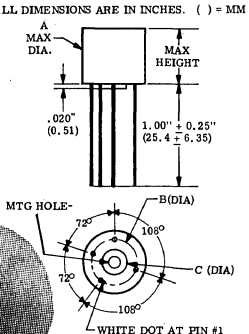
PICO's miniature HIGH "Q" INDUCTORS

- ± 1% inductance stability vs temperature
- Smallest possible size
- Extreme resistance to thermal shock
- Meets Mil-T-27D (TF5R20ZZ)
- All units are magnetically shielded
- Non-standard inductance values available at 10% higher cost than nearest standard inductor.

TYPE	MAX HEIGHT	A MAX DIA.	B BOLT CIRCLE	C STAND-OFF
63000	.290 (7.37)	.410 (10.41)	.260 (6.6)	.160 (4.06)
64000	.340 (8.63)	.500 (12.7)	.350 (8.89)	.250 (6.35)
65000	.450 (11.43)	.630 (16.0)	.440 (11.17)	.340 (8.64)

NOTE: ALL DIMENSIONS ARE IN INCHES. ( ) = MM

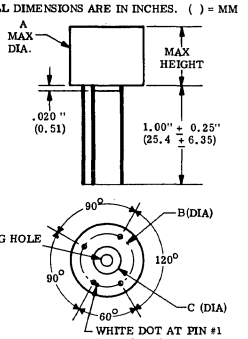




WHITE DOT AT PIN #1 TERMINALS ARE CLOCK-WISE FROM PIN #1. NO CONNECTION TO PIN #1 AND #3 (MECHANICAL SUPPORT)

TYPE	MAX HEIGHT	A MAX DIA	B BOLT CIRCLE	C STAND-OFF
66000	.540 (13.72)	.800 (20.32)	.560 (14.22)	.460 (11.68)

NOTE: ALL DIMENSIONS ARE IN INCHES. ( ) = MM



WHITE DOT AT PIN #1 TERMINALS ARE CLOCK-WISE FROM PIN #1. NO CONNECTION TO PIN #2 AND #4 (MECHANICAL SUPPORT)

ALL INDUCTORS ARE MEASURED AT 0 DC. THE MAXIMUM DC LISTINGS ARE FOR APPROXIMATELY 5% DROP IN INDUCTANCE AND NEGLIGIBLE HEAT RISE. THE CHANGE OF INDUCTANCE WITH AC OR DC CURRENTS IS ILLUSTRATED BY THE CURVES SHOWN FOR EACH INDUCTOR TYPE. THE EXCITATION IS PLOTTED IN mA X $\sqrt{mHy}$. FOR EXAMPLE THE 10 mH INDUCTOR (64314) WITH 79 mA DC FLOWING WILL HAVE AN EXCITATION OF mA X $\sqrt{mH}$ = 79 X $\sqrt{10}$ = 250 AND THE INDUCTANCE WILL DROP FROM 10 mH TO 9mH. IF THE 79 mA WAS AC THE INDUCTANCE WOULD BE 9.65 mH.

For immediate engineering assistance or to order—
Call Toll Free 800-431-1064

PICO Electronics, Inc.
453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

"63000" SERIES

PART NUMBER	INDUCTANCE	D.C. RESISTANCE (OHMS)	APPROXIMATE SELF RESONANT FREQUENCY (KHz)	MAXIMUM DC CURRENT (mA)	MINIMUM Q	*** PRICE (1-9)
63120	1 Hy	1840	47	5.7	30 at (10 kHz)	14.99
63140	750 mH	1380	54	6.6	30 at (10 kHz)	14.46
63160	500 mH	920	66	8	30 at (10 kHz)	13.62
63180	200 mH	368	105	12.5	60 at (20 kHz)	13.62
63200	100 mH	185	148	18	60 at (20 kHz)	13.62
63220	75 mH	140	172	20.8	100 at (40 kHz)	13.62
63240	50 mH	90	210	25.5	100 at (40 kHz)	13.62
63260	30 mH	55	270	33	100 at (40 kHz)	13.62
63280	20 mH	37	332	40	100 at (40 kHz)	13.62
63300	15 mH	28	383	46	100 at (40 kHz)	13.62
63320	10 mH	18.5	470	57	100 at (40 kHz)	13.62
63340	5 mH	10	665	80	100 at (40 kHz)	13.62
63360	1 mH	2	1480	180	100 at (40 kHz)	14.99

"64000" SERIES

PART NUMBER	INDUCTANCE	D.C. RESISTANCE (OHMS)	APPROXIMATE SELF RESONANT F REQUENCY (KHz)	MAXIMUM DC CURRENT (mA)	MINIMUM Q	*** PRICE (1-9)
64114	5 Hy	3000	17	2.8	15 at (2 kHz)	16.30
64134	3 Hy	1800	22	3.6	30 at (4 kHz)	15.72
64154	2 Hy	1200	27	4.4	30 at (4 kHz)	14.99
64174	1 Hy	600	38	6.3	30 at (4 kHz)	13.62
64194	750 mH	450	44	7.3	30 at (4 kHz)	13.62
64214	500 mH	300	54	9	30 at (4 kHz)	13.62
64234	250 mH	150	76	13	65 at (10 kHz)	13.62
64254	100 mH	60	120	20	65 at (10 kHz)	13.62
64274	75 mH	45	139	23	120 at (20 kHz)	13.62
64294	50 mH	30	170	28	120 at (20 kHz)	13.62
64314	10 mH	6	380	63	200 at (40 kHz)	13.62
64334	5 mH	3	537	89	200 at (40 kHz)	13.62
64354	1 mH	.6	1200	200	200 at (40 kHz)	14.99

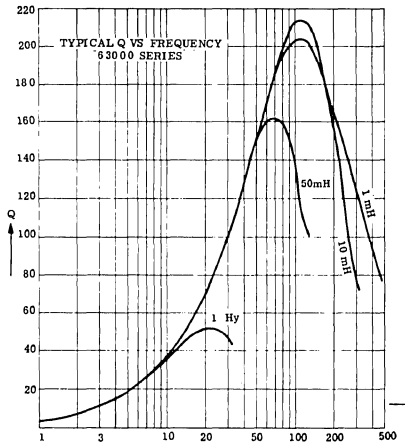
"65000" SERIES

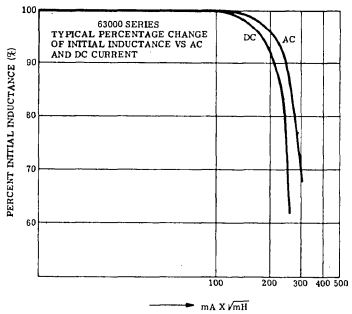
PART NUMBER	INDUCTANCE	D.C. RESISTANCE (OHMS)	APPROXIMATE SELF RESONANT FREQUENCY (kHz)	MAXIMUM DC CURRENT (mA)	MINIMUM Q	*** PRICE (1-9)
65413	10 Hy	3800	11.7	2.8	28 at (2 kHz)	16.30
65433	5 Hy	1900	16.5	3.9	28 at (2 kHz)	15.72
65453	3 Hy	1140	21	5.1	28 at (2 kHz)	14.99
65473	2 Hy	760	26	6.3	56 at (4 kHz)	14.99
65493	1 Hy	380	37	8.8	56 at (4 kHz)	13.62
65513	500 mH	190	52	12.5	56 at (4 kHz)	13.62
65533	250 mH	95	74	17.7	140 at (10 kHz)	13.62
65553	100 mH	38	117	28	140 at (10 kHz)	13.62
65573	50 mH	19	165	39.6	240 at (20 kHz)	13.62
65593	10 mH	3.8	370	88.5	240 at (20 kHz)	13.62

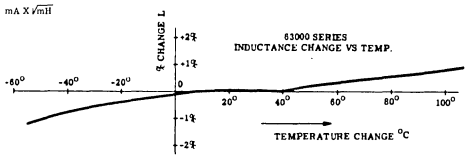
"66000" SERIES

PART NUMBER	INDUCTANCE	D.C. RESISTANCE (OHMS)	APPROXIMATE SELF RESONANT FREQUENCY (kHz)	MAXIMUM DC CURRENT (mA)	MINIMUM Q	*** PRICE (1-9)
66218	10 Hy	2200	11	4.2	50 at (2 kHz)	16.30
66238	5 Hy	1100	15.7	6	50 at (2 kHz)	15.72
66258	3 Hy	660	20	7.7	100 at (4 kHz)	15.72
66278	2 Hy	440	25	9.4	100 at (4 kHz)	13.62
66298	1 Hy	220	35	13	100 at (4 kHz)	13.62
66318	500 mH	110	49	18.8	100 at (4 kHz)	13.62
66338	250 mH	55	70	26.6	200 at (10 kHz)	13.62
66358	100 mH	22	110	42	200 at (10 kHz)	13.62
66378	50 mH	11	156	59	200 at (10 kHz)	13.62
66398	10 mH	2.2	350	133	200 at (10 kHz)	13.62

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

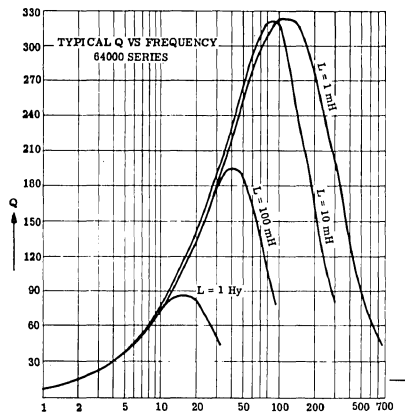


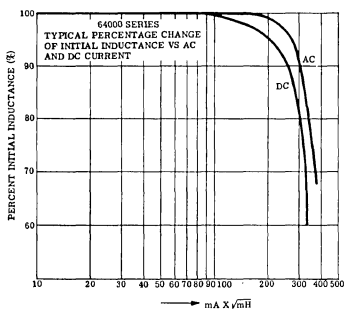


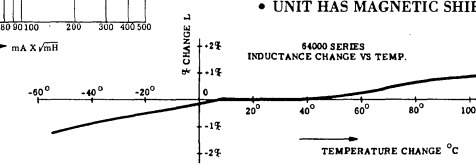


SPECIFICATIONS: **"63000" SERIES**

- INDUCTANCE TOLERANCE
  ± 2% AT .1V - 4 kHz.
- INDUCTANCE STABILITY VS TEMP.
  ± 1% - 30°C TO + 105°C
  + 1% - 55°C TO + 105°C
  - 2%
- MEETS MIL -T-27D (MIL TYPE TF5R20ZZ)
- WEIGHT 2.2 GRAMS
- THERMAL SHOCK:
  100 CYCLES, METHOD 107D, MIL-STD 202E, TEST CONDITION A-3
- UNIT HAS MAGNETIC SHIELD

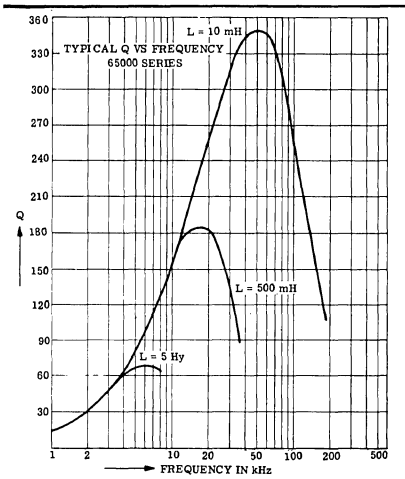


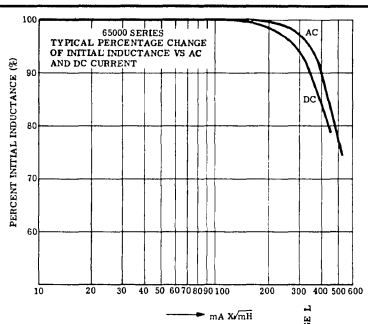


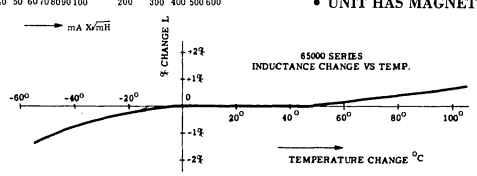


SPECIFICATIONS: **"64000" SERIES**

- INDUCTANCE TOLERANCE
  ± 2% AT .1V - 2 kHz
- INDUCTANCE STABILITY VS TEMP.
  ± 1% - 30°C TO + 105°C
  + 1% - 55°C TO + 105°C
  - 2%
- MEETS MIL -T-27D (MIL TYPE TF5R20ZZ)
- WEIGHT 3 GRAMS
- THERMAL SHOCK:
  100 CYCLES, METHOD 107D, MIL-STD 202E, TEST CONDITION A-3
- UNIT HAS MAGNETIC SHIELD

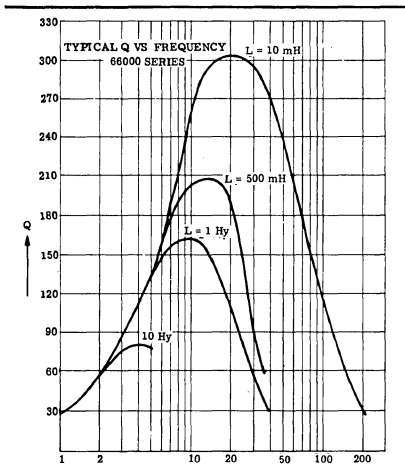


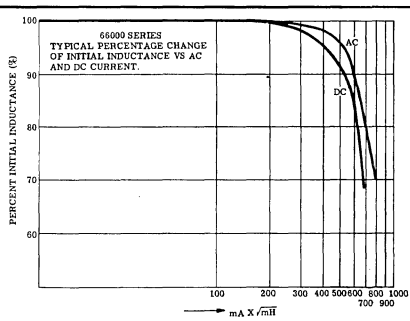


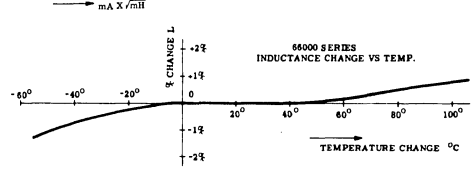


SPECIFICATIONS: **"65000" SERIES**

- INDUCTANCE TOLERANCE
  ± 2% AT .1V - 1 kHz
- INDUCTANCE STABILITY VS TEMP.
  ± 1% - 30°C TO + 105°C
  + 1% - 55°C TO + 105°C
  - 2%
- MEETS MIL -T-27D (MIL TYPE TF5R20ZZ)
- WEIGHT 6 GRAMS
- THERMAL SHOCK:
  100 CYCLES, METHOD 107D, MIL-STD 202E, TEST CONDITION A-3
- UNIT HAS MAGNETIC SHIELD







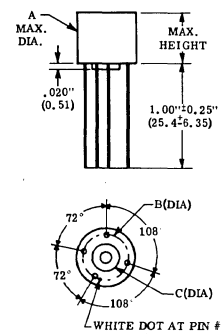
SPECIFICATIONS: **"66000" SERIES**

- INDUCTANCE TOLERANCE
  ± 2% AT .1V - 1 kHz
- INDUCTANCE STABILITY VS TEMP.
  ± 1% - 30°C TO + 105°C
  + 1% - 55°C TO + 105°C
  - 2%
- MEETS MIL -T-27D (MIL TYPE TF5R20ZZ)
- WEIGHT 13 GRAMS
- THERMAL SHOCK:
  100 CYCLES, METHOD 107D, MIL-STD 202E, TEST CONDITION A-3
- UNIT HAS MAGNETIC SHIELD

PICO's Miniaturized Power Inductors

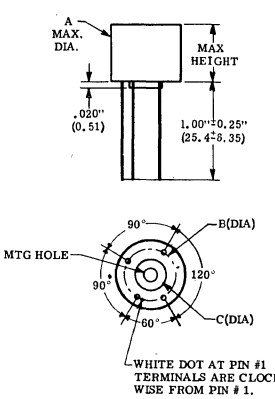
SIZE	MAX. HEIGHT	A MAX. DIA.	B BOLT CIRCLE	C STAND-OFF
1	.280 (7.11)	.410 (10.41)	.260 (6.6)	.160 (4.06)
2	.340 (8.63)	.500 (12.7)	.350 (8.89)	.250 (6.35)
3	.415 (10.54)	.630 (16.0)	.440 (11.17)	.340 (8.64)

NOTE: ALL DIMENSIONS ARE IN INCHES, ( ) = MM

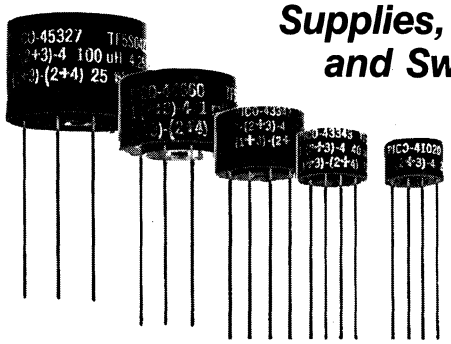


SIZE	MAX. HEIGHT	A MAX. DIA.	B BOLT CIRCLE	C STAND-OFF	MTG. HOLE
4	.500 (12.7)	.800 (20.32)	.560 (14.22)	.460 (11.68)	.140 (3.55)
5	.635 (16.12)	.950 (24.13)	.670 (17.0)	.570 (14.48)	.140 (3.55)

NOTE: ALL DIMENSIONS ARE IN INCHES, ( ) = MM



These Inductors are ideal for Noise, Spike and Power Filtering Applications in Power Supplies, DC-DC Converters and Switching Regulators



- Minimum possible size
- Meets MIL-T-27D (TF5S04ZZ)
- Special high frequency core material to insure low losses
- All units have split windings
- Large selection of sizes available
- All units are magnetically shielded

All inductors have split windings—ratings shown in table are for series connection. Parallel connection will have ¼ inductance at twice the DC current and ¼ the DC resistance, ie. parallel connection of PICO-41020 will have 5 millihenry at .12 Amps DC with DC resistance of 13.5 Ohms

INDUCTANCE	I_{DC} (AMPS)	R_{DC} (OHMS)	SIZE	MODEL NUMBER	*** PRICE 1-9
20 MILLI-HENRY	.06	54.	1	41020	11.24
	.10	29	2	42105	11.24
	.14	20	3	43103	11.24
	.22	12.4	4	44500	13.45
	.29	10.2	5	45107	13.45
15 MILLI-HENRY	.07	40.5	1	41040	11.24
	.12	22	2	42125	11.24
	.16	15	3	43123	11.24
	.25	9.3	4	44520	13.45
	.33	7.7	5	45127	13.45
10 MILLI-HENRY	.08	27	1	41060	11.24
	.14	14.6	2	42145	11.24
	.20	10	3	43143	11.24
	.31	6.2	4	44560	13.45
	.40	5.1	5	45147	13.45
7.5 MILLI-HENRY	.10	20.3	1	41080	11.24
	.17	11	2	42165	11.24
	.24	7.5	3	43163	11.24
	.38	4.7	4	44580	13.45
	.49	3.8	5	45167	13.45
5 MILLI-HENRY	.12	13.5	1	41100	11.24
	.21	7.3	2	42185	11.24
	.30	5	3	43183	11.24
	.47	3.1	4	44600	13.45
	.6	2.6	5	45187	13.45
3 MILLI-HENRY	.16	8.1	1	41120	11.24
	.27	4.4	2	42205	11.24
	.38	3	3	43203	11.24
	.6	1.9	4	44620	13.45
	.78	1.5	5	45207	13.45

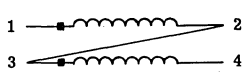
INDUCTANCE	I_{DC} (AMPS)	R_{DC} (OHMS)	SIZE	MODEL NUMBER	*** PRICE 1-9
2 MILLI-HENRY	.19	5.4	1	41140	11.24
	.33	2.9	2	42225	11.24
	.47	2	3	43223	11.24
	.74	1.3	4	44640	13.45
	.95	1	5	45227	13.45
1 MILLI-HENRY	.27	2.7	1	41160	11.24
	.47	1.5	2	42245	11.24
	.66	1	3	43243	11.24
	1	.62	4	44660	13.45
	1.3	.5	5	45247	13.45
750 MICRO-HENRY	.31	2	1	41180	11.24
	.54	1	2	42265	11.24
	.76	.75	3	43263	11.24
	1.2	.47	4	44680	13.45
	1.6	.38	5	45267	13.45
500 MICRO-HENRY	.38	1.3	1	41200	11.24
	.66	.66	2	42285	11.24
	.93	.5	3	43283	11.24
	1.47	.31	4	44700	13.45
	1.9	.25	5	45287	13.45
250 MICRO-HENRY	.53	.66	1	41220	11.24
	.93	.33	2	42305	11.24
	1.3	.25	3	43303	11.24
	2.08	.16	4	44720	13.45
	2.7	.13	5	45307	13.45
100 MICRO-HENRY	.84	.26	1	41240	11.24
	1.47	.13	2	42325	11.24
	2.07	.1	3	43323	11.24
	3.28	.062	4	44740	13.45
	4.25	.05	5	45327	13.45
40 MICRO-HENRY	1.33	.11	1	41260	11.24
	2.33	.053	2	42345	11.24
	3.28	.04	3	43343	11.24

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

SPECIFICATIONS:

- All units meet MIL-T-27D and are type TF5S04ZZ
- Inductance measured at 0.1 VRMS-10 kHz
- Temperature rise at rated D.C. current is less than 30°C
- Maximum ambient is 100°C
- Unit has magnetic shield

TERMINAL ARRANGEMENT SERIES CONNECTION



PARALLEL CONNECTION

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York.

For immediate engineering assistance or to place an order—

Call Toll Free 800-431-1064

PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

Delivery— stock to one week

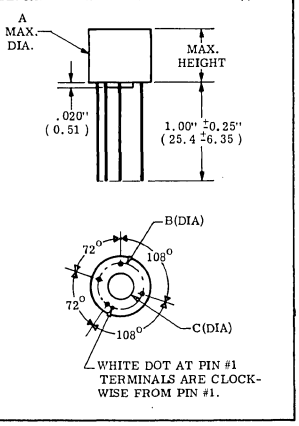
PICO's EMI Common Mode Suppression Inductors

- **Minimum possible size**
- **130°C operation (Ambient + Temp. Rise)**
- **Windings Balance ± 1%**
- **Dielectric Strength .... 1500 Volts RMS**
- **All units are magnetically shielded**

These Inductors are well suited for use in Switching Regulators, DC to DC Power Supplies and all types of Electrical Equipment where the elimination of line transmitted Electromagnetic Interference is important. Electrical equipment will generate noise due to switching operations of transistors, SCR's, relays, triacs, etc. By using these Inductors, noise being fed back to the power line is minimized to an acceptable level and this noise will not interfere with other equipment operating on the same power line.

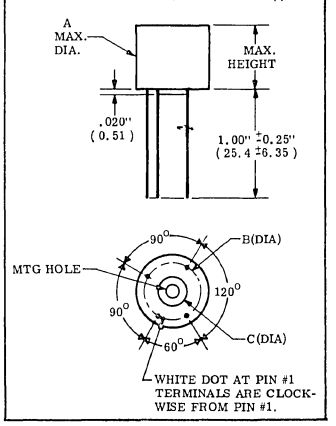
SIZE	MAX. HEIGHT	A MAX DIA	B BOLT CIRCLE	C STAND-OFF
1	.280 (7.11)	.410 (10.41)	.260 (6.6)	.160 (4.06)
2	.340 (8.63)	.500 (12.7)	.350 (8.89)	.250 (6.35)
3	.415 (10.54)	.630 (16.0)	.440 (11.17)	.340 (8.64)

NOTE: ALL DIMENSIONS ARE IN INCHES ( )= MM



SIZE	MAX. HEIGHT	A MAX DIA	B BOLT CIRCLE	C STAND-OFF	MTG HOLE
4	.500 (12.7)	.800 (20.32)	.560 (14.22)	.460 (11.68)	
5	.635 (16.12)	.950 (24.13)	.670 (17.0)	.570 (14.48)	.140 (3.55)
6	.745 (18.92)	1.125 (28.57)	.800 (20.32)	.700 (17.78)	.170 (4.31)

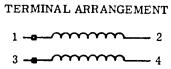
NOTE: ALL DIMENSIONS ARE IN INCHES ( )= MM



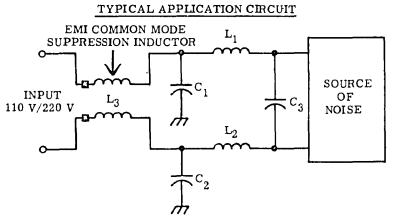
SPECIFICATIONS

- **All units meet MIL-T-27D and are type TF5S04ZZ**
- **Inductance measured at 0.1VRMS-10kHz**
- **Unit has magnetic shield**
- **Dielectric Strength .... 1500 Volts RMS**
- **Windings Balanced ± 1%**
- **Maximum ambient plus temp. rise limited to 130°C (ie maximum ambient of part no. 46282 would be 105°C if IRMS is 1.47 AMPS)**

TERMINAL ARRANGEMENT



TYPICAL APPLICATION CIRCUIT



A TYPICAL CIRCUIT FOR THE ELIMINATION OF NOISE IS SHOWN ABOVE. THE FILTER CONTAINS TWO STAGES, ONE FOR COMMON MODE NOISE (L_3, C_1, C_2) AND ONE FOR CONDUCTED NOISE (L_1, L_2, AND C_3).

Delivery— stock to one week

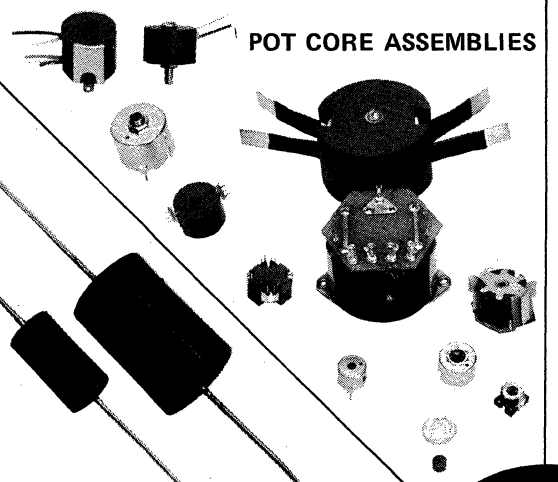
INDUCTANCE	IRMS (AMPS) TEMP. RISE 60°C	TEMP. RISE 40°C	TEMP. RISE 25°C	RDC. (OHMS) EACH WDG.	APPROX. LEAKAGE INDUCTANCE (MICRO-HENRY)	SIZE	MODEL NUMBER	PRICE 1-9
100 MICRO-HENRY	2.22	1.78	1.47	.041	3.5	1	46282	12.57
	2.92	2.50	2.16	.026	3.5	2	47290	12.57
	5.03	4.31	3.67	.012	4	3	48380	12.57
250 MICRO-HENRY	1.42	1.14	1.09	.10	5	1	46262	12.57
	1.83	1.57	1.35	.066	5	2	47270	12.57
	3.18	2.72	2.32	.03	4.5	3	48360	12.57
	5.20	4.35	3.48	.015	4.5	4	49460	15.09
500 MICRO-HENRY	.980	.785	.650	.21	9	1	46242	12.57
	1.30	1.12	.967	.13	8	2	47250	12.57
	2.25	1.93	1.64	.06	8	3	48340	12.57
	3.67	3.07	2.46	.03	7.5	4	49440	15.09
	5.34	4.75	3.45	.017	6.5	5	50240	15.09
750 MICRO-HENRY	.808	.646	.536	.31	10.3	1	46222	12.57
	1.05	.900	.779	.20	8.9	2	47230	12.57
	1.84	1.57	1.34	.09	8.4	3	48320	12.57
	3.00	2.50	2.01	.045	7.7	4	49420	15.09
	4.32	3.85	2.79	.026	7.5	5	50220	15.09
1 MILLI-HENRY	.703	.562	.466	.41	13.8	1	46202	12.57
	.925	.789	.683	.26	11.9	2	47210	12.57
	1.59	1.36	1.16	.12	11.3	3	48300	12.57
	2.60	2.17	1.74	.06	10.3	4	49400	15.09
	3.78	3.36	2.44	.034	10.0	5	50200	15.09
	5.80	4.81	4.29	.022	9.4	6	51302	16.56
2 MILLI-HENRY	.497	.397	.330	.82	27.5	1	46182	12.57
	.654	.558	.483	.52	23.8	2	47190	12.57
	1.12	.963	.821	.24	22.5	3	48280	12.57
	1.83	1.54	1.23	.12	20.6	4	49380	15.09
	2.63	2.34	1.70	.07	20	5	50180	15.09
	4.30	3.57	3.18	.04	18.8	6	51282	16.56
4 MILLI-HENRY	.350	.280	.232	1.65	55	1	46162	12.57
	.460	.392	.340	1.05	47.5	2	47170	12.57
	.804	.688	.587	.47	45.0	3	48260	12.57
	1.30	1.09	.871	.24	41.3	4	49360	15.09
	1.86	1.65	1.20	.14	40.0	5	50160	15.09
	2.87	2.38	2.12	.09	37.5	6	51262	16.56
9 MILLI-HENRY	.233	.187	.154	3.71	123.8	1	46142	12.57
	.307	.262	.227	2.36	106.9	2	47150	12.57
	.532	.456	.389	1.07	101.3	3	48240	12.57
	.874	.731	.586	.53	92.8	4	49340	15.09
	1.25	1.11	.808	.31	90.0	5	50140	15.09
	1.92	1.60	1.42	.20	84.4	6	51242	16.56
16 MILLI-HENRY	.175	.140	.115	6.6	220	1	46122	12.57
	.230	.195	.170	4.2	190	2	47130	12.57
	.40	.340	.290	1.9	180	3	48220	12.57
	.650	.546	.430	.95	165	4	49320	15.09
	.940	.830	.600	.55	160	5	50120	15.09
	1.45	1.20	1.07	.35	150	6	51222	16.56

For immediate engineering assistance or to place an order—

Call Toll Free 800-431-1064

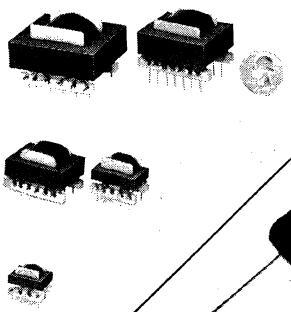
PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

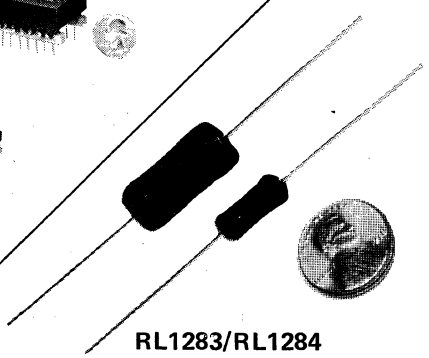


POT CORE ASSEMBLIES

RL1287
FERRITE TRANSFORMERS
(to your specifications)



RL1123/RL1124
SHIELDED INDUCTORS
Low Level Power Supplies
Telecommunications



RL1283/RL1284
POWER LINE INDUCTORS
Power Supplies Filters
Speaker Crossover

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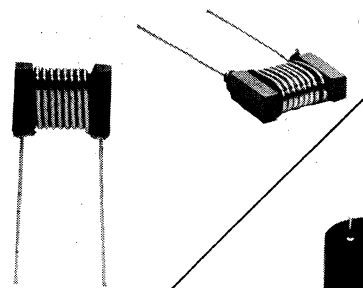
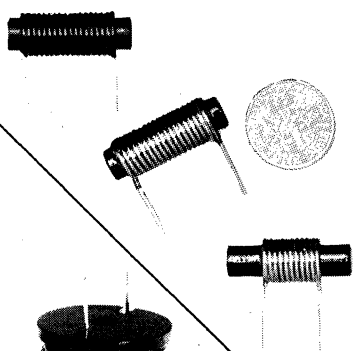
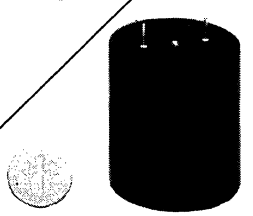
Serving the Industry
Since 1955

RL1160
FLAT COIL INDUCTORS
RF & Audio Applications
Compact High Q

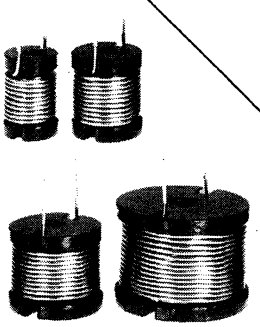


RL1281/RL1285
LOW COST CHOKES
SCR/Triac Control Circuits
Audio Power Supplies





RL1324
MIL SPEC INDUCTORS
MIL-T-27D Applications
Filters Power Amplifiers
Switching Regulators



RL1256
POWER LINE CHOKES
Switching Regulators
SCR/Triac Controls
Filters

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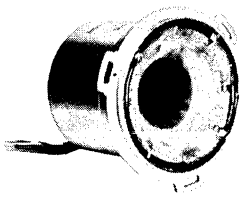
So, give me a call, Edward Rensing, at (516) 586-5566 and let me help you with your coil wound needs. I think you'll discover no one will service your requirements better!

RENCO ELECTRONICS, INC.
60 Jefryn Boulevard East,
Deer Park, New York 11729
(516) 586-5566

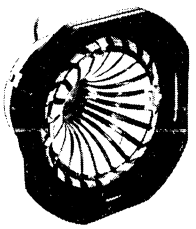
TOLL-FREE ENGINEERING HOT LINE 800•645•5828
In New York, call (516) 586-5566

syntronic

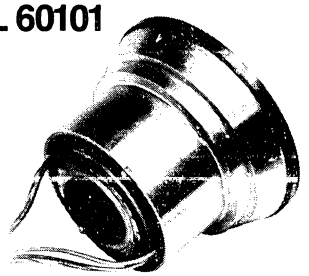
SYNTRONIC INSTRUMENTS, INC.
100 Industrial Road, Addison, IL 60101



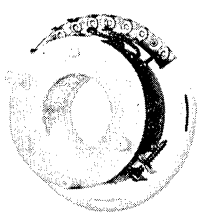
MILITARY/AIRBORNE/SHIP-BOARD YOKES
Compact, lightweight, ruggedized yokes designed to withstand the rigors of environmental stresses. Typical applications include TV raster scans, HUD, HDD, alpha-numeric, cockpit displays as well as military ground support and shipboard displays.



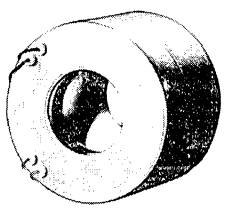
COMMERCIAL YOKES
Extensively tooled for volume production reflecting excellent cost effectiveness. Ideal for all variations of CRT terminals including alphanumeric computer output displays, medical wave-form and video. Can be supplied with built-in geometry correction and beam centering provisions.



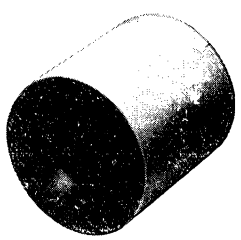
SPECIAL YOKES
Designed to solve unusual problems in unique displays such as phototypesetting, random graphics, vectors, line scan, monochrome or color projection simulators, and applications demanding accurate beam positioning, superior focus, and zero astigmatism.



Y3802 YOKE
CHARACTER WRITING
Stator Ferrite Core. High frequency yoke provides effective way to produce display characters and symbols independent of main yoke. Mounts directly behind Y38 series of yokes. Low inductances as required.



F50/55 FOCUS COILS
Static/Dynamic shielded units designed for electromagnetically focused precision displays where high resolution is required anywhere on the screen. Fits 38 mm (1½") neck diameter CRTs.



FIBER OPTIC
CRT YOKES
Precision yokes developed for phototypesetter applications provide excellent linearity and minimum spot growth center to edge of fiber optic CRT. Ten years engineering experience with phototypesetter applications.

When the electronics industry needed high quality precision components for CRT display systems, Syntronic Instruments was able to provide the technology. As a manufacturer of precision yokes, coils and related components, Syntronic enjoys a substantial share of the deflection component market and has acquired an industry-wide reputation for its quality engineering and ability to manufacture these devices in any quantity.

Quality control with such components is imperative. Syntronic engineers have designed and built much of the test equipment for these precision instruments and consistently lead in the development of new test equipment.

Today's requirements for high resolution, solid-state driven, high-speed displays require continuing effort to advance the design of deflection components. Syntronic Instruments' experienced engineering group provides such present-day technology to every application.

SYNTRONIC INSTRUMENTS, INC., 100 INDUSTRIAL ROAD, ADDISON, IL 60101 U.S.A.
Phone (312) 543-6444
TWX: 910-651-2191

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

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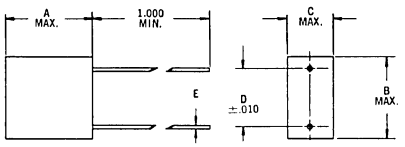
INDUCTORS

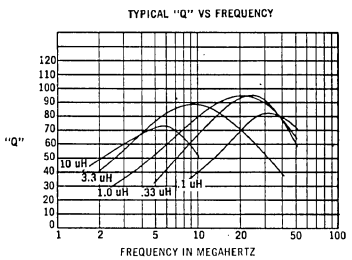
MINI-L
ENCAPSULATED RF INDUCTORS



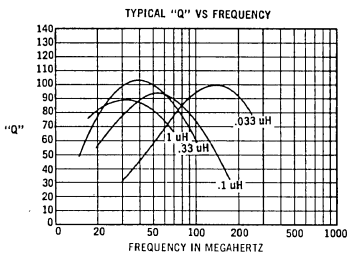
Type	A	B	C	D	E	Wt.
TA-TF	.225	.210	.110	.100	.020	.01 oz.
TB	.300	.280	.160	.200	.025	.02 oz.
TD	.390	.390	.197	.200	.025	.04 oz.

Designed to meet the requirements of MIL-C-15305, Grade 1, Class B (−55°C to +125°C). The rated temperature rise is 35°C above an ambient of 90°C. Overload current should not exceed 1.4 times the rated current. Dielectric withstanding voltage is 700 volts rms. The powdered iron cores used in these items possess excellent temperature stability and result in an inductor with low external magnetic field. This allows mounting in close proximity to each other and to other circuit components without ill effects.

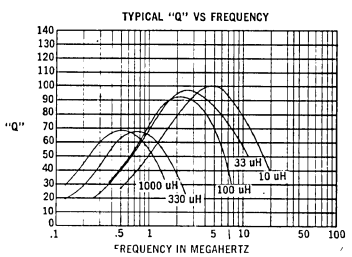
TA



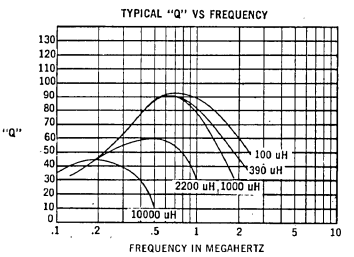
TF



TB



TD



TA SERIES

Frequency Range: 1 to 50 MHz.

Inductance Tolerances: Less than 1.0 uH, ±10%. Greater than or equal to 1.0 uH, ±5%. Closer tolerances available by special request.

Inductance TC: +50 PPM/°C maximum.

Maximum Power Dissipation: 0.2 watt.

Leads: 1 inch minimum AWG 24 tinned copper wire. Weldable gold plated Dumet leads are available.

Method of Measurement: Apparent inductance measured on HP4342A "Q" meter with leads connected ¼ inch from inductor body directly to "Q" meter terminals. Residual "Q" meter inductance of 0.01 uH should be subtracted from reading.

MIL-C-15305, Grade 1, Class B.

Part No.	Apparent Inductance (uH)	Minimum "Q"	Test Frequency (MHz)	Minimum SRF (MHz)	Maximum DCR (ohms)	DC Current (mA)
TA-1	0.10	60	25	450	0.04	2230
TA-2	0.12	60	25	410	0.05	2000
TA-3	0.15	65	25	350	0.06	1825
TA-4	0.18	65	25	325	0.07	1675
TA-5	0.22	65	25	300	0.08	1550
TA-6	0.27	65	25	280	0.09	1475
TA-7	0.33	65	25	260	0.10	1400
TA-8	0.39	70	25	240	0.11	1325
TA-9	0.47	70	25	220	0.15	1125
TA-10	0.56	70	25	200	0.20	1000
TA-11	0.68	70	25	180	0.25	900
TA-12	0.82	70	25	165	0.30	810
TA-13	1.0	70	25	150	0.35	750
TA-14	1.2	65	7.9	130	0.25	875
TA-15	1.5	65	7.9	120	0.30	800
TA-16	1.8	65	7.9	110	0.50	600
TA-17	2.2	65	7.9	100	0.75	500
TA-18	2.7	65	7.9	90	0.90	450
TA-19	3.3	65	7.9	70	1.0	425
TA-20	3.9	65	7.9	60	1.2	400
TA-21	4.7	60	7.9	50	1.5	350
TA-22	5.6	60	7.9	45	1.7	325
TA-23	6.8	60	7.9	40	2.0	300
TA-24	8.2	60	7.9	37	2.4	290
TA-25	10.0	60	7.9	35	2.6	280

TB SERIES

Recommended Frequency Range: 50 KHz to 35 MHz.

Inductance Tolerance: ±5%. Closer tolerances available by special request.

Inductance TC: From +60 PPM/°C maximum to +300 PPM/°C maximum, depending upon inductance value.

Maximum Power Dissipation: .33 watt.

Leads: 1 inch minimum AWG 22 tinned copper wire. Weldable gold plated Dumet leads are available.

Method of Measurement: Apparent inductance measured on HP4342A "Q" meter with leads connected ¼ inch from inductor body directly to "Q" meter terminals. Residual "Q" meter inductance of 0.01 uH should be subtracted from reading.

Part No.	Apparent Inductance (uH)	Minimum "Q"	Test Frequency (MHz)	Minimum SRF (MHz)	Maximum DCR (ohms)	DC Current (mA)
TB-1	10	75	2.5	35	1.1	550
TB-2	12	75	2.5	31	1.3	500
TB-3	15	75	2.5	27	1.5	460
TB-4	18	80	2.5	25	1.9	410
TB-5	22	80	2.5	22	2.2	380
TB-6	27	80	2.5	20	2.6	350
TB-7	33	80	2.5	18	3.3	320
TB-8	39	80	2.5	16	3.8	290
TB-9	47	80	2.5	14	4.6	260
TB-10	56	80	2.5	12	5.6	240
TB-11	68	80	2.5	11	6.7	220
TB-12	82	80	2.5	10	8.1	200
TB-13	100	80	2.5	9.1	9.6	180
TB-14	120	50	0.79	8.2	10.0	175
TB-15	150	50	0.79	7.5	11.0	160
TB-16	180	50	0.79	6.5	12.0	155
TB-17	220	50	0.79	5.6	13.0	150
TB-18	270	55	0.79	5.0	17.0	125
TB-19	330	55	0.79	4.5	19.0	130
TB-20	390	55	0.79	4.0	21.0	120
TB-21	470	55	0.79	3.5	22.0	115
TB-22	560	55	0.79	3.0	24.0	110
TB-23	680	55	0.79	2.8	19.0	130
TB-24	820	50	0.79	2.5	23.0	120
TB-25	1000	50	0.79	2.2	26.0	110

TF SERIES

Frequency Range: 15 to 300 MHz.

Inductance Tolerances: Less than 0.1 uH, ±20%. Greater than or equal to 0.1 uH, ±10%. Closer tolerances available by special request.

Inductance TC: +200 PPM/°C maximum.

Maximum Power Dissipation: 0.2 watt.

Leads: 1 inch minimum AWG 24 tinned copper wire. Weldable gold plated Dumet leads are available.

Method of Measurement: Apparent inductance measured on Boonton 190-A "Q" meter with leads connected ¼ inch from inductor body directly to "Q" meter terminals. Residual "Q" meter inductance of 0.0026 uH should be subtracted from value calculated from C and F readings.

MIL-C-15305, Grade 1, Class B.

Part No.	Apparent Inductance (uH)	Minimum "Q"	Test Frequency (MHz)	Minimum SRF (MHz)	Maximum DCR (ohms)	DC Current (mA)
TF-1	0.01	60	150	1000	0.02	3100
TF-2	0.012	60	150	1000	0.02	3100
TF-3	0.015	60	150	1000	0.02	3100
TF-4	0.018	60	150	1000	0.02	3100
TF-5	0.022	60	100	900	0.02	3100
TF-6	0.027	60	100	800	0.02	3100
TF-7	0.033	60	100	750	0.02	3100
TF-8	0.039	60	100	700	0.02	3100
TF-9	0.047	60	100	650	0.02	3100
TF-10	0.056	60	100	600	0.02	3100
TF-11	0.068	60	100	550	0.03	2500
TF-12	0.082	60	100	500	0.03	2500
TF-13	0.10	70	50	450	0.04	2200
TF-14	0.12	70	50	400	0.05	2000
TF-15	0.15	70	50	350	0.06	1800
TF-16	0.18	70	50	320	0.07	1650
TF-17	0.22	70	50	300	0.08	1500
TF-18	0.27	70	50	280	0.10	1400
TF-19	0.33	70	50	260	0.12	1300
TF-20	0.39	60	50	240	0.15	1150
TF-21	0.47	60	50	220	0.20	1000
TF-22	0.56	60	50	200	0.25	900
TF-23	0.68	60	50	180	0.30	800
TF-24	0.82	60	50	160	0.35	750
TF-25	1.0	60	50	150	0.40	700

TD SERIES

Recommended Frequency Range: 50 KHz to 10 MHz.

Inductance Tolerance: ±5%. Closer tolerances available by special request.

Inductance TC: From +60 PPM/°C maximum to +300 PPM/°C maximum, depending upon inductance value.

Maximum Power Dissipation: .50 watt.

Leads: 1 inch minimum AWG 22 tinned copper wire. Weldable gold plated Dumet leads are available.

Method of Measurement: Apparent inductance measured on HP4342A "Q" meter with leads connected ¼ inch from inductor body directly to "Q" meter terminals.

Part No.	Apparent Inductance (uH)	Minimum "Q"	Test Frequency (KHz)	Minimum SRF (MHz)	Maximum DCR (ohms)	DC Current (mA)
TD-1	100	75	790	8.4	6	280
TD-2	120	75	790	7.5	7	260
TD-3	150	75	790	6.8	8	240
TD-4	180	75	790	6.1	10	220
TD-5	220	80	790	5.4	12	200
TD-6	270	80	790	4.7	14	180
TD-7	330	80	790	4.2	17	165
TD-8	390	80	790	3.8	20	150
TD-9	470	75	790	3.4	24	140
TD-10	560	75	790	3.1	28	130
TD-11	680	75	790	2.8	33	120
TD-12	820	75	790	2.5	40	110
TD-13	1000	75	790	2.2	46	100
TD-14	1200	45	250	1.9	30	120
TD-15	1500	45	250	1.6	35	110
TD-16	1800	50	250	1.4	40	105
TD-17	2200	50	250	1.3	50	95
TD-18	2700	50	250	1.2	60	85
TD-19	3300	50	250	1.1	70	80
TD-20	3900	50	250	1.0	80	75
TD-21	4700	50	250	0.9	90	70
TD-22	5600	45	250	0.8	100	65
TD-23	6800	40	250	0.7	140	60
TD-24	8200	40	250	0.6	160	55
TD-25	10,000	40	250	0.6	175	50

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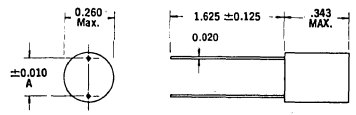
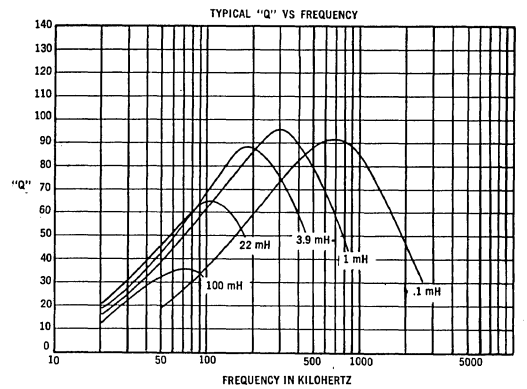
INDUCTORS

MINI-L ENCAPSULATED INDUCTORS
TE/TJ SERIES



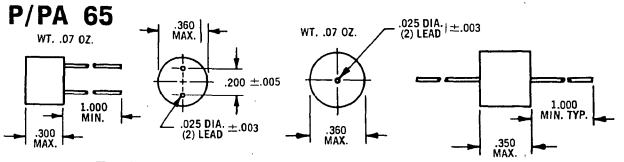
Series	A	WT.
TE	.200	.03 oz.
TJ	.100	.03 oz.

Recommended Frequency Range: 25 KHz to 2.5 MHz.
Inductance Tolerances: ±10% @ 1 KHz.
Maximum Power Dissipation: .33 watt.
Leads: 1.625 ±.125 AWG #24 tinned copper leads. Add suffix "D" to Part Number for Weldable Gold Plated Dumet leads.
Method of Measurement: Inductance at 1 KHz measured on General Radio inductance bridge Type 1632A with leads connected directly to bridge. "Q" at test frequency, measured on HP4342A "Q" meter with leads connected directly to meter terminals.
MIL-C-15305, Grade 1, Class B.



Part Number		Inductance Ref. @ 1 KHz (mH)	Minimum "Q"	"Q" Test Frequency (KHz)	Minimum SRF (MHz)	Maximum DCR (ohms)	DC Current (mA)
TJ-1	TE-1	0.10	80	790	4.5	1.8	450
TJ-2	TE-2	0.12	80	790	3.9	2.1	425
TJ-3	TE-3	0.15	75	790	3.6	2.3	400
TJ-4	TE-4	0.18	75	790	3.3	2.7	380
TJ-5	TE-5	0.22	75	790	3.0	2.9	360
TJ-6	TE-6	0.27	75	790	2.7	3.2	320
TJ-7	TE-7	0.33	70	790	2.5	3.6	300
TJ-8	TE-8	0.39	70	790	2.3	4.0	275
TJ-9	TE-9	0.47	65	790	2.1	4.4	265
TJ-10	TE-10	0.56	60	790	2.0	4.7	250
TJ-11	TE-11	0.68	55	790	1.8	5.4	240
TJ-12	TE-12	0.82	50	790	1.6	5.8	225
TJ-13	TE-13	1.00	80	250	1.5	8.7	190
TJ-14	TE-14	1.20	75	250	1.4	9.5	180
TJ-15	TE-15	1.50	75	250	1.2	11.6	160
TJ-16	TE-16	1.80	75	250	1.1	15.8	140
TJ-17	TE-17	2.20	75	250	0.95	17.3	130
TJ-18	TE-18	2.70	70	250	0.87	18.9	125
TJ-19	TE-19	3.30	70	250	0.80	25.2	110
TJ-20	TE-20	3.90	70	250	0.75	27.2	105
TJ-21	TE-21	4.70	65	250	0.70	31.5	100
TJ-22	TE-22	5.60	65	250	0.60	42.0	85
TJ-23	TE-23	6.80	60	250	0.55	52.5	75
TJ-24	TE-24	8.20	55	250	0.50	63.0	65
TJ-25	TE-25	10.0	45	250	0.45	89.2	55
TJ-26	TE-26	12.0	40	79	0.40	105.0	50
TJ-27	TE-27	15.0	40	79	0.35	121.0	45
TJ-28	TE-28	18.0	40	79	0.33	136.0	40
TJ-29	TE-29	22.0	40	79	0.30	147.0	35
TJ-30	TE-30	27.0	40	79	0.26	241.0	30
TJ-31	TE-31	33.0	35	79	0.24	325.0	28
TJ-32	TE-32	39.0	35	79	0.22	367.0	25
TJ-33	TE-33	47.0	35	79	0.20	420.0	23
TJ-34	TE-34	56.0	30	79	0.18	483.0	20
TJ-35	TE-35	68.0	25	79	0.16	630.0	18
TJ-36	TE-36	82.0	20	79	0.14	893.0	16
TJ-37	TE-37	100.0	20	79	0.12	1100	15
TJ-38	TE-38	120.0	10	50	0.10	1200	14
TJ-39	TE-39	150.0	10	50	0.095	1360	13
TJ-40	TE-40	180.0	10	40	0.080	1520	11
TJ-41	TE-41	220.0	10	40	0.070	1890	10

P/PA 65

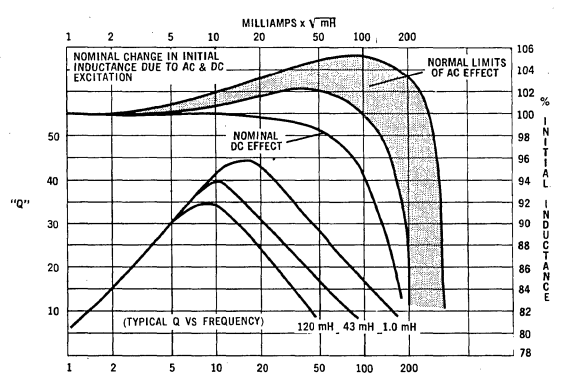


Frequency Range: 1 to 50 KHz **MIL-T-27 Grade 5, Class S.**

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.

EXAMPLE: **PA65 — XX**

CASE TYPE — PART NUMBER



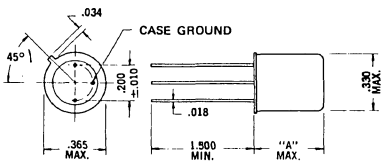
CORE NO. 65

Inductance ±2% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.00	65-1	.934	12
1.25	65-2	1.310	12
1.50	65-3	1.430	12
1.75	65-4	1.550	14
2.00	65-5	2.020	14
2.40	65-6	2.200	14
2.50	65-7	2.250	14
3.00	65-8	3.010	16
3.60	65-9	3.300	16
4.30	65-10	3.600	16
5.00	65-11	4.260	18
6.00	65-12	4.680	18
7.20	65-13	5.120	18
7.50	65-14	7.000	20
8.00	65-15	7.700	22
8.60	65-16	8.000	22
10.00	65-17	10.300	24
12.00	65-18	11.300	24
12.50	65-19	11.600	24
15.00	65-20	16.500	26
17.50	65-21	17.800	26
20.00	65-22	19.000	28
24.00	65-23	28.500	28
25.00	65-24	29.100	30
30.00	65-25	31.900	30
36.00	65-26	34.900	32
43.00	65-27	42.100	32
50.00	65-28	48.000	34
60.00	65-29	52.600	34
72.00	65-30	61.500	36
75.00	65-31	78.700	36
86.00	65-32	84.200	36
100.00	65-33	90.800	38
120.00	65-34	115.000	40

TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

MINI-L HERMETICALLY SEALED RF INDUCTORS TG, TH SERIES



Series	A max.	Weight
TG	.390	.06 oz.
TH	.350	.07 oz.

The TG and TH series offer high "Q" inductors in a TO-5 transistor can configuration. High density packaging can be accomplished with little regard to coupling between adjacent circuitry since construction of these units results in a low external magnetic and electrostatic field.

TG SERIES

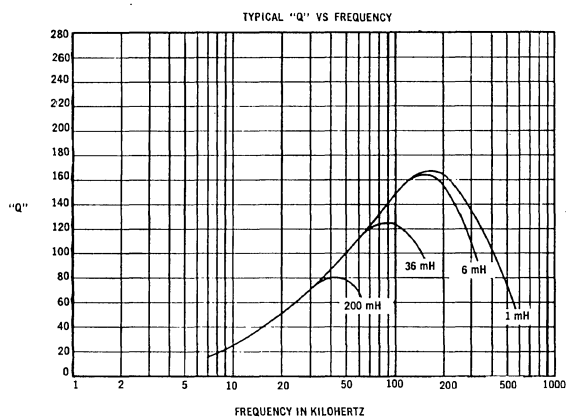
Recommended Frequency Range: 10 KHz to 500 KHz.
Inductance Tolerance: ±5%.
Inductance Stability: Less than ±2% from −20°C to +130°C.
Method of Test: Inductance is measured on a General Radio inductance bridge, Type 1632A with leads connected directly to bridge. "Q" is measured on HP4342A "Q" meter with leads connected directly to the "Q" meter terminals.
MIL-T-27, Grade 4, Class S.
Temperature Range: −55°C to +130°C.
Insulation Resistance: 10,000 Megohms minimum at 100 volts DC.
Dielectric Withstanding Voltage: 100 volts rms.

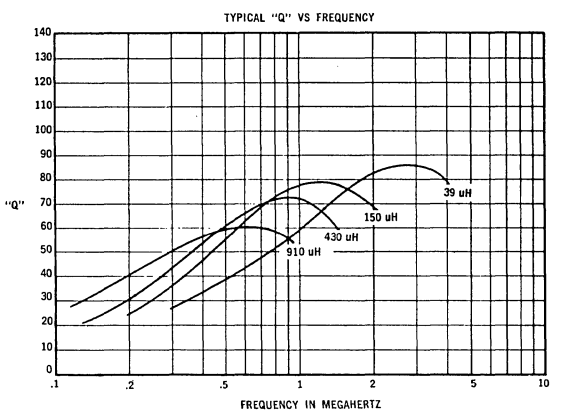
Part Number	Inductance (mH)	Inductance Test Frequency (KHz)	"Q" Minimum	"Q" Test Frequency (KHz)	Maximum DCR (ohms)	Minimum SRF (KHz)	DC Current (mA)
TG-1	1.0	10	120	200	3.3	1500	123
TG-2	1.2	10	120	200	3.6	1300	118
TG-3	1.5	10	120	200	4.8	1160	102
TG-4	1.75	10	120	200	5.2	1080	98
TG-5	2.0	10	120	200	5.7	1000	94
TG-6	2.4	10	120	200	7.9	920	80
TG-7	3.0	10	120	150	8.9	820	75
TG-8	3.6	10	120	150	9.8	730	71
TG-9	4.3	10	120	150	13.7	660	60
TG-10	5.0	10	120	150	14.7	600	58
TG-11	6.0	10	120	150	20.0	540	50
TG-12	7.2	10	120	100	21.8	480	48
TG-13	8.6	10	100	100	24.0	430	45
TG-14	10.0	10	100	100	32.4	400	39
TG-15	12.0	10	100	100	34.8	360	38
TG-16	15.0	10	100	100	39.1	320	36
TG-17	17.5	10	85	70	55.0	300	30
TG-18	20.0	10	85	70	60.0	280	29
TG-19	24.0	10	85	70	64.7	250	28
TG-20	30.0	10	85	70	86.3	220	24
TG-21	36.0	10	85	70	95.8	195	23
TG-22	43.0	10	85	70	132	185	19
TG-23	50.0	10	85	70	143	165	18
TG-24	60.0	10	75	50	155	145	18
TG-25	72.0	10	75	50	172	130	17
TG-26	86.0	10	75	50	233	125	15
TG-27	100	10	75	50	252	115	14
TG-28	120	5	75	50	290	105	13
TG-29	150	5	50	40	323	95	13
TG-30	175	5	50	40	350	85	12
TG-31	200	5	50	40	477	80	10
TG-32	240	5	50	40	693	71	10
TG-33	300	5	50	40	735	63	8
TG-34	360	5	30	30	1005	57	7
TG-35	430	5	30	30	1100	51	6.5
TG-36	500	5	30	20	1200	48	6.5

TH SERIES

Recommended Frequency Range: 100 KHz to 10 MHz.
Inductance Tolerances: 10 uH through 33 uH, ±10%, 39 uH through 130 uH, ±5%, greater than and including 150 uH, ±3%.
Inductance Stability: Less than or equal to ±2% from −20°C to +85°C.
Method of Test: Inductance and "Q" are measured on HP4342A "Q" meter with leads connected directly to the "Q" meter terminals.
MIL-C-15305, Grade 1, Class C.
Temperature Range: −55°C to +130°C.
Insulation Resistance: 10,000 Megohms minimum at 100 volts DC.
Dielectric Withstanding Voltage: 100 volts rms.

Part Number	Inductance (uH)	Inductance Test Frequency (KHz)	"Q" Minimum	"Q" Test Frequency (KHz)	Maximum DCR (ohms)	Minimum SRF (MHz)	DC Current (mA)
TH-7	10	1000	75	2500	2.4	35.0	102
TH-8	12	1000	75	2500	2.5	30.0	100
TH-9	15	1000	75	2500	2.6	25.0	98
TH-10	18	1000	75	2500	2.7	23.0	96
TH-11	22	1000	75	2500	2.8	20.0	94
TH-12	27	1000	75	2500	2.9	17.0	93
TH-13	33	1000	75	2500	3.0	14.0	91
TH-14	39	500	70	2500	3.1	11.0	90
TH-15	47	500	70	2500	3.2	10.0	88
TH-16	56	500	70	2500	3.3	9.5	87
TH-17	68	500	70	2500	3.4	9.0	85
TH-18	82	500	70	2500	4.5	8.0	74
TH-19	100	500	70	1500	5.1	7.5	70
TH-20	110	500	70	1500	6.0	7.0	64
TH-21	120	500	70	1500	6.2	6.5	63
TH-22	130	500	70	1500	6.4	6.0	62
TH-23	150	500	70	1500	6.6	5.5	61
TH-24	160	500	60	790	8.6	5.3	54
TH-25	180	500	60	790	9.0	5.0	52
TH-26	200	500	60	790	9.5	4.5	51
TH-27	220	250	60	790	10.0	4.0	50
TH-28	240	250	60	790	10.6	3.8	48
TH-29	270	250	60	790	11.2	3.6	48
TH-30	300	250	60	790	14.2	3.4	42
TH-31	330	250	60	790	14.6	3.2	41
TH-32	360	250	60	790	15.0	3.0	41
TH-33	390	250	60	790	15.6	2.9	40
TH-34	430	250	60	790	16.4	2.8	39
TH-35	470	250	60	790	20.4	2.7	35
TH-36	510	250	60	790	21.8	2.6	34
TH-37	560	250	60	790	23.6	2.5	32
TH-38	620	250	60	790	24.6	2.3	32
TH-39	680	250	50	790	25.8	2.1	31
TH-40	750	250	50	790	26.8	1.9	31
TH-41	820	250	50	790	38.4	1.7	25
TH-42	910	250	50	790	40.8	1.5	24
TH-43	1000	250	50	790	42.6	1.4	24





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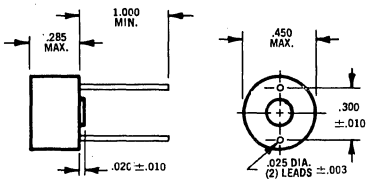
INDUCTORS

MINIATURE TOROIDS

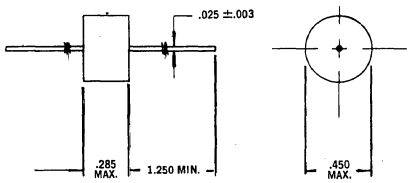
TYPE P/PF
Epoxy Encapsulated
MIL-T-27 Grade 5, Glass S



WT. .08 oz.

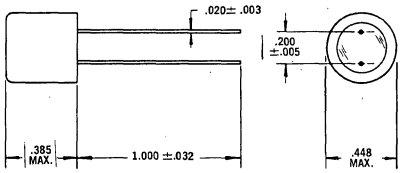
P	PF
NO FOOT	WITH FOOT

TYPICAL TYPE PA
Axial Lead Epoxy Encapsulated



WT. .08 oz.

TYPE M
Metal Cased
MIL-T-27 Grade 4, Class R



WT. .15 oz.

CORE NO. 03
Recommended Frequency: Up to 100 KHz.
Maximum Inductance: 250 mH.
Special Core Stabilization Available: D, W, M, L.

CORE NO. 13
Recommended Frequency: 10 KHz to 200 KHz.
Maximum Inductance: 100 mH.
Special Core Stabilization Available: D, W, M, L.

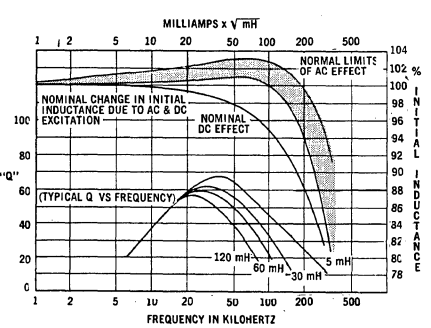
CORE NO. 29
Recommended Frequency: 50 KHz to 5 MHz.
Maximum Inductance: 15 mH.
Only Core Stabilization Available: ±90 PPM/°C

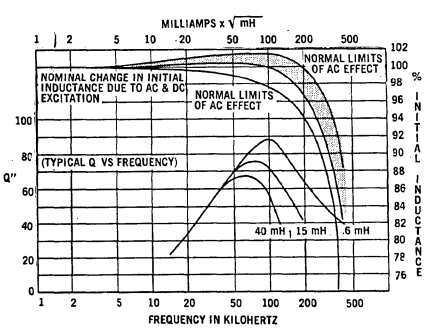
When ordering add the prefix P, PA, PF, or M to the Part Number for the case type desired.

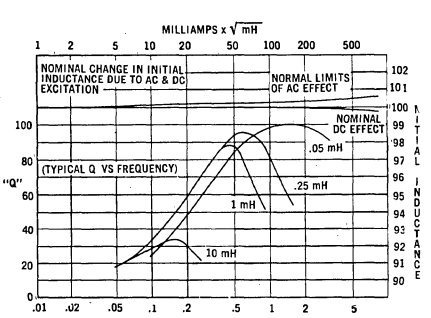
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.00	03-1	1.5	14
1.25	03-2	1.7	14
1.50	03-3	2.4	18
1.75	03-4	2.6	20
2.00	03-5	2.7	20
2.40	03-6	3.7	22
2.50	03-7	3.8	22
3.00	03-8	4.0	24
3.60	03-9	5.7	24
4.30	03-10	6.2	24
5.00	03-11	6.7	26
6.00	03-12	9.3	26
7.20	03-13	10.0	26
7.50	03-14	10.5	28
8.00	03-15	11.0	28
8.60	03-16	14.0	28
10.00	03-17	15.0	30
12.00	03-18	15.5	32
12.50	03-19	16.0	34
15.00	03-20	23.0	36
17.50	03-21	25.0	38
20.00	03-22	26.0	40
24.00	03-23	35.0	42
30.00	03-24	39.0	44
36.00	03-25	58.0	46
43.00	03-26	64.0	48
50.00	03-27	69.0	50
60.00	03-28	78.0	52
72.00	03-29	106.0	54
75.00	03-30	108.0	56
86.00	03-31	140.0	58
100.00	03-32	150.0	60
120.00	03-33	155.0	62
150.00	03-34	228.0	64
175.00	03-35	246.0	66
178.00	03-36	248.0	66
200.00	03-37	333.0	68
250.00	03-38	373.0	70

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
.50	13-1	1.5	14
.60	13-2	1.6	14
.72	13-3	2.4	14
.86	13-4	2.6	14
1.00	13-5	2.8	16
1.25	13-6	3.9	16
1.50	13-7	4.1	18
1.75	13-8	5.7	18
2.00	13-9	6.1	20
2.40	13-10	6.7	22
2.50	13-11	6.8	24
3.00	13-12	9.5	24
3.60	13-13	10.5	26
4.30	13-14	14.7	28
5.00	13-15	15.5	30
6.00	13-16	16.0	30
7.20	13-17	24.0	32
8.60	13-18	26.0	34
10.00	13-19	27.0	36
12.00	13-20	39.0	38
15.00	13-21	41.0	40
17.50	13-22	59.0	40
20.00	13-23	63.0	42
24.00	13-24	67.0	42
25.00	13-25	68.0	44
30.00	13-26	100.0	44
36.00	13-27	103.0	46
40.00	13-28	108.0	46
43.00	13-29	142.0	48
50.00	13-30	154.0	48
60.00	13-31	168.0	50
72.00	13-32	228.0	50
86.00	13-33	250.0	52
100.00	13-34	340.0	52

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
.050	29-1	1.2	10
.060	29-2	1.6	10
.072	29-3	1.8	10
.075	29-4	1.8	12
.086	29-5	1.9	12
.100	29-6	2.1	12
.120	29-7	2.3	12
.125	29-8	3.0	12
.150	29-9	3.3	12
.175	29-10	3.5	14
.200	29-11	4.5	14
.240	29-12	4.9	14
.250	29-13	5.0	14
.300	29-14	7.0	14
.360	29-15	7.7	14
.400	29-16	8.1	16
.430	29-17	10.5	16
.500	29-18	12.3	16
.600	29-19	13.5	16
.720	29-20	16.2	16
.750	29-21	16.5	18
.860	29-22	17.7	18
1.000	29-23	19.1	18
1.200	29-24	25.9	20
1.250	29-25	26.4	20
1.500	29-26	29.0	22
1.750	29-27	37.6	22
2.000	29-28	40.3	24
2.400	29-29	44.0	24
2.500	29-30	45.0	26
3.000	29-31	64.0	28
3.600	29-32	69.0	28
4.000	29-33	73.0	30
4.300	29-34	76.0	32
5.000	29-35	102.0	34
6.000	29-36	112.0	34
7.200	29-37	122.0	36
7.500	29-38	125.0	38
8.600	29-39	162.0	40
10.000	29-40	175.0	42







INDUCTORS

TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

MINIATURE TOROIDS

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.

EXAMPLE P 03-1

CASE TYPE — PART NUMBER

CORE NO. 82

Recommended Frequency: Up to 50 KHz.
Maximum Inductance: 250 mH.
Special Core Stabilization: D, W, M, L.

When ordering add the prefix P, PA, PF, or M, to the part number for the case type desired.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.00	82-1	1.23	12
1.25	82-2	1.38	14
1.50	82-3	1.85	14
1.75	82-4	2.00	16
2.00	82-5	2.34	16
2.40	82-6	2.56	18
2.50	82-7	2.62	18
3.00	82-8	3.87	18
3.60	82-9	4.25	20
4.30	82-10	4.63	22
5.00	82-11	6.29	22
6.00	82-12	6.91	24
7.20	82-13	7.55	24
7.50	82-14	9.27	26
8.00	82-15	9.57	26
8.60	82-16	9.93	28
10.00	82-17	10.70	28
12.00	82-18	14.20	30
15.00	82-19	15.90	30
17.50	82-20	22.10	32
20.00	82-21	23.60	34
24.00	82-22	25.90	36
30.00	82-23	36.50	36
36.00	82-24	40.00	38
43.00	82-25	43.70	38
50.00	82-26	56.70	40
60.00	82-27	62.10	40
72.00	82-28	68.10	42
86.00	82-29	96.80	44
100.00	82-30	104.00	44
120.00	82-31	149.00	46
150.00	82-32	206.00	48
175.00	82-33	223.00	48
200.00	82-34	305.00	50
250.00	82-35	341.00	50

CORE NO. 72

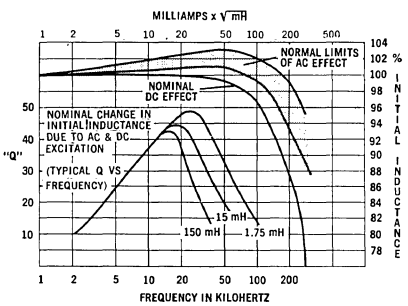
Recommended Frequency: Up to 30 KHz.
Maximum Inductance: 360 mH.
Special Core Stabilization: D, W, M, L.

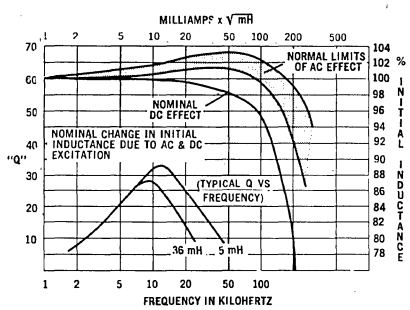
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.25	72-1	1.23	12
1.50	72-2	1.34	14
1.75	72-3	1.78	14
2.00	72-4	1.90	16
2.40	72-5	2.28	16
2.50	72-6	2.34	18
3.00	72-7	2.55	18
3.60	72-8	3.78	18
4.30	72-9	4.14	20
5.00	72-10	4.45	22
6.00	72-11	6.15	22
7.20	72-12	6.75	24
7.50	72-13	6.88	24
8.00	72-14	7.09	26
8.60	72-15	8.86	26
10.00	72-16	9.54	28
12.00	72-17	10.50	28
15.00	72-18	14.20	30
17.50	72-19	15.30	30
20.00	72-20	16.40	32
24.00	72-21	23.10	34
30.00	72-22	25.80	36
36.00	72-23	35.70	36
43.00	72-24	39.00	38
50.00	72-25	42.00	38
60.00	72-26	55.40	40
72.00	72-27	60.70	40
86.00	72-28	66.40	42
100.00	72-29	71.60	44
120.00	72-30	102.00	44
150.00	72-31	148.00	46
175.00	72-32	160.00	48
200.00	72-33	213.00	48
250.00	72-34	304.00	50
300.00	72-35	333.00	52
360.00	72-36	365.00	54

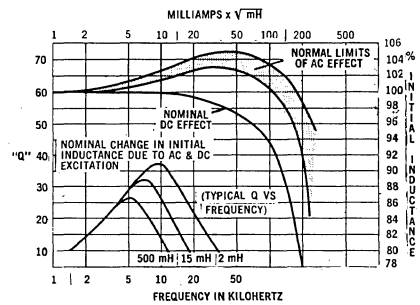
CORE NO. 52

Recommended Frequency: Up to 15 KHz.
Maximum Inductance: 500 mH.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
2.0	52-1	1.27	12
2.4	52-2	1.39	14
2.5	52-3	1.74	14
3.0	52-4	1.91	16
3.6	52-5	2.28	16
4.3	52-6	2.49	18
5.0	52-7	2.70	18
6.0	52-8	4.00	18
7.2	52-9	4.38	20
7.5	52-10	4.47	22
8.0	52-11	4.61	22
8.6	52-12	6.02	24
10.0	52-13	6.50	24
12.0	52-14	7.11	26
15.0	52-15	9.57	26
17.5	52-16	10.30	28
20.0	52-17	11.10	28
24.0	52-18	14.70	30
30.0	52-19	16.40	30
36.0	52-20	23.20	32
43.0	52-21	25.30	34
50.0	52-22	27.30	36
60.0	52-23	37.70	36
72.0	52-24	41.30	38
86.0	52-25	54.30	38
100.0	52-26	58.60	40
120.0	52-27	64.20	40
150.0	52-28	71.70	42
175.0	52-29	101.00	44
200.0	52-30	140.00	44
250.0	52-31	156.00	46
300.0	52-32	213.00	48
360.0	52-33	233.00	48
400.0	52-34	315.00	50
430.0	52-35	326.00	52
500.0	52-36	352.00	54







TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

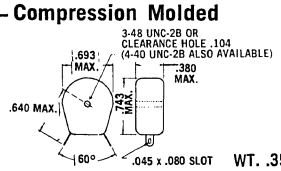
MINIATURE INDUCTORS

Mechanical Tolerance: ±.015 unless otherwise indicated.

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.†
EXAMPLE: U 55-1
CASE TYPE — PART NUMBER

† Add "C" to part number of molded inductor if clearance hole is desired.

TYPE P — Compression Molded



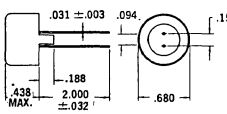
WT. .35 oz.

CORE NO. 50

Recommended Frequency: Up to 50 KHz.
Maximum Inductance: 4.5 H.
Special Core Stabilization Available: D, L, M, W.

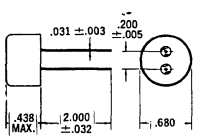
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.0	50-1	.6	30
2.5	50-2	1.4	31
5.0	50-3	2.8	31
6.0	50-40	3.3	32
7.2	50-41	3.9	32
7.5	50-4	4.1	32
8.6	50-42	4.7	33
10.0	50-5	5.4	33
12.0	50-43	6.5	33
12.5	50-6	6.6	33
15.0	50-7	7.5	34
17.5	50-44	9.4	34
20.0	50-8	10.7	34
24.0	50-45	12.9	34
25.0	50-9	13.5	34
30.0	50-10	16.1	35
36.0	50-46	19.4	35
40.0	50-11	21.5	35
43.0	50-47	23.1	36
50.0	50-12	27.3	36
60.0	50-48	32.6	36
72.0	50-49	38.9	37
75.0	50-13	41.0	37
86.0	50-50	47.0	38
100.0	50-14	54.0	38
120.0	50-51	66.0	38
125.0	50-15	68.0	39
150.0	50-16	81.0	39
175.0	50-53	95.0	40
200.0	50-17	108.0	40
240.0	50-54	130.0	41
250.0	50-52	135.0	41
300.0	50-18	161.0	42
360.0	50-55	194.0	42
400.0	50-19	215.0	43
430.0	50-56	231.0	43
500.0	50-20	268.0	44
600.0	50-57	321.0	44
720.0	50-58	387.0	45
750.0	50-21	403.0	45
860.0	50-59	461.0	46
1.00 H	50-22	536.0	46
1.20 H	50-60	643.0	47
1.25 H	50-61	672.0	47
1.50 H	50-62	804.0	48
1.75 H	50-63	938.0	48
2.00 H	50-64	1103.0	49
2.40 H	50-67	1286.0	50
2.50 H	50-66	1339.0	50
3.00 H	50-65	1607.0	51

TYPE M — Metal Cased



WT. .45 oz.

TYPE MG — Metal Cased - Grid Spacing



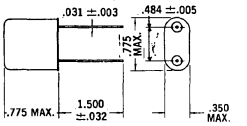
WT. .45 oz.

CORE NO. 51

Recommended Frequency: 10 KHz to 200 KHz.
Maximum Inductance: 1 H.
Special Core Stabilization Available: D, M, W, L.

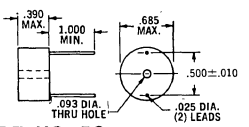
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.00	51-1	1.2	25
1.20	51-2	1.3	25
1.50	51-3	1.7	26
1.75	51-4	1.9	26
2.00	51-5	2.5	26
2.40	51-6	2.7	26
3.00	51-7	3.3	27
3.60	51-8	4.4	27
4.30	51-9	4.7	27
5.00	51-10	5.5	28
6.00	51-11	6.6	28
7.20	51-12	7.8	28
8.60	51-13	9.4	28
10.00	51-14	10.9	28
12.00	51-15	13.1	28
15.00	51-16	16.3	29
17.50	51-17	18.9	29
20.00	51-18	21.7	29
24.00	51-19	26.0	29
30.00	51-20	33.0	29
36.00	51-21	39.0	29
43.00	51-22	47.0	29
50.00	51-23	55.0	30
60.00	51-24	66.0	30
72.00	51-25	78.0	30
86.00	51-26	94.0	30
100.00	51-27	109.0	31
120.00	51-28	130.0	31
150.00	51-29	162.0	31
175.00	51-30	189.0	31
200.00	51-31	217.0	32
240.00	51-32	260.0	32
300.00	51-33	325.0	33
360.00	51-34	389.0	33
430.00	51-35	466.0	34
500.00	51-36	546.0	35

TYPE MC — Metal Cased



WT. .45 oz.

TYPE PT — Printed Circuit

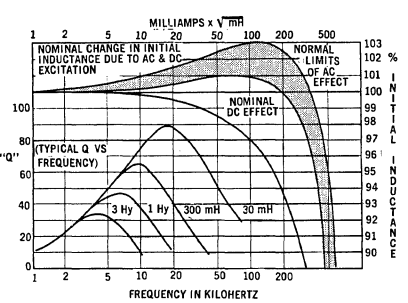


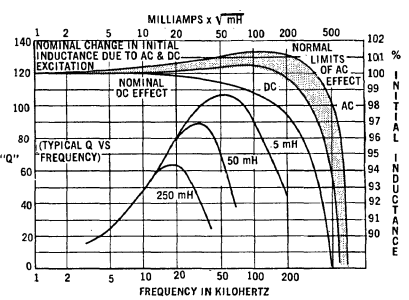
WT. .35 oz.

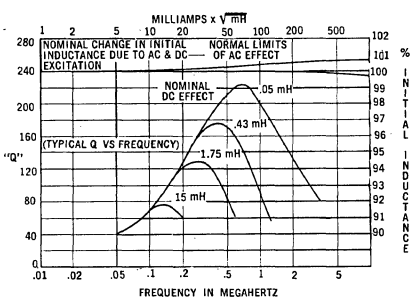
CORE NO. 53

Recommended Frequency: 50 KHz to 2 MHz.
Maximum Inductance: 20 mH.
Only Core Stabilization Available: ±90 PPM/°C

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
0.050	53-1	.42	6
0.060	53-2	.50	6
0.072	53-3	.60	6
0.075	53-4	.61	6
0.086	53-5	.72	6
0.100	53-6	.78	6
0.120	53-7	.89	6
0.125	53-8	.94	6
0.150	53-9	1.17	7
0.175	53-10	1.26	7
0.200	53-11	1.72	7
0.240	53-12	2.02	7
0.250	53-13	2.08	8
0.300	53-14	2.28	8
0.360	53-15	2.44	8
0.400	53-16	3.20	8
0.430	53-17	3.30	8
0.500	53-18	4.80	8
0.600	53-19	5.60	8
0.720	53-20	5.90	8
0.750	53-21	7.40	8
0.860	53-22	7.50	8
1.000	53-23	10.10	8
1.200	53-24	11.30	8
1.250	53-25	11.40	8
1.500	53-26	12.50	8
1.750	53-27	13.50	9
2.000	53-28	18.20	9
2.400	53-29	19.90	9
2.500	53-30	20.80	9
3.000	53-31	23.10	9
3.600	53-32	23.20	9
4.000	53-33	25.90	9
4.300	53-34	27.10	9
5.000	53-35	36.00	9
6.000	53-36	39.00	9
7.200	53-37	51.00	9
7.500	53-38	52.00	9
8.600	53-39	57.00	9
10.000	53-40	64.00	9
12.000	53-41	86.00	9
12.500	53-42	94.00	9
15.000	53-43	104.00	9





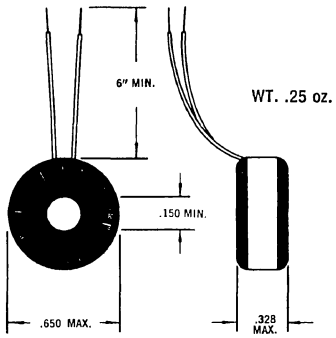


INDUCTORS

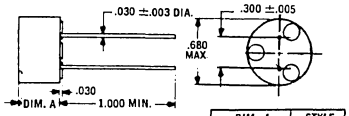
TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

MINIATURE INDUCTORS

TYPE U — Uncased



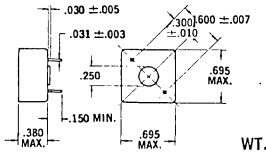
TYPE PS/PST/PW/PWT — Printed Circuit



DIM. A		STYLE
.435	.390	
PS	PST	FEET
PW	PWT	NO FEET

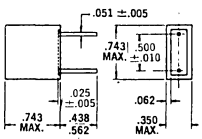
WT. .35 oz.

TYPE S — Printed Circuit



WT. .35 oz.

TYPE PC — Printed Circuit

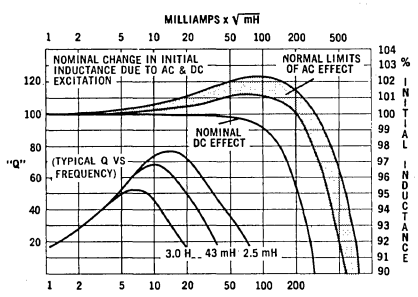


WT. .35 oz.

CORE NO. 55

Recommended Frequency: Up to 50 KHz.
Maximum Inductance: 5 H.
Special Core Stabilization: D, W, M, L.

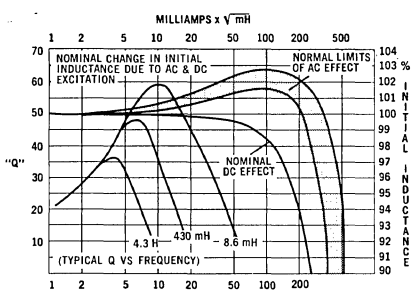
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.20	55-1	0.50	30
1.50	55-2	0.71	30
1.75	55-3	0.77	32
2.00	55-4	0.82	32
2.40	55-5	1.13	32
3.00	55-6	1.26	34
3.60	55-7	1.38	34
4.30	55-8	1.51	34
5.00	55-9	1.63	34
6.00	55-10	2.32	34
7.20	55-11	3.20	36
8.60	55-12	3.51	36
10.00	55-13	4.68	36
12.00	55-14	5.11	36
15.00	55-15	5.72	36
17.50	55-16	7.60	38
20.00	55-17	8.12	38
24.00	55-18	8.89	38
30.00	55-19	12.30	38
36.00	55-20	13.40	40
43.00	55-21	18.20	40
50.00	55-22	19.60	40
60.00	55-23	27.00	42
72.00	55-24	29.60	42
86.00	55-25	40.70	42
100.00	55-26	43.90	42
120.00	55-27	48.10	44
150.00	55-28	71.50	44
175.00	55-29	77.30	44
200.00	55-30	82.60	46
240.00	55-31	117.00	46
300.00	55-32	131.00	46
360.00	55-33	143.00	48
430.00	55-34	196.00	48
500.00	55-35	211.00	48
600.00	55-36	292.00	50
720.00	55-37	320.00	50
860.00	55-38	350.00	52
1.00 H	55-39	475.00	52
1.20 H	55-40	520.00	54
1.50 H	55-41	735.00	54
1.75 H	55-42	794.00	54
2.00 H	55-43	1080.00	56
2.40 H	55-44	1180.00	56
3.00 H	55-45	1320.00	56



CORE NO. 56

Recommended Frequency: Up to 40 KHz.
Maximum Inductance: 7 H.
Special Core Stabilization: D, W, M, L.

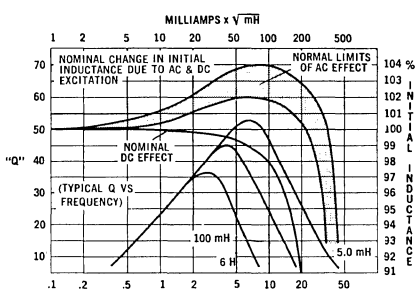
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.50	56-1	0.50	36
1.75	56-2	0.54	36
2.00	56-3	0.58	36
2.40	56-4	0.80	36
3.00	56-5	0.90	38
3.60	56-6	1.23	38
4.30	56-7	1.35	38
5.00	56-8	1.46	38
6.00	56-9	1.60	38
7.20	56-10	2.27	40
8.60	56-11	3.13	40
10.00	56-12	3.38	40
12.00	56-13	3.70	42
15.00	56-14	5.11	42
17.50	56-15	5.53	42
20.00	56-16	5.90	44
24.00	56-17	7.95	44
30.00	56-18	8.89	44
36.00	56-19	12.00	46
43.00	56-20	13.10	46
50.00	56-21	14.10	46
60.00	56-22	19.20	46
72.00	56-23	26.40	48
86.00	56-24	28.90	48
100.00	56-25	31.20	48
120.00	56-26	43.00	50
150.00	56-27	48.10	50
175.00	56-28	51.90	52
200.00	56-29	73.90	52
240.00	56-30	80.90	54
300.00	56-31	117.00	54
360.00	56-32	128.00	54
430.00	56-33	140.00	56
500.00	56-34	189.00	56
600.00	56-35	207.00	58
720.00	56-36	286.00	58
860.00	56-37	313.00	60
1.00 H	56-38	337.00	60
1.20 H	56-39	369.00	62
1.50 H	56-40	520.00	62
1.75 H	56-41	710.00	64
2.00 H	56-42	759.00	64
2.40 H	56-43	832.00	66
3.00 H	56-44	1180.00	66
3.60 H	56-45	1290.00	66



CORE NO. 57

Recommended Frequency: Up to 20 KHz.
Maximum Inductance: 10 H.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
2.0	57-1	0.48	40
2.4	57-2	0.52	40
3.0	57-3	0.74	42
3.6	57-4	0.81	42
4.3	57-5	1.11	42
5.0	57-6	1.19	44
6.0	57-7	1.31	44
7.2	57-8	1.43	44
8.6	57-9	1.56	46
10.0	57-10	2.19	46
12.0	57-11	2.40	46
15.0	57-12	3.40	46
17.5	57-13	3.66	48
20.0	57-14	4.84	48
24.0	57-15	5.30	50
30.0	57-16	7.29	50
36.0	57-17	7.99	52
43.0	57-18	8.73	52
50.0	57-19	11.60	54
60.0	57-20	12.70	54
72.0	57-21	13.90	56
86.0	57-22	18.80	56
100.0	57-23	20.30	56
120.0	57-24	28.00	58
150.0	57-25	31.30	58
175.0	57-26	42.60	60
200.0	57-27	45.50	62
240.0	57-28	49.80	62
300.0	57-29	74.10	64
360.0	57-30	81.20	64
430.0	57-31	115.00	64
500.0	57-32	124.00	66
600.0	57-33	136.00	66
720.0	57-34	186.00	66
860.0	57-35	203.00	68
1.00 H	57-36	219.00	68
1.20 H	57-37	303.00	70
1.50 H	57-38	338.00	72
1.75 H	57-39	366.00	72
2.00 H	57-40	492.00	74
2.40 H	57-41	682.00	74
3.00 H	57-42	762.00	74
3.60 H	57-43	835.00	76
4.30 H	57-44	1160.00	76
5.00 H	57-45	1250.00	76



TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

TOROIDAL INDUCTORS

Studs are available on the "M" Series on special request.

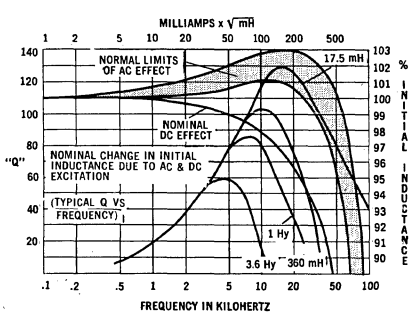
Mechanical Tolerance: ±.015 unless otherwise indicated.

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.
EXAMPLE: PS 90-1
CASE TYPE — PART NUMBER

CORE NO. 90

Recommended Frequency: Up to 50 KHz.
Maximum Inductance: 9 H.
Special Core Stabilization: D, L, M, W.

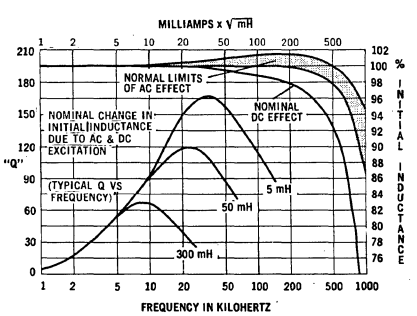
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
3.0	90-1	1.10	34
3.6	90-2	1.20	35
4.0	90-3	1.61	35
4.3	90-4	1.67	36
5.0	90-5	1.80	36
6.0	90-6	1.97	36
7.2	90-7	2.70	37
7.5	90-8	2.75	37
8.6	90-9	2.95	37
10.0	90-10	3.82	38
12.0	90-11	4.19	38
12.5	90-12	4.28	38
15.0	90-13	4.68	38
17.5	90-14	6.15	39
20.0	90-15	6.57	39
24.0	90-16	9.18	39
25.0	90-17	9.36	39
30.0	90-18	10.30	40
36.0	90-19	11.30	40
40.0	90-20	15.10	40
43.0	90-21	15.70	41
50.0	90-22	16.90	41
60.0	90-23	18.50	42
72.0	90-24	25.40	42
75.0	90-25	25.90	43
86.0	90-26	27.70	43
100.0	90-27	29.90	44
120.0	90-28	42.30	45
125.0	90-29	43.10	45
150.0	90-30	47.20	46
175.0	90-31	63.00	46
200.0	90-32	67.50	47
240.0	90-33	74.00	47
250.0	90-34	75.50	48
300.0	90-35	104.00	48
360.0	90-36	114.00	49
400.0	90-37	120.00	49
430.0	90-38	165.00	50
500.0	90-39	178.00	50
600.0	90-40	195.00	50
720.0	90-41	264.00	51
750.0	90-42	270.00	51
860.0	90-43	288.00	52
1.00 H	90-44	312.00	52
1.20 H	90-45	480.00	53
1.25 H	90-46	490.00	53
1.50 H	90-47	610.00	54
1.75 H	90-48	659.00	54
2.00 H	90-49	705.00	55
2.40 H	90-50	772.00	55
2.50 H	90-51	788.00	56
3.00 H	90-52	1090.00	56
3.60 H	90-53	1190.00	57
4.00 H	90-54	1522.00	57
5.00 H	90-55	1705.00	58
6.00 H	90-56	2420.00	58



CORE NO. 89

Recommended Frequency: Up to 200 KHz.
Maximum Inductance: 1.5 H.
Special Core Stabilization: D, L, M, W

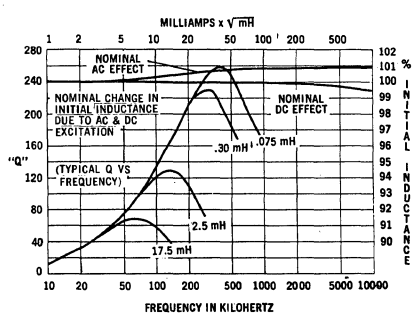
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
1.50	89-1	1.12	27
1.75	89-2	1.20	27
2.00	89-3	1.63	28
2.40	89-4	1.89	28
3.00	89-5	2.00	29
3.60	89-6	2.74	29
4.30	89-7	2.98	30
5.00	89-8	3.87	31
6.00	89-9	4.24	31
7.20	89-10	4.65	32
8.60	89-11	6.18	32
10.00	89-12	6.67	33
12.00	89-13	9.30	33
15.00	89-14	10.40	34
17.50	89-15	11.20	34
20.00	89-16	15.20	35
24.00	89-17	16.70	35
30.00	89-18	18.70	36
36.00	89-19	25.80	36
43.00	89-20	28.20	37
50.00	89-21	30.40	37
60.00	89-22	42.80	38
72.00	89-23	46.80	38
86.00	89-24	62.50	39
100.00	89-25	68.50	39
120.00	89-26	74.90	40
150.00	89-27	105.00	41
175.00	89-28	114.00	42
200.00	89-29	122.00	43
240.00	89-30	177.00	44
300.00	89-31	197.00	45
360.00	89-32	268.00	46
430.00	89-33	292.00	47
500.00	89-34	315.00	48
600.00	89-35	422.00	49



CORE NO. 68

Recommended Frequency: 50 KHz to 2 MHz.
Maximum Inductance: 30 mH.
Only Core Stabilization Available: ±90 PPM/°C.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
0.075	68-1	0.40	9
0.086	68-2	0.54	9
0.100	68-3	0.59	9
0.120	68-4	0.64	9
0.125	68-5	0.65	10
0.150	68-6	0.83	10
0.175	68-7	0.90	10
0.200	68-8	0.96	10
0.240	68-9	1.31	10
0.250	68-10	1.34	10
0.300	68-11	1.47	10
0.360	68-12	1.95	10
0.400	68-13	2.06	10
0.430	68-14	2.14	10
0.500	68-15	2.30	10
0.600	68-16	3.25	11
0.720	68-17	3.56	11
0.750	68-18	3.64	11
0.860	68-19	3.90	11
1.000	68-20	5.02	11
1.200	68-21	5.50	11
1.250	68-22	5.62	11
1.500	68-23	6.15	11
1.750	68-24	8.53	11
2.000	68-25	9.10	11
2.400	68-26	9.98	12
2.500	68-27	10.20	12
3.000	68-28	14.10	12
3.600	68-29	15.50	12
4.000	68-30	16.30	12
4.300	68-31	16.90	12
5.000	68-32	23.40	12
6.000	68-33	25.60	13
7.200	68-34	33.40	13
7.500	68-35	34.00	13
8.600	68-36	36.40	13
10.000	68-37	39.30	13
12.000	68-38	55.50	14
12.500	68-39	56.70	14
15.000	68-40	75.80	15
17.500	68-41	81.80	15



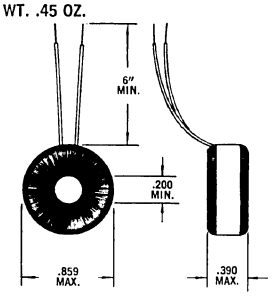
INDUCTORS

TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

TOROIDAL INDUCTORS

TYPE U — Uncased

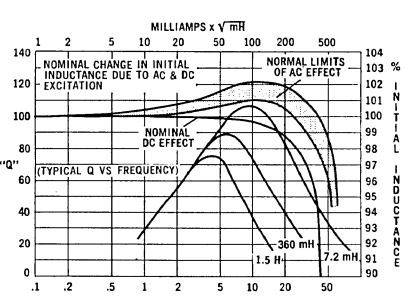
WT. .45 OZ.



CORE NO. 91

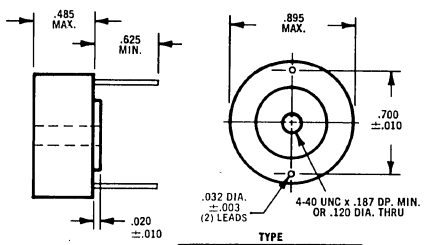
Recommended Frequency: Up to 30 KHz.
Maximum Inductance: 11 H.
Special Core Stabilization: D, W, M, L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
3.0	91-1	0.96	36
3.6	91-2	1.05	36
4.3	91-3	1.14	36
5.0	91-4	1.23	36
6.0	91-5	1.73	38
7.2	91-6	1.90	38
8.6	91-7	2.60	38
10.0	91-8	2.80	38
12.0	91-9	3.07	38
15.0	91-10	4.02	40
17.5	91-11	4.34	40
20.0	91-12	4.64	40
24.0	91-13	6.50	42
30.0	91-14	7.26	42
36.0	91-15	10.00	42
43.0	91-16	10.90	44
50.0	91-17	11.80	44
60.0	91-18	16.30	46
72.0	91-19	17.90	46
86.0	91-20	19.50	46
100.0	91-21	26.60	46
120.0	91-22	29.10	48
150.0	91-23	41.30	48
175.0	91-24	44.60	48
200.0	91-25	47.70	50
240.0	91-26	52.20	50
300.0	91-27	73.10	52
360.0	91-28	80.10	52
430.0	91-29	110.00	54
500.0	91-30	119.00	54
600.0	91-31	170.00	54
720.0	91-32	186.00	56
860.0	91-33	204.00	56
1.00 H	91-34	278.00	58
1.20 H	91-35	305.00	58
1.50 H	91-36	423.00	58
1.75 H	91-37	457.00	60
2.00 H	91-38	489.00	60
2.40 H	91-39	680.00	62
3.00 H	91-40	760.00	62
3.60 H	91-41	833.00	62
4.30 H	91-42	1130.00	64
5.00 H	91-43	1570.00	64
6.00 H	91-44	1720.00	66



TYPE PS/PF/PFC/PSC — Printed Circuit

WT. .8 OZ.



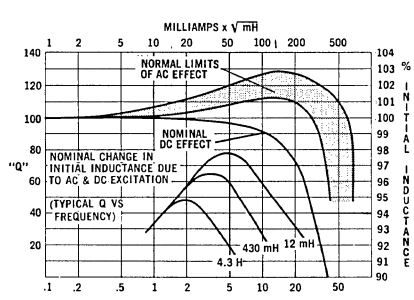
TYPE

PREFIX TABLE		
4-40 UNC	THRU HOLE	STYLE
PS	PSC	NO FOOT
PF	PFC	WITH FOOT

CORE NO. 92

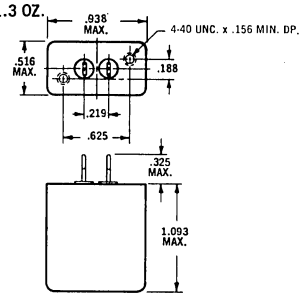
Recommended Frequency: Up to 20 KHz.
Maximum Inductance: 14 H.
Special Core Stabilization: D, W, M, L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
3.6	92-1	0.93	40
4.3	92-2	1.02	42
5.0	92-3	1.10	42
6.0	92-4	1.20	44
7.2	92-5	1.70	44
8.6	92-6	1.85	44
10.0	92-7	2.51	46
12.0	92-8	2.74	46
15.0	92-9	3.07	46
17.5	92-10	3.88	48
20.0	92-11	4.15	48
24.0	92-12	4.55	50
30.0	92-13	6.50	50
36.0	92-14	7.12	52
43.0	92-15	9.76	52
50.0	92-16	10.50	54
60.0	92-17	11.50	54
72.0	92-18	16.00	54
86.0	92-19	17.50	56
100.0	92-20	18.80	56
120.0	92-21	26.10	56
150.0	92-22	29.10	58
175.0	92-23	39.90	58
200.0	92-24	42.70	60
240.0	92-25	46.70	60
300.0	92-26	52.20	62
360.0	92-27	71.60	62
430.0	92-28	78.30	64
500.0	92-29	106.00	64
600.0	92-30	116.00	64
720.0	92-31	167.00	66
860.0	92-32	182.00	66
1.00 H	92-33	196.00	68
1.20 H	92-34	273.00	68
1.50 H	92-35	305.00	70
1.75 H	92-36	409.00	72
2.00 H	92-37	437.00	72
2.40 H	92-38	479.00	74
3.00 H	92-39	680.00	74
3.60 H	92-40	745.00	74
4.30 H	92-41	814.00	76
5.00 H	92-42	1090.00	76
6.00 H	92-43	1540.00	78
7.20 H	92-44	1690.00	80



TYPE M — Metal Cased

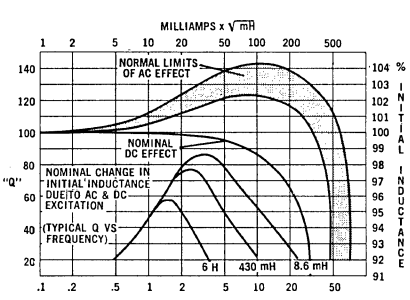
WT. 1.3 OZ.



CORE NO. 93

Recommended Frequency: Up to 10 KHz.
Maximum Inductance: 20 H.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
5.0	93-1	0.90	46
6.0	93-2	0.98	46
7.2	93-3	1.08	46
8.6	93-4	1.18	48
10.0	93-5	1.63	48
12.0	93-6	1.78	50
15.0	93-7	2.50	52
17.5	93-8	2.70	52
20.0	93-9	2.89	54
24.0	93-10	3.70	54
30.0	93-11	4.14	54
36.0	93-12	4.54	56
43.0	93-13	6.35	56
50.0	93-14	6.84	58
60.0	93-15	9.41	58
72.0	93-16	10.30	60
86.0	93-17	11.30	62
100.0	93-18	15.40	62
120.0	93-19	16.80	62
150.0	93-20	18.80	64
175.0	93-21	25.70	64
200.0	93-22	27.40	66
240.0	93-23	30.00	66
300.0	93-24	42.60	68
360.0	93-25	46.70	68
430.0	93-26	51.00	68
500.0	93-27	68.80	70
600.0	93-28	75.40	70
720.0	93-29	104.00	72
860.0	93-30	114.00	72
1.00 H	93-31	160.00	74
1.20 H	93-32	175.00	74
1.50 H	93-33	196.00	76
1.75 H	93-34	269.00	76
2.00 H	93-35	287.00	76
2.40 H	93-36	315.00	78
3.00 H	93-37	436.00	80
3.60 H	93-38	478.00	82
4.30 H	93-39	664.00	82
5.00 H	93-40	716.00	84
6.00 H	93-41	784.00	86
7.20 H	93-42	1070.00	86
8.60 H	93-43	1170.00	88
10.00 H	93-44	1620.00	90



TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

TOROIDAL INDUCTORS

Studs are available on the "M" Series on special request.

Mechanical Tolerance: ±.015 unless otherwise indicated.

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.†

EXAMPLE: U 24-1

CASE TYPE — PART NUMBER

† Add "C" to Part Number of molded inductor if clearance hole is desired.

CORE NO. 06

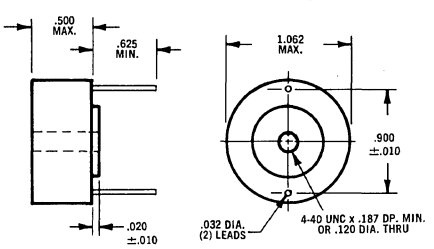
Recommended Frequency: Up to 30 KHz

Maximum Inductance: 7.2 H.

Special Core Stabilization Available: B, D, L, M, W.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
5.0	06-1	1.05	40
6.0	06-40	1.26	42
7.2	06-41	1.51	43
7.5	06-2	1.58	43
8.6	06-42	1.80	43
10.0	06-3	2.10	44
12.0	06-43	2.52	44
12.5	06-4	2.63	44
15.0	06-5	3.15	44
17.5	06-44	3.67	45
20.0	06-6	4.20	45
24.0	06-45	5.04	45
25.0	06-7	5.25	46
30.0	06-8	6.30	46
36.0	06-46	7.56	47
40.0	06-9	8.40	48
43.0	06-47	9.03	48
50.0	06-10	10.50	48
60.0	06-48	12.60	49
72.0	06-49	15.10	49
75.0	06-11	15.80	49
86.0	06-50	18.00	49
100.0	06-12	21.00	50
120.0	06-51	25.20	50
125.0	06-13	26.30	51
150.0	06-14	31.50	51
175.0	06-53	36.80	51
200.0	06-15	42.00	52
240.0	06-54	50.40	52
250.0	06-52	52.50	52
300.0	06-16	63.00	53
360.0	06-55	75.60	53
400.0	06-17	84.00	54
430.0	06-56	90.30	54
500.0	06-18	105.00	55
600.0	06-57	126.00	55
720.0	06-58	151.00	55
750.0	06-19	158.00	56
860.0	06-59	180.00	56
1.00 H	06-20	210.00	57
1.20 H	06-60	252.00	57
1.25 H	06-21	263.00	57
1.50 H	06-22	315.00	58
1.75 H	06-61	368.00	58
2.00 H	06-23	420.00	58
2.40 H	06-62	504.00	59
2.50 H	06-69	525.00	59
3.00 H	06-24	630.00	59
3.60 H	06-70	756.00	60
4.30 H	06-71	840.00	60
5.00 H	06-72	903.00	61
6.00 H	06-73	1260.00	62
7.20 H	06-74	1512.00	62

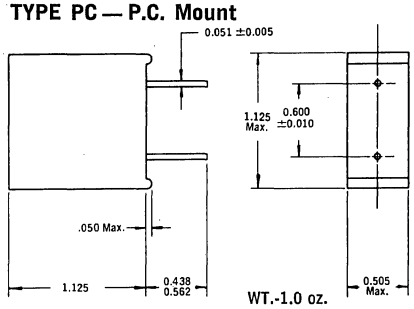
TYPE PS/PF/PFC/PSC — P.C. Mount



WT.-1.0 oz.

TYPE PREFIX TABLE		
4-40 UNC	THRU HOLE	STYLE
PS	PSC	NO FOOT
PF	PFC	WITH FOOT

TYPE PC — P.C. Mount



WT.-1.0 oz.

CORE NO. 48

Recommended Frequency: Up to 100 KHz.

Maximum Inductance: 1 H.

Special Core Stabilization Available: B, D, M, W, L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
2.0	48-1	0.84	30
2.4	48-2	1.01	31
3.0	48-3	1.26	31
3.6	48-4	1.51	32
4.3	48-5	1.80	32
5.0	48-6	2.10	33
6.0	48-7	2.50	33
7.2	48-8	3.02	34
8.6	48-9	3.61	34
10.0	48-10	4.20	35
12.0	48-11	5.05	35
15.0	48-12	6.30	36
17.5	48-13	7.35	36
20.0	48-14	8.40	37
24.0	48-15	10.10	37
30.0	48-16	12.60	38
36.0	48-17	15.10	39
43.0	48-18	18.00	39
50.0	48-19	21.00	40
60.0	48-20	25.20	41
72.0	48-21	30.20	42
86.0	48-22	36.10	43
100.0	48-23	42.00	44
120.0	48-24	50.40	45
150.0	48-25	63.00	46
175.0	48-26	73.50	47
200.0	48-27	84.00	48
240.0	48-28	101.00	49
300.0	48-29	126.00	50
360.0	48-30	151.00	51
430.0	48-31	180.00	52
500.0	48-32	210.00	53
600.0	48-33	252.00	54

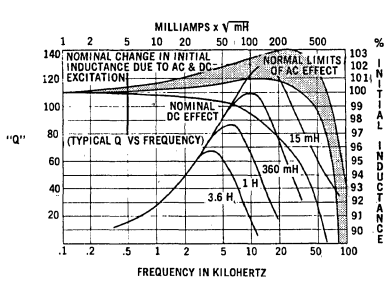
CORE NO. 74

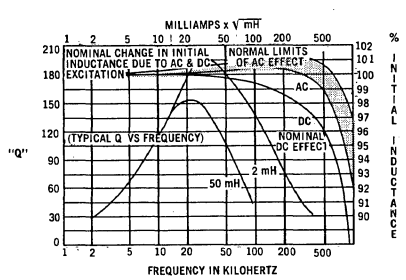
Recommended Frequency: 25 KHz to 1 MHz.

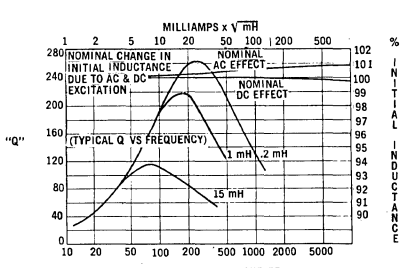
Maximum Inductance: 30 mH.

Only Core Stabilization Available: H.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
0.100	74-1	0.31	18
0.120	74-2	0.36	18
0.125	74-3	0.39	19
0.150	74-4	0.46	19
0.175	74-5	0.55	20
0.200	74-6	0.62	20
0.240	74-7	0.74	20
0.250	74-8	0.77	21
0.300	74-9	0.92	21
0.360	74-10	1.11	21
0.400	74-11	1.23	21
0.430	74-12	1.33	22
0.500	74-13	1.54	22
0.600	74-14	1.85	22
0.720	74-15	2.21	23
0.750	74-16	2.31	23
0.860	74-17	2.65	23
1.000	74-18	3.08	23
1.200	74-19	3.60	24
1.250	74-20	3.80	24
1.500	74-21	4.60	24
1.750	74-22	5.50	25
2.000	74-23	6.20	25
2.400	74-24	7.40	25
2.500	74-25	7.70	26
3.000	74-26	9.20	26
3.600	74-27	11.10	27
4.000	74-28	12.30	27
4.300	74-29	13.30	28
5.000	74-30	15.40	28
6.000	74-31	18.50	29
7.200	74-32	22.10	29
7.500	74-33	23.10	30
8.600	74-34	26.50	30
10.000	74-35	30.80	31
12.000	74-36	36.90	32
12.250	74-37	38.50	33
15.000	74-38	46.20	33
17.500	74-39	53.90	34
20.000	74-40	61.60	35





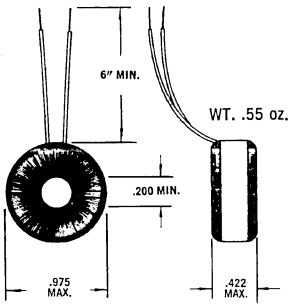


INDUCTORS

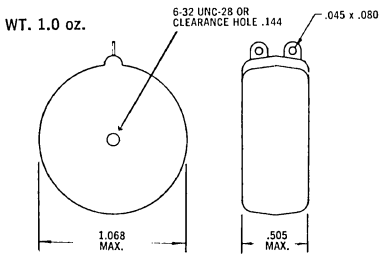
TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

TOROIDAL INDUCTORS

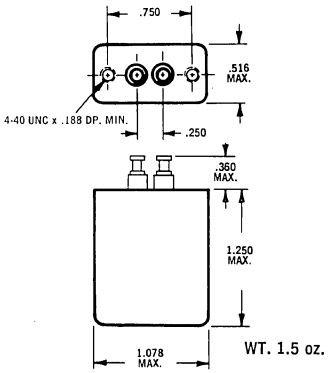
TYPE U — Uncased



TYPE P — Compression Molded



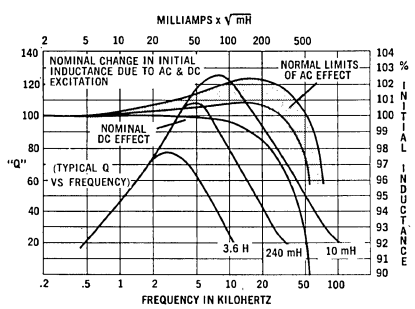
TYPE M — Metal Cased



CORE NO. 24

Recommended Frequency: Up to 20 KHz
Maximum Inductance: 12 H.
Special Core Stabilization: D, W, M, L.

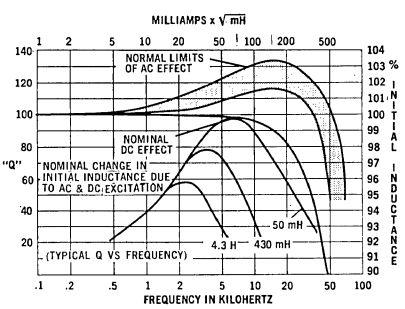
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
6.0	24-1	0.88	40
7.2	24-2	0.97	40
8.6	24-3	1.33	42
10.0	24-4	1.44	42
12.0	24-5	1.80	42
15.0	24-6	2.01	44
17.5	24-7	2.74	44
20.0	24-8	2.93	44
24.0	24-9	3.21	44
30.0	24-10	5.20	46
36.0	24-11	5.70	46
43.0	24-12	6.23	46
50.0	24-13	8.31	46
60.0	24-14	9.10	48
72.0	24-15	9.97	48
86.0	24-16	13.50	48
100.0	24-17	14.50	50
120.0	24-18	20.00	50
150.0	24-19	22.40	50
175.0	24-20	30.80	52
200.0	24-21	32.90	52
240.0	24-22	36.10	52
300.0	24-23	52.50	54
360.0	24-24	57.50	54
430.0	24-25	62.90	56
500.0	24-26	87.00	56
600.0	24-27	95.30	56
720.0	24-28	104.00	58
860.0	24-29	142.00	58
1.00 H	24-30	153.00	58
1.20 H	24-31	212.00	60
1.50 H	24-32	237.00	62
1.75 H	24-33	256.00	62
2.00 H	24-34	345.00	64
2.40 H	24-35	376.00	64
3.00 H	24-36	522.00	64
3.60 H	24-37	572.00	66
4.30 H	24-38	768.00	66
5.00 H	24-39	861.00	68
6.00 H	24-40	1150.00	68
7.20 H	24-41	1260.00	68
8.60 H	24-42	1740.00	70



CORE NO. 23

Recommended Frequency Up to 15 KHz.
Maximum Inductance: 15 H.
Special Core Stabilization: D, W, M, L.

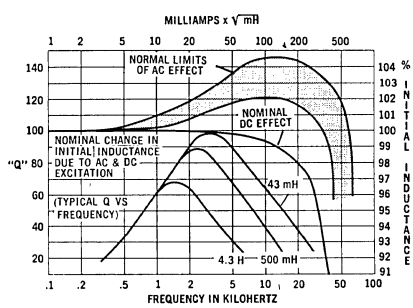
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
7.2	23-1	0.86	44
8.6	23-2	0.94	44
10.0	22-3	1.29	44
12.0	23-4	1.41	46
15.0	23-5	1.80	46
17.5	23-6	1.95	46
20.0	23-7	2.08	46
24.0	23-8	2.87	48
30.0	23-9	3.21	48
36.0	23-10	5.09	48
43.0	23-11	5.56	48
50.0	23-12	6.00	48
60.0	23-13	8.13	50
72.0	23-14	8.91	50
86.0	23-15	9.73	50
100.0	23-16	13.00	52
120.0	23-17	14.20	52
150.0	23-18	20.00	54
175.0	23-19	21.60	54
200.0	23-20	23.10	54
240.0	23-21	32.20	56
300.0	23-22	36.00	56
360.0	23-23	51.40	58
430.0	23-24	56.20	58
500.0	23-25	60.60	60
600.0	23-26	85.20	60
720.0	23-27	93.30	62
860.0	23-28	102.00	64
1.00 H	23-29	137.00	64
1.20 H	23-30	150.00	66
1.50 H	23-31	211.00	66
1.75 H	23-32	228.00	68
2.00 H	23-33	244.00	68
2.40 H	23-34	336.00	68
3.00 H	23-35	376.00	70
3.60 H	23-36	511.00	72
4.30 H	23-37	559.00	74
5.00 H	23-38	602.00	74
6.00 H	23-39	842.00	76
7.20 H	23-40	1130.00	78
8.60 H	23-41	1230.00	80
10.00 H	23-42	1680.00	82



CORE NO. 21

Recommended Frequency: Up to 5 KHz.
Maximum Inductance: 20 H.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
10.0	21-1	0.83	50
12.0	21-2	0.91	52
15.0	21-3	1.29	52
17.5	21-4	1.39	54
20.0	21-5	1.70	54
24.0	21-6	1.86	54
30.0	21-7	2.08	56
36.0	21-8	2.87	56
43.0	21-9	3.14	58
50.0	21-10	4.91	58
60.0	21-11	5.38	60
72.0	21-12	5.89	60
86.0	21-13	7.96	62
100.0	21-14	8.58	62
120.0	21-15	9.40	64
150.0	21-16	13.00	64
175.0	21-17	14.00	64
200.0	21-18	15.00	66
240.0	21-19	20.70	66
300.0	21-20	23.20	66
360.0	21-21	32.30	68
430.0	21-22	35.20	68
500.0	21-23	38.00	70
600.0	21-24	54.30	70
720.0	21-25	59.40	72
860.0	21-26	83.40	74
1.00 H	21-27	90.00	74
1.20 H	21-28	98.50	76
1.50 H	21-29	137.00	76
1.75 H	21-30	148.00	76
2.00 H	21-31	199.00	78
2.40 H	21-32	219.00	78
3.00 H	21-33	244.00	80
3.60 H	21-34	337.00	80
4.30 H	21-35	368.00	82
5.00 H	21-36	492.00	84
6.00 H	21-37	540.00	84
7.20 H	21-38	591.00	86
8.60 H	21-39	825.00	86
10.00 H	21-40	1090.00	88
12.00 H	21-41	1190.00	88
15.00 H	21-42	1680.00	90

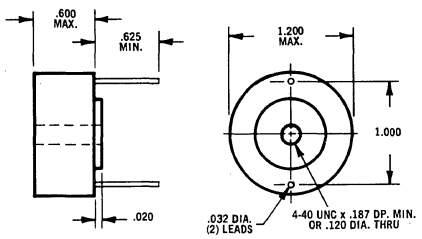


TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

TOROIDAL INDUCTORS

TYPE PS/PF/PFC/PSC

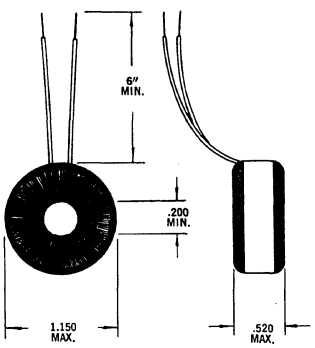


WT. 1.5 oz

TYPE PREFIX TABLE

4-40 UNC	THRU HOLE	STYLE
PS	PSC	NO FOOT
PF	PFC	WITH FOOT

TYPE U



WT. .82 oz.

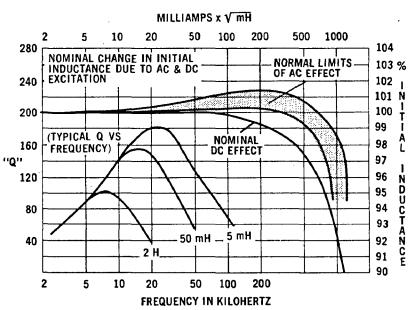
Mech. Tol. = ±.010 unless indicated.

WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.
EXAMPLE: U 59-1
CASE TYPE — PART NUMBER

CORE NO. 59

Recommended Frequency: Up to 50 KHz.
Maximum Inductance: 5 H.
Special Core Stabilization: D, W, M, L.

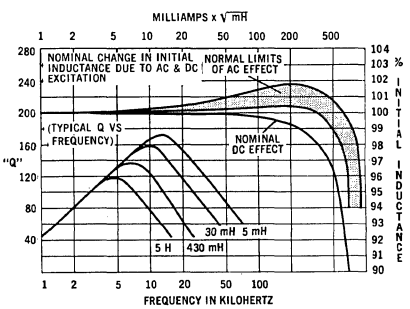
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
3.0	59-1	0.85	50
3.6	59-2	1.17	54
4.3	59-3	1.27	56
5.0	59-4	1.67	60
6.0	59-5	1.83	64
7.2	59-6	2.00	66
8.6	59-7	2.75	68
10.0	59-8	2.97	70
12.0	59-9	3.25	74
15.0	59-10	4.45	76
17.5	59-11	4.80	78
20.0	59-12	6.64	80
24.0	59-13	7.27	82
30.0	59-14	8.13	84
36.0	59-15	11.30	84
43.0	59-16	12.30	86
50.0	59-17	13.30	88
60.0	59-18	18.50	90
72.0	59-19	20.30	92
86.0	59-20	22.20	94
100.0	59-21	30.70	96
120.0	59-22	33.60	98
150.0	59-23	48.30	100
175.0	59-24	52.10	102
200.0	59-25	55.70	104
240.0	59-26	76.90	104
300.0	59-27	86.00	106
360.0	59-28	119.00	106
430.0	59-29	130.00	108
500.0	59-30	140.00	110
600.0	59-31	188.00	112
720.0	59-32	205.00	114
860.0	59-33	225.00	116
1.00 H	59-34	306.00	118
1.20 H	59-35	335.00	120
1.50 H	59-36	472.00	124
1.75 H	59-37	510.00	126
2.00 H	59-38	709.00	130
2.40 H	59-39	777.00	136
3.00 H	59-40	868.00	140
3.60 H	59-41	1200.00	150



CORE NO. 10

Recommended Frequency: Up to 25 KHz.
Maximum Inductance: 12 H.
Special Core Stabilization: D, W, M, L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
5.0	10-1	0.76	50
6.0	10-2	0.83	54
7.2	10-3	1.14	56
8.6	10-4	1.25	60
10.0	10-5	1.34	64
12.0	10-6	1.79	66
15.0	10-7	2.00	68
17.5	10-8	2.71	70
20.0	10-9	2.90	74
24.0	10-10	3.17	76
30.0	10-11	4.34	78
36.0	10-12	4.75	80
43.0	10-13	6.72	82
50.0	10-14	7.25	84
60.0	10-15	7.94	84
72.0	10-16	11.00	86
86.0	10-17	12.00	88
100.0	10-18	13.00	90
120.0	10-19	18.10	92
150.0	10-20	20.20	94
175.0	10-21	21.80	96
200.0	10-22	30.00	98
240.0	10-23	32.90	100
300.0	10-24	47.20	102
360.0	10-25	51.70	104
430.0	10-26	56.50	104
500.0	10-27	76.70	106
600.0	10-28	84.10	106
720.0	10-29	116.00	108
860.0	10-30	127.00	110
1.00 H	10-31	137.00	112
1.20 H	10-32	183.00	114
1.50 H	10-33	205.00	116
1.75 H	10-34	221.00	118
2.00 H	10-35	299.00	120
2.40 H	10-36	328.00	124
3.00 H	10-37	366.00	126
3.60 H	10-38	506.00	130
4.30 H	10-39	719.00	136
5.00 H	10-40	775.00	140
6.00 H	10-41	849.00	150
7.20 H	10-42	1170.00	156
8.60 H	10-43	1610.00	160



INDUCTORS

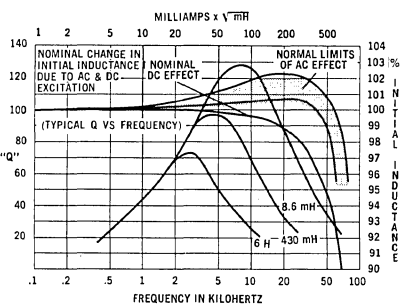
TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

TOROIDAL INDUCTORS

CORE NO. 08

Recommended Frequency: Up to 20 KHz.
Maximum Inductance: 16 H.
Special Core Stabilization: D, W, M, L.

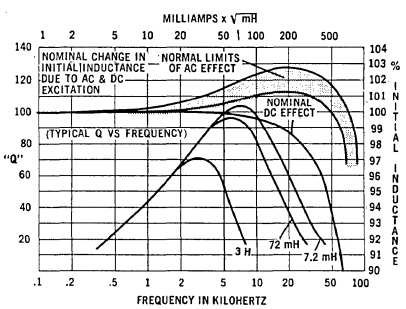
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
7.2	08-1	0.80	60
8.6	08-2	0.88	64
10.0	08-3	1.19	66
12.0	08-4	1.30	68
15.0	08-5	1.77	70
17.5	08-6	1.91	74
20.0	08-7	2.04	76
24.0	08-8	2.81	80
30.0	08-9	3.14	84
36.0	08-10	4.21	86
43.0	08-11	4.60	88
50.0	08-12	4.96	90
60.0	08-13	7.03	94
72.0	08-14	7.70	96
86.0	08-15	8.42	96
100.0	08-16	11.50	98
120.0	08-17	12.60	100
150.0	08-18	14.00	104
175.0	08-19	19.30	106
200.0	08-20	20.70	106
240.0	08-21	29.10	108
300.0	08-22	32.50	110
360.0	08-23	45.70	112
430.0	08-24	50.00	114
500.0	08-25	53.90	116
600.0	08-26	74.40	118
720.0	08-27	81.50	120
860.0	08-28	89.00	124
1.00 H	08-29	121.00	126
1.20 H	08-30	133.00	128
1.50 H	08-31	148.00	130
1.75 H	08-32	196.00	134
2.00 H	08-33	209.00	136
2.40 H	08-34	229.00	140
3.00 H	08-35	324.00	144
3.60 H	08-36	355.00	146
4.30 H	08-37	489.00	150
5.00 H	08-38	527.00	154
6.00 H	08-39	751.00	160
7.20 H	08-40	823.00	166
8.60 H	08-41	938.00	168
10.00 H	08-42	1220.00	170



CORE NO. 07

Recommended Frequency: Up to 15 KHz.
Maximum Inductance: 18 H.
Special Core Stabilization: D, W, M, L.

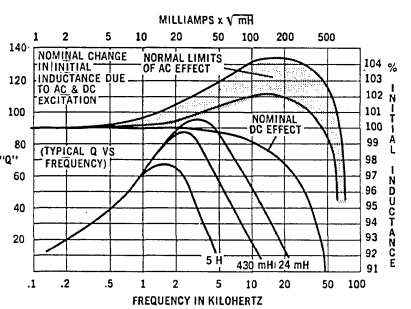
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
10.0	07-1	0.85	60
12.0	07-2	1.17	64
15.0	07-3	1.30	66
17.5	07-4	1.71	68
20.0	07-5	1.83	70
24.0	07-6	2.00	74
30.0	07-7	2.81	76
36.0	07-8	3.08	80
43.0	07-9	3.36	84
50.0	07-10	4.43	86
60.0	07-11	4.85	88
72.0	07-12	6.88	90
86.0	07-13	7.52	94
100.0	07-14	8.11	96
120.0	07-15	11.20	96
150.0	07-16	12.60	98
175.0	07-17	13.60	100
200.0	07-18	18.50	104
240.0	07-19	20.20	106
300.0	07-20	29.00	106
360.0	07-21	31.80	108
430.0	07-22	44.70	110
500.0	07-23	48.10	112
600.0	07-24	52.70	114
720.0	07-25	57.80	116
860.0	07-26	79.60	118
1.00 H	07-27	85.80	120
1.20 H	07-28	119.00	124
1.50 H	07-29	132.00	126
1.75 H	07-30	143.00	128
2.00 H	07-31	187.00	130
2.40 H	07-32	205.00	134
3.00 H	07-33	229.00	136
3.60 H	07-34	317.00	140
4.30 H	07-35	347.00	144
5.00 H	07-36	471.00	146
6.00 H	07-37	516.00	150
7.20 H	07-38	735.00	154
8.60 H	07-39	803.00	160
10.00 H	07-40	866.00	166
12.00 H	07-41	1200.00	170



CORE NO. 05

Recommended Frequency: Up to 5 KHz.
Maximum Inductance: 25 H.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
15.0	05-1	0.85	70
17.5	05-2	1.15	74
20.0	05-3	1.23	76
24.0	05-4	1.34	80
30.0	05-5	1.83	84
36.0	05-6	2.00	86
43.0	05-7	2.74	88
50.0	05-8	2.96	90
60.0	05-9	3.24	92
72.0	05-10	4.34	94
86.0	05-11	4.74	96
100.0	05-12	6.62	100
120.0	05-13	7.25	104
150.0	05-14	8.11	106
175.0	05-15	11.10	108
200.0	05-16	11.80	110
240.0	05-17	13.00	112
300.0	05-18	18.50	114
360.0	05-19	20.20	116
430.0	05-20	22.10	118
500.0	05-21	30.60	120
600.0	05-22	33.50	124
720.0	05-23	47.20	126
860.0	05-24	51.60	130
1.00 H	05-25	55.60	134
1.20 H	05-26	76.70	136
1.50 H	05-27	85.80	138
1.75 H	05-28	117.00	140
2.00 H	05-29	125.00	144
2.40 H	05-30	137.00	146
3.00 H	05-31	187.00	150
3.60 H	05-32	205.00	154
4.30 H	05-33	224.00	156
5.00 H	05-34	305.00	160
6.00 H	05-35	334.00	164
7.20 H	05-36	366.00	166
8.60 H	05-37	504.00	168
10.00 H	05-38	707.00	170
12.00 H	05-39	775.00	174
15.00 H	05-40	866.00	180
17.50 H	05-41	1180.00	186
20.00 H	05-42	1590.00	190

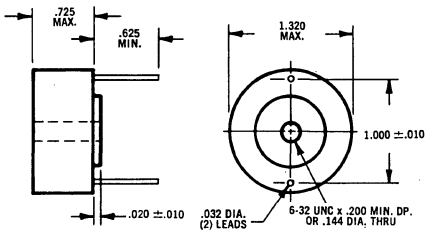


TOROTEL PRODUCTS INC. 13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

INDUCTORS

TOROIDAL INDUCTORS

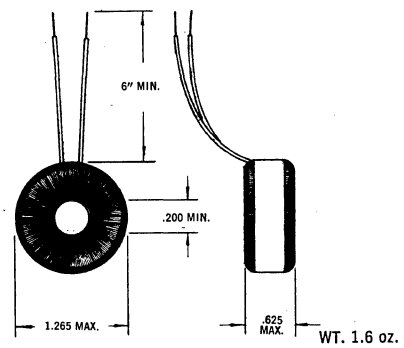
TYPE PS/PF/PSC/PFC—Printed Circuit



WT. 2.5 oz.

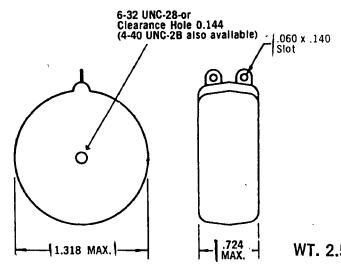
TYPE PREFIX TABLE		
6-32 UNC	THRU HOLE	STYLE
PS	PSC	NO FOOT
PF	PFC	WITH FOOT

TYPE U—Uncased



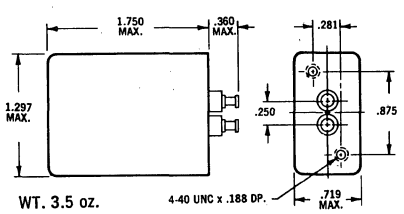
WT. 1.6 oz.

TYPE P—Compression Molded



WT. 2.5 oz.

TYPE M—Metal Cased



WT. 3.5 oz.

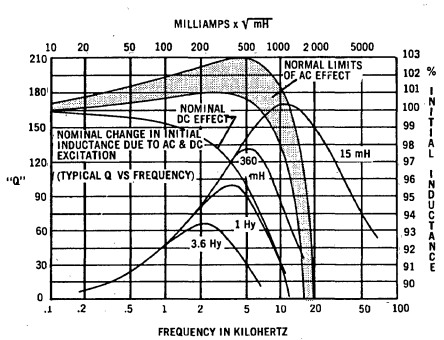
Mechanical Tolerance: ±.015 unless otherwise indicated.

Studs are available on the "M" Series on special request.

CORE NO. 30

Recommended Frequency: Up to 20 KHz.
Maximum Inductance: 17.5 H.
Special Core Stabilization Available: B, D, L, M, W.

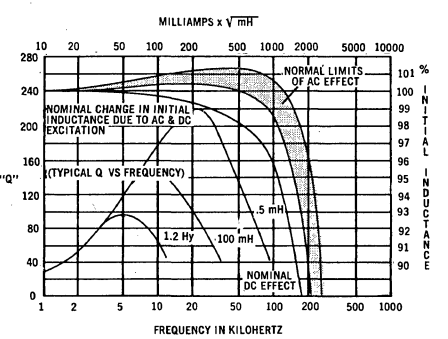
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
5.0	30-1	0.53	63
6.0	30-40	0.63	64
7.2	30-41	0.76	65
7.5	30-2	0.79	66
8.6	30-42	0.90	67
10.0	30-3	1.05	68
12.0	30-43	1.26	69
12.5	30-4	1.31	69
15.0	30-5	1.58	70
17.5	30-44	1.84	71
20.0	30-6	2.10	72
24.0	30-45	2.52	73
25.0	30-7	2.63	73
30.0	30-8	3.15	75
36.0	30-46	3.78	76
40.0	30-9	4.20	77
43.0	30-47	4.52	78
50.0	30-10	5.25	79
60.0	30-48	6.30	80
72.0	30-49	7.56	81
75.0	30-11	7.86	81
86.0	30-50	9.03	82
100.0	30-12	10.50	83
120.0	30-51	12.60	84
125.0	30-13	13.10	84
150.0	30-14	15.80	85
175.0	30-53	18.40	86
200.0	30-15	21.00	87
240.0	30-54	25.20	88
250.0	30-52	26.30	88
300.0	30-16	31.50	89
360.0	30-55	37.80	90
400.0	30-17	42.00	91
430.0	30-56	45.20	91
500.0	30-18	52.50	92
600.0	30-57	63.00	93
720.0	30-58	75.60	94
750.0	30-19	78.70	96
860.0	30-59	90.30	97
1.00 H	30-20	105.00	98
1.20 H	30-60	126.00	99
1.25 H	30-21	131.30	99
1.50 H	30-22	157.50	100
1.75 H	30-61	183.80	101
2.00 H	30-23	210.00	102
2.40 H	30 62	252.00	103
2.50 H	30-69	262.50	103
3.00 H	30-24	315.00	104
3.60 H	30-63	378.00	106
4.00 H	30-25	420.00	107
4.30 H	30-64	451.50	108
5.00 H	30-26	525.00	109
6.00 H	30-65	630.00	110
7.20 H	30-66	756.00	111
7.50 H	30-27	787.50	112
8.60 H	30-67	903.00	113
10.00 H	30-28	1050.00	114
12.00 H	30-68	1260.00	115
12.50 H	30-29	1312.50	116
15.00 H	30-30	1575.00	117
17.50 H	30-31	1837.50	118



CORE NO. 94

Recommended Frequency: Up to 75 KHz.
Maximum Inductance: 1 H.
Special Core Stabilization Available: B, D, M, W, L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
5.0	94-1	1.05	32
6.0	94-2	1.26	32
7.2	94-3	1.51	33
7.5	94-4	1.58	34
8.6	94-5	1.80	35
10.0	94-6	2.10	35
12.0	94-7	2.52	36
12.5	94-8	2.63	37
15.0	94-9	3.15	38
17.5	94-10	3.67	39
20.0	94-11	4.20	40
24.0	94-12	5.04	41
25.0	94-13	5.25	41
30.0	94-14	6.30	42
36.0	94-15	7.56	43
40.0	94-16	8.40	44
43.0	94-17	9.03	44
50.0	94-18	10.50	45
60.0	94-19	12.60	46
72.0	94-20	15.10	46
75.0	94-21	15.80	47
86.0	94-22	18.00	47
100.0	94-23	21.00	48
120.0	94-24	25.20	49
125.0	94-25	26.30	49
150.0	94-26	31.50	50
175.0	94-27	36.80	51
200.0	94-28	42.00	52
240.0	94-29	50.40	53
250.0	94-30	52.50	54
300.0	94-31	63.00	54
360.0	94-32	75.60	56
400.0	94-33	84.00	57
430.0	94-34	90.00	57
500.0	94-35	105.00	57
600.0	94-36	126.00	58
720.0	94-37	151.00	58
750.0	94-38	158.00	59
860.0	94-39	181.00	59



INDUCTORS

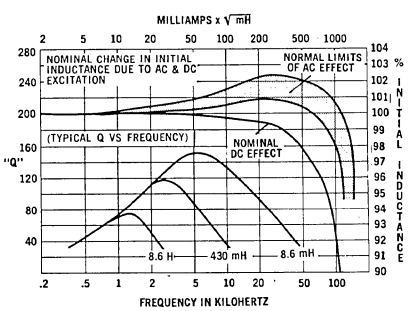
TOROTEL PRODUCTS INC./13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

TOROIDAL INDUCTORS

CORE NO. 28

Recommended Frequency: Up to 35 KHz.
Maximum Inductance: 25 H.
Special Core Stabilization: D, W, M, L.

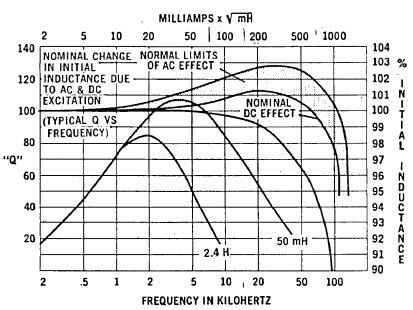
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
7.2	28-1	0.64	60
8.6	28-2	0.70	64
10.0	28-3	0.97	66
12.0	28-4	1.06	68
15.0	28-5	1.19	70
17.5	28-6	1.66	74
20.0	28-7	1.78	76
24.0	28-8	1.95	78
30.0	28-9	2.57	80
36.0	28-10	2.82	84
43.0	28-11	3.86	86
50.0	28-12	4.16	88
60.0	28-13	4.55	90
72.0	28-14	6.33	94
86.0	28-15	6.91	96
100.0	28-16	9.36	98
120.0	28-17	10.30	100
150.0	28-18	11.50	102
175.0	28-19	16.20	104
200.0	28-20	17.30	106
240.0	28-21	18.90	108
300.0	28-22	26.50	110
360.0	28-23	29.00	114
430.0	28-24	31.70	116
500.0	28-25	42.10	118
600.0	28-26	46.20	120
720.0	28-27	64.50	124
860.0	28-28	70.50	126
1.00 H	28-29	93.90	128
1.20 H	28-30	103.00	130
1.50 H	28-31	115.00	134
1.75 H	28-32	154.00	136
2.00 H	28-33	164.00	140
2.40 H	28-34	229.00	144
3.00 H	28-35	256.00	146
3.60 H	28-36	281.00	148
4.30 H	28-37	388.00	150
5.00 H	28-38	419.00	152
6.00 H	28-39	510.00	154
7.20 H	28-40	624.00	156
8.60 H	28-41	682.00	158
10.00 H	28-42	930.00	160
12.00 H	28-43	1020.00	164
15.00 H	28-44	1440.00	166
17.50 H	28-45	1550.00	168
20.00 H	28-46	1660.00	170



CORE NO. 27

Recommended Frequency: Up to 20 KHz.
Maximum Inductance: 30 H.
Special Core Stabilization: D, W, M, L.

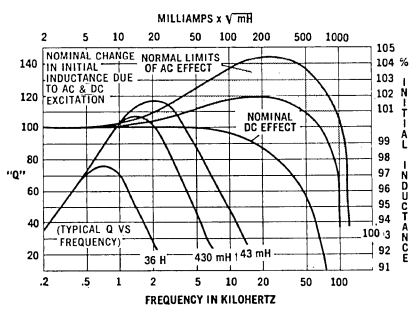
Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
8.6	27-1	0.63	60
10.0	27-2	0.68	64
12.0	27-3	0.95	66
15.0	27-4	1.06	68
17.5	27-5	1.15	70
20.0	27-6	1.59	74
24.0	27-7	1.74	76
30.0	27-8	1.95	78
36.0	27-9	2.52	80
43.0	27-10	2.76	84
50.0	27-11	2.97	86
60.0	27-12	4.07	88
72.0	27-13	4.46	90
86.0	27-14	6.18	94
100.0	27-15	6.67	96
120.0	27-16	7.30	98
150.0	27-17	10.30	100
175.0	27-18	11.10	102
200.0	27-19	15.50	104
240.0	27-20	16.90	106
300.0	27-21	18.90	108
360.0	27-22	26.00	110
430.0	27-23	28.40	114
500.0	27-24	37.70	116
600.0	27-25	41.30	118
720.0	27-26	45.30	120
860.0	27-27	63.10	124
1.00 H	27-28	68.00	126
1.20 H	27-29	74.50	128
1.50 H	27-30	103.00	130
1.75 H	27-31	111.00	134
2.00 H	27-32	147.00	136
2.40 H	27-33	161.00	140
3.00 H	27-34	229.00	144
3.60 H	27-35	251.00	146
4.30 H	27-36	274.00	148
5.00 H	27-37	374.00	150
6.00 H	27-38	410.00	152
7.20 H	27-39	559.00	154
8.60 H	27-40	611.00	156
10.00 H	27-41	659.00	158
12.00 H	27-42	912.00	160
15.00 H	27-43	1020.00	164
17.50 H	27-44	1390.00	166
20.00 H	27-45	1490.00	168
24.00 H	27-46	1630.00	170



CORE NO. 25

Recommended Frequency: Up to 5 KHz.
Maximum Inductance: 40 H.
Special Core Stabilization: L.

Inductance ±1% (mH)	Part Number	Typical DCR (ohms)	Typical Distributed Capacity (pf)
12.0	25-1	0.60	80
15.0	25-2	0.67	84
17.5	25-3	0.94	86
20.0	25-4	1.00	88
24.0	25-5	1.10	90
30.0	25-6	1.59	94
36.0	25-7	1.74	96
43.0	25-8	1.91	98
50.0	25-9	2.42	100
60.0	25-10	2.66	104
72.0	25-11	2.91	106
86.0	25-12	3.98	108
100.0	25-13	4.29	110
120.0	25-14	5.96	112
150.0	25-15	6.67	114
175.0	25-16	7.20	116
200.0	25-17	9.67	118
240.0	25-18	10.60	120
300.0	25-19	15.50	124
360.0	25-20	16.90	126
430.0	25-21	18.50	128
500.0	25-22	25.00	130
600.0	25-23	27.40	132
720.0	25-24	30.00	134
860.0	25-25	40.40	136
1.00 H	25-26	43.50	138
1.20 H	25-27	60.80	140
1.50 H	25-28	68.00	144
1.75 H	25-29	73.40	146
2.00 H	25-30	97.00	150
2.40 H	25-31	106.00	154
3.00 H	25-32	147.00	156
3.60 H	25-33	161.00	158
4.30 H	25-34	224.00	160
5.00 H	25-35	241.00	166
6.00 H	25-36	264.00	168
7.20 H	25-37	367.00	170
8.60 H	25-38	401.00	174
10.00 H	25-39	432.00	176
12.00 H	25-40	589.00	178
15.00 H	25-41	658.00	180
17.50 H	25-42	900.00	184
20.00 H	25-43	970.00	186
24.00 H	25-44	1060.00	190
30.00 H	25-45	1490.00	196
36.00 H	25-46	1630.00	200



WHEN ORDERING, ADD CASE PREFIX (TYPE) TO PART NUMBER.†
EXAMPLE: U 30-1
CASE TYPE — PART NUMBER

† Add "C" to part number of molded inductor if clearance hole is desired.

Selection Guide for TRW High Q Coils and Chokes

Over 40 years of specialization in High Q Inductors are reflected in the superior Q and temperature stability of the molybdenum permalloy dust toroid, ferrites, and laminated structures produced by TRW Inductive Products today. Range of application is from DC to 30 MHz.

This catalog lists many different types of stock inductors, but special custom designs produced to customers' specifications are available on special order. Characteristics such as taps, additional windings, special adjustments such as in a resonant circuit, higher voltage capability, inductance adjusted with DC, special mechanical configurations, and even better temperature stability than our stock items are available to customers' requirements.

WHILE THE TOROIDAL COIL is superior for frequencies above 1 kHz, the laminated structure is superior for lower frequencies. The ML, MO, and MQM uses a hum-reducing lamination structure and, in addition, the ML, and MQM are in hipermalloy shield cases.

The toroidal coils MS, MP, MM, MH, MW, FE, MQE have extremely low hum pickup due to the symmetrical winding on the toroidal core.

ALL STOCK INDUCTORS are measured at 0 DC. The maximum DC listings are for approximately 5% drop in inductance, and negligible heat rise. The typical curves of inductance variation with AC or DC currents, illustrated on the following pages, best show the range of operation for a particular inductor. The excitation is plotted in milliamperes $\times \sqrt{\text{mHy}}$. For example, the 100 mHy MS toroid (MS-100) with 10 ma of DC flowing has an excitation factor of 10 ma $\times \sqrt{100\ \text{mHy}}$ = 100, and the curve shows that approximately 90 mHy will be measured with 10 ma DC.

Since these high Q coils will saturate before any appreciable temperature rises occur, heating is usually not a problem. A general rule would be that four times the DC listings may be applied without any detrimental heating due to copper loss.

FOR VARIABLE INDUCTORS such as HVC, TVC and VIC, the DC values listed apply at the mean to minimum inductance settings only. The maximum inductance cannot be obtained with that amount of DC current flowing.

Temperature stability of all TRW/UTC inductors is excellent. Guaranteed limits and typical curves of inductance variation with temperature are shown for most types.

Engineering, laboratory, and production facilities are available for full engineering discussion, sampling, and large quantity production to meet special requirements.

Intermediate inductance values in an existing stock toroidal series are available, priced as the next higher inductance unit.

HIGH Q INDUCTORS — FIXED

Type No.	Stock Line Inductance Range	Approx. DCR Ohm/Hy	Approximate Peak Q	Approximate @ Freq.	Inductance Tolerance Adjustment	Temp. Stability	MIL Gr.
CH-100 thru CH-200	100 μHy-200 μHy	51,000	85	1500 kHz	±5% @ 1V, 500 kHz	±2%	4
CH-300 thru CH-1000	300 μHy-1000 μHy	42,000	85	790 kHz	±5% @ 1V, 250 kHz	±2%	4
CM	0.25 MHy-50 MHy	3300	120	200 kHz	±5% @ 1V, 10 kHz	±3%	4
FE	.01 Hy-2 Hy	200	125	8 kHz	±1% @ 1V, 1 kHz	±1.5%	5
LL	30 μHy-5000 μHy	1000	—	—	min.	—	5
MH	.6 MHy-40 MHy	2700	80	100 kHz	±2% @ .1V, 1 kHz	±1%	5
ML-0 thru ML-4	.15 Hy-1.4 Hy	150	22	1.5 kHz	±3% @ 1V, 1 kHz	within 2%	5
ML-5 thru ML-10	2.5 Hy-60 Hy	85	22	800 Hz	±3% @ 1V, 400 Hz	±2%	5
MM	3 MHy-120 MHy	1300	60	30 kHz	±2% @ .1V, 1 kHz	±2%	5
MO-.1 thru MO-1	.1 Hy-1 Hy	130	27	1.5 kHz	±2% @ 1V, 1 kHz	+1% −2%	5
MO-2 thru MO-100	2 Hy-100 Hy	65	25	600 Hz	±2% @ 1V, 400 Hz	+1% −3%	5
MP	100 MHy-750 MHy	600	45	10 kHz	±2% @ .1V, 1 kHz	±2%	5
MQE	4 MHy-2 Hy	170	140	8 kHz	±1% @ 1V, 1 kHz	±1%	4
MQL	.25 Hy-2500 Hy	5	45	100 Hz	±2% series @ 1V, 60 Hz parallel @ .5V, 60 Hz	<3%	4
MQM	.5 Hy-600 Hy	10	40	200 Hz	±2% series @ 1V, 60 Hz parallel @ .5V, 60 Hz	±2%	4
MS	1 MHy-100 MHy	1300	40	20 kHz	±2% @ .1V, 1 kHz	±2%	5
MW	.05 Hy-5 Hy	500	80	10 kHz	±1% @ 1V, 1 kHz	±1%	5

HIGH Q INDUCTORS — VARIABLE

Type No.	Mean Inductance Range	Variable Inductance Range	Temp. Stability	MIL Gr
HVC	.006 Hy-150 Hy	+200% −70% (10 to 1)	±1.5%	4
TVC*	.006 Hy-150 Hy	+200% −70% (10 to 1)	±1.5%	4
VIC	.0085 Hy-130 Hy	+85% −45% (3 to 1)	±3%	comml.

* Same as HVC but with taps @ 30, +50%

SR INDUCTORS — FIXED

Type No	Stock Line Inductance Range	DC Current Range	Approx. DCR Ohm/Hy	Inductance Tolerance Adjustment	MIL Gr
SRA	8 μHy-1250 μHy	up to 15A	510	+15%, −5% @ 1V, 10 kHz	5
SRB	20 μHy-3000 μHy	up to 15A	360	+15%, −5% @ 1V, 10 kHz	5
SRC	60 μHy-10,000 μHy	up to 13.6A	190	+15%, −5% @ 1V, 10 kHz	5
SRD	500 μHy-5.6 Hy	Up to 13A	63	+15%, −5% @ 1V, 10 kHz	5

High-Frequency High-Q Inductors

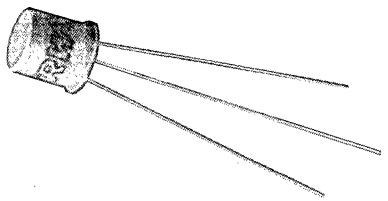
PACKAGING Temperature stable inductors in a TO-5 metal case.

MIL SPECS CM to complete MIL-T-27D Specs. Type number TF4S20YY. CH to complete MIL-C-15305E Specs. Type: LT10K.

APPLICATION CM Series shielded inductors have Qs over 120, and cover a frequency range from 10 to 800 kHz. Peak Q is centered at approximately 150 kHz.

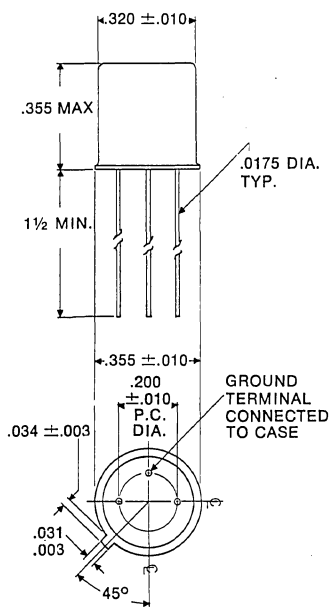
CH Series shielded inductors have Qs over 100, and cover a frequency range from 0.2 to 3.0 MHz. Peak Q is centered at approximately 1.5 MHz.

CURRENT RATINGS CM Series DC rating is for approximately 10% drop in inductance, with negligible heat rise. CH Series DC rating is for a 40°C maximum heat rise, with negligible drop in inductance.



Type No.	Inductance Tolerance at 25°C	Test Frequency, kHz	Test Level, RMS V	Max. L Variation, −55°C to +105°C
CM	±5%	10	1.0	±3%
CH-100 thru CH-200	±5%	500	1.0	±2%
CH-300 thru CH-1000	±5%	250	1.0	±2%

CM and CH Series

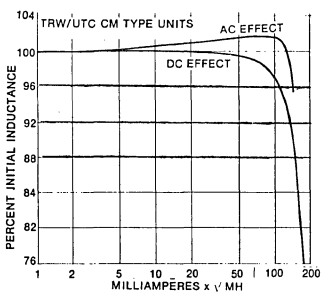


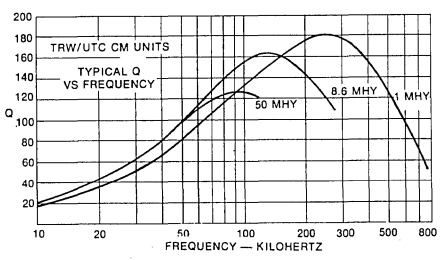
CM SERIES

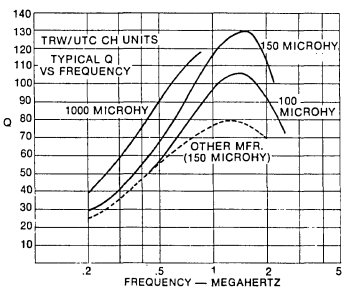
Type No.	Inductance at 0 DC, mHy	Max. DC Resistance, Ohms	Min. Q	Min. SRF, kHz	Max. DC Current, mA
CM-.25	0.25	0.9	120 @ 200 kHz	3000	260
CM-.50	0.50	1.8	120 @ 200 kHz	2100	180
CM-1.0	1.0	3.3	120 @ 200 kHz	1500	130
CM-1.5	1.5	4.8	120 @ 200 kHz	1160	105
CM-2.5	2.5	8.2	120 @ 150 kHz	900	83
CM-3.6	3.6	10	120 @ 150 kHz	730	70
CM-5.0	5.0	15	120 @ 150 kHz	600	59
CM-7.5	7.5	22	120 @ 100 kHz	470	48
CM-8.6	8.6	24	120 @ 100 kHz	430	45
CM-10	10	33	100 @ 100 kHz	400	41
CM-15	15	40	100 @ 100 kHz	320	34
CM-20	20	60	85 @ 70 kHz	280	29
CM-30	30	90	85 @ 70 kHz	220	24
CM-50	50	150	85 @ 70 kHz	165	18

CH SERIES

Type No.	MIL Part No.	Inductance at 0 DC, μHy	Max. DC Resistance, Ohms	Min. Q	Min. SRF, MHz	Max. DC Current, mA
CH-100	MS2/358-44	100	5.1	85 @ 1500 kHz	7.5	191
CH-150	MS2/358-45	150	6.6	85 @ 1500 kHz	5.5	168
CH-200	MS2/358-46	200	9.5	85 @ 790 kHz	4.5	140
CH-300	MS2/358-47	300	14	85 @ 790 kHz	3.4	115
CH-390	MS2/358-48	390	16	85 @ 790 kHz	2.9	108
CH-500	MS2/358-49	500	21	85 @ 790 kHz	2.6	94
CH-560	MS2/358-50	560	23	85 @ 790 kHz	2.5	88
CH-680	MS2/358-51	680	26	85 @ 790 kHz	2.1	85
CH-1000	MS2/358-52	1000	43	60 @ 790 kHz	1.6	65







Miniductor™ Series

PACKAGING Hermetically sealed, MS, MM, MH, MP, MW, epoxy molded symmetrical toroids. ML hipermalloy shield cased, hum reducing laminated inductor. MO, epoxy molded hum reducing laminated inductor. All have straight pin terminals for printed circuit applications.

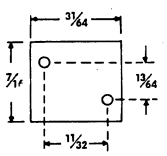
TERMINALS Per MIL-STD-1276.

MIL SPECS To complete MIL-T-27D Specs. MIL Type No. TF5R20ZZ.

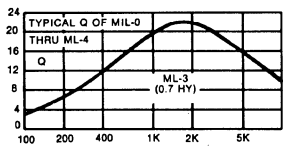
Type No.	Inductance Tolerance at 25°C	Test Frequency	Test Level RMS V	Max L Variation −55°C to +105°C
ML-0 thru 4	±3%	1 kHz	1.0	Within 2%
ML-5 thru 10	±3%	400 Hz	1.0	±2%
MO-.1 thru 1	±2%	1 kHz	1.0	+1% −2%
MO-2 thru 100	±2%	400 Hz	1.0	+1% −3%
MS	±2%	1 kHz	0.1	±2%
MP	±2%	1 kHz	0.1	±2%
MM	±2%	1 kHz	0.1	±2%
MH	±2%	1 kHz	0.1	±1%
MW	±1%	1 kHz	1.0	±1%

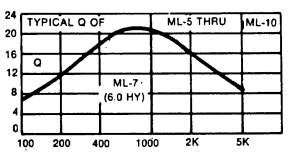
Laminated Types ML Series

TERMINAL LAYOUT

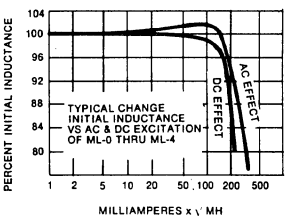


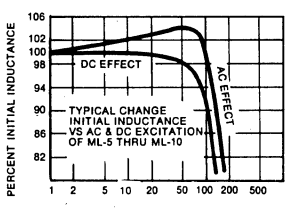
ML CASE
7/16″ x 31/64″ x 9/16″ high
Weight: .2 oz.
TERMINALS: Type D — Tinned Dumet .025″ Dia. x 1″ long

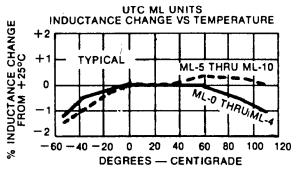




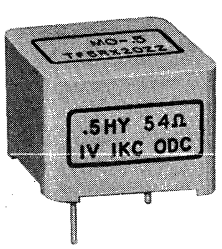
Type No.	MIL Part No.	Ind. Hy (0 DC)	ma DC Max.	DCRΩ ±20%
ML-0	M27/164-01	.15	12	33
ML-1	M27/164-02	.25	9	55
ML-2	M27/164-03	.4	7	90
ML-3	M27/164-04	.7	5	135
ML-4	M27/164-05	1.4	3	210
ML-5	M27/164-06	2.5	1	210
ML-6	M27/164-07	4.0	.7	340
ML-7	M27/164-08	6.0	.6	530
ML-8	M27/164-09	10	.5	850
ML-9	M27/164-10	25	.3	2300
ML-10	M27/164-11	60	.2	5160



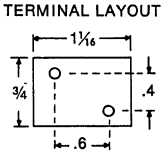




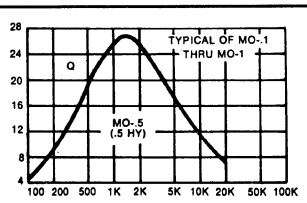
MO Series

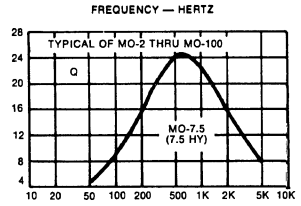


TERMINAL LAYOUT

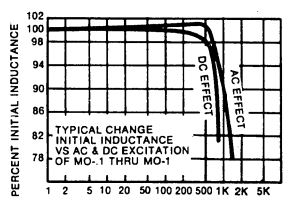


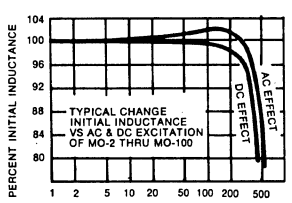
MO CASE
3/4″ x 1 1/16″ x 13/16″ high
Weight: 1 oz.
TERMINALS: Tinned Dumet .040″ Dia. x 3/32″ long

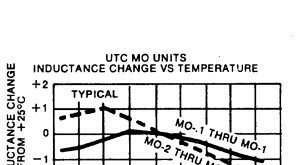




Type No.	MIL Part No.	Ind. Hy (0 DC)	ma DC Max.	DCRΩ ±20%
MO-.1	M27/168-01	1	55	14
MO-.15	M27/168-02	.15	45	22
MO-.3	M27/168-03	.3	28	34
MO-.5	M27/168-04	.5	23	54
MO-1	M27/168-05	1	16	130
MO-2	M27/168-06	2	8	130
MO-5	M27/168-07	5	5	340
MO-7.5	M27/168-08	7.5	4.5	517
MO-20	M27/168-09	20	2.7	1310
MO-50	M27/168-10	50	1.4	3180
MO-100	M27/168-11	100	1.1	8550

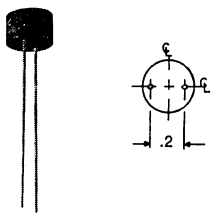


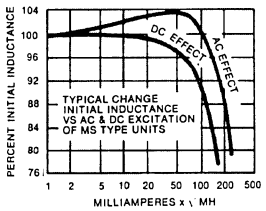


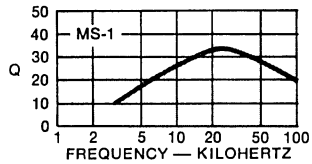


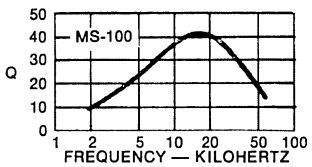
Miniductor™ Series

Toroidal Types MS Series

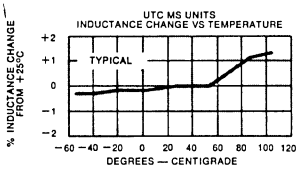






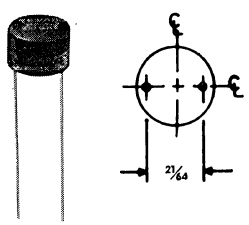


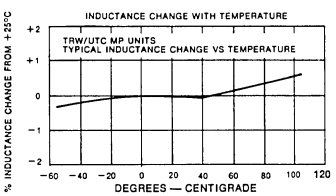
Type No.	MIL Part No.	Ind. mHy (0 DC)	ma DC Max.	DCRΩ Max.
MS-1	M27/146-01	1	60	1.4
MS-5	M27/146-02	5	28	7
MS-10	M27/146-03	10	20	11
MS-25	M27/146-04	25	13	38
MS-50	M27/146-05	50	9	75
MS-100	M27/146-06	100	6	132

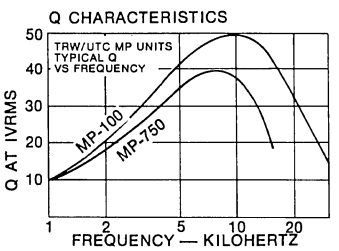


MS CASE
.35″ Dia. x .23″ high
Weight: 1.3 Gm.
TERMINALS: Type D — Tinned Dumet
.025″ Dia. x 1¼″ long
MIL Type No. TF5R20ZZ

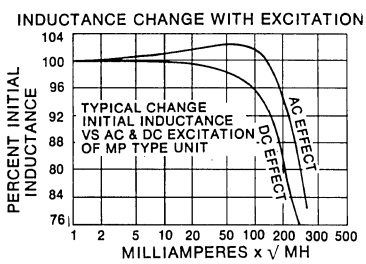
MP Series





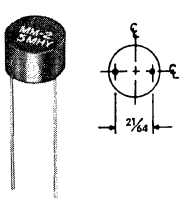


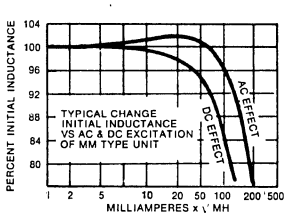
Type No.	MIL Part No.	Ind. mHy (0 DC)	ma DC Max.*	DCRΩ Max.
MP-100	M27/285-01	100	7.0	70
MP-150	M27/285-02	150	6.0	100
MP-250	M27/285-03	250	4.5	180
MP-350	M27/285-04	350	3.7	265
MP-500	M27/285-05	500	3.0	360
MP-750	M27/285-06	750	2.5	540

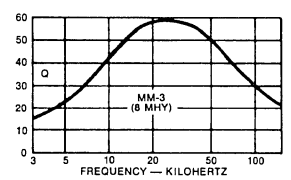


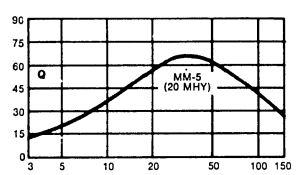
MP CASE
7⁄16″ Dia. x ¼″ high
Weight: .07 oz.
TERMINALS: Type D — Tinned Dumet
.025″ Dia. x 1¼″ long
MIL Type No. TF5R20ZZ

MM Series

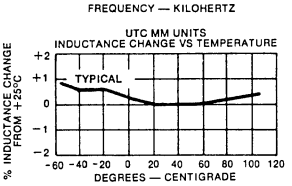








Type No.	MIL Part No.	Ind. mHy (0 DC)	ma DC Max.	DCRΩ Max.
MM-1	M27/240-01	3	50	4.8
MM-2	M27/240-02	5	40	8.0
MM-3	M27/240-03	8	30	13
MM-4	M27/240-04	12.5	25	19
MM-5	M27/240-05	20	20	31
MM-6	M27/240-06	30	16	47
MM-7	M27/240-07	60	11	94
MM-8	M27/240-08	120	8	186

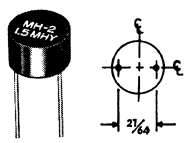


MM CASE
7⁄16″ Dia. x ¼″ high
Weight: .07 oz.
TERMINALS: Type D — Tinned Dumet
.025″ Dia. x 1¼″ long
MIL Type No. TF5R20ZZ

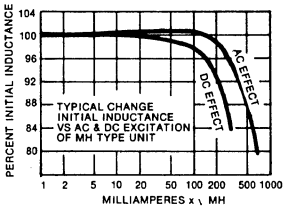
TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

Miniductor™ Series

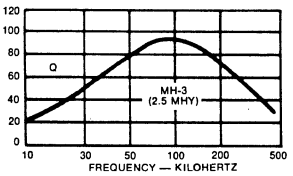
Toroidal Types MH Series

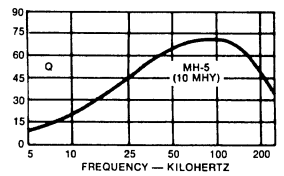


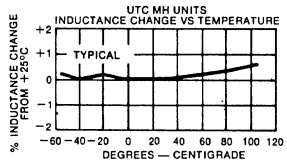
MH CASE
7/16″ Dia. x 1/4″ high
Weight: .07 oz.
TERMINALS: Type D — Tinned Dumet
.025″ Dia. x 1 1/4″ long
MIL Type No. TF5R20ZZ



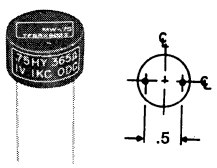
Type No.	MIL Part No.	Ind. mHy (0 DC)	ma DC Max.	DCRΩ Max.
MH-1	M27/241-01	.6	90	1.9
MH-2	M27/241-02	1.5	57	4.9
MH-3	M27/241-03	2.5	44	8.2
MH-4	M27/241-04	6	28	19
MH-5	M27/241-05	10	22	32
MH-6	M27/241-06	15	18	49
MH-7	M27/241-07	25	14	82
MH-8	M27/241-08	40	11	130



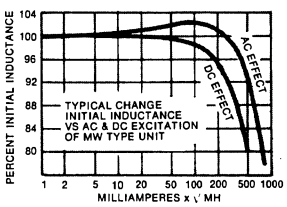




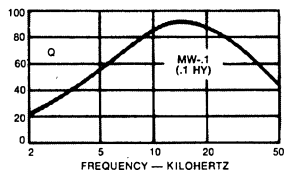
MW Series

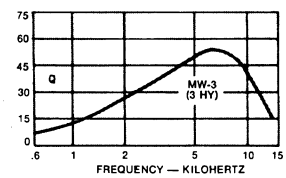


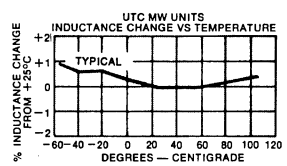
MW CASE
23/32″ Dia. x 13/32″ high
Weight: .25 oz.
TERMINALS: Type N-2 — Tinned Nickel
.040″ Dia. x 3/8″ long
MIL Type No. TF5R20ZZ



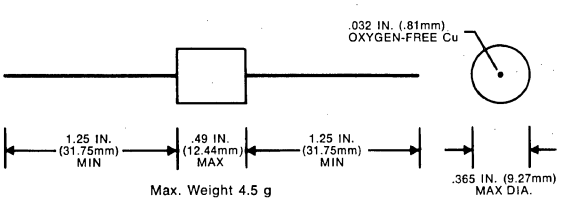
Type No.	MIL Part No.	Ind. Hy (0 DC)	ma DC Max.	DCRΩ ±20%
MW-.05	M27/161-01	.05	25	27
MW-.10	M27/161-02	.10	18	51
MW-.25	M27/161-03	.25	11	136
MW-.5	M27/161-04	.5	8	243
MW-.75	M27/161-05	.75	7	355
MW-1	M27/161-06	1.0	6	500
MW-1.2	M27/161-07	1.2	5	560
MW-2	M27/161-08	2	4	870
MW-3	M27/161-09	3	3.5	1340
MW-5	M27/161-10	5	3	2500



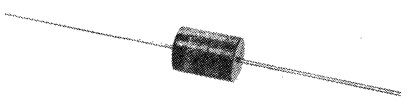




LL Series Power Inductor

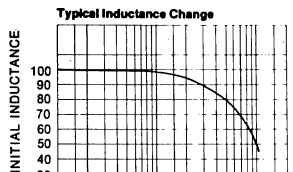


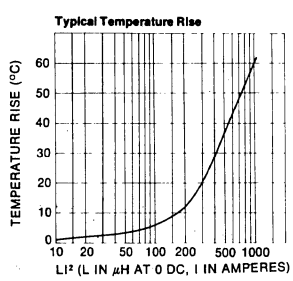
Max. Weight 4.5 g



- Mountable through PC board or to posts
- Inductance from 30 to 5000 μH
- Rated current range: 1.6 to 0.25 A
- Low inductance drop at rated current
- Less than 3/8 inch in diameter
- Suitable for reel-mounted assembly
- Manufactured to meet MIL-T-27
- MIL Type No. TF5R04ZZ

Type	Inductance at 1 V, 20 kHz (μH)	Max. DCR (ohms)	Rated Current (amps)	MIL Part No.
LL-30	30	.035	3.0	M27/286-07
LL-50	50	.056	2.5	M27/286-08
LL-120	120	0.14	1.6	M27/286-01
LL-300	300	0.35	1.0	M27/286-02
LL-500	500	0.56	0.75	M27/286-03
LL-1200	1200	1.40	0.50	M27/286-04
LL-3000	3000	3.50	0.30	M27/286-05
LL-5000	5000	5.60	0.25	M27/286-06

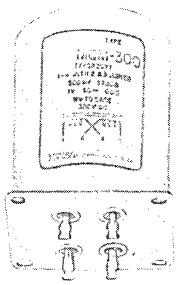




TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

Hermetically Sealed High Q Coils

Low Frequency High Q Laminated Inductors MQM Series



MQM CASE
1 5/16" Dia. x 1 5/8" high
Weight: 5 oz.
Mounting Holes: 1 1/8" x 1 1/8"
Screws: 4-40
Cutout: 1" Dia.
MIL Type No. TF4R20YY

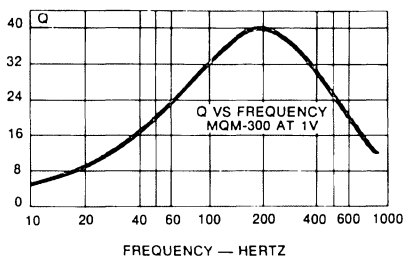
CONNECTIONS Two identical windings brought out to four terminals permit series, parallel, center tapped, or transformer type connections.

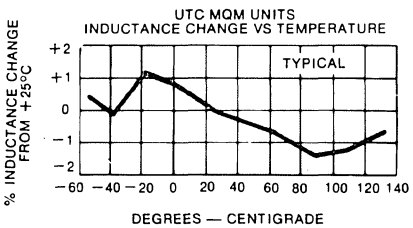
TOLERANCE ±2% @ 60 Hz, 1 V series, 0.5 V parallel.

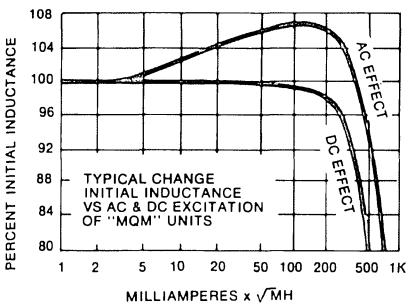
MIL SPECS To complete MIL-T-27D Specs.

TEMPERATURE STABILITY MQM, −55° to +130°C, ±2%.

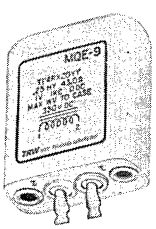
Type No.	MIL Part No.	Series Henries (0 DC)	Parallel Henries (0 DC)	Series DCRΩ ±20%
MQM-2	M27/162-01	2	.5	21
MQM-16	M27/162-02	16	4	143
MQM-40	M27/162-03	40	10	368
MQM-300	M27/162-04	300	75	3700
MQM-600	M27/162-05	600	150	5720







Hermetically Sealed High Q Toroidal Inductors MQE Series



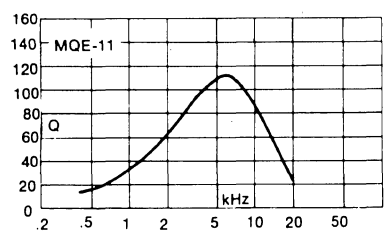
MQE CASE
1 1/16" long x 1/2" wide x 1 7/32" high
Unit Weight: 1.5 oz.
Mounting Holes: 3/4"
Screws: 4-40
Cutout: 5/16" x 1/2"

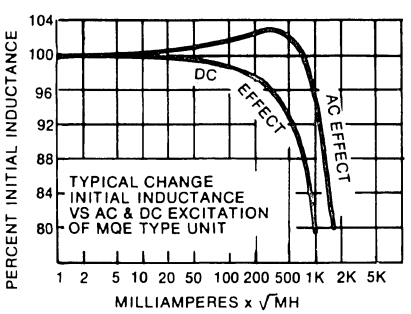
ADJUSTMENT MQE, ±1% @ 1 V, 1 kHz.

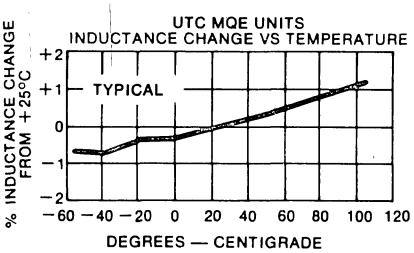
MIL SPECS To complete MIL-T-27D Specs.

TEMPERATURE STABILITY From −55°C to +105°C. MQE, ±1%.

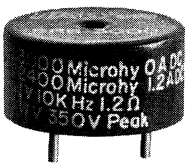
Type No.	MIL Type	Inductance (0 DC)	ma DC Max.	DCRΩ ±20%
MQE-0	TF4R20YY	4 mHy	160	.7
MQE-1	TF4R20YY	7 mHy	135	1.2
MQE-2	TF4R20YY	12 mHy	100	2.0
MQE-3	TF4R20YY	20 mHy	80	3.1
MQE-4	TF4R20YY	30 mHy	65	4.8
MQE-5	TF4R20YY	50 mHy	50	8.0
MQE-6	TF4R20YY	70 mHy	40	12
MQE-7	TF4R20YY	100 mHy	35	17
MQE-8	TF4R20YY	150 mHy	30	27
MQE-9	TF4R20YY	.25 Hy	22	43
MQE-10	TF4R20YY	.4 Hy	17	69
MQE-11	TF4R20YY	.6 Hy	14	102
MQE-12	TF4R20YY	.9 Hy	12	160
MQE-13	TF4R20YY	1.5 Hy	9	266
MQE-14	TF4R20YY	2 Hy	8	385







SR Power Inductors



PACKAGING Hermetically sealed, molded case.

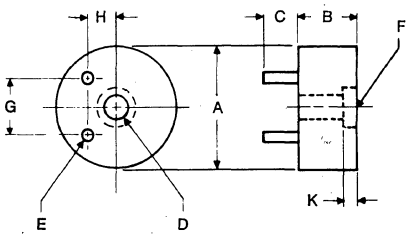
MIL SPECS To complete MIL-T-27D specs. Type number TF5S04ZZ.

APPLICATION These inductors have low losses in the 3 to 100 kHz frequency range, making them ideal for switching regulator and AC filter choke applications.

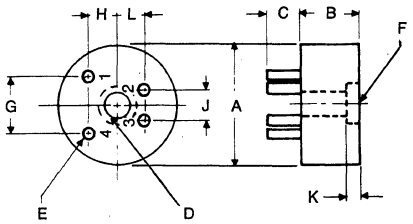
INDUCTANCE Type numbers correspond to inductance values in microhenries, which are measured at 1 V, 10 kHz, 0 DC with an inductance tolerance of +15%, −5%. Values of inductance other than listed in an existing size are available. Part Number would be: SR(A, B or C) — (inductance in microhy at 0 DC).

CURRENT RATINGS Listing I_1 is for approximately 10% drop in inductance with a typical 20°C temperature rise, and Listing I_2 is for approximately 20% drop in inductance with a typical 40°C temperature rise.

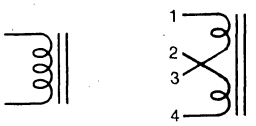
SINGLE WINDING



DOUBLE WINDING

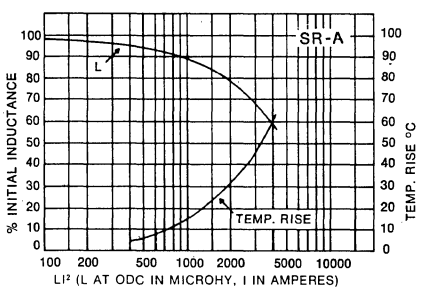


SCHEMS.



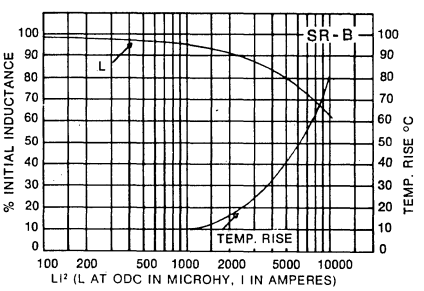
DIMENSIONS IN INCHES

Type	Winding	A dia. ±.030	B ±.063	C ±.030	D dia. ±.010	E dia. ±.005	F dia. ±.015	G ±.010	H ±.010	J ±.010	K C'bore ±.015	L ±.010	Wt. Oz.
SRA	Single	.875	.438	.250	.156	.073	.281	.400	.200	—	.082	—	.6
	Double		.563							.200		.200	
SRB	Single	1.188	.563	.250	.156	.073	.281	.600	.300	—	.082	—	1.5
	Double		.688							.400		.300	
SRC	Single	1.375	.750	.250	.156	.073	.281	.800	.300	—	.082	—	3
	Double		.813							.400		.500	



SRA

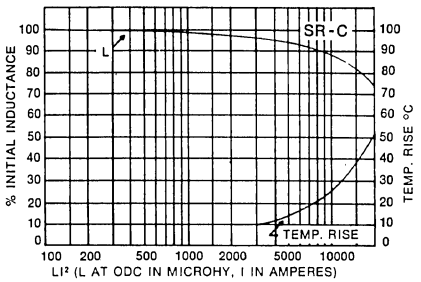
Type	No. of Windings	Inductance at 0 DC (μH)	I_1, at 10% drop in L (amps)	I_2, at 20% drop in L (amps)	Max. DCR (ohms)	MIL Part No.
SRA-1250	1	1250	.8	1.2	.7	M27/287-01
SRA-800	1	800	1	1.5	.45	M27/287-02
SRA-500	1	500	1.2	1.8	.3	M27/287-03
SRA-350	1	350	1.5	2.2	.2	M27/287-04
SRA-200*	2	200 (SER) 50 (PAR)	2 4	3 6	.12 .03	M27/287-05
SRA-88*	2	88 (SER) 22 (PAR)	3 6	4.5 9	.052 .013	M27/287-06
SRA-32*	2	32 (SER) 8 (PAR)	5 10	7.5 15	.02 .005	M27/287-07



SRB

Type	No. of Windings	Inductance at 0 DC (μH)	I_1, at 10% drop in L (amps)	I_2, at 20% drop in L (amps)	Max. DCR (ohms)	MIL Part No.
SRB-3000	1	3000	.8	1.2	1.2	M27/288-01
SRB-2000	1	2000	1	1.5	.8	M27/288-02
SRB-1200	1	1200	1.25	1.88	.5	M27/288-03
SRB-780	1	780	1.6	2.4	.3	M27/288-04
SRB-520	1	520	2	3	.2	M27/288-05
SRB-320	1	320	2.5	3.75	.13	M27/288-06
SRB-220*	2	220 (SER) 55 (PAR)	3 6	4.5 9	.08 .02	M27/288-07
SRB-120*	2	120 (SER) 30 (PAR)	4 8	6 12	.05 .013	M27/288-08
SRB-80*	2	80 (SER) 20 (PAR)	5 10	7.5 15	.032 .008	M27/288-09

SR Power Inductors

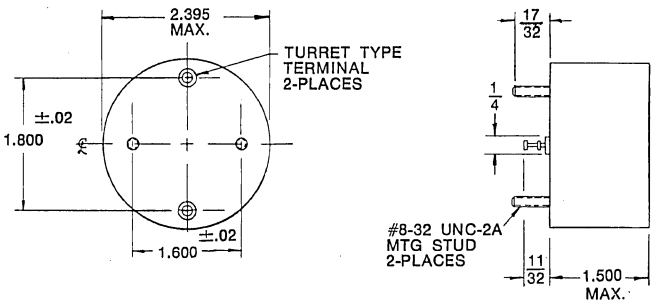


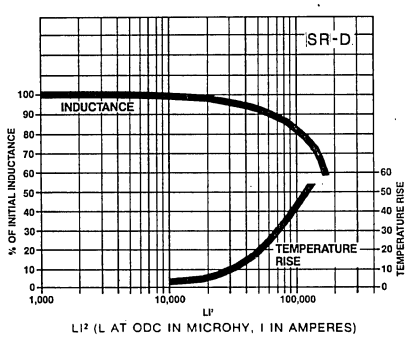
SRC

Type	No. of Windings	Inductance at 0 DC (μH)	I_1, at 10% drop in L (amps)	I_2, at 20% drop in L (amps)	Max. DCR (ohms)	MIL Part No.
SRC-10000	1	10,000	.84	1.1	2.1	M27/289-01
SRC-6400	1	6400	1	1.35	1.4	M27/289-02
SRC-2500	1	2500	1.6	2.2	.55	M27/289-03
SRC-1600	1	1600	2.1	2.8	.34	M27/289-04
SRC-1000	1	1000	2.6	3.5	.21	M27/289-05
SRC-640*	2	640 (SER) 160 (PAR)	3.3 6.6	4.5 9	.13 .033	M27/289-06
SRC-400*	2	400 (SER) 100 (PAR)	4 8	5.4 10.8	.088 .022	M27/289-07
SRC-240*	2	240 (SER) 60 (PAR)	5 10	6.8 13.6	.056 .014	M27/289-08

* Two identical windings brought out to four terminals permit series, parallel, center tapped or transformer connections.

SRD

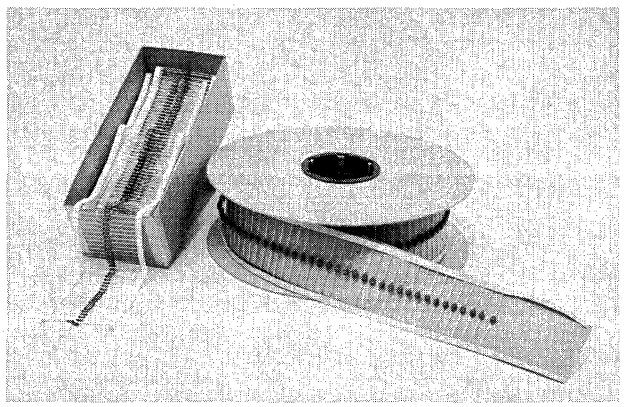


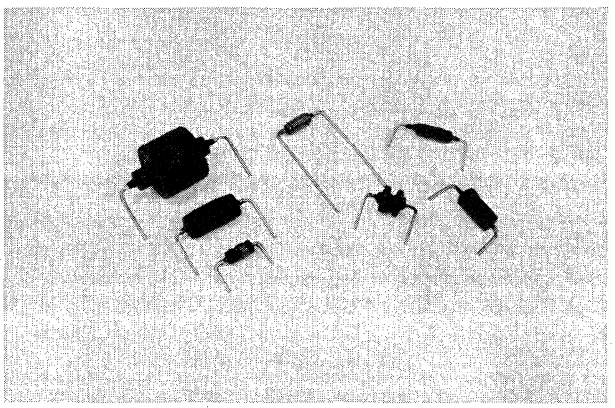


Type	No. of Windings	Inductance at 0 DC (μH)	I_1, at 10% drop in L (amps)	I_2, at 20% drop in L (amps)	Max. DCR (ohms)	MIL Part No.
SRD-500	1	500	9.5	13	.033	—
SRD-900	1	900	7.3	10	.057	—
SRD-2500	1	2500	4.4	6	.15	—
SRD-5000	1	5000	3.1	4.2	.33	—
SRD-10000	1	10,000	2.2	3	.60	—
SRD-22000	1	22,000	1.4	2	1.4	—
SRD-40000	1	40,000	1.1	1.5	2.4	—
SRD-90000	1	90,000	.73	1	5.4	—
SRD-360000	1	360,000	.36	.50	22	—
SRD-1.4	1	1.4 Hy	.18	.25	88	—
SRD-5.6	1	5.6 Hy	.09	.125	352	—

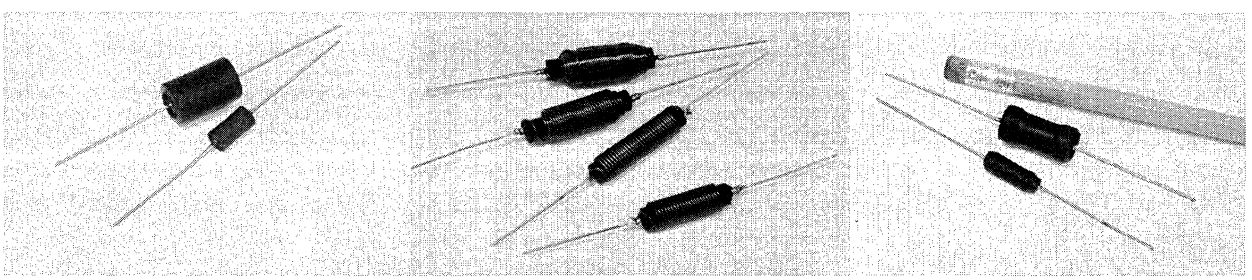
THE WILCO

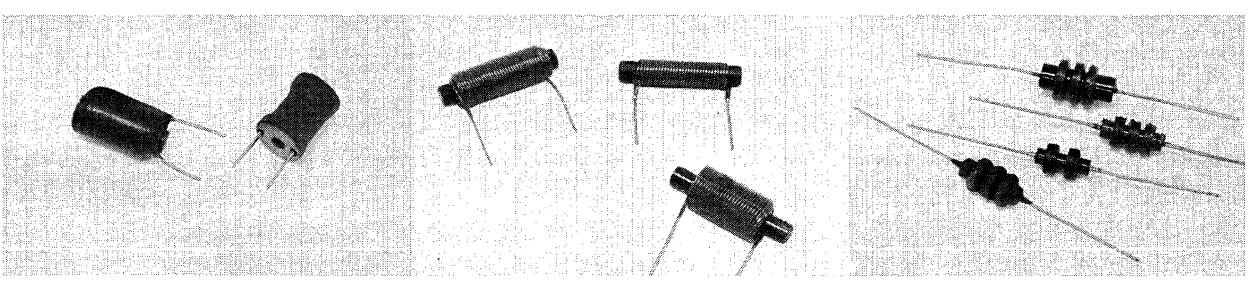
After 30 years of successful electronic component manufacturing, we at Wilco have learned that we can't be everything to everyone. What perhaps we have become best known and respected for is our responsive engineering and prompt shipments. What and when we say we'll deliver, will be delivered!





Special services include reel taping, cut & formed leads, custom prototypes, and engineering sample kits.





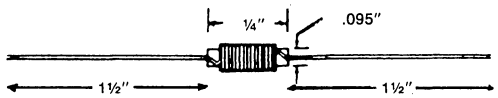
Custom inductive products include: high current filter chokes, hash chokes, shielded inductors and 3-section pi type windings.

For additional information on custom requirements at competitive pricing, contact Wilco Corporation.

WILCO CORPORATION

4030 W. TENTH STREET
INDIANAPOLIS, IN 46222
(317) 241-2516

COMMITMENT

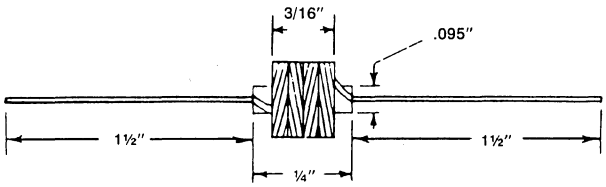


"ML" SERIES

WILCO PART # ML SERIES	L uh	Q NOM.	S.R.F. NOM. (MHz)	R.D.C. OHMs NOM.	I (MA) MAX	DIA. NOM.
ML 10S	.10	45	750+	.04	1824	.107
ML 15S	.15	48	712	.04	1824	.111
ML 22S	.22	46	541	.06	1490	.111
ML 33S	.33	44	428	.12	1054	.107
ML 47S	.47	43	387	.16	912	.107
ML 68S	.68	46.9	308	.15	942	.109
ML 10G	1.0	30.3	253	.33	635	.106
ML 15G	1.5	31.3	208	.58	479	.104
ML 22G	2.2	32.1	169	1.17	337	.102
ML 33G	3.3	33.3	137	2.68	223	.100
ML 47G	4.7	33.5	114	3.44	197	"
ML 68G	6.8	42.7	54.0	.43	557	.104
ML 100	10	39.1	48.6	.72	430	"
ML 150	15	64.5	36.5	1.43	300	.102
ML 270	27	64.8	27.0	3.54	194	.100

Intermediate Values Available

All choke coils in this series are the same size as the unit illustrated. Leads are of No. 21 tinned wire. Tolerances are ± 15% for ML10S through ML82S: ± 10% from ML10G through ML270. All units are impregnated with thermosetting varnish. Color coding available.

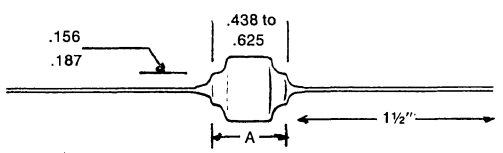


"MU" SERIES

WILCO PART #	L uh	Q NOM.	S.R.F. NOM. (MHz)	R.D.C. OHMs NOM.	I (MA) MAX	DIA. NOM.
MU 390	39	20.0	11.2	5.8	185	.156
MU 470	47	18.2	10.9	6.5	175	"
MU 560	56	17.7	10.6	7.1	162	"
MU 680	68	17.0	10.5	7.8	165	"
MU 820	82	16.0	10.4	8.6	163	.187
MU 101	100	15.5	10.3	9.3	159	"
MU 121	120	22.4	9.6	10.8	150	"
MU 151	150	22.8	9.0	12.2	143	"
MU 181	180	23.4	7.6	13.7	140	"
MU 271	270	23.9	5.7	16.9	130	.218
MU 331	330	24.4	5.2	18.9	126	"
MU 471	470	23.1	4.3	22.6	117	"
MU 681	680	49.0	2.9	12.7	141	.187
MU 102	1000	43.6	2.1	15.5	131	"
MU 152	1500	56.7	1.9	23.9	117	.218

Intermediate Values Available

All choke coils in this series are the same size as the unit illustrated. Leads are of No. 21 tinned wire. Tolerances are ± 10%. All units are impregnated with thermosetting varnish. Color coding available.

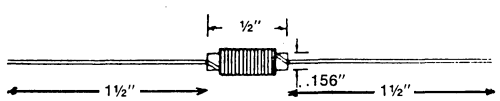


"U" SERIES

WILCO PART #	L uh	Q NOM.	S.R.F. NOM. (MHz)	R.D.C. OHMs NOM.	I (MA) MAX	DIA. NOM.
U 150	15	24.9	20.00	1.7	480	.218
U 350	35	20.5	14.00	2.6	420	.250
U 550	55	18.1	11.40	3.4	380	.281
U 101	100	15.6	8.80	4.4	350	.312
U 141	140	24.7	7.21	5.5	330	.343
U 181	180	24.4	6.52	6.3	320	.375
U 301	300	24.2	5.11	8.5	290	.437
U 501	500	23.6	4.02	11.0	270	.500
U 701	700	38.4	3.33	27.0	160	.562
U 901	900	36.4	2.87	31.0	150	.562
U 252	2.5 MH	70.8	1.02	32.0	150	.500
U 752	7.5 MH	64.6	.62	65.0	130	.500
U 153	15.0 MH	72	.44	64.8	110	.418
U 253	25.0 MH	70	.34	88	95	.512

Intermediate Values Available

All choke coils in this series are Durez covered and EIA color coded. They have an inductance tolerance of ± 10% and leads are No. 20 AWG tinned copper 1½" long. Parts U150 through U501 are wound on .156" dia. phenolic forms with "A" dimensions 7/16". Parts U601 through U102 are wound on the same form with "A" dimensions ½". Parts U252 through U752 use .156" dia. powdered iron forms, "A" dimension ½". Parts U103 through U253 use .187" dia. iron forms, "A" dimension ⅝". Diameters of coils vary from ¼" to ⅝" depending on inductance value.



"W" SERIES

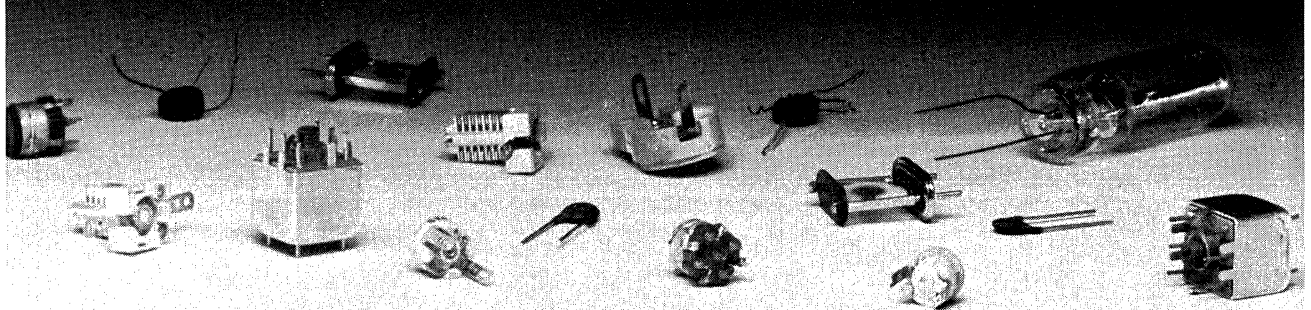
WILCO PART #	L uh	Q NOM.	S.R.F. NOM. (MHz)	R.D.C. OHMs NOM.	I (MA) MAX	DIA. NOM.
W 10 G	1.0	45	238	.11	1965	.179
W 12 G	1.2	45	218	.12	1882	.179
W 15 G	1.5	45	200	.14	1742	.179
W 22 G	2.2	45	165	.26	1278	.175
W 27 G	2.7	45	149	.34	1118	.175
W 39 G	3.9	45	127	.61	835	.172
W 47 G	4.7	50	114	.80	729	.170
W 68 G	6.8	50	94.8	1.35	561	.169
W 100	10	50	78.5	2.50	412	.167
W 150	15	30	63.9	5.10	288	.165
W 220	22	85	36.1	1.10	622	.170
W 330	33	80	30.6	1.38	555	.169
W 470	47	90	24.9	2.32	428	.167
W 680	68	90	21.6	3.00	376	.166
W 101	100	100	17.8	5.40	280	.165

Intermediate Values Available

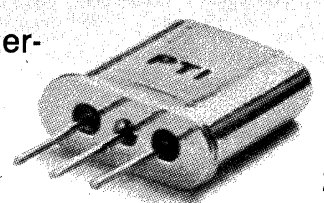
All choke coils in this series are the same size as the unit illustrated. Leads are of No. 20 tinned wire. Tolerances are ± 20% for W10G through W22G: ± 10% from W27G through W101. All units are impregnated with thermosetting varnish and are EIA color coded.

Our more popular, cataloged stock units are available in quantity for immediate delivery.

We gave up a lot to improve crystal filter reliability, size and cost.



A lot of components and interconnections, that is. The basic PTI monolithic filter consists of two electrode pairs deposited on the faces of a quartz wafer to form a two-resonator structure. Acoustical coupling between electrode pairs creates a two-pole response.



Simply by designing two-pole filters in cascade, using modern network theory, we can develop four to ten-pole tandem monolithic crystal filters offering maximum reliability, economy, mode suppression, attenuation and minimum size.

There's nothing else. It's that simple. Piezo Technology is the USA's leading supplier of monolithic and tandem monolithic filters, designed specifically for use in communications equipment requiring filtering from 5 to 300 MHz.

Choose from over 100 standard models from 10.7 to 200 MHz in a wide range of miniature, ultraminiature, upright, flat-pack and tandem configurations. Custom designs from below 5 MHz to 300 MHz are available with guaranteed IM, phase noise, linear phase or controlled group delay specifications.

For more information contact: Piezo Technology, Inc., P.O. Box 7859, Orlando, Florida 32854. (305) 298-2000. TWX: 810-850-4136.

PTI

Piezo Technology, Inc.

CRYSTALS

Manufacturer	Crystal Blanks	Frequency Control	Micro-processing	Quartz	Quartz (for watches)	MIL	Crystal Holders
Bliley Electric		1•1284		1•1284		1•1284	1•1288
Colorado Crystal		1•1292		1•1292			1•1292
Croven Crystals	1•1300	1•1300		1•1300		1•1300	
CTS Knights		1•1301	1•1301	1•1301		1•1301	
Fox		1•1320		1•1320	1•1320		
Frequency Control Prods.		1•1322	1•1322	1•1322		1•1322	1•1322
International Crystal	1•1332	1•1332		1•1332			1•1332
ITT Components		1•1333	1•1333	1•1333			
McCoy Electronics		1•1339					
Monitor Products	1•1345	1•1345	1•1345	1•1345		1•1345	
M-Tron		1•1338	1•1338	1•1338		1•1338	1•1338
Murata Erie		1•1348	1•1348	1•1348		1•1348	
NEL/Midland Ross		1•1350	1•1350	1•1350			
Reeves Hoffman		1•1366		1•1366		1•1366	
Saronix		1•1368	1•1368	1•1368			1•1368
Seiko Instrument		1•1371	1•1371	1•1371	1•1371		
Sokol Crystal		1•1372	1•1373	1•1372		1•1373	
Statek		1•1377	1•1377	1•1377			

FILTERS

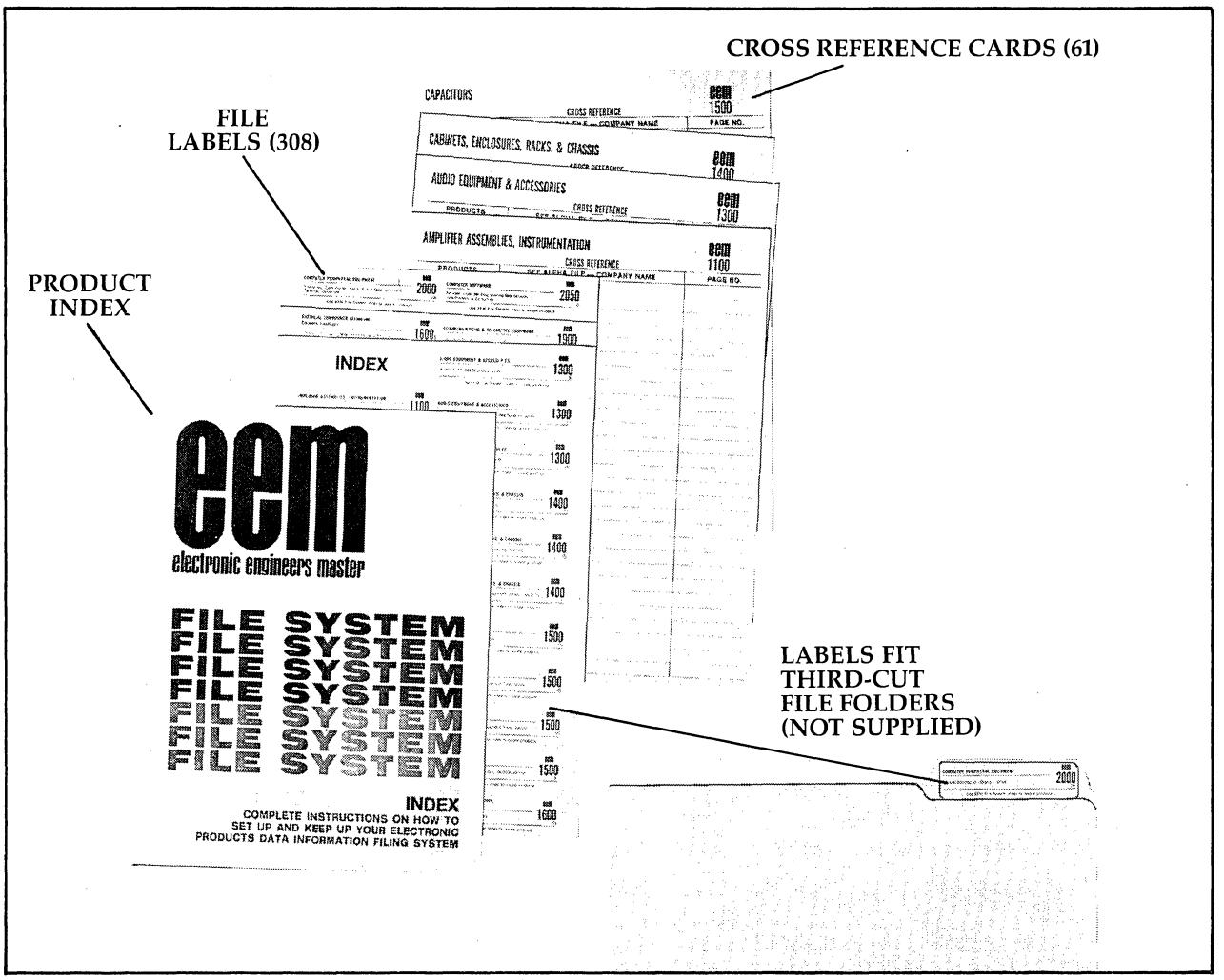
Manufacturer	Active	AF	Notch (Band Elimination)	Bandpass	Ceramic	Comb	Crystal	Equalizer	High Pass	Hybrid
Comstron	1•1295		1•1295	1•1295			1•1295			1•1295
Damon		1•1316	1•1316	1•1316			1•1316		1•1316	
Frequency Electronics			1•1327	1•1327			1•1327			
FSN	1•1328		1•1328	1•1328			1•1328	1•1328	1•1328	1•1328
Hughes Solid State			1•1330	1•1330			1•1330			
McCoy		1•1340	1•1341	1•1340			1•1340			
Microsonics			1•1344	1•1344		1•1344	1•1344			
Monitor Products							1•1345			
Murata Erie				1•1349	1•1349		1•1348			
Opt Industries		1•1351	1•1351	1•1351			1•1351		1•1351	
Piezo Technology		1•1367	1•1359	1•1360			1•1359			
Reeves Hoffman	1•1367		1•1367	1•1367		1•1367	1•1367	1•1367	1•1367	
Sokol			1•1372	1•1372			1•1372			

FILTERS

Manufacturer	IF	LC	Linear Phase	Low Pass	Microwave	RF	Single Sideband	UHF/VHF	Vestigial Sideband	MIL Electrical & Networks
Comstron	1•1295	1•1295			1•1295	1•1295	1•1295	1•1295	1•1295	1•1295
Damon	1•1316			1•1316		1•1316				
Frequency Electronics						1•1327	1•1327			
FSN		1•1328	1•1328	1•1328			1•1328			1•1328
Hughes Solid State										1•1330
McCoy	1•1340					1•1340		1•1341		
Microsonics		1•1344	1•1344				1•1344			
Monitor Products		1•1345				1•1345				1•1345
Murata Erie	1•1348					1•1348				1•1348
Opt Industries	1•1351	1•1351		1•1351				1•1351		
Piezo Technology	1•1359					1•1359		1•1358		
Reeves Hoffman			1•1367	1•1367		1•1367	1•1367			1•1367
Sokol		1•1372				1•1372		1•1372		1•1372

OSCILLATORS

Manufacturer	AF	Clock	Crystal Controlled (Module)	LC	Low Frequency	Microwave	Oven	Pulse (Module)	RC Module	RF Module	Sinusoidal (Module)	Square Wave (Module)	Temperature Compensated	Tuning Fork Controlled	UHF/VHF (Module)	Ultrasonic	VCO (Modules)	MIL Crystal & Ovens	MIL, VCO, Solid State, RF	Power (Module)
Austron			1•1282		1•1282			1•1282		1•1282		1•1282	1•1282		1•1282			1•1282	1•1282	
Bliley	1•1291	1•1290	1•1290		1•1290			1•1290		1•1290	1•1290	1•1290	1•1291		1•1290		1•1291			
Comstron			1•1293		1•1293	1•1293	1•1293			1•1293	1•1293	1•1293	1•1293		1•1293		1•1293	1•1293	1•1293	
Conner-Winfield		1•1296	1•1296	1•1297	1•1296			1•1296		1•1296	1•1296	1•1296	1•1298		1•1296		1•1298			
CTS Knights		1•1312	1•1308		1•1309		1•1310	1•1308			1•1308	1•1308	1•1308		1•1312		1•1308	1•1311		
Dale Electronics		1•1314	1•1314					1•1314				1•1314	1•1314		1•1314					
Damon/Electronic Div.			1•1316					1•1316		1•1316	1•1316				1•1316		1•1316			
Electronic Research			1•1318				1•1318	1•1318		1•1318	1•1318	1•1318			1•1318					
Fox Electronics		1•1320	1•1320					1•1320				1•1320			1•1320					
Frequency Control		1•1322	1•1322		1•1322		1•1322				1•1322		1•1322	1•1322			1•1322	1•1322		
Frequency Electronics			1•1327	1•1327		1•1327				1•1327	1•1327		1•1327				1•1327			
Greenray			1•1329		1•1329								1•1329				1•1329	1•1329		
Hughes Solid State			1•1330					1•1330		1•1330		1•1330	1•1330				1•1330	1•1330		
Isotemp			1•1334					1•1334		1•1334	1•1334	1•1334	1•1334		1•1334					
ITT Compononets		1•1333	1•1333							1•1333					1•1333					
Leach		1•1336	1•1336		1•1336					1•1336	1•1336	1•1336			1•1336			1•1336		
McCoy Electronics	1•1342	1•1342	1•1342		1•1342		1•1342	1•1342		1•1342	1•1342	1•1342	1•1342		1•1342			1•1342		
M. F. Electronics Corp.		1•1337															1•1337			
Microsonics		1•1344	1•1344				1•1344	1•1344		1•1344	1•1344	1•1344	1•1344					1•1344	1•1344	
Midland-Ross		1•1350	1•1350					1•1350				1•1350								
Monitor Products			1•1345		1•1345			1•1345		1•1345		1•1345	1•1345		1•1345		1•1345	1•1345	1•1345	
Motorola/Component Prod.		1•1347	1•1347					1•1347				1•1347			1•1347					
M-Tron	1•1338		1•1338		1•1338					1•1338		1•1338			1•1338					
Murata/Erie		1•1348	1•1348		1•1348		1•1348			1•1348	1•1348	1•1348	1•1348		1•1348		1•1348			
Oscillatek			1•1353					1•1353		1•1353	1•1353	1•1353	1•1353					1•1353		
Ovenaire	1•1355		1•1354	1•1356	1•1354		1•1354	1•1354	1•1356	1•1354	1•1354	1•1354	1•1354		1•1354		1•1356			
Piezo Technology			1•1358				1•1358						1•1358							
Q-Tech		1•1362	1•1362					1•1362				1•1362			1•1362		1•1362	1•1362		
Reeves-Hoffman	1•1365	1•1365	1•1365	1•1365					1•1365	1•1365		1•1365	1•1365			1•1365	1•1365			
Saronix		1•1368	1•1368					1•1368		1•1368	1•1368	1•1368								
Seiko Instruments		1•1371	1•1371					1•1371				1•1371			1•1371					
Sokol Crystal Prod.		1•1373	1•1373							1•1373					1•1373					
Spectrum		1•1374	1•1374							1•1374	1•1374	1•1374	1•1374		1•1374		1•1374	1•1374		
Statek			1•1377		1•1377			1•1377			1•1377	1•1377		1•1377						
Tech-Trol			1•1380			1•1380	1•1380			1•1380	1•1380				1•1380		1•1380			
Vectron		1•1382	1•1386		1•1382		1•1385	1•1382		1•1382	1•1383	1•1382	1•1384		1•1383		1•1386	1•1382	1•1382	1•1383
XSIS Electronics		1•1387	1•1387									1•1387								



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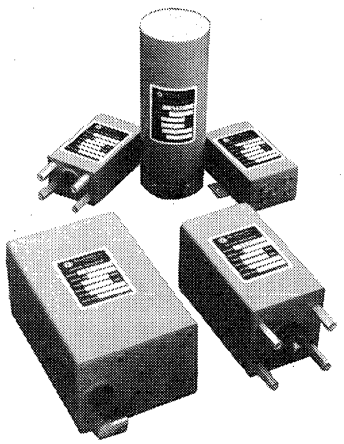


AUSTRON OFFERS A COMPLETE LINE OF HIGH PRECISION OVENIZED CRYSTAL OSCILLATORS

- Up to 5 × 10^{-11}/24 hours aging
- Frequencies from 1 to 120 MHz
- MIL-SPEC, JANTX, Radiation hardened
- Custom engineering

SMALL LIGHT WEIGHT

The Austron Model 1100 Crystal Oscillator combines high stability with low power drain in a small, lightweight, plug-in package. This hermetically sealed crystal oscillator finds application whenever space is at a premium and performance cannot be compromised.

DIGITAL APPLICATIONS

The Austron Model 1105 is a low profile solid-state crystal oscillator designed to provide a highly stable 1 MHz logic output for IC applications. The Model 1105 operates from a 5 volt power supply. The size, weight, and stability performance have been packaged in a configuration for the IC instrument designer.

EXTREMELY LOW POWER

The Austron Model 1115 5 MHz Oscillator was specifically designed for undersea applications where high stability and minimal power drain are of prime importance.

VERSATILITY

The Austron Model 1120 is a compact, rugged crystal oscillator designed for a wide range of applications. This unit is available at many different frequencies, input voltages, and mechanical configurations.

LOW PHASE NOISE

The Austron 1120L features extremely low phase noise performance.

ULTRA HIGH STABILITY

The Austron Model 1150 is a very rugged, high precision crystal oscillator which was specifically developed for use in satellite navigation systems. The Model 1150 has application whenever system requirements demand a precise time base or frequency reference. Technical features include an ultimate aging of 5 × 10^{-11}/day, low phase noise, and a standard frequency of 5 MHz.

HIGHER FREQUENCY

Austron's latest addition to the Austron family of oscillators, the Austron Model 1170 Series VHF Oscillator, includes several units in the range of 35 MHz to 120 MHz.

OUTPUT FREQUENCY:	5 MHz Standard
AGING RATE:	5, 2 OR 1 × 10^{-9}/24 Hrs. after 72 hours continuous operation.
AMBIENT TEMPERATURE STABILITY:	Less than 2.5 × 10^{-8} from −20° to +65°C
MECHANICAL:	Size: 1.25 × 1.75 × 3.25 inches

OUTPUT FREQUENCY:	1 MHz; TTL Logic
AGING RATE:	10, 5, 2 or 1 × 10^{-9}/24 hours after 72 hours operation
AMBIENT TEMPERATURE STABILITY:	Less than 5 × 10^{-9} from 0°C to 55°C
MECHANICAL:	Size 1.25 × 1.75 × 3.25 inches

OUTPUT FREQUENCY:	5 MHz
AGING:	3 × 10^{-9}/24 hrs after 72 hours operation
AMBIENT TEMPERATURE	1 × 10^{-9}/24 hrs after 30 days operation
STABILITY:	Less than 5 × 10^{-9} from −2°C to 25°C NOTE: Higher temperature models available
MECHANICAL:	Size: Cylinder 2" diameter, 5.5" long.

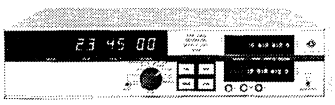
OUTPUT FREQUENCY:	1 MHZ THRU 10 MHZ
AGING RATE:	5, 2 or 1 × 10^{-9}/24 Hrs. after 72 hours continuous operation.
AMBIENT TEMPERATURE STABILITY:	Less than 2 × 10^{-9} from −20° to + 65°
MECHANICAL:	Size: 2.27 × 2.14 × 4 inches

OUTPUT FREQUENCY:	5MHz OR 10 MHz
PHASE NOISE: (1 Hz BW)	135 dB, Ten Hz 155 dB, One Hundred Hz 160 dB, One kHz

OUTPUT FREQUENCY:	5 MHz Standard
AGING RATE:	5 × 10^{-10}/24 hrs after operation. 1 × 10^{-10}/24 hrs after 30 days operation. Ultimate drift is typically 5 × 10^{-11} after 90 days operation.
AMBIENT TEMPERATURE STABILITY:	Less than 2 × 10^{-9} from −55°C to +60°C Less than 5 × 10^{-10} from 0°C to 50°C.
MECHANICAL:	Size: 2.37 × 3.18 × 5.0 inches.

CALL FOR DETAILS

Time/frequency instruments

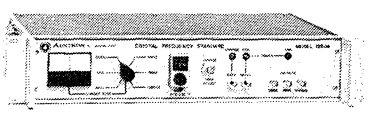


AUSTRON 8154

The Austron Time Code Instrumentation — a complete line of instruments from basic generators and readers to full complement tape search and control units. Available for bench, panel, rack, or portable; all standard IRIG, XR3, and NASA codes are available to give these instruments the flexibility to meet any system requirement.

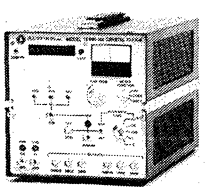
AUSTRON 2100

The Austron Loran-C receivers are microprocessor based automatic acquisition and tracking receivers that utilize the Loran-C groundwave to provide a traceable reference for time epoch determination, frequency management, calibration, and control. These receivers provide time accuracy to one microsecond and frequency accuracy to parts in 10^{-12}.



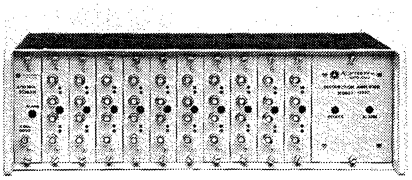
AUSTRON 1250A

The Austron Model 1250A Crystal Frequency Standard generates highly stable output frequencies at 5 MHz, 1 MHz, and 100 kHz. Each of these outputs has excellent waveform and spectral purity. Containing its own internal battery back-up, it also may be used with an external standby power supply such as the Austron Model 1290A Standby Power Supply.



AUSTRON 1210D

The Austron Model 1210D series of Portable Crystal Clocks are compact, self-contained, self-powered time references providing stable time outputs at several pulse and sinusoidal frequencies, as well as a digital time-of-day display.



AUSTRON 1295C

The Austron Model 1295C Distribution Amplifier provides the necessary noise immunity and drive capability to interface a localized frequency standard to other equipment at distances up to 1,000 feet. Four standard frequencies, 10 MHz, 5 MHz, 1 MHz and 0.1 MHz can be accommodated (for other frequencies consult factory). Input frequencies and number of outputs for each frequency are customer specified to provide a more cost effective system. Single frequency units can have up to 40 individual outputs, while units with 2 to 4 frequency inputs will have four or more outputs for each input.

SYSTEMS—complete systems for generation, management, and distribution of precise time and frequency. Austron's engineering has led to such sophistication as the secure communications frequency control sets AN/GSQ-174 and AN/GSQ-183. Time and Frequency Receivers, Disciplined Frequency Standards, Distribution Amplifiers, Time Code Generators and Readers, and all ancillary equipment along with Austron Engineering . . . put it to work, for you!

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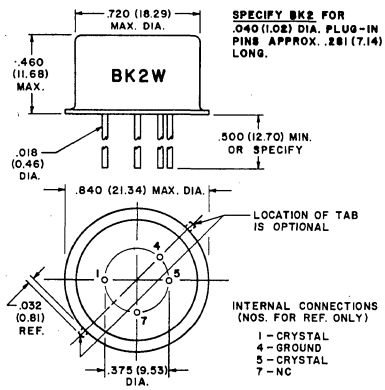
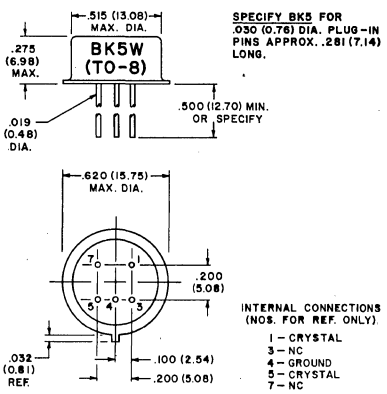
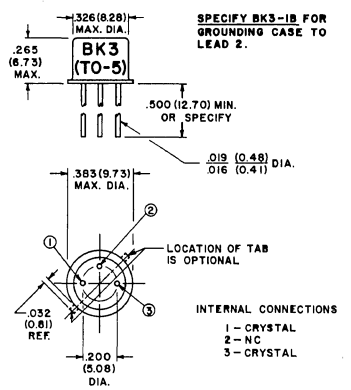
Coldweld Vacuum Sealed Transistor Case Styles

UNMATCHED PERFORMANCE DURING EXTREME SHOCK AND VIBRATION COMBINED WITH SUPERIOR AGING AND HIGH RELIABILITY HAVE FIRMLY ESTABLISHED THIS STYLE AS FIRST CHOICE IN ADVANCED MILITARY AND SPACE SYSTEMS. EASE OF MOUNTING, FORM COMPATIBILITY AND MODERATE COST ALSO ATTRACT QUALITY COMMERCIAL USAGE.







BLILEY TYPE	FREQUENCY RANGE (MHz)	FREQ. TOL. (%) vs TEMP. RANGE (°C) (INCLUDES CALIBRATION AT +25°C)				MAX. SERIES RES. (Ω)	CRYSTAL CUT-AT (MODE)	TYPICAL DRIVE LEVEL (mW)
		0 TO 50	0 TO 70	−40 TO +70	−55 TO +105			
BK2W	.86 - .99	±.0015	±.002	±.0025	±.003	300	FUNDAMENTAL	1.0
	1 - 1.9					150		
	2 - 2.9					40		
	3 - 6.0					25		
BK5W	2 - 2.9					250		
	3 - 3.9					120		
	4 - 4.9					60		
	5 - 5.9					30		
	6 - 7.9					22		
	8 - 15					15		
BK3	7 - 9.9					40		0.5
	10 - 25					25		
	25 - 75					40	3RD	
	75 - 125					60	5TH	
	125 - 150					100	7TH	

BLILEY TYPE	BK2W	BK3-1B	BK5W
MIL-H-10056 HOLDER DESIGNATION	HC-40/U	HC-35/U	HC-37/U
AGING GUIDELINES: 1ST MONTH	2 PPM	2 PPM	2 PPM
FOLLOWING YEAR	1.5 PPM	3 PPM	2 PPM
VIBRATION	20G FROM 10 - 2000 Hz		
SHOCK	150G FOR 7 ms		

For further information call (814) 838-3571 or TWX 510-696-6886
BLILEY ELECTRIC COMPANY
2545 W. GRANDVIEW BOULEVARD
P. O. BOX 3428
ERIE/PENNSYLVANIA 16508

CRYSTALS

Bliley

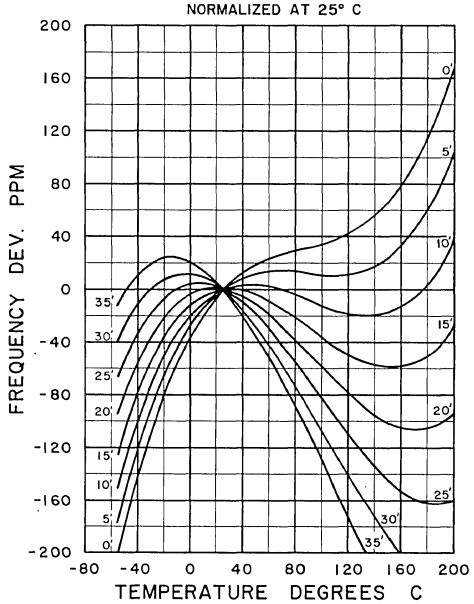
first name in frequency control

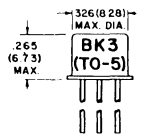
Stress Compensated Double Angle Rotation • SC Cut

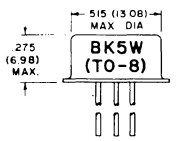
- IMPROVED FREQUENCY STABILITY DURING ACCELERATION AND VIBRATION
- HIGH DRIVE CAPABILITY — SEVERAL TIMES TYPICAL AT CUT LEVELS
- LOW PHASE NOISE
- LOW AGING RATE
- FAST WARM-UP

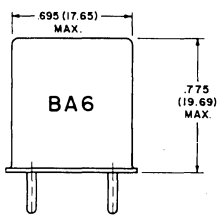
SC CUT

GENERALIZED TEMP./FREQ. CHARACTERISTICS
NORMALIZED AT 25° C







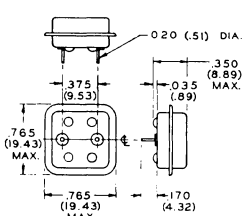


BLILEY TYPE	FREQUENCY RANGE (MHz)	MODE
BK5/BK5W	5–15	FUND.
BK3/BK3-1B	15–33	
BA6/BA6W	5–45	3RD
BK5/BK5W	33–45	
BK3/BK3-1B	45–100	
	75–140	5TH

TEMPERATURE RANGE (°C)	FREQUENCY TOLERANCE*
0 TO +50	±.0018%
–10 TO +60	±.0023%
–40 TO +85	±.0048%
–55 TO +85	±.006%
–55 TO +105	±.007%
–55 TO +125	±.0075%
–55 TO +200	±.01%
+20 TO +85	±.0023%
+60 TO +90	±.001%

*INCLUDES STABILITY OVER TEMP. RANGE & CALIBRATION TOLERANCE.

For PC Board Mount • Coldweld Sealed • DT-SL-AT Cuts



HB2
(HC-39/U)

BLILEY TYPE	FREQUENCY RANGE (kHz)	FREQ. TOL. (%) vs TEMP. RANGE (°C) 0 TO 50	0 TO 75	–40 TO +70	–55 TO +90	MAX. SERIES RES. (Ω)	CUT
HB2	200-299	±.007	±.008	±.01	±.015	4000	DT
	300-399					5500	
	400-450					6000	
	450-599	±.003	±.004	±.007	±.011	2000	SL
	600-800					2500	
	1-2 MHz	±.002	±.0025	±.003	±.004	400	A_f
	2-3 MHz					200	
	3-4 MHz					100	
	4-7 MHz					60	
	7-10 MHz					30	
	10-20 MHz					25	
	20-50 MHz					40	A_3

ALL FREQUENCY TOLERANCES INCLUDE INITIAL CALIBRATION AT +25°C.

A_f AND A_3 DENOTE AT CUT-FUNDAMENTAL MODE AND 3RD OVERTONE MODE.

For further information call (814) 838-3571 or TWX 510-696-6886
BLILEY ELECTRIC COMPANY
2545 W. GRANDVIEW BOULEVARD
P.O. BOX 3428
ERIE/PENNSYLVANIA 16508

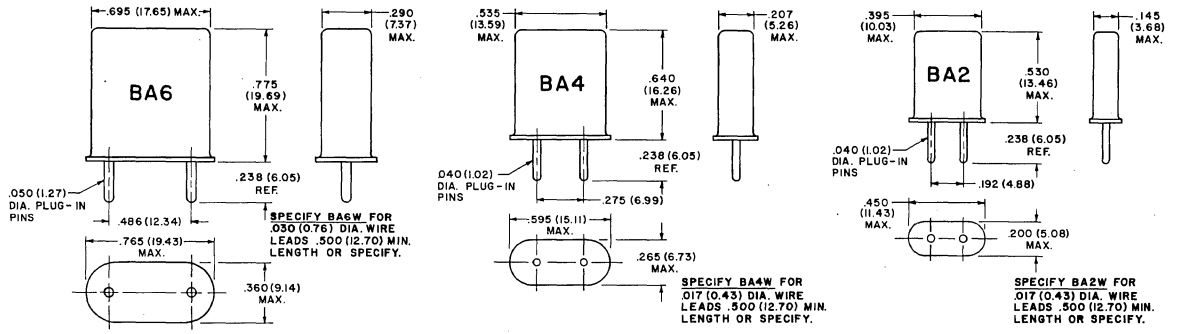
CRYSTALS

Bliley

Coldweld Vacuum Sealed

first name in frequency control

ALTHOUGH SIMILAR IN APPEARANCE AND CONFIGURATION TO A COMMONLY USED SOLDER-SEALED COUNTERPART, BLILEY'S **BA** SERIES FEATURES UNEXCELLED PROCESS CLEANLINESS AND FLUX-FREE SEALING IN VACUUM TO MINIMIZE CONTAMINATION. IMPROVED AGING AND RELIABILITY RESULT AT A MODEST COST PREMIUM. THE DATA FOLLOWING IS SUGGESTED FOR GENERAL GUIDANCE. SUPERIOR PERFORMANCE IN TEMPERATURE STABILITY AND AGING CAN BE PROVIDED IF REQUIRED.



BLILEY TYPE	FREQUENCY RANGE	FREQ. TOL. (%) vs TEMP. RANGE (°C) (INCLUDES CALIBRATION AT +25°C)				MAX. SERIES RES. (Ω)	CRYSTAL CUT	AGING (PPM)		MAX. DRIVE LEVEL (mW)
		0 TO 50	0 TO 75	−40 TO +70	−55 TO +90			1ST MONTH	NEXT 12 MONTHS	
BA6	200–299 kHz	±.007	±.008	±.01	±.015	3000	DT	20	40	2
	300–399 kHz					4000				
	400–500 kHz					5000				
	325–499 kHz	±.0025	±.003	±.005	±.007	1500	GT			
	500–600 kHz					2000				
	300–500 kHz	±.003	±.004	±.007	± 011	1000	SL			
BA6 & BA2	500–599 kHz					1500				
	600–800 kHz					2000				
BA6	1–2 MHz	±.0015	±.002	±.0025	−55 to+105	350	A_f	3	2	5
BA6 & BA4	2–3 MHz				±.004	175			3	
	3–4 MHz					75				
BA6, BA4, & BA2	4–7 MHz					50				
	7–10 MHz					30				
	10–20 MHz					25				
	20–60 MHz					40	A_3			2
BA2	60–87 MHz					50	A_5			1
	87–100 MHz					60				
	100–150 MHz					90	A_7			

AGING VALUES ARE BASED UPON CONTINUOUS OPERATION AT +85°C AND DRIVE LEVELS AS INDICATED.
A_f, A_3, A_5, A_7 DENOTE AT CUT-FUNDAMENTAL MODE, 3RD OVERTONE MODE, ETC.

BLILEY TYPE	BA6	BA6W	BA4	BA4W	BA2	BA2W
MIL-H-10056 HOLDER DESIGNATION	HC-36/U	HC-47/U	HC-46/U	–	HC-42/U	HC-43/U
VIBRATION	10G FROM 10–2000 Hz					
SHOCK	100G FOR 11 ms					

INTERNALLY RUGGEDIZED DESIGNS ARE AVAILABLE FOR HIGHER LEVEL SHOCK AND VIBRATION.

For further information call (814) 838-3571 or TWX 510-696-6886
BLILEY ELECTRIC COMPANY
2545 W. GRANDVIEW BOULEVARD
P.O. BOX 3428
ERIE/PENNSYLVANIA 16508

CRYSTALS

Bliley

General Purpose and Mil-Spec.

first name in frequency control

GOOD PERFORMANCE AND RELIABILITY PLUS VERSATILITY IN MOUNTING AND ECONOMY PINPOINT THIS GROUP AS THE LOGICAL CHOICE FOR MOST COMPUTER, DATA PROCESSING AND GENERAL PURPOSE APPLICATIONS. A VARIETY OF HOLDER STYLES IS AVAILABLE WITH THE FAMILIAR MIL-SPEC SOLDER SEAL OR OUR "RESISTANCE-WELD" SEAL, A NEWER PROCESS IDEALLY ADAPTED TO VOLUME PRODUCTION AT LOWEST COST WITH A REDUCED POSSIBILITY OF CONTAMINATION.

BLILEY TYPE	FREQUENCY RANGE (kHz)	TEMPERATURE RANGE (°C) 0 TO 50 FREQ. TOL. (%)	0 TO 50 MAX. SERIES RES. (Ω)	0 TO 75 FREQ. TOL. (%)	0 TO 75 MAX. SERIES RES. (Ω)	−40 TO +70 FREQ. TOL. (%)	−40 TO +70 MAX. SERIES RES. (Ω)	−55 TO +90 FREQ. TOL. (%)	−55 TO +90 MAX. SERIES RES. (Ω)	CRYSTAL CUT	AGING (PPM) 1ST MONTH	AGING (PPM) NEXT 12 MOS.	MAX. DRIVE LEVEL (mW)
BH9	2.5-5	±.01	75k	±.015	85k	±.02	85k	±.025	100k	JT	40	100	0.1
	5-8		60k		75k		75k		90k				
	8-13.5		50k		60k		60k		75k				
	13.5-30	±.005	75k	±.009	100k	±.012	100k	±.02	125k	NT	20	50	
	30-50		65k		90k		90k		110k				
	50-100		55k		75k		75k		90k				
	90-175	±.015	3.5k	±.017	3.5k	±.02	4k	±.03	5k	+5°X	25	70	2
	175-250		4k		4k		4.5k		6k				
BH6	200-300		4k		4k		4.5k		6k				

		FREQ. TOL. (%) vs TEMP. RANGE (°C) 0 TO 50	0 TO 75	−40 TO +70	−55 TO +90	MAX. SERIES RES. (Ω)	CRYSTAL CUT	AGING (PPM) 1ST MONTH	AGING (PPM) NEXT 12 MOS.	MAX. DRIVE LEVEL (mW)
BH6/BR6	200-299	±.007	±.008	±.01	±.015	4000	DT	20	40	2
	300-399					5000				
	400-500					6000				
BH6/BR6 & BX/BR2	300-500	±.003	±.004	±.007	±.011	1500	SL			
	500-599					2000				
	600-800					2500				
BH6/BR6	325-499	±.0025	±.003	±.005	±.007	2000	GT			
	500-600					2500				
	450-599	±.007	±.009	±.01	±.02	2500	P			
	600-750					3000				
BH6/BR6 & BH4	1-2 MHz	±.002	±.0025	±.003	−55 to +105	400	A_f	4	3	5
	2-3 MHz				±.005	200				
	3-4 MHz					100				
BH6/BR6 BH4 & BX/BR2	4-7 MHz					60				
	7-10 MHz					30				
	10-20 MHz					25				
	20-60 MHz					40	A_3			2
BX/BR2	60-87 MHz					60	A_5	4	4	
	87-100 MHz					75				
	100-150 MHz					90	A_7			

ALL FREQUENCY TOLERANCES INCLUDE INITIAL CALIBRATION AT +25°C.
AGING VALUES ARE BASED UPON CONTINUOUS OPERATION AT +85°C AND DRIVE LEVELS AS INDICATED.
A_f, A_3, A_5, A_7 DENOTE AT CUT-FUNDAMENTAL MODE, 3RD OVERTONE MODE, ETC.

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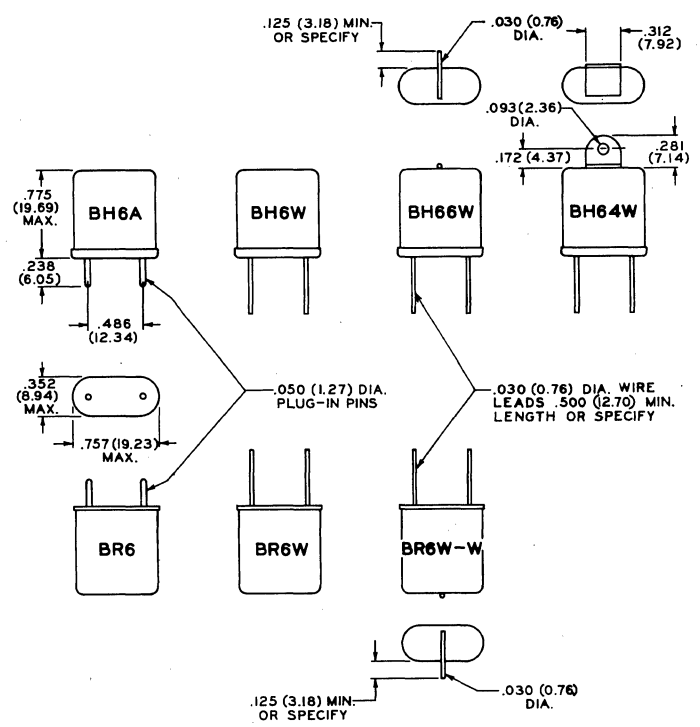
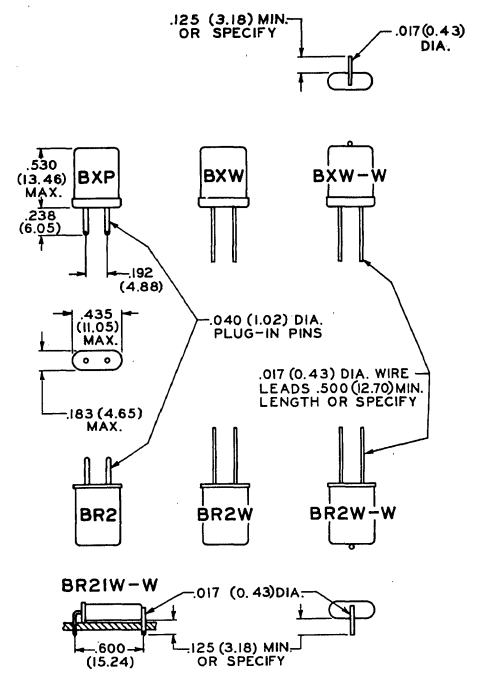
2545 W. GRANDVIEW BOULEVARD
P.O. BOX 3428
ERIE/PENNSYLVANIA 16508

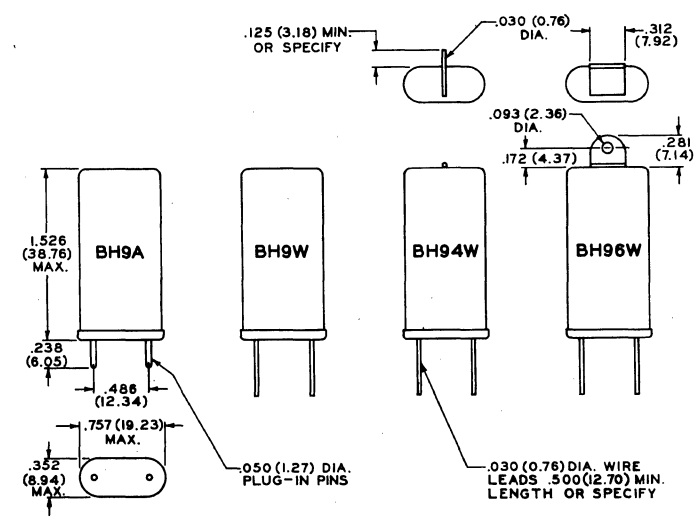
CRYSTAL HOLDERS

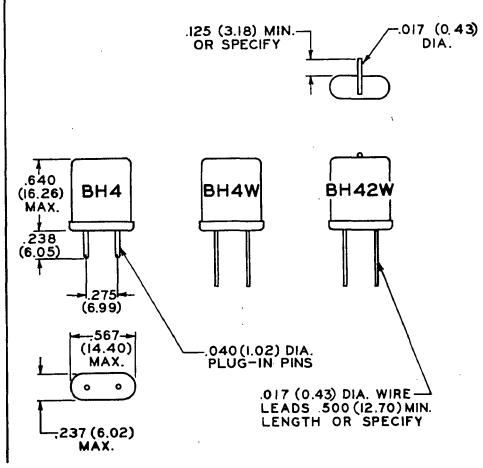
Bliley — first name in frequency control

BH & BX Series • solder sealed
BR Series • resistance-weld sealed









BLILEY TYPE	BH6A	BH6W	BR6	BR6W	BXP	BXW	BR2	BR2W	BH9A	BH9W	BH4
MIL-H-10056 HOLDER DESIGNATION	HC-6/U	HC-33/U	HC-48/U	HC-51/U	HC-25/U	HC-18/U	HC-50/U	HC-49/U	HC-13/U	HC-34/U	HC-32/U
VIBRATION	10 G FROM 10 TO 500 Hz										
SHOCK	100 G FOR 11 ms										

INTERNALLY RUGGEDIZED DESIGNS ARE AVAILABLE FOR HIGHER LEVEL SHOCK AND VIBRATION.

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CRYSTALS

Bliley

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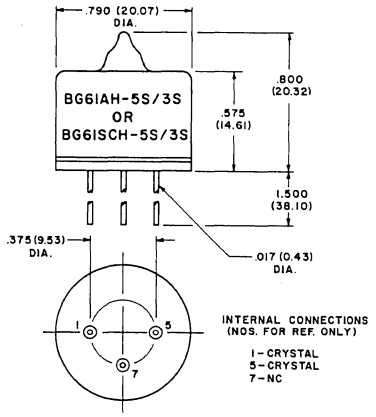
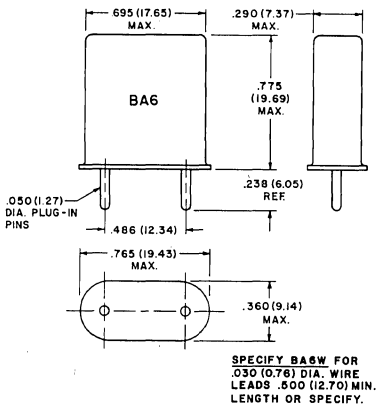
Vacuum Sealed
Ultra High Stability

DESIGNED FOR OPTIMUM PERFORMANCE WITH TEMPERATURE CONTROL

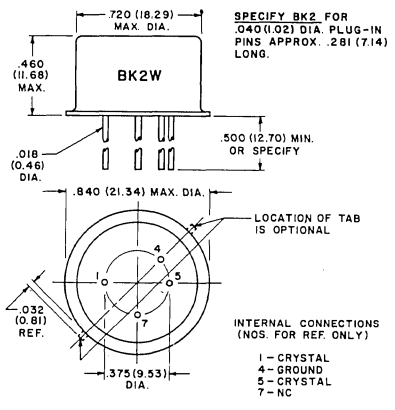
THIS OUTSTANDING GROUP INCORPORATES THE TECHNOLOGY AND CRAFTSMANSHIP THAT HAS MADE BLILEY FAMOUS FOR QUALITY WITHOUT COMPROMISE. EXCEPTIONALLY LOW AGING AND HIGH Q CHARACTERISTICS PROVIDE PRECISION REFERENCE FOR FREQUENCY STANDARDS, SYNTHESIZERS AND ULTRA STABLE SYSTEM CLOCKS.



BG61AH-5S/3S OR BG61SCH-5S/3S
(GLASS ENCLOSURES)



BA6/BA6W
(COLDWELD SEALED METAL ENCLOSURES)

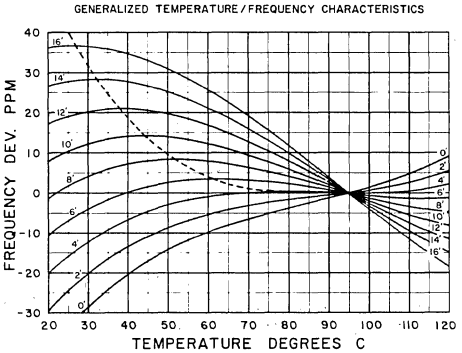


BK2/BK2W

	5TH OVERTONE (AT CUT)	3RD OVERTONE (AT CUT)					
BLILEY TYPE	BG61AH-5S	BG61AH-3S	BA6/BA6W		BK2/BK2W		
FREQ.MHz	5	3.8 – 6.0	3.8 – 7.9	8 – 12	3.8 – 6.0	6.1 – 10.9	11 – 15
AVERAGE Q (10^6)	2.5	1.5		0.6	1.0	0.6	0.4
MAX SERIES RESISTANCE (Ω)	140	50		35	50	40	35
FREQ. TOL. AT TURNING POINT	± 1 PPM	± 4 PPM	± 5 PPM				
TURNING POINT	AVAILABLE AT ANY TEMPERATURE (± 5°C) FROM +45° TO +90°C (TOLERANCE OF ± 3° OR ±4° AVAILABLE UPON REQUEST)						
TEMPERATURE COEFFICIENT	$< 1 \times 10^{-7}$/°C FOR 1° EACH SIDE OF TURNING POINT						
AGING AT +75°C	5×10^{-10}/DAY AFTER 3 DAYS; 7×10^{-10}/WEEK AFTER 1 MONTH	2×10^{-9}/DAY AFTER 3 DAYS; 2×10^{-9}/WEEK AFTER 1 MONTH	2×10^{-8}/WEEK AFTER 1 WEEK				
DRIVE LEVEL	70μA ± 20%	15μW MAX.	25μW MAX.				
FREQ. CHANGE 50G SHOCK OR 10G VIBRATION	$< \pm 1 \times 10^{-8}$	$< \pm 2 \times 10^{-8}$					
	10 – 200 Hz		10 – 1500 Hz		10 – 2000 Hz		

SC CUT

GENERALIZED TEMPERATURE/FREQUENCY CHARACTERISTICS



	STRESS COMPENSATED – DOUBLE ANGLE ROTATION				
	5TH OVERTONE (SC CUT)	3RD OVERTONE (SC CUT)			
BLILEY TYPE	BG61SCH-5S	BG61SCH-3S		BA6/BA6W AND BK2/BK2W	
FREQ. (MHz)	5	5	10	5	10
AVERAGE Q (x 10^6)	2.5	2.2	1.2	2.0	1.0
MAX SERIES RESISTANCE (Ω)	350	110	65	120	70
FREQ.TOL. (PPM) AT TURNING POINT	±0.5	±1.5	±1.5	±1.5	±1.5
TURNING POINT	WITHIN ±5°C OF ANY TEMP. IN THE RANGE OF 50°C TO 75°C			WITHIN ±5°C OF ANY TEMP. IN THE RANGE OF 30°C TO 75°C	
AGING AT +75°C	7×10^{-10}/WEEK AFTER 1 MO.	2×10^{-9}/WEEK AFTER 1 MO.		2×10^{-8}/WEEK AFTER 1 WEEK	

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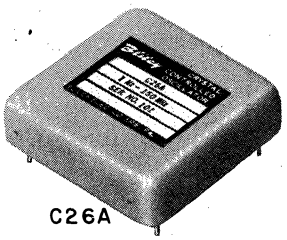
BLILEY ELECTRIC COMPANY
2545 W. GRANDVIEW BOULEVARD
P. O. BOX 3428
ERIE / PENNSYLVANIA 16508

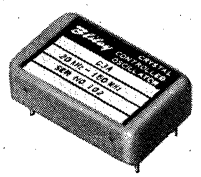
CRYSTAL OSCILLATORS

General Purpose-Clock Oscillators

first name in frequency control

Designed with primary emphasis on Quality — Backed up by Top Technology

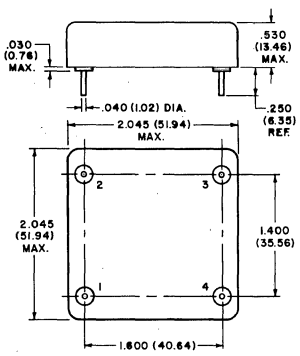

C26A


C3A

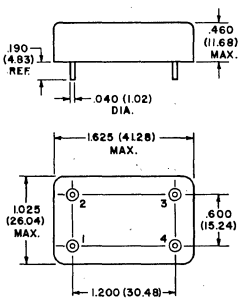
C76A

C8A

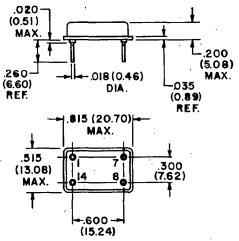
C79A



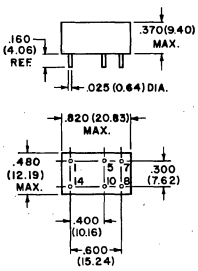
1 — NEG. OSC. & RF GND.
2 — VOLTAGE CONTROL OR N.C.
3 — +5 Vdc
4 — OUTPUT



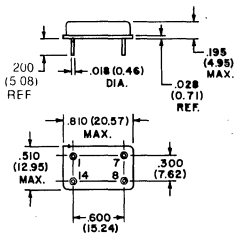
1 — NEG. OSC. & RF GND.
2 — N.C.
3 — +5 Vdc
4 — OUTPUT



1 — N.C.
7 — GROUND
8 — OUTPUT
14 — +5 Vdc
(14 PIN DIP COMPATABLE)



1, 5, 10 — N.C.
7 — GROUND
8 — OUTPUT
14 — +5 Vdc
(14 PIN DIP COMPATABLE)



1 — N.C.
7 — GROUND
8 — OUTPUT
14 — +5 Vdc
(14 PIN DIP COMPATABLE)

BLILEY TYPE	FREQUENCY RANGE	FREQ. TOL. (%) vs TEMP. RANGE (°C) (INCLUDES CALIBRATION AT +25°C)				OUTPUT
		0 TO 50	0 TO 70	−20 TO +70	−40 TO +70	
C26A	1 Hz — 2 MHz	± .001	± .0015	± .002	± .0025	TTL LOGIC
	50 kHz — 100 MHz	± .001	± .0012	± .0015	± .002	
	800 kHz — 150 MHz					SINE WAVE
C3A	20 kHz — 25 MHz	± .001	± .0012	± .0015	± .002	TTL LOGIC
	25 MHz — 50 MHz	± .001	± .0012	± .002	—	
	3 MHz — 100 MHz	± .001	± .0012	± .0015	± .002	SINE WAVE
C76A	1 MHz — 25 MHz	—	± .01	—	—	TTL LOGIC
	25 MHz — 40 MHz	—	± .02	—	—	
C8A	4 MHz — 60 MHz	± .004	± .005	± .01	—	
C79A*	1 MHz — 25 MHz	—	± .01	—	—	
	25 MHz — 40 MHz	—	± .02	—	—	

*(CASE DESIGN INCORPORATES AN ALL METAL RESISTANCE — WELD HERMETIC SEAL ENCLOSURE.)

GENERAL SPECIFICATIONS

SUPPLY: +5 VDC
OUTPUT: TTL LOGIC "1" +2.4 V MIN., LOGIC "0" +0.4 V MAX.
SYMMETRY: 60/40 DUTY CYCLE WORST CASE
LOAD: 10 TTL GATES
SINE WAVE: 0.7 VRMS (1000 Ω LOAD), 800 kHz — 25 MHz
0.2 VRMS (50 Ω LOAD), 1 — 150 MHz
CUSTOM OPTIONS AVAILABLE: CMOS LOGIC, COMPLEMENTARY OUTPUTS, DUAL-FREQUENCY OUTPUTS
FREQUENCY ADJUSTMENT: ELECTRICAL OR MECHANICAL AVAILABLE ON C26A AS A CUSTOM OPTION
HERMETIC ENCLOSURES: C26A, C3A AND C79A

For further information call (814) 838-3571 or TWX 510-696-6886
BLILEY ELECTRIC COMPANY
2545 W. GRANDVIEW BOULEVARD
P. O. BOX 3428
ERIE/PENNSYLVANIA 16508

CRYSTAL OSCILLATORS

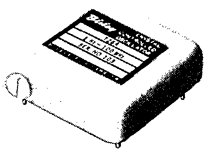
Bliley — first name in frequency control

Temperature Compensated (TCXO) Crystal Oscillators

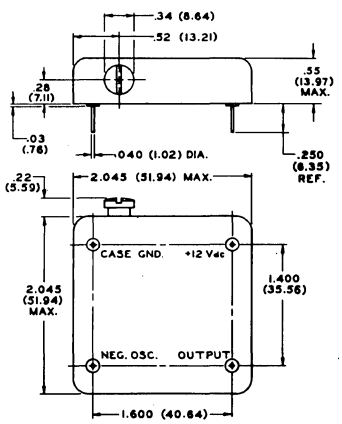
BLILEY TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS ARE DESIGNED TO INTEGRATE THE CHARACTERISTICS OF HIGH QUALITY COLDWELD SEALED CRYSTALS WITH TEMPERATURE COMPENSATED CIRCUITRY TO ACHIEVE IMPROVED FREQUENCY STABILITY WITHOUT TEMPERATURE CONTROL AND LOW AGING TO ASSURE LONG TERM RELIABILITY.

STOCK OSCILLATORS – FAST DELIVERY						
BLILEY TYPE NO.	FREQ. (MHz)	FREQ. STABILITY	SUPPLY (DC) VOLTS	REG.	mA	TTL LOGIC OUTPUT
T26A411	1	±1 x 10^{-6} OVER 0–50°C	+ 5	± 1%	35	"0": +0.4V MAX. "1": +2.4V MIN. T_r & T_f: 12 NS MAX. SYMMETRY: 60/40 LOAD: 10 TTL GATES
T26A412			+12	±10%	30	
T26A413/440*	5/10*		+ 5	± 1%	25	
T26A414/441*			+12	±10%	35	

FREQ. ADJUST. RANGE: ±5 X 10^{-6} MIN. AGING RATE: 1 X 10^{-6}/YR.


T26A

CUSTOM OSCILLATORS / BLILEY TYPE T26A SERIES		
FREQUENCY RANGE / OUTPUT WAVEFORM	FREQUENCY STABILITY vs TEMPERATURE RANGE	
1 MHz – 20 MHz SINEWAVE OR 50 kHz – 20 MHz TTL LOGIC	±1 x 10–6	0 to +60°C
	±5 x 10–7	
	±1 x 10–6	–20 to +70°C
	±5 x 10–7	
	±1 x 10–6	–40 to +70°C
	±2 x 10–6	–55 to +70°C
	±1 x 10–7	+20 to +40°C



SUPPLY REQUIREMENTS:
+12 VDC ±10% REG. AGING RATE: 1 X 10^{-6}/YR.

Options available:

- CMOS logic output from 1 Hz – 20 MHz
- Sine Wave & TTL logic output from 20 MHz – 100 MHz
- Other Supply Voltages

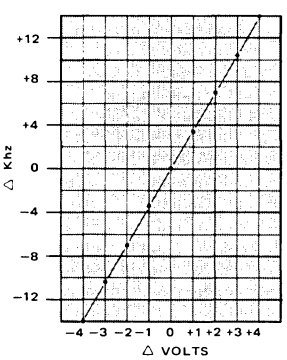
Voltage Controlled (VCXO) Crystal Oscillators

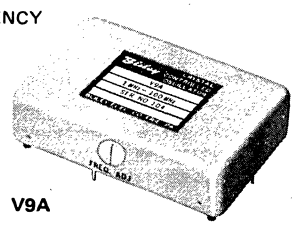
BLILEY VOLTAGE CONTROLLED CRYSTAL OSCILLATORS COMBINE INHERENT CRYSTAL STABILITY AND VOLTAGE CONTROLLED FREQUENCY DEVIATION IN A SINGLE SOLID STATE DEVICE. CENTER FREQUENCY RANGE FROM 1–100 MHz WITH PERFORMANCE CHARACTERISTICS TABULATED BELOW:

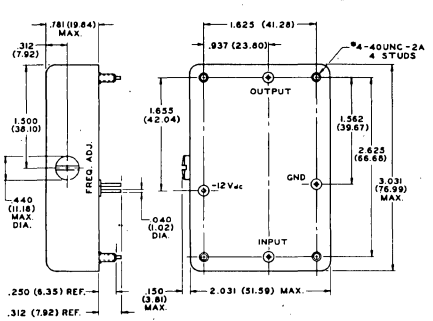
FREQUENCY DEVIATION	FREQUENCY STABILITY	TEMPERATURE RANGE
± .01%	± .001% ± .002%	0 to 50°C –20 to +70°C
± .05%	± .002% ± .005%	0 to 50°C –20 to +70°C
± .1%	± .004% ± .008%	0 to 50°C –20 to +70°C
± .2%	± .005% ± .01%	0 to 50°C –20 to +70°C

- Standard design parameters are based on operation with –12 Vdc; 25 mA supply. Other voltages may be specified as a custom option.
- Standard output is sine wave, typical 1V rms into 1000 ohms or .25V rms into 50 ohms.
- Mechanical trim is provided for center frequency adjustment.
- Typical modulation voltage is ±5V with a modulating input impedance of 10K ohms and modulation rate from DC to 20 kHz

TYPICAL LINEARITY CHART (C.F. 45 MHz & ± 14 kHz DEVIATION)



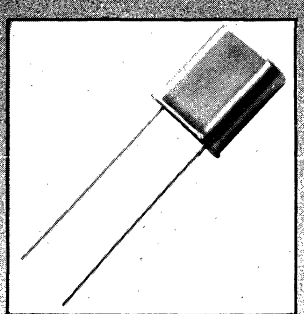

V9A



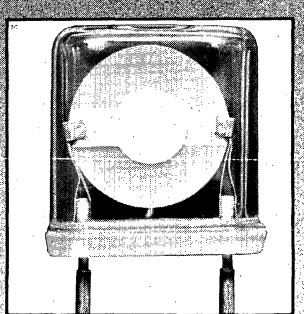
The CRYSTAL that's a cut above.

Colorado Crystal Corp., a leader in precision crystals, offers AT, SC and AC cuts in a variety of holders ranging from the HC 27/U glass to the HC 40/U coldweld.

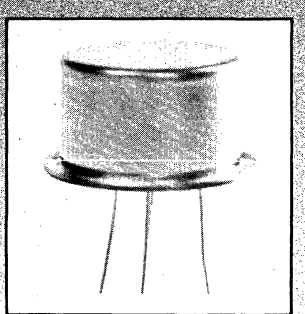
Our innovative production methods give us a decisive edge in supplying high quality crystals in the 1 to 200 megacycle range. We can meet your most precise specifications.



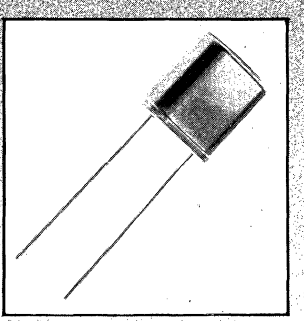
Resistance Weld Holders



Glass Holders



Coldweld Holders



Solder Seal Holders

Whatever your crystal needs, go with the leader and place your confidence in Colorado Crystal Technology.

CCC

Colorado Crystal Corporation

(303) 667-9248

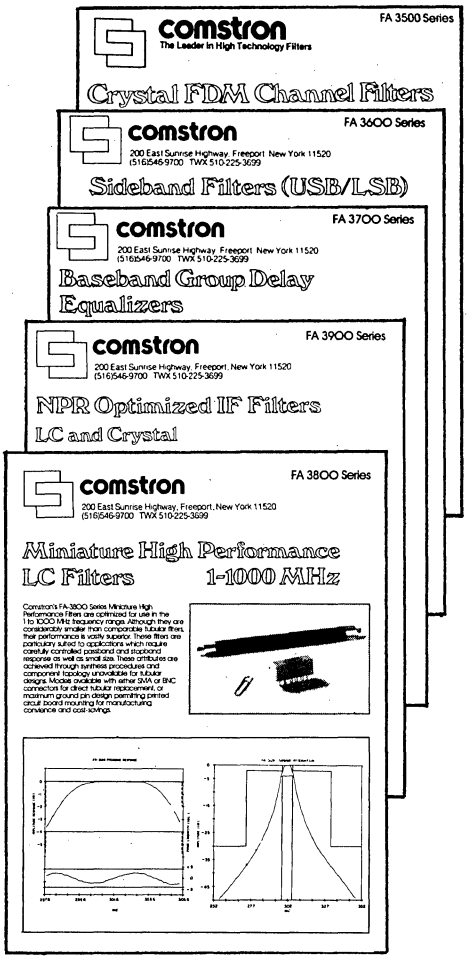
2303 West 8th St. / Loveland, Colo. 80537

comstron corporation

TECHNOLOGY " + " FILTERS

The Extra Edge in Systems Performance DC to 1 GHz

Comstron has developed optimum frequency or time domain filters to produce near theoretical system performance. These technology + filters are available as catalog items or custom tailored to your needs.



Design

Comstron has implemented modern network synthesis and physical realization techniques to the point where highly reliable, compact, LC and crystal filters are available – quickly and economically. Proprietary computer analysis, modeling, and optimization programs efficiently arrive at near-optium solutions to spectral, time domain, and stochastic problems. The Company's Enhanced Synthesis Program (ESP), Filter Optimization Program (FOP) and Parameter Optimization Program (POP) provide design parameters for systems oriented functions. Requirements for group delay equalization, wide band arithmetic symmetry, x/sin x amplitude correction, corrected Nyquist filters, phase compensation, and time domain response designs are routinely and efficiently handled.

Test

The Company's commitment to excellence is evident in its extensive test facilities. Automatic computer based network analyzers cover the frequency range from dc to 1.3 GHz with full plotting and printer output capability. Parameters which are automatically measured include amplitude response, phase response, group delay, and return loss. Time domain testing can also be performed to verify impulse response or response to complex waveforms.
Computer directed environmental testing allows unattended measurements of performance over temperature on a production basis. Comstron's proprietary Automatic Filter Test (AFT) programs permits rapid and accurate generation of acceptance test procedures as well as full documentation and data files when required.

Quality Control

Comstron maintains a Quality Control Department that ensures compliance with MIL-I-45208A and MIL-Q-9858A when applicable. Microscopic inspection, controlled environment, material control and traceability, solder training programs, and strict configuration management all contribute to producing an exceptionally reliable product.
The quality control program is continuously monitored. Over the years since its inception, Comstron has assembled a dedicated, conscientious staff whose pride of workmanship and customer loyalty is the keynote of the Company.

Send for our complete Data Sheets.

Standard Filter Catagories

- FDM Channel
- Quad Phase Matched
- Miniature LC.
- USB/LSB
- Fiber Optic Repeater
- Group Delay Equalizer
- NPR Optimized
- Pulse Response Optimized
- Nyquist
- Video
- Speech Plus
- Group/Super Group/Master Group/Pilot Notch
- 70/140 MHz Satellite IF Filters
- 70 MHz Switchable Equalizer (Delay or Amplitude)

Call Comstron for applications assistance for your LC and Crystal Filter requirements.

comstron corporation

200 East Sunrise Highway, Freeport, New York 11520
(516)546-9700 TWX 510-225-3699

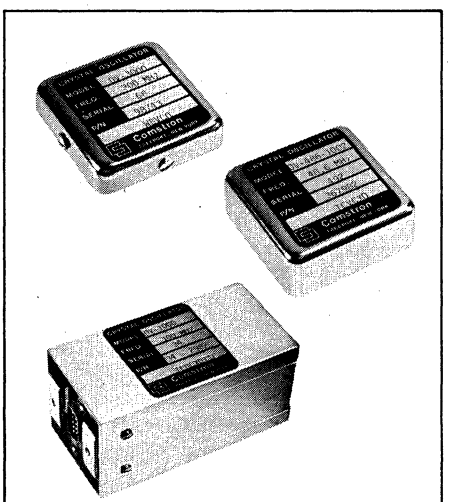
CRYSTAL OSCILLATORS

VCXO's To 1 GHz
TCXO's To 1 GHz

Comstron, the technology leader in oscillators for military, commercial, and deep-space applications, welcomes the opportunity to assist you with your crystal oscillator requirements. Through proprietary computer-generated design, testing and production techniques, Comstron delivers state-of-the-art low noise performance on VCXO's, TCXO's, Oven Controlled Crystal Oscillators and phase locked sources to 1 GHz. The Company's Design for Optimum Performance (DOP) programs provide optimization of performance attributes as well as sensitivity analysis. Our design and high reliability resources can make the difference in your system. Listed are typical standard designs from our Oscillator product library. However, modifications to suit your specific needs are easily accommodated.

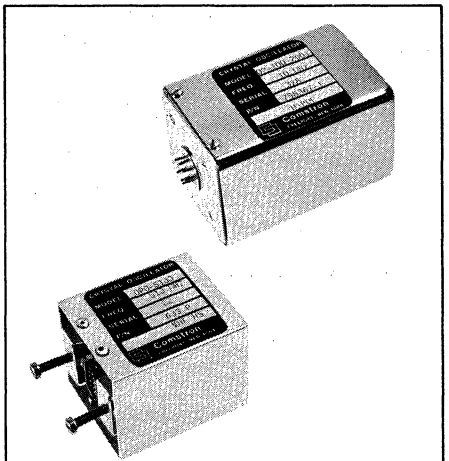
Voltage Controlled Crystal Oscillators

Frequency	1 - 25 MHz	25 - 150 MHz	150 MHz to 1 GHz
Mod Range	± .1%	± .01%	± .01%
	Wider or Narrower Mod Range Available		
Output	Sine OdBm/ 50 ohm	OdBm/50 ohm	OdBm/50 ohm
	ECL	ECL	N/A
	CMOS to 10 MHz	N/A	N/A
	TTL	STTL to 100 MHz	N/A
Mod Voltage	± 5V	± 5V	± 5V
	Variation in Sensitivity Available		
Linearity	± 1%	± 2%	± 5%
Temperature Range	0 - 55°C	0 - 55°C	0 - 55°C
	Wider Temperature Range Available		
Stability	1 ppm	1 ppm	2 ppm
Size	2 x 2 x .75"	2 x 2 x .75"	3 x 1.5 x .75"
Connector	PC Mount	PC Mount	PC Mount
	Special Connectors Available		



Ovenized Crystal Oscillators

Frequency	.1 to 25 MHz	25 MHz to 500 MHz
Aging Rate	1×10^{-9}/day	1×10^{-8}/day
	Improved Stability Available	
Output	Sine OdBm/50 ohm	OdBm/50 ohm
Temperature Range	- 20 to + 60°C	- 20 to + 60°C
Temperature Stability	3×10^{-8}	5×10^{-8}
Supply Voltage	28 V	28 V
Adjustment Range	± 1 ppm min.	± 1 ppm min.
Size	2" x 2" x 4"	2" x 2" x 4"

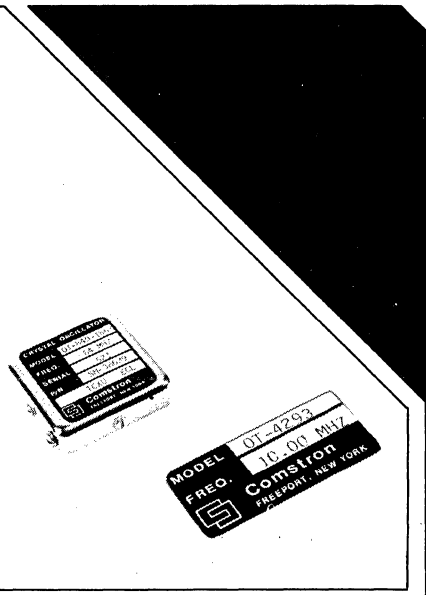


See our ads in Sections 2700 & 2900

comstron corporation
200 East Sunrise Highway, Freeport, New York 11520
(516) 546-9700 TWX 510-225-3699

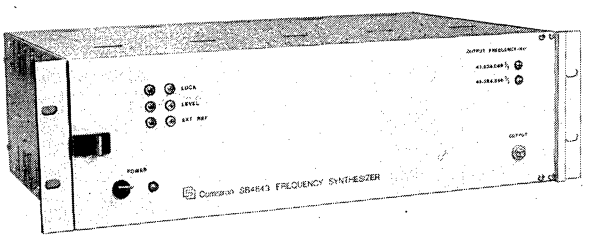
Temperature Compensated Crystal Oscillators

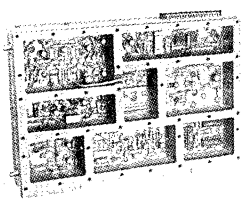
Frequency	.1 to 25 MHz	25 MHz 150 MHz	150 MHz to 1 GHz
Temperature Range	0°C - 60°C	0°C - 60°C	0°C - 60°C
	Wider Temperature Ranges Available		
Stability	5×10^{-7}	5×10^{-7}	1×10^{-6}
Output	Sine 0dBm/ 50 ohm	0dBm/50 ohm	0dBm/50 ohm
	ECL	ECL	N/A
	CMOS to 10 MHz	N/A	N/A
	TTL	STTL to 100 MHz	N/A
Aging Rate	1×10^{-6}/year	2×10^{-6}/year	2×10^{-6}/year
Supply Voltage	12 V	12 V	12 V
Current	10 ma	10 ma	10 ma
Size	2" x 2" x .75"	2" x 2" x .75"	3" x 1.5" x .75"
Connectors	PC Mount	PC Mount	PC Mount
	Special Connectors Available		

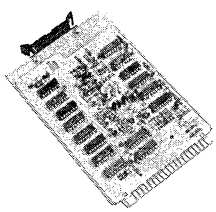


Phase Locked Crystal Oscillators

Comstron's preeminant technology in frequency synthesizers and locked sources can be put to use in your system. Modular building blocks are configurable to cover frequencies from low audio to 1 GHz. When system requirements dictate superior short term stability (phase noise), long term stability and reliability, Comstron's OEM line fills the need.







Ordering Information

How to Specify Part Number:

O for Oscillator;

plus one letter for type.

P = Oven controlled Crystal Oscillator
V = VCXO
T = TCXO

plus one letter for output

S = Sine
E = ECL
C = CMOS
T = TTL

plus four digits for frequency

XXXX in .1 MHz

Example:

OVS-0214

Oscillator VCXO Sine 21.4 MHz

Where requirements differ from listed models, choose the closest model and provide details regarding your specific needs.

See our ads in Sections 2700 & 2900.

comstron corporation

200 East Sunrise Highway, Freeport, New York 11520
(516) 546-9700 TWX 510-225-3699

THE CONNOR-WINFIELD CORPORATION
WEST CHICAGO, IL 60185 PHONE (312) 231-5270
CABLE CONWINWCGO TWX NO. 910-230-3231

OSCILLATORS

For over twenty years, the CONNOR WINFIELD Corporation has been producing high frequency control products for both military and commercial applications. CONNOR WINFIELD has built an excellent reputation as a source of custom designed oscillators. We are also able to provide attractive discounts on large volume orders, but if you are in a hurry, our low volume lead times are consistently short on all standard models.

What follows is only a partial listing of the extensive oscillator capabilities we have available. We invite you to write or call us with your special oscillator requirements; or if you would like to know more about our new models, our engineers and sales staff are available to assist you.

CONNOR WINFIELD spotlights these new models:

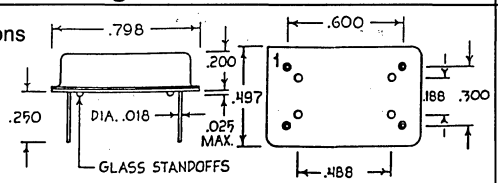
- ★ECL-A,B : ECL logic in a DIP metal package—up to 200 MHz (pg. 1)
- ★PL14R1,2,3 : phase lock oscillator in a 14 pin DIP package. (pg. 3)
- ★SW1, SW2 : High frequency sine wave—up to 200MHz in a .2" high DIP package. (pg. 1)
- ★TC10A,B : High frequency TCXO in a 1" × 1" × .62" package (pg. 3)
- ★C13R1,2 : rugged solid state oscillator in a .2" high DIP metal package. (pg. 2)
- ★C14R5L : low current CMOS logic—<1mA (pg. 1)
- ★S15R8 : Low cost, fast delivery of TTL DIP oscillators—stock frequencies only. (pg. 2)

● FULL MILITARY SCREENING AVAILABLE ON MOST OSCILLATOR MODELS!

DIP CRYSTAL OSCILLATORS

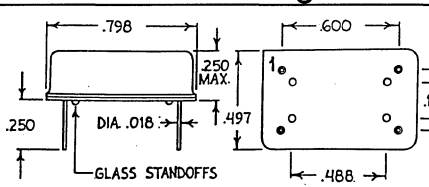
Package Outline 1

Pin Connections
1 N/C
7 Common
8 Output
14 Vcc



All dimensions in inches

Package Outline 2



Pin Connections
1 Output
7 Ground
8 Osc. Monitor
14 Vcc

All dimensions in inches

TTL SERIES*

Output load	1 – 10 TTL
Duty Cycle	50/50 ± 10%
Supply Voltage	+5Vdc ± 5%
Supply Current	85ma max.

Available Options:

Gating-Pin 1-Logic 0 enables-Logic 1 disables
Other Temperature Ranges and Frequency Tolerances Available

Low cost on large volume orders

LSTTL SERIES

Output Load 1–10 LSTTL 1–3 TTL
Duty Cycle 50/50 ± 10%
Supply Voltage +5Vdc Supply Current - 50ma max.

CMOS SERIES**

Output Load CMOS
Duty Cycle 50/50 ± 10%
Supply Voltage +5 to +15Vdc Supply Current 3–20ma

100K ECL SERIES

Output 100K ECL
Duty Cycle 50/50 ± 10%
Supply Voltage –4.5Vdc or –5.2 Current 50ma
Please specify No load

SINEWAVE SERIES

DPS1 – Supply Voltage +5Vdc
Output Voltage 1Vrms 10k Load

DPS2 – Supply Voltage +8Vdc to +15Vdc
Output Voltage 1.5Vrms to 3Vrms 10k Load

SW1 – Supply Voltage +5Vdc
Output Voltage 0dBm 50Ω Load

SW2 – Supply Voltage +12Vdc
Output Voltage 10dBm 50Ω Load

Total Harmonic Distortion <5%

Model	Package	Frequency Range	Freq. Toler.	Temperature Range
S14R5	1	20kHz to 20MHz	±.005%	–25°C to +75°C
S15R5	1		±.01%	0° to +70°C
S14R6	1	255kHz to 60MHz	±.005%	–25°C to +75°C
S15R6	1		±.01%	0°C to +70°C
S14R7	1	1Hz to 255kHz	±.005%	–25°C to +75°C
S15R7	1		±.01%	0°C to +70°C
SR721	1	25MHz to 80MHz	±.01%	0°C to +75°C
SR722	1		±.005%	0°C to +70°C
SR723	1		±.01%	–40°C to +85°C
S14P5	2	<1Hz to 10MHz	±.005%	–25°C to +75°C
S15P5	2		±.01%	0°C to +70°C
S14P6	1	20kHz to 20MHz	±.005%	–25°C to +75°C
S15P6	1		±.01%	0°C to +70°C
C14R5	1	200Hz to 8MHz	±.005%	–25°C to +75°C
C15R5	1		±.01%	0°C to +70°C
C14C5	2	<1Hz to 200Hz	±.005%	–25°C to +75°C
S15C5	2		±.01%	0°C to +70°C
ECL-A	2	30MHz to 200MHz	±.005%	–25°C to +75°C
ECL-B	2	30MHz to 200MHz	±.01%	0°C to +70°C
DPS1	2	1KHz to 75KHz	±.01%	–25°C to +75°C
SW1	1	30MHz to 200MHz		0°C to +70°C
DPS2	2	100Hz to 100KHz	±.01%	–25°C to +75°C
SW2	1	30MHz to 200MHz		0°C to +70°C

* See Page 2 for Fast Delivery TTL Clocks

** New Product: C14R5L Low Current CMOS Oscillator ⩽1mA at 5Vdc, ⩽5ma at 15Vdc

Engineer Note: CW Hybrid Facilities are capable of producing custom Hybrid Oscillators to meet your special requirements.

Specifications subject to change without notice

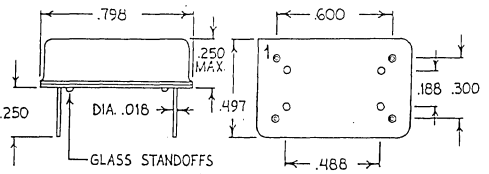
THE CONNOR-WINFIELD CORPORATION
WEST CHICAGO, IL 60185 PHONE (312) 231-5270
CABLE CONWINWCGO TWX NO. 910-230-3231

OSCILLATORS

TTL DIP CRYSTAL CLOCKS

Fast Delivery on Stock TTL Frequencies

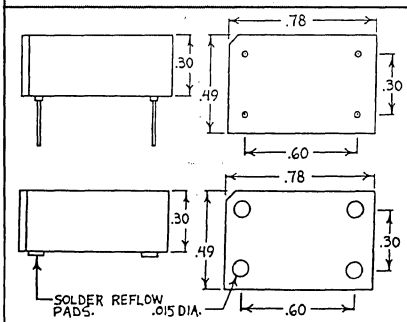
20Mhz–16Mhz–12Mhz–10Mhz–8Mhz–6Mhz–4Mhz–2.048Mhz–2Mhz–1Mhz



Pin Connections
1-NC 8-Output
7-Ground 14-Vcc

Model	S14R8	S15R8
Freq. Tolerance	±.005%	±.01%
Temp. Range	0°C to +70°C	
Supply Voltage	+5Vdc ±10%	60mA max.
Load	1 to 10 TTL	

EPOXY ENCAPSULATED DIP CRYSTAL OSCILLATORS

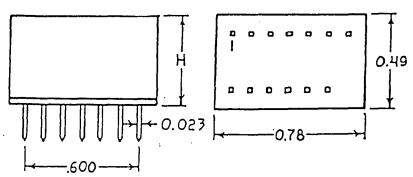


Pin Connections
14 Vcc
7 Ground
Output:
S13, D13, Pin 8 Output
S14, D14 Pin 1 Output
S11, D11 Reflow Pads
Pads 1&8 Output

Model Number	S13R1 S14R1 S11R1	S13R1A S14R1A S11R1A	S13R1B S14R1B S11R1B	D13C D14C D11C	D13D D14D D11D	D13E D14E D11E
Freq. Range	3MHz to 25MHz			15kHz to 20MHz		
Frequency Tolerance	±.01% −25°C to +75°C	±.005% 0°C to +70°C	±.01% −40°C to +85°C	±.005% 0°C to +50°C	±.0075% 0°C to +65°C	±.01% −25°C to +75°C
Output	TTL			1–10TTL		
Symmetry	50/50 ± 10%					
Supply Voltage	+5Vdc ±10% <20mA			+5Vdc 20 to 75mA		

NON CRYSTAL SOLID STATE OSCILLATORS

L13-L14 SERIES



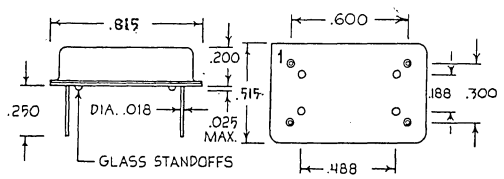
Pin Connections L13-Square Pins
14 Vcc .017″ x .017″
12 Output L14-Flat Pins
7 Ground 0.16″ x .023″

NEW MODELS

—0.2″ High—

Model	L13LT L14LT	L13LC L14LC	L13SW L14SW	L13Q L14Q	L13QC L14QC	L13B L14B
Frequency Range	<1Hz to 4MHz	<1HZ to 10MHz	500kHz to 10MHz	<1Hz to 4MHz	<1Hz to 10MHz	1kHz to 4MHz
Output	TTL 10TTL	CMOS	Sinewave 1Vrms 10k 0dBm 50Ω	TTL 10TTL	CMOS	Sinewave 3Vrms 10k 0dBm 50Ω
Supply Voltage	5Vdc	+5 to +15Vdc	+5 to +15Vdc	5Vdc	+5 to +15Vdc	5Vdc
Frequency Stability	±0.1%			±1.0%		
Temperature Range	0°C to +50°C					
Frequency Trimmer	Internal ±2% min			External Resistor ±2% min.		
Height	0.17″ to 0.57″ Depending on Frequency					

C13R1 & C13R2 All Metal DIP Package C13R1 is equivalent to L13QC, C13R2 is equivalent to L13LC



Pin Connections 1-N.C. 7-Ground 8-Output 14-Vcc
All Metal Packages Hermetically Sealed

MICROPROCESSOR OSCILLATORS

Model	S1160AA	S1160AB	S1160AC
Frequency	4MHz	6MHz	2.5MHz
Frequency Tolerance	+0% to −.02%		0°C to +70°C
Supply	+5Vdc +10%		85mA max.
Load Capacitance	150 pf max.		
Designed to Drive Z80*, Z80A*, Z80B* Microprocessors			

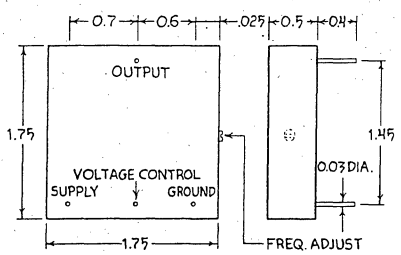
*Trademark of Zilog, Inc.

** All dimensions in inches Specifications subject to change without notice

THE CONNOR-WINFIELD CORPORATION
WEST CHICAGO, IL 60185 PHONE (312) 231-5270
CABLE CONWINWCGO TWX NO. 910-230-3231

OSCILLATORS

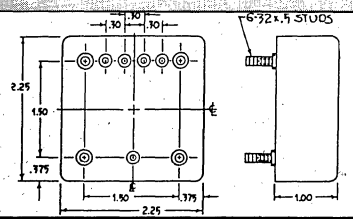
VCXO SERIES



Model	V175A	V175B	V175C	V175D
Frequency Tolerance	± .001% 20°C to +40°C	± .0025% 0°C to +50°C	± .005% 0°C to 65°C	± .0075% −25°C to +65°C
Frequency	<1Hz to 30MHz			
Output	TTL	CMOS	Sine	
Supply	+5Vdc ± 1% 10 to 75mA	+5 to +15Vdc ± 1% 25 to 50mA	+5 to +30Vdc ± 1% 25 to 50mA	
Load	1–10 TTL	CMOS	50Ω or 10kΩ	
Voltage Control	@12Vdc supply: 0 to +10V or ± 5V @5Vdc supply: 0 to +4V or ± 2V		20ppm / V ± 1ppm Wider deviations available	

VCO Models also available **New Product:** Phase Lock VCO-TTL DIP 20 to 60MHz PL14R1 - ± 1% PL14R2 - ± 10%

DCXO SERIES



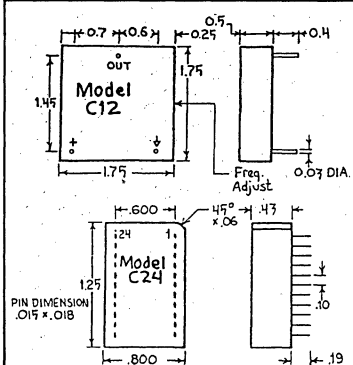
MODEL D5000
Digitally Compensated Crystal Oscillator

The DCXO provides the high stability of an ovenized crystal oscillator while consuming much less power and requiring no warm up time.

The memory in the DCXO is also re-programable should the crystal age or drift out of tolerance over time.

Frequency Range	1MHz to 20MHz	
Output	LSTTL or CMOS	
Frequency Tolerance	A ± 1 × 10 − 6	−55°C to +125°C
	B ± 5 × 10 − 7	−40°C to +85°C
	C ± 2.5 × 10 − 7	0°C to +70°C
Aging Rate	1ppm / year	
Supplies	± 12Vdc +5Vdc	500mW

TCXO SERIES



MODELS C12 *___ AND C24 *___

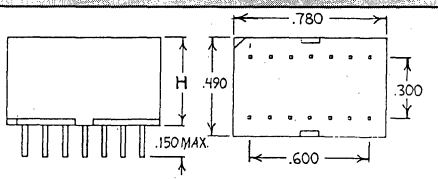
Outputs	TTL	CMOS	SINE	ECL
Frequency Range	<1Hz to 30MHz	<1Hz to 12MHz	(C12) 1Hz to 30MHz	<1Hz to 30MHz
Output Load	1 to 10TTL	CMOS	50Ω or 10kΩ	100k ECL
Supply Voltage	+5Vdc ± 1%	+5 to +15Vdc	+5 to +30Vdc	−4.5 or −5.2Vdc
Supply Current	<60mA	<20mA	<60mA	<50mA
Frequency Tolerance	A ± .00005%,	+20°C to +40°C		
*Add Suffix A, B, or C to Model Number	B ± .00015%,	0°C to +50°C		
	C ± .00025%	−25°C to +65°C		

PIN CONNECTIONS
5 OUTPUT
12 GROUND
24 POSITIVE +

NEW! Model TC10A or B, VHF TCXO, 30 to 200MHz + 12Vdc Supply, ≤0 dBm Output, Package 1″x1″x.5″
Also Available: 1st Quarter 84-14 Pin DIP TCXO Series

EPOXY ENCAPSULATED DIP OSCILLATORS

PIN CONN.
7 GROUND
14 +
PER OUTPUT
CHART



TTL or Sinewave Series
Tight Tolerance Crystal Oscillators
L11* through L14* Series-Discrete Oscillators
F11* through F14* Series-Thick Film Oscillators

Model*	L12*	F12*	L14*	F14*	L11*	F11*	L13*	F13*
Frequency Range	<1.0Hz to 60MHz							
Output Logic	TTL - Suffix C, D, E,				Sinewave - Suffix F, G, I			
Freq. Tolerance *add suffix to model number	C - F	± .001%,			0°C to +50°C			
	D - G	± .0025%,			0°C to +65°C			
	E - I	± .005%,			−25°C to +75°C			
Output Pins	8	8	12	12	8	8	12	12
Pin Sizes	Flat Pins .016″ x .023″				Square Pins .017″ x .017″			
Output Load	1 - 10TTL 50/50 ± 10%				3Vrms ± 1Vrms 10kΩ			
Supply Voltage	+5Vdc ± 5%				20mA to 100mA			
H: Height	0.44″				0.57″			

** All dimensions in inches
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OSCILLATORS

SERIES 76

Fill in Blanks to Construct Your Model Number.

Example: X F 3

When ordering Please Specify; Series No., Model No., Frequency & Supply Voltage.

X	F	3
FREQ. STAB. W, X or Z	OUTPUT A, B, D, E, F or G	PACKAGE 1, 2, 3, 4 or 5

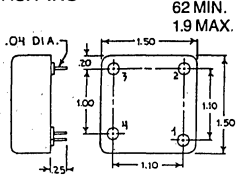
Frequency Stability Ordering Guide

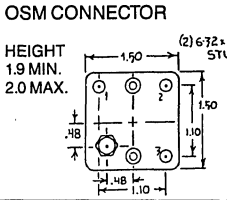
Parameter	W	X	Z
Temperature Range	−55°C to +75°C	0°C to +60°C	+15°C to +35°C
Frequency Stability	±.005%	±.001%	±.0005%

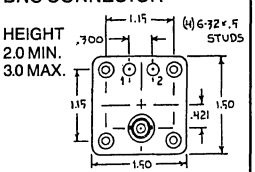
Output Specifications Ordering Guide

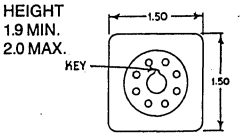
Parameter	A	B	D	E	F	G
Frequency Range	1 Hz to 5MHz	100Hz to 100MHz	10MHz to 300MHz	60Hz to 1MHz	1MHz to 400MHz	30MHz to 300MHz
Supply Voltage	+5 to +15Vdc	+5Vdc ±5%	−5.2Vdc ±5%	+12Vdc ±5%	+12Vdc	−4.5Vdc ±5%
Supply Current	3 to 20mA	<50mA	<50mA	<15ma	<50ma	50ma @ No load
Output	CMOS	TTL	10K ECL compatible	Sine 1 Vrms ± 10%	Sine +10dBm ± 3dbm	100K ECL
Tr/Tf	<100ns	<100ns	≤1.5ns	———	———	≤1
Symmetry	50/50 ±10%	50/50 ±10%	———	———	———	50/50 ±10%
Distortion	———	———	———	<5%	−25dBm	
Load	CMOS	1−10 TTL	>10 ECL	10KΩ	50Ω	>10 ECL
Termination*	1−4−5	1−4−5	1−2−3	1−4−5	2−3	1−2−3

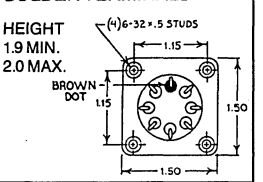
1	2	3	4	5
P.C. PINS HEIGHT 62 MIN. 1.9 MAX.	OSM CONNECTOR HEIGHT 1.9 MIN. 2.0 MAX.	BNC CONNECTOR HEIGHT 2.0 MIN. 3.0 MAX.	OCTAL PLUG HEIGHT 1.9 MIN. 2.0 MAX.	SOLDER TERMINALS HEIGHT 1.9 MIN. 2.0 MAX.



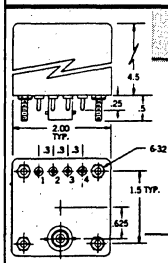








SERIES 79

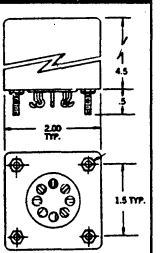


PIN CONNECTIONS
#1 OSC VDC
#2 OSC GND
#3 OVN GND
#4 OVN VDC
BNC OUTPUT

Frequency Stability Ordering Guide

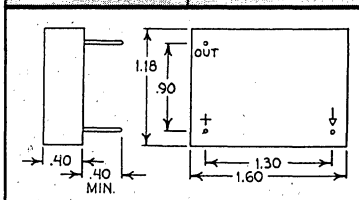
Parameter	A	B	C
Frequency Range	1MHz to 20MHz	20MHz to 60 MHz	60MHz to 150MHz
Temperature Range	0°C to +60°C	0°C to +60°C	0°C to +60°C
Frequency Stability	±5 x 10−8	±1 x 10−7	±5 x 10−7

PIN CONNECTIONS
#1 OSC GND
#2 OSC VDC
#5 OVN VDC
#6 OVN GND
#8 OUTPUT



Output Specifications Ordering Guide

Parameter	S	T	V	W	X	Y
Frequency Range	1MHz to 20MHz	20MHz to 60MHz	60MHz to 100MHz	100MHz to 150MHz	1MHz to 20MHz	20MHz to 60MHz
Osc Supply	+12Vdc, 35mA	+12Vdc, 50mA	+12Vdc, 50mA	+12Vdc, 50mA	+12Vdc, 30mA	+12Vdc, 50mA
Oven Supply	+28Vdc, 6W Avg.	+28Vdc, 6W Avg.	+28Vdc, 6W Avg.	+28Vdc, 6W Avg.	+28Vdc, 6W Avg.	+28Vdc, 6W Avg.
Output, Load	Sine, 50Ω	Sine, 50Ω	Sine, 50Ω	Sine, 50Ω	TTL, 1−10TTL	TTL, 1−10 TTL
Output Voltage	0dBm ± 1.5dBm	0dBm ± 1.5dBm	0dBm ± 1.5dBm	0dBm ± 1.5dBm	TTL	TTL
Harmonic Content	−30dBm	−30dBm	−30dBm	−30dBm	———	———



PC BOARD MOUNT OSC

Model	IC5 TTL Series	C123 CMOS Series
Frequency Range	1Hz to 10MHz	0.1Hz to 8MHz
Frequency Tolerance	±.001%, +20°C to +40°C — ±.005%, −25°C to +75°C	±.0025%, 0°C to +50°C — ±.01%, −55°C to +125°C
Supply	+5Vdc, 15 to 100mA	+5 to +15Vdc

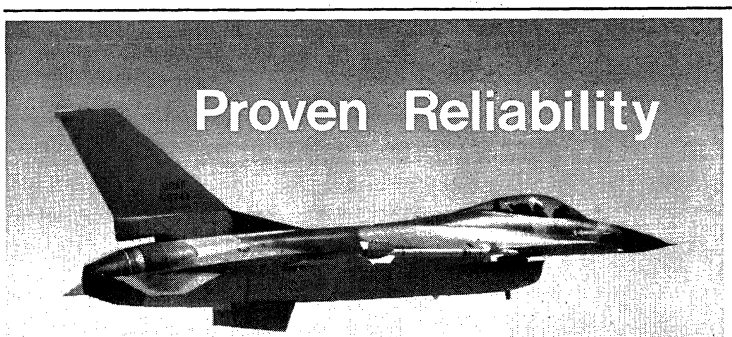
*All dimensions in inches
Specifications subject to change without notice

CROVEN CRYSTALS

Division of Kidde Canada Limited

KIDDE

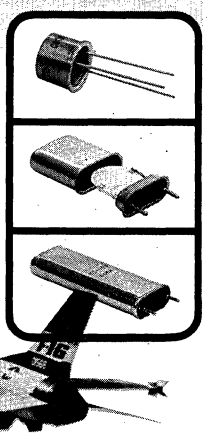
500 Beech Street
Whitby, Ontario
Canada L1N 5S5
416 668-3324
TWX: 610-384-2750



Croven Crystals perform with proven reliability and frequency stability in the toughest environments faced by men and machines.

Croven Crystals were the ultimate choice for the sophisticated radar system used in the F-16 Fighter Aircraft, as well as other high reliability requirements around the world.

If your system requires superior component performance, call us or write for our free catalogue.



All U.S. shipments are quoted in U.S. dollars f.o.b. BUFFALO, N.Y. We clear customs and pay all duties.

CROVEN
Division of Kidde Canada Limited
KIDDE

500 Beech Street, Whitby, Ontario, Canada
Telephone (416) 668-3324 TWX 610-384-2750

MILITARY CRYSTAL UNITS

We are on the Qualified Products List (QPL) for the types below.

MILITARY CR-TYPE	MILITARY SPEC. NO.	FREQUENCY RANGE IN MHZ	CROVEN CODE
CR-5A/U*	3098/77	2.000- 10.000	A170 FWM-25
CR-6A/U*	3098/78	2.000- 10.000	A170 FWJ-13
CR-8A/U*	3098/111	1.000- 10.000	A170 FWJ-00
CR-18A/U*	3098/3	0.800- 20.000	A061 FWM-32
CR-19A/U*	3098/4	0.800- 20.000	A061 FWM-00
CR-52A/U*	3098/30	10.000- 61.000	B061 FWM-00
CR-55A/U*	3098/33	17.000- 62.000	B180 FWM-00
CR-56A/U*	3098/34	50.000-125.000	C180 FWM-00
CR-58A/U*	3098/36	0.800- 20.000	A170 FWM-32
CR-59A/U*	3098/37	50.000-125.000	C180 EBS-00
CR-60A/U*	3098/38	5.000- 20.000	A180 FWM-00
CR-61/U*	3098/39	17.000- 61.000	B180 EBS-00
CR-64/U*	3098/42	2.900- 20.000	A180 FWM-30
CR-65/U*	3098/43	10.000- 61.000	B061 CXP-00
CR-67A/U*	3098/45	17.000- 62.000	B180 CUM-00
CR-69A/U*	3098/47	2.900- 25.000	A180 CSM-30
CR-72/U*	3098/50	17.000- 61.000	B259 FWM-00
CR-76A/U*	3098/53	16.000- 61.000	B180 CSM-00
CR-77/U*	3098/55	17.000- 62.000	B251 CSM-00
CR-78A/U*	3098/62	2.200- 20.000	A251 FWM-30
CR-79/U*	3098/63	2.200- 20.000	A251 FWM-00
CR-80/U*	3098/57	50.000-125.000	C180 CSM-00
CR-81/U*	3098/58	17.000- 61.000	B251 FWM-00
CR-82/U*	3098/59	50.000-125.000	C251 FWM-00
CR-83/U*	3098/60	50.000-125.000	C251 CSM-00
CR-84/U*	3098/61	17.000- 61.000	B251 EBS-00
CR-89/U*	3098/67	2.120- 6.200	A321 FWM-30
CR-97/U*	3098/72	8.000- 10.000	A180 FWJ-32
CR-106A/U*	3098/82	10.500- 11.500	A180 FWM-32
CR-117/U*	3098/93	30.000- 63.000	B251 DEJ-00
CR-139/U*	3098/118	20.000- 22.000	A180 FWM-30
CR-140/U*	3098/119	3.500- 12.500	A061 FWM-60
CR-157/U*	3098/137	0.800- 20.000	A330 FWM-00

HOW TO SPECIFY A QUARTZ CRYSTAL

If the parameters for the crystal in question are not already covered by a MIL-SPECIFICATION or by a formal SPECIFICATION CONTROL DRAWING, then Items 1 through 6 are essential.

(1) **MODE OF OPERATION** i.e. fundamental, third, fifth, seventh, ninth or eleventh overtone.
(2) **HOLDER STYLE** i.e. HC-6/u, HC-18/u, HC-35/u, etc, depending on your individual application and the frequency.
(3) **CALIBRATION TOLERANCE AT REFERENCE TEMPERATURE** i.e. ± 20 ppm @ + 25°C, ± 5 ppm @ + 75°C, etc.
(4) **TEMPERATURE STABILITY** the allowable frequency deviation over a specified temperature range, with reference to the actual frequency measured at the calibration temperature. (i.e. ± 15 ppm, ± 2.0 ppm, etc.)
OR TOTAL TOLERANCE the total allowable deviation over a specified temperature range, with reference to the nominal frequency (i.e. calibration tolerance and temperature stability combined). (i.e. ± 50 ppm, ± 30 ppm, etc.)
(5) **OPERATING TEMPERATURE RANGE** the temperature range over which the temperature stability or the total tolerance is to be effective.
(6) **CIRCUIT CONDITION** will be either PARALLEL or SERIES resonance. If PARALLEL resonance, please state the load capacitance.

SPECIFICATION CODING

We use a system whereby we code the major parameters of a crystal specification using a combination of 9 digits. A typical code would be **A251DFE-32** and would be interpreted as follows. **A** = fundamental mode, **25** = HC-25/U holder, **1** = undercut pins per MIL-H-10056, **D** = calibration tolerance of ± 10 ppm @ + 25°C, **F** = temperature stability of ± 20 ppm with reference to the actual frequency measured @ + 25°C, **E** = temperature range of — 15°C to + 65°C over which the temperature stability is effective, **-32** = a circuit condition of parallel resonance and with a load capacitance of 32 pF.

MODE		HOLDER			CALIBRATION TOLERANCE AT REFERENCE TEMPERATURE		TEMPERATURE STABILITY OR TOTAL TOLERANCE		OPERATING TEMPERATURE RANGE (C)		CIRCUIT CONDITION	
CODE	DESC.	CODE	DESCRIPTION	CODE	DESCRIPTION***	CODE	DESCRIPTION	CODE	DESCRIPTION	CODE	DESCRIPTION	CODE	DESCRIPTION
A	Fund	06	HC- 6 standard **	0	Standard			X	± 2PPM stability	X	+ 15 to + 35	00	Series resonance
B	3rd ot.	13	HC-13 standard	1	Undercut pins			Y	± 3PPM stability	Y	+ 10 to + 40		
C*	5th ot.	17	HC-17 standard	2	Modified can height			Z	± 4PPM stability	Z	+ 5 to + 45		
D*	7th ot.	18	HC-18 standard							A	+ 0 to + 50		
E*	9th ot.	25	HC-25 standard	3	Slimline	B	± 5 PPM	B	± 5PPM stability	B	— 5 to + 55		
		32	HC-32 standard	4	3rd wire	C	± 7 PPM	C	± 7PPM stability				
		33	HC-33 (HC-6 wires)	5	Modified can height	D	± 10PPM	D	± 10PPM stability	D	— 10 to + 60	01	Parallel resonance load capacity 100pf or more.
		34	HC-34 (HC-13 wires)			E	± 15PPM	E	± 15PPM stability	E	— 15 to + 65		
		35	HC-35 (TO 5 - type)	6	Modified can height	F	± 20PPM	F	± 20PPM stability	F	— 20 to + 70		
		37	HC-37 (TO 8 - type)			G	± 25PPM	G	± 25PPM stability	G	— 25 to + 75		
		39	HC-39 (Flat-Pack)	7	Coldweld	H	± 30PPM	H	± 30PPM stability	H	— 30 to + 80		
		80	HC-45 (micro-min.)					J	± 40PPM stability	J	— 40 to + 90		
				9	Resistance Weld	M	± 50PPM	M	± 50PPM stability	M	— 55 to + 105		
								L	± 75PPM stability	L	+ 55/+ 65 Oven		
								K	±100PPM stability	T	+ 60/+ 70 Oven	10 to 90	Parallel resonance load capacity in pf as indicated by code. ****
								N	±150PPM stability	N	+ 65/+ 75 Oven		
								S	Specific curve	P	+ 70/+ 80 Oven		
								T	± 20PPM‡ (B)†	R	+ 75/+ 85 Oven		
								U	± 25PPM‡ (C)†	S	+ 80/+ 90 Oven		
								V	± 30PPM‡ (D)†				
								W	± 50PPM‡ (F)†		Reference or Calibration temperature is the mid-point of the above ranges	99	Calibration at reference temperature in customer's oscillator.
								P	±100PPM‡ (H)†				
								R	±200PPM‡ (M)†				
								O	Not Specified	O	Not Specified		

† We use these calibration codes with corresponding total tolerances

* Available at series resonance only
** Standard types for all codes as per MIL-H-10056
*** Not all holders available with modifications
**** When using a Croven code only to describe your requirement, you must choose from one of the following standard load capacitance values, 10, 12, 14, 16, 18, 20, 24, 27, 30, 32, 35, 40, 45, 50, 55, 60, 70, 80, 90, 100 pf.
‡ Total tolerance (measured from nominal frequency)

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

1.0-175.0 MHz CRYSTALS

STANDARD DESIGNS

CTS Knights offers standard crystals, available in **Resistance Weld, Solder Seal** and **Coldweld** packages. All three are available in the two basic holder sizes (HC-18 and HC-6), with pin or wire lead terminations.

CHART A shows standard part numbers which can be purchased by specifying only part number and frequency. The type of seal is indicated by the part number prefix.

R = Resistance Weld
S = Solder Seal
K = Coldweld

In chart A all part numbers have the R prefix. If you wish **Solder Seal** or **Coldweld,** change the prefix letter. When ordering standard crystals by part number, you will receive the following electrical specifications:

CALIBRATION TOLERANCE:

Solder Seal	±.003% @ 25°C
Resistance Weld	±.002% @ 25°C
Coldweld	±.002% @ 25°C

LOAD CAPACITY: Last letter specifies load:
A = 20 PF
B = 32 PF
C = series resonance

RESISTANCE: Specified on chart A

SHUNT CAPACITY: 7 PF Max.

STABILITY: ±.003% of 25°C frequency from −40 to +70°C

AGING:

Solder Seal —	< 10 PPM/YR
Resistance Weld —	< 5 PPM/YR
Coldweld —	< 3 PPM/YR

To order standard crystals, specify P/N and frequency. EXAMPLE: To order the basic HC-49 package size with wire leads, **Resistance Weld,** at 4.00 MHz, 20 PF load capacity, specify: "R1335-2-BA @ 4.00 MHz."

CRYSTAL PERFORMANCE CURVES

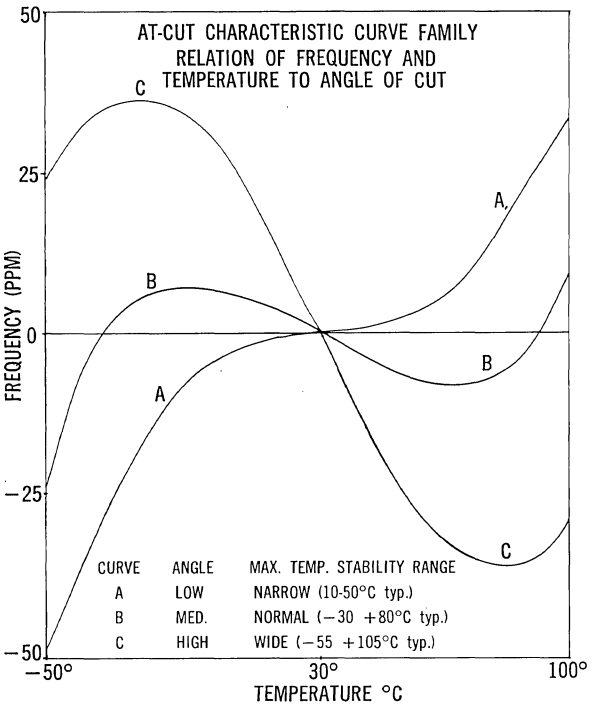


FIG. 1

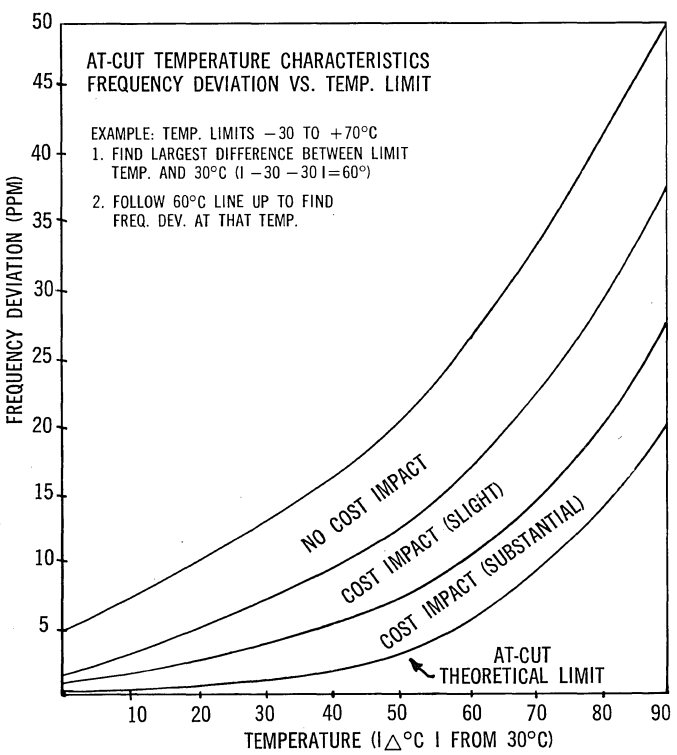


FIG. 2

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

1.0-175.0 MHz CRYSTALS

CRYSTAL PERFORMANCE CURVES

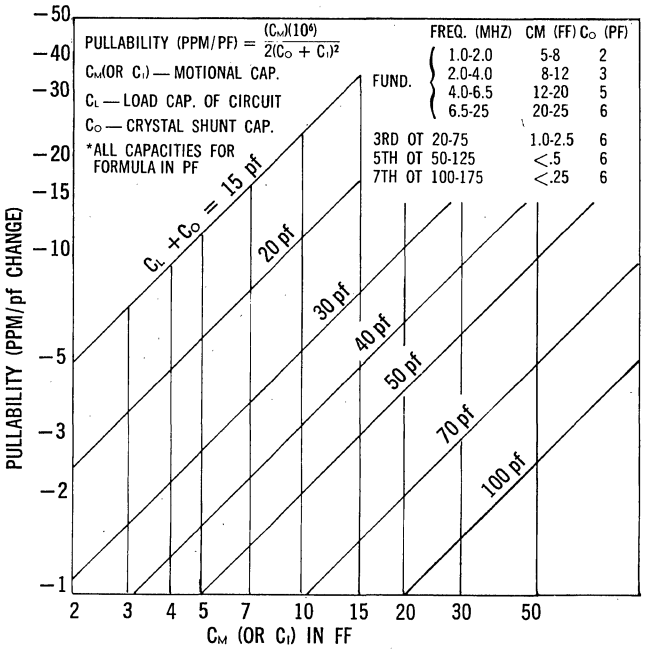


FIG. 3

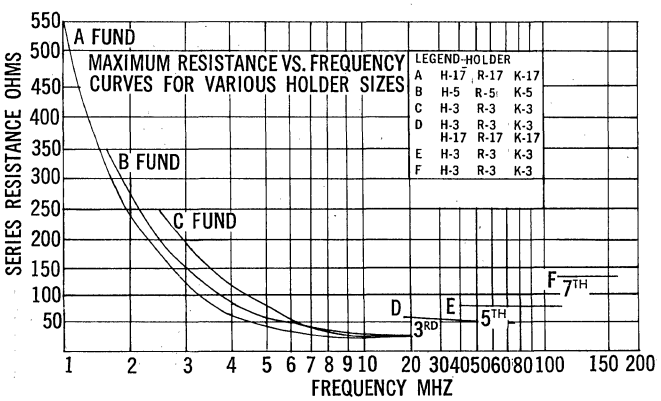


FIG. 4

CUSTOM DESIGNS

Custom crystals include any which cannot be ordered by Specific CTS Knights part number. It does not automatically mean increased cost. Tighter specifications, detailed parameter testing, etc., involve additional cost factors.

Design limits are stated below. Your own specification can be written within these limits. This is intended as a practical window and does not exclude other designs. Query us first on State-of-the-Art needs.

HOLDER: **Resistance Weld, Solder Seal** and **Coldweld** holders are available. See outline drawings section. Note availability of hold-down top wires.

FREQUENCY RANGE: 1 MHz to 175 MHz (see chart A for holder vs frequency).

CALIBRATION: ±.0005 to ±0.1% @ 25°C

TEMP. STABILITY: ±.0002% to ±.01% of 25°C Frequency depending on temperature range.

TEMPERATURE RANGE: Common ranges are:

0 to 70°C
−30 to + 85°C
−55 to +105°C

PULLABILITY: If required (see Fig. 3)

LOAD CAPACITY: When designing your circuit, keep in mind that 20 PF, 32 PF and series resonance are common load capacities. Spec the load of your circuit. Loads between 15 PF and series can be specified without cost impact.

SERIES RESISTANCE (Rs): See performance curve

DRIVE LEVEL: 1-10 MHz 0.1 to 5.0 MW
Above 10 MHz 0.1 to 2.0 MW

SPURIOUS FREQUENCY: 6 db min. separation (2:1 for Resistance) is practical for any crystal frequency. Better attenuation is available in many areas.

To order custom crystals, describe the crystal in full, using the parameter format shown. Consult the factory if necessary.

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

PRECISION CRYSTALS

HIGH STABILITY PRECISION CRYSTALS 1 MHz - 40 MHz

Precision crystals are used in applications where long term aging of better than 2 PPM/YR is required. Two groups are available; those calibrated at room temperature and those calibrated at an elevated temperature, usually between 70° - 100°C, for ovenized oscillator use.

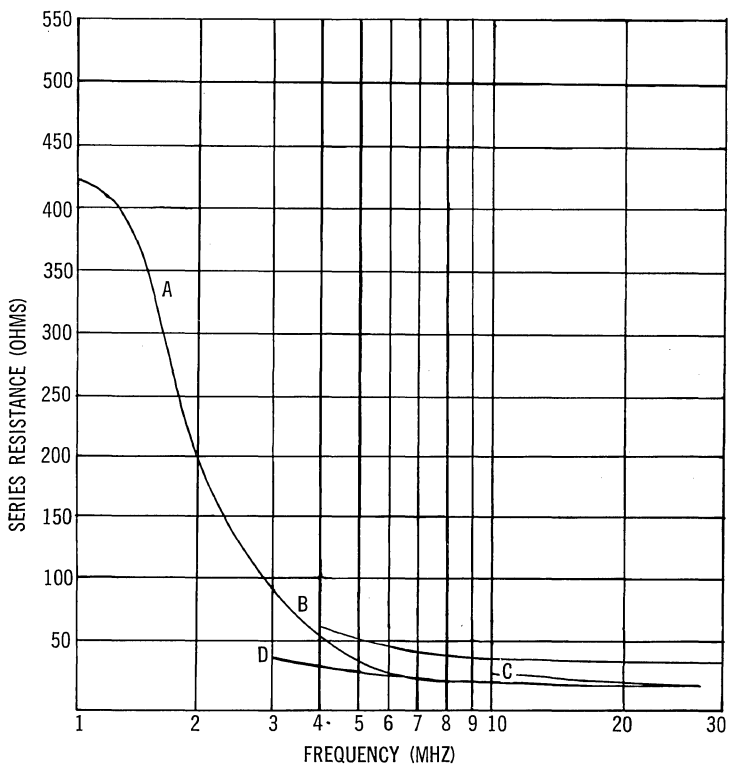
Frequency stability over temperature is tailored to customer's specific need. Frequency deviation over temperature may be held within $\pm 5 \times 10^{-7}$ of the characteristic AT curve.

CRYSTAL TYPE	CTS HOLDER‡	FREQUENCY RANGE	MODE	CALIBRATION TOLERANCE	AGING	DRIVE	Q
For Room Temperature Oscillator use	K3/K3W	8-25 MHz	Fund.	$\pm 10\times10^{-6}$ @ 25°C	1×10^{-8}/day	.1 MW	100K-400K
	K3/K3W	25-40 MHz	3rd	$\pm 10\times10^{-6}$ @ 25°C	1×10^{-8}/day	.1 MW	100K-400K
	K5/K5W	3-10 MHz	Fund.	$\pm 10\times10^{-6}$ @ 25°C	1×10^{-8}/day	.1 MW	100K-400K
	K17/K17W	1- 5 MHz	Fund.	$\pm 10\times10^{-6}$ @ 25°C	1×10^{-8}/day	.1 MW	100K-400K
For Ovenized Oscillator use	K17/K17W	1- 5 MHz	Fund.	$\pm 5\times10^{-6}$ @ Temp.	1×10^{-9}/day	.1 MW	100K-500K
	K17/K17W	4- 7 MHz	3rd	$\pm 5\times10^{-6}$ @ Temp.	1×10^{-9}/day*	.1 MW	800K-1.5KK
	K17/K17W	7-30 MHz	3rd	$\pm 5\times10^{-6}$ @ Temp.	1×10^{-9}/day	.1 MW	800K-1.5KK

* 5×10^{-10}/day available.

‡ TO5 and TO8 holders are available at many frequencies, consult factory for details.

PERFORMANCE CURVES

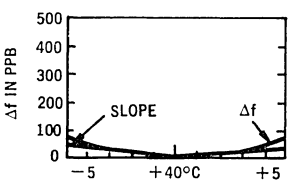


LEGEND

A K17 1-10 MHZ (FUND.)
B K17 4-30 MHZ 3RD O.T.)
C K3 8-25 MHZ (FUND.)
D K5 3-10 MHZ (FUND.)

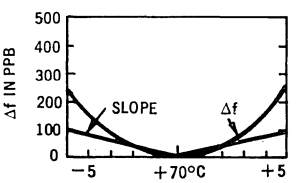
FIG. 5

STABILITY VS. TEMPERATURE



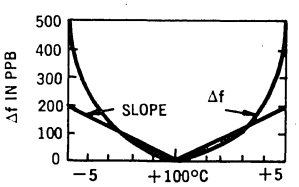
$\frac{\Delta f}{f} = (3ppb/°C^2)x\Delta T^2$

Slope = (6ppb/°C)xΔT



$\frac{\Delta f}{f} = (10ppb/°C^2)x\Delta T^2$

Slope = (20ppb/°C)xΔT



$\frac{\Delta f}{f} = (20ppb/°C^2)x\Delta T^2$

Slope = (40ppb/°C)xΔT

NOTE: Curves assume no thermal shock due to oven cycling.

FIG. 6

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

MILITARY CRYSTALS

MILITARY CRYSTALS

CTS KNIGHT'S test lab is government approved for qualification testing to military specification MIL-C-3098G, and includes equipment for environmental testing such as humidity, shock, vibration and aging. Production test equipment conforms to maintenance and periodic re-calibration required by US Government calibration system requirements in MIL-C-45662A.

CTS KNIGHTS is QPL Approved On The Following Military Types:

CR-18A/U (1-5, 10-20 MHz)
CR-19A/U (1-5, 10-20 MHz)
CR-52A/U (19-61 MHz)
CR-54A/U (50-110 MHz)
CR-55A/U
CR-56A/U (50-110 MHz)
CR-58A/U (1-20 MHz)
CR-60A/U
CR-64/U (4.2-20 MHz)
CR-67A/U
CR-72/U
CR-75/U (50-110 MHz)
CR76A/U (17-61 MHz)
CR-78A/U (4.2-20 MHz)
CR-79/U (4.2-20 MHz)
CR-81/U (17-62 MHz)
CR-82/U (50-110 MHz)
CR-83/U (50-110 MHz)
CR-89/U
CR-97/U
CR-106/U
CR-111/U
CR-114/U
CR-117/U (30-62 MHz)
CR-124/U
CR-128/U
CR-139/U (20 MHz)
CR-140/U
CR-141/U (50-90 MHz)
CR-157/U (1-20 MHz)

MIL-EQUIVALENT CRYSTALS

MIL-C-3098G requires special testing to ensure compliance with the entire specification. Any crystal marked with the "CR" number must receive this testing.

If your required crystal details match those of a mil spec in general parameters, but your commercial application does not demand the exhaustive testing, you can order a mil equivalent crystal. The design will be the same. The crystal **will not** receive the detailed testing. Marking will be standard commercial marking. The "CR" number will not appear on the crystal.

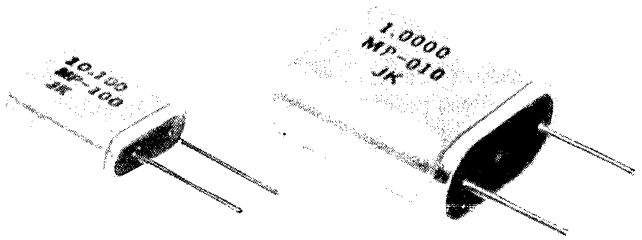
A mil vs commercial cross reference is shown below:

SPEC SHEET MIL-C-3098	MIL TYPE	MIL HOLDER	CTS HOLDER	FREQUENCY RANGE - MHz	VIBRATION MODE	OPERATING TEMPERATURE RANGE (°C)	FREQ. TOL. VS. TEMP. (%)	LOAD CAP. OR SERIES
/3	CR-18A/U	HC-6/U	R17	1.0-20.0	Fund.	−55 to +105	±.005	32 pf
/4	CR-19A/U	HC-6/U	R17	1.0-20.0	Fund.	−55 to +105	±.005	Series
/30	CR-52A/U	HC-6/U	R17	20.0-61.0	3rd O.T.	−55 to +105	±.005	Series
/32	CR-54A/U	HC-6/U	R17	50.0-100.0	5th O.T.	−55 to +105	±.005	Series
/33	CR-55A/U	HC-18/U	R3W	20.0-62.0	3rd O.T.	−55 to +105	±.005	Series
/34	CR-56A/U	HC-18/U	R3W	50.0-110.0	5th O.T.	−55 to +105	±.005	Series
/36	CR-58A/U	HC-17/U	R17 Mod.	1.0-20.0	Fund.	−55 to +105	±.005	32 pf
/38	CR-60A/U	HC-18/U	R3W	5.0-20.0	Fund.	−55 to +105	±.005	Series
/42	CR-64/U	HC-18/U	R3W	4.2-20.0	Fund.	−55 to +105	±.005	30 pf
/45	CR-67A/U	HC-18/U	R3W	20.0-61.0	3rd O.T.	−55 to +105	±.0025	Series
/50	CR-72/U	HC-25/U Mod.	R3 Mod.	20.0-61.0	3rd O.T.	−55 to +105	±.005	Series
/53	CR-76A/U	HC-18/U	R3W	20.0-61.0	3rd O.T.	−40 to +90	±.002	Series
/55	CR-77/U	HC-25/U	R3	17.0-62.0	3rd O.T.	−(55 to 40) & +(90 to 105)	±.003	Series
/62	CR-78A/U	HC-25/U	R3	4.2-20.0	Fund.	−55 to +105	±.005	30 pf
/63	CR-79/U	HC-25/U	R3	4.2-20.0	Fund.	−55 to +105	±.005	Series
/58	CR-81/U	HC-25/U	R3	20.0-62.0	3rd O.T.	−55 to +105	±.005	Series
/59	CR-82/U	HC-25/U	R3	50.0-110.0	5th O.T.	−55 to +105	±.005	Series
/60	CR-83/U	HC-25/U	R3	50.0-110.0	5th O.T.	−40 to +90 −(55 to 40) & +(90 to 105)	±.002 ±.003	Series
/67	CR-89/U	HC-32/U	R5	2.12-6.2	Fund.	−55 to +90	±.005	30 pf
/72	CR-97/U	HC-18/U	R3W	8.0-10.0	Fund.	−40 to +85	±.005	32 pf
/82	CR-106/U	HC-18/U	R3W	10.5-11.5	Fund.	−55 to +105	±.005	32 pf
/87	CR-111/U	HC-18/U	R3W	20.0-62.0	3rd O.T.	−55 to +105	±.005	Series
/90	CR-114/U	HC-25/U Mod.	R3 Mod.	2.9-3.85	Fund.	−55 to +105	±.005	32 pf
/93	CR-117/U	HC-25/U	R3	30.0-63.0	3rd O.T.	Ref. 25°C −40 to +65	±.001 ±.0015	Series
/101	CR-124/U	HC-18/U	R3W	2.9-3.8	Fund.	−55 to +100	±.005	32 pf
/108	CR-128/U	HC-18/U	R3W	20.0-62.0	3rd O.T.	−55 to +105	±.005	Series
/118	CR-139/U	HC-18/U	R3W	20.0-22.0	Fund.	−55 to +105	±.005	30 pf
/119	CR-140/U	HC-6/U	R17	9.5-12.5	Fund.	−55 to +90	±.005	60 pf
/122	CR-141/U	HC-18/U Mod.	R3W Mod.	50.0-90.0	5th O.T.	−30 to +55 −(55 to 30) & +(55 to 65)	±.0025 ±.0045	Series
/137	CR-157/U	HC-33/U	R17W	1.0-20.0	Fund.	−55 to +105	±.005	Series

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

MICROPROCESSOR CRYSTALS



CTS Knights microprocessor crystals offer a low cost crystal for microprocessor clock applications. Reliability is assured by the use of a mil-approved quality control process. These are solder seal and resistance weld crystals with 0.5" min. lead length.

Microprocessor crystals are available as "off the shelf" items from CTS authorized distributors.

Frequency MHz	CTS P/N	Microprocessor or Clock ICN	Specifications	Load Capacity
1.0	MP010	6800 Series, 6500 Series, INS8060 SCMPII, MC14500, 6809, 6860, 2150(AMI), 2650	±.020% 0-70°C H17W	13pf
1.8432	MP018	MC14411 Baud Rate Generator	±.020% 0-70°C H17W	13pf
2.0	MP020	6800 Series, 6500 Series, INS8060 SCMPII, 2650, INS8090, F8(3850CPU), IM6102, 68B09	±.015% 0-70°C H17W	20pf
2.097152	MP021	MM5378, MM5379 — NSC Auto Clock	±.015% 0-70°C H17W	20pf
2.4576	MP024	34702 Baud Rate Generator	±.015% 0-70°C H17W	32pf
3.0	MP030	MCS-48, 8021, 8022, 8035, 8041, 8048, 8741, 8748, IM8048, IM8748	±.015% 0-70°C H17W	18pf
3.2768	MP032	IM6100C, ICM7205	±.015% 0-70°C H17W	15pf
3.579545	MP036	IM5369, Color tv burst, IM6102, PPS-8, 6801, 6803	±.015% 0-70°C H17W	18pf
3.579545	MP036S	IM5369, Color tv burst, IM6102, PPS-8, 6801, 6803	±.015% 0-70°C H3W	18pf
4.0	MP040	MCS-40, 4004, 4040, 4201, 6802, 6808, MK3870, 3872, 3873, 3876, INS8060 SCMPII	±.015% 0-70°C H3W	20pf
4.0	MP04A	PACE-NSC, MC6875, Z80, Z80A	±.015% 0-70°C H3W	Series
4.194304	MP041	ICM7038, 7213, 7049	±.007% 0-50°C H3W	12pf
4.91520	MP042	Standard Clock Frequency	±.015% 0-70°C H3W	20pf
5.0	MP05A	Special Frequency	±.015% 0-70°C H3W	20pf
5.00	MP05B	CDP1802, 1803, TMS9985, TMS9940, IM6100A	±.015% 0-70°C H3W	Series
5.0688	MP050	COM5016, 5016T, Dual BRG	±.015% 0-70°C H3W	Series
5.185	MP051	MCS-40, 4004, 4040, 4201	±.015% 0-70°C H3W	20pf
5.7143	MP057	PACE-NSC	±.015% 0-70°C H3W	Series
5.7143	MP057A	IM6100A	±.015% 0-70°C H3W	20pf
6.0	MP060	MCS-48, 8035, 8041, 8048, 8741, 8748, IM8048, IM8748	±.015% 0-70°C H3W	20pf
6.144	MP061	MCS-85, 8085	±.015% 0-70°C H3W	20pf
6.250	MP062	MCS-85, 8085	±.015% 0-70°C H3W	30pf
6.5536	MP065	ICM7045, Timer Crystal	±.015% 0-70°C H3W	20pf
8.0	MP080	8X30, MC6875	±.015% 0-70°C H3W	Series
8.00	MP080A	IM6100A, MC68000, Z8000, Z8, CDP1804 9940-8-Fair	±.015% 0-70°C H3W	20pf
10.0	MP100	Special Frequency	±.015% 0-70°C H3W	Series
10.0	MP101	MCS-85, 8085A-2, 9940-10-Fair	±.015% 0-70°C H3W	30pf
11.0	MP110	MCS-48, 8039, 8049	±.015% 0-70°C H3W	18pf
12.00	MP120	MCS-86, 8086/8284, 9940-12-Fair, 8202 Ram Controller	±.015% 0-70°C H3W	Series
15.00	MP150	MCS-86, 8086/8284, 8202 Ram Controller	±.015% 0-70°C H3W	Series
18.00	MP180	MCS-80, 8080A/8224	±.015% 0-70°C H3W	Series
18.432	MP184	MCS-80, 8080A/8224	±.015% 0-70°C H3W	Series
20.0	MP200	MCS-80, 8080A/8224	±.015% 0-70°C H3W	Series
22.1184	MP221	MCS-80, 8080A/8224	±.015% 0-70°C H3W	Series
24.0	MP240	MCS-86, 8086/8284	±.015% 0-70°C H3W	Series
25.0	MP250	8202 Ram Controller	±.015% 0-70°C H3W	Series
27.0	MP270	MCS-80, 8080A/8224	±.015% 0-70°C H3W	Series
36.0	MP360	9080A/8224-2AMD	±.015% 0-70°C H3W	Series
48.0	MP480	TMS9900 Series/TIM9904(LS362)-TI	±.015% 0-70°C H3W	Series

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

OUTLINE DRAWINGS CRYSTALS

OUTLINE DRAWINGS

CTS Knights supplies crystals in four package sizes, (groups) of holders. Physical size and configuration distinguish each group. These are:

HC-18 GROUP
H3 (HC-25/U)
H3W (HC-18/U)
R3 (HC-50/U)
R3W (HC-49/U)
K3 (HC-42/U)
K3W (HC-43/U)

HC-32 GROUP
H5 (HC-32/U)
H5W
R5
R5W
K5
K5W (HC-46/U)

HC-6 GROUP
H17 (HC-6/U)
H17W (HC-33/U)
R17 (HC-48/U)
R17W (HC-51/U)
K17 (HC-36/U)
K17W (HC-47/U)

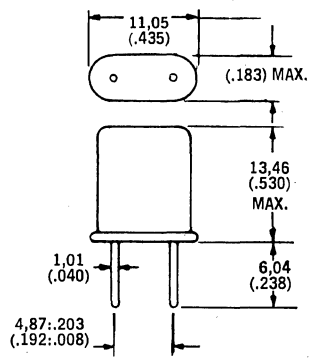
SPECIAL GROUP
TO5 (HC-35/U)
TO8 (HC-37/U)
R2W (Similar to HC44/U)
HC-40/U

Three sealing methods are used. "H" holders are solder sealed. "R" holders are resistance welded. "K" and "T" holders are coldwelded. These sealing techniques ensure long term isolation from external environments. Solder sealing, resistance welding and coldwelding are designed to meet the military leak rate specification. Pin-type leads are normally used in sockets; wire-type leads are common for circuit board use. Resistance and coldweld are intrinsically cleaner packages and thus have better reliability.

HC-18 GROUP

mm (IN.)

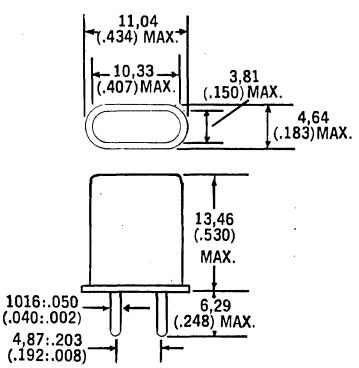
SOLDER SEAL
H3 (HC-25/U)



H3W (HC 18/U)
12,70 (.500) LEADS
0,48 (.019) DIA.

FIG. 7

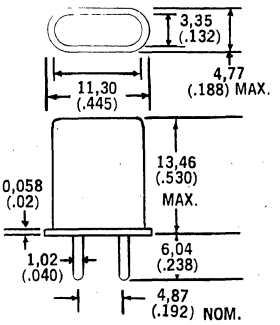
RESISTANCE WELD
R3 (HC-50/U)



R3W (HC-49/U)
12,70 (.500) LEADS
0,48 (.019) DIA.

FIG. 8

COLDWELD
K3 (HC-42/U)



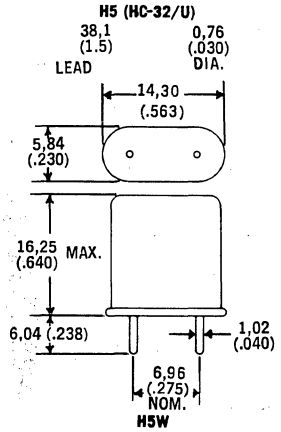
K3W (HC-43/U)
12,7 (.500) LEAD LENGTH
0,48 (.019) MAX. DIA.

FIG. 9

HC-32 GROUP

mm (IN.)

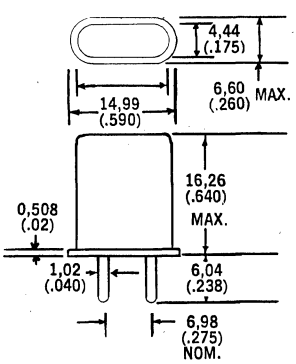
SOLDER SEAL
H5 (HC-32/U)



H5W
12,70 (.500) LEADS
0,51 (.020) DIA.

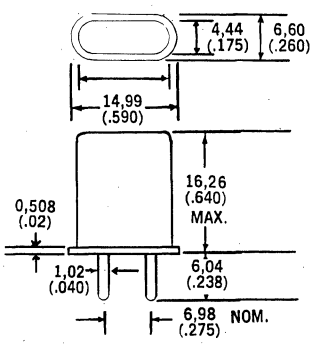
FIG. 10

RESISTANCE WELD
R5



H5W R5W
12,7 (.500) LEADS
0,51 (.020) DIA.

COLDWELD
K5



K5W (HC-46/U)
25,4 (1.0) LEADS
0,51 (.020) DIA.

FIG. 11

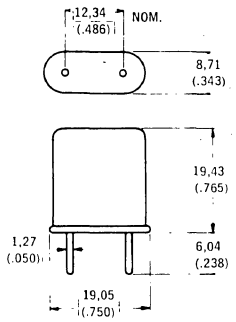
CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

OUTLINE DRAWINGS
CRYSTALS

HC-6 GROUP

SOLDER SEAL
H17 (HC-6/U)



H17W (HC-33/U)

38,1 LEADS (1.5) LEADS
0,762 DIA. (.030) DIA.

FIG. 12

RESISTANCE WELD
R17 (HC-48/U)

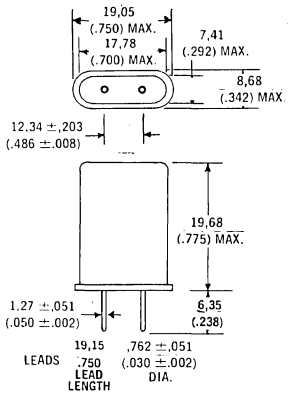
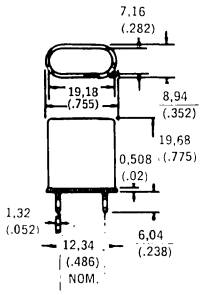


FIG. 13

COLDWELD
K17 (HC-36/U)



K17W (HC-47/U)

19,15 .750 MIN. LEAD LENGTH
0.76 (.030) DIA.

FIG. 14

SPECIAL GROUP

COLDWELD or RESISTANCE WELD
TO5 (HC-35/U)

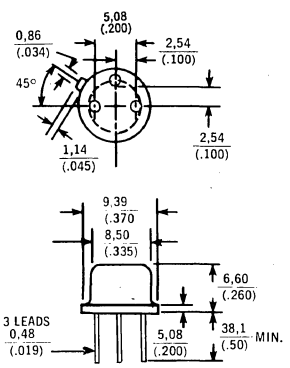


FIG. 15

R-2W (Similar to HC-44/U) RESISTANCE WELD
R-2W

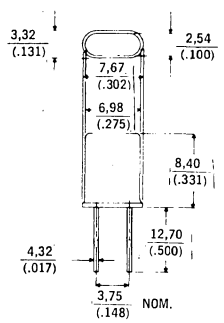


FIG. 16

TO-8 (HC-37/U) COLDWELD
TO-8

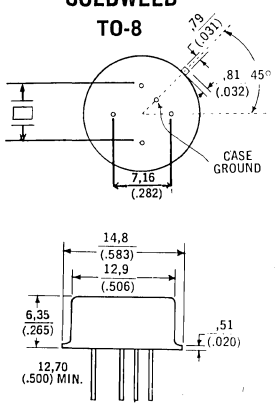
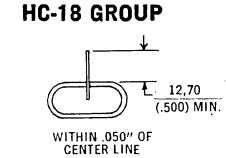


FIG. 17

Wire lead versions of Solder Seal, Resistance Weld and Cold-weld Holders are available with a hold-down wire for circuit board mounting.

HC-18 GROUP



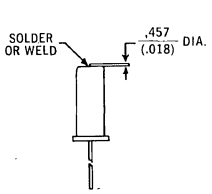
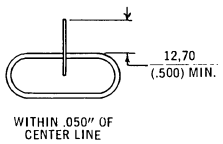


FIG. 18

HC-32 GROUP



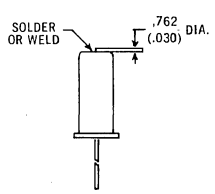
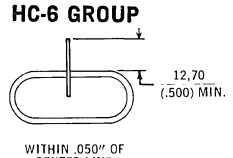


FIG. 19

HC-6 GROUP



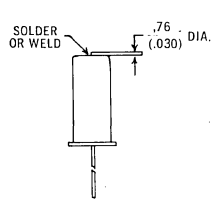


FIG. 20

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

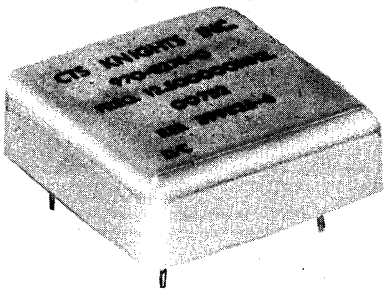
TCXO-TCVCXO CRYSTAL OSCILLATORS

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS (TCXO's)
VOLTAGE CONTROLLED - TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS (TCVCXO's)

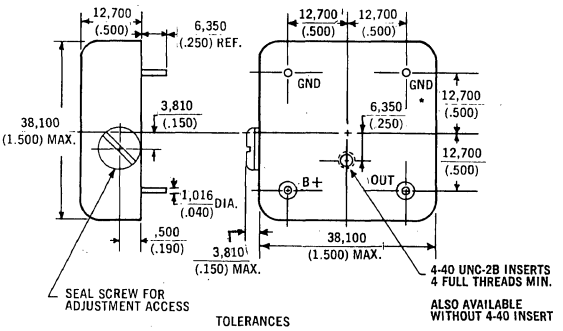
Low power consumption, high stability over wide temperature extremes, and small physical size characterize CTS Knights' TCXO and TCVCXO crystal oscillators. Add excellent environmental characteristics including immunity to humidity, vibration and shock, satisfying the requirements of the instruments and communications industries.

High reliability and stringent long term qualities common in military applications are available in a variety of designs. Note the options and modifications, the flexibility of design which offers the user choices to fulfill specific needs.

JKXO-12 (TCXO)
JKVXO-12 (TCVCXO)



FEATURES:
Low profile
Solder seal
Vibration 15G's, 10-2000 Hz

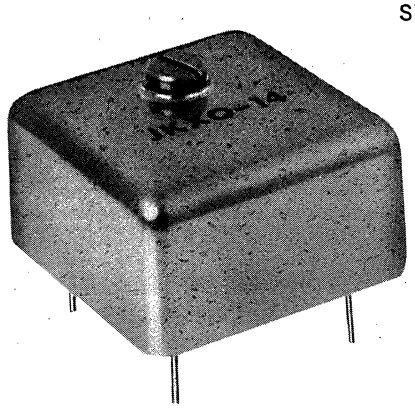


* VCO INPUT ON TCVCXO MODELS

FIG. 21

JKXO-14 (TCXO)

FEATURES:
Top access hex drive trim adjustment
Sine or TTL output



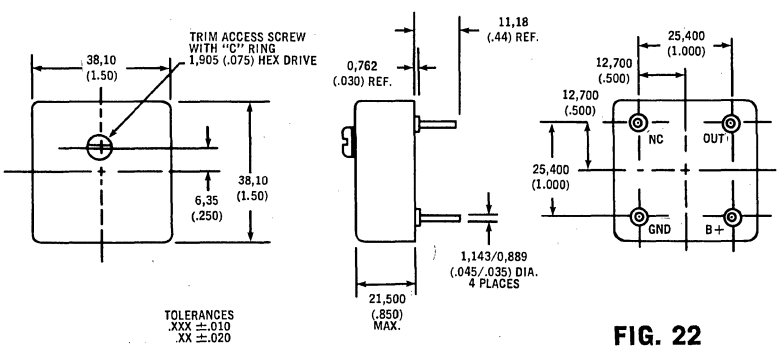


FIG. 22

JKXO-16 (TCXO)
JKVXO-16 (TCVCXO)

FEATURES:
Solder seal
Wide frequency range
Specialized outputs available

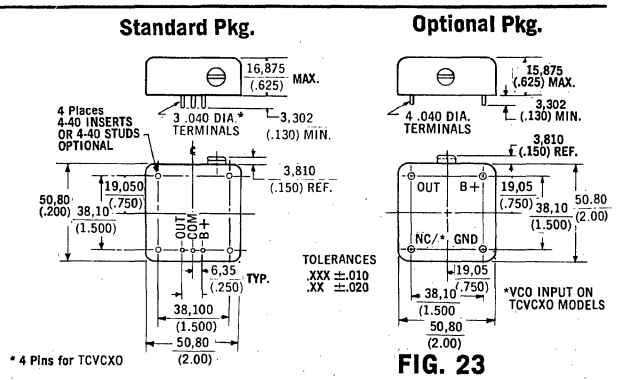


FIG. 23

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

TCXO-TCVCXO CRYSTAL OSCILLATORS

JKVXO-22

FEATURES:

Available as VCXO or TCVCXO. Temperature stability and deviation are customized per application. 5 volt supply, Mod voltage range 0 to +5 VDC.

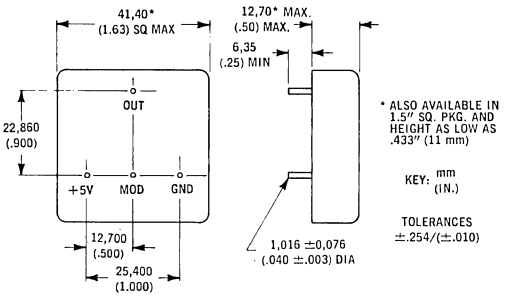
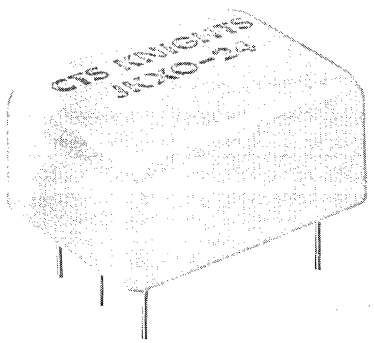


FIG. 24

JKXO-24 (TCXO)



FEATURES:

Compact size with hermetic seal. Frequency adjustment is via an externally applied voltage or a 10K pot. Also available with internal mechanical adjust trimmer with seal screw.

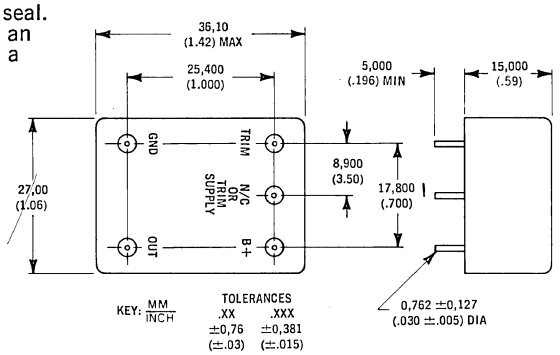


FIG. 25

FIG.	MODEL	FREQUENCY RANGE	SUPPLY VOLTAGE OPTIONS (VDC)	STABILITY WITH TEMPERATURE	VCXO DEVIATION OPTIONS	TYPICAL AGING PER YEAR	OUTPUT OPTIONS
21	JKXO-12A	3-50 MHz	9-20	±2 PPM, −55 to +85°C	NONE	1 PPM	Sine Wave, TTL CMOS (Below 10 MHz) ECL (−5V Supply Req.)
	JKXO-12B	3-30 MHz	9-20	±1 PPM, −40 to +75°C	NONE	1 PPM	
	JKXO-12C	3-50 MHz	9-20	±.5 PPM, 0 to +70°C	NONE	1 PPM	
22	JKXO-14A	3-30 MHz	9-28	±.5 PPM, 0 to +50°C	NONE	1 PPM	TTL or Sine
	JKXO-14B	3-30 MHz	9-28	±1 PPM, 0 to +70°C	NONE	1 PPM	
23	JKXO-16A	1 Hz to 30 MHz	9-28	±1 PPM, −40 to +75°C	NONE	1 PPM	Sine (Above 500 KHz) ECL, TTL CMOS (Below 10 MHz)
	JKXO-16B	1 Hz to 30 MHz	9-28	±1 PPM, −55 to +85°C	NONE	1 PPM	
	JKXO-16C	1 Hz to 30 MHz	9-28	±2 PPM, −40 to +75°C	NONE	1 PPM	
	JKXO-16D	30 to 100 MHz	9-28	±2 PPM, −20 to +70°C	NONE	1 PPM	
	JKXO-16E	1 KHz to 30 MHz	5	±2 PPM, −20 to +70°C	NONE	1 PPM	
25	JKXO-24A	3-30 MHz	8-20	±2 PPM, −20 to +80°C	NONE	1 PPM	TTL or 1.0 VP-P into 1 KΩ
	JKXO-24B	3-30 MHz	9-20	±1 PPM, 0 to +70°C	NONE	1 PPM	
21	JKVXO-12A	3-30 MHz	9-20	±10 PPM, 0 to +70°C	±150 PPM, ±5V Input	1 PPM	TTL
	JKVXO-12B	30 to 50 MHz	9-20	±2 PPM, 0 to +70°C	±15 PPM, ±3V Input	1 PPM	Sine Wave
	JKVXO-12C	8 to 35 MHz	9-20	±2 PPM, 0 to +70°C	±40 PPM, ±3V Input	1 PPM	Sine, TTL, ECL
	JKVXO-12D	1 MHz to 30 MHz	5	±30 PPM, −55 to +85°C	±100 PPM, ±5 VDC or 0 to 5V	1 PPM	TTL, ECL, CMOS, Sine
23	JKVXO-16A	1 KHz to 30 MHz	9-20	±10 PPM, 0 to +65°C	±40 PPM, 1 to 4 VDC	1 PPM	TTL, ECL CMOS (Below 10 MHz) Sine (Above 500 KHz)
	JKVXO-16B	1 KHz to 30 MHz	9-20	±20 PPM, −20 to +70°C	±150 PPM, ±5V Input	1 PPM	
	JKVXO-16C	1 MHz to 30 MHz	5	±30 PPM, −55 to +85°C	±100 PPM, ±5V Input	1 PPM	
	JKVXO-16D	30 MHz to 150 MHz	12-20	±5 PPM, 0 to +50°C	±15 PPM, ±5V Input	1 PPM	Sine, ECL
24	JKVXO-22A	1 KHz to 30 MHz	5	±10 PPM, 0 to +50°C	±40 PPM, 0 to +5 VDC	2 PPM	TTL, CMOS
	JKVXO-22B	30 MHz to 50 MHz	5	±5 PPM, 0 to +50°C	±15 PPM, 0 to +5 VDC	2 PPM	TTL ECL (−5V Supply Req.)
	JKVXO-22C	1 MHz to 30 MHz	5	±15 PPM, −20 to +70°C	±150 PPM, 0 to +5 VDC	2 PPM	

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTAL OSCILLATORS

HIGH STABILITY OVENIZED CRYSTAL OSCILLATORS

CTS Knights ovenized oscillators are available in thermostatically controlled models as well as proportional control models. A variety of design options are available to the user, including very high stability, low power, small size and sine wave or square wave (TTS or CMOS) output. Contact CTS Knights for your special requirements.

MODEL	FREQUENCY RANGE	DIMENSIONS INCHES	DIMENSIONS mm	OSCILLATOR INPUT*	OVEN INPUT*	TEMPERATURE CONTROL	STABILITY VS. TIME	STABILITY VS. TEMPERATURE
JKXO-23	60 Hz-4 MHz	1.578x1.875 x4.442 HT	40,081x47,625 x112,32	+12 VDC	+28 VDC/AC, 115 VAC 11 W.	Thermostat	$\pm2.5x10^{-7}$/day $\pm1x10^{-6}$/yr	−40 to +70°C $\pm7.5x10^{-7}$
JKXO-30	1-4 MHz	2.0x2.0x4.0	50,8x50,8 x101,6	+28 VDC	+28 VDC or 115 VAC 10 W. Max.	Proportional	$\pm1x10^{-8}$/day $\pm1x10^{-6}$/yr	−10 to +55°C $\pm5x10^{-8}$
JKXO-30	4-10 MHz	2.0x2.0x4.0	50,8x50,8 x101,6	+12 to +28 VDC	+28 VDC or 115 VAC 10 W. Max.	Proportional	$\pm1x10^{-8}$/day $\pm1x10^{-6}$/yr	−10 to +55°C $\pm5x10^{-8}$
JKXO-41	1-10 MHz	2.0x2.0x4.25	50,8x50,8 x107,95	+28 VDC	+28 VDC 10 W. Max.	Proportional	$\pm1x10^{-9}$/day $\pm1x10^{-7}$/yr	−40 to +70°C $\pm3x10^{-8}$
JKXO-41	10-100 MHz	2.0x2.0x4.25	50,8x50,8 x107,95	+28 VDC	+28 VDC 10 W. Max.	Proportional	$\pm5x10^{-8}$/day $\pm1x10^{-6}$/yr	−25 to +65°C $\pm5x10^{-8}$
JKXO-51	1-2 MHz	1.844x2.0 x3.436	46,838x50,8 x87,274	+28 VDC	+28 VDC 10 W. Max.	Proportional	$\pm1x10^{-8}$/day $\pm3x10^{-7}$/yr	−55 to +75°C $\pm5x10^{-8}$
JKXO-88-1	1-10 MHz	2.0x2.25 x.800	50,8x57,15 x20,32	5 & 12 VDC	+28 VDC 10 W. Max.	Proportional	$\pm5x10^{-9}$/day $\pm3x10^{-7}$/yr	−25 to +65°C $\pm1x10^{-7}$
JKSC-127	10 MHz	4.5x2.5x2.5	114,3x63,5 x63,5	±15 VDC	+28 VDC 32 W. Max.	Double Oven Proportional	$\pm5x10^{-10}$/day $\pm3x10^{-8}$/yr	−55 to +71°C $\pm5x10^{-9}$
JKXO-130	256 KHz-10 MHz	4.5x1.6x2.11	114,3x40,6 x53,6	+15 VDC	+15 VDC 10 W. Max.	Proportional	$\pm5x10^{-10}$/day $\pm3x10^{-8}$/yr	0 to +60°C $\pm1x10^{-8}$

* Other voltages available

VOLTAGE CONTROLLED CRYSTAL OSCILLATORS

Voltage controlled oscillators can be supplied by CTS Knights for various stability versus temperature requirements by adding oven control or temperature compensating circuitry. Contact CTS Knights for special requirements.

MODEL	FREQUENCY RANGE	DIMENSIONS INCHES	DIMENSIONS mm	OSCILLATOR INPUT	OVEN INPUT	MODULATION INPUT	MODULATION DEVIATION	MODULATION LINEARITY	STABILITY VS. TEMPERATURE	DIMEN. OUTLINE
JKVXO-86	5-30 MHz	2.0x 2.00x.750	50,8x 50,8x19,05	12 VDC ±1	None	±3 VP.P., DC to 20 KHz	±1000 PPM	±10%	0 to +50°C $\pm100x10^{-6}$	Fig. 26
JKVXO-87	10-27 MHz	2.0x 2.25x.800	50,8x 57,2x20,32	+12 & +5 VDC	+28 VDC	±3 VP.P., DC to 20 KHz	±1000 PPM	±5%	−40 to +70°C $\pm10x10^{-6}$	Fig. 27
JKVXO-87	10-27 MHz	Vibration and shock, satisfying the requirements of the instrument and communications industries.							0 to +55°C $\pm5x10^{-6}$	Fig. 27
JKVXO-100 Hybrid Design	10-25 MHz	.860x .830x.350	21,844x 21,082x8,89	+12 & +5 VDC	None	±5 VP.P., DC to 10 KHz	±200 PPM	±10%	0 to +60°C $\pm4x10^{-5}$	Fig. 28

All dimensions are maximum unless otherwise noted.

KEY: MM / INCH

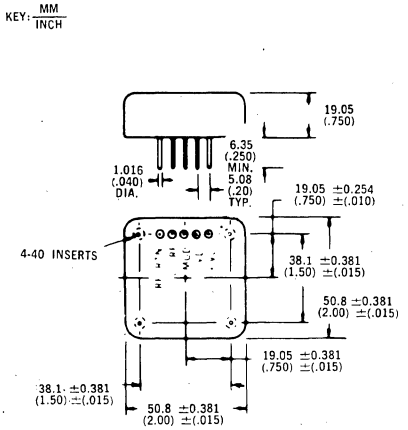


FIG. 26
JKVXO-86

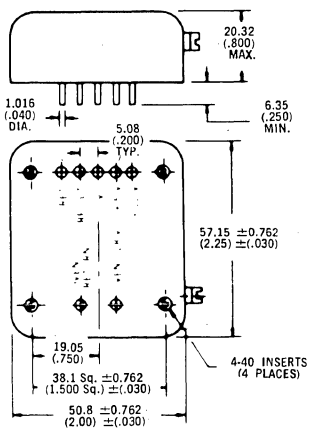


FIG. 27
JKVXO-87

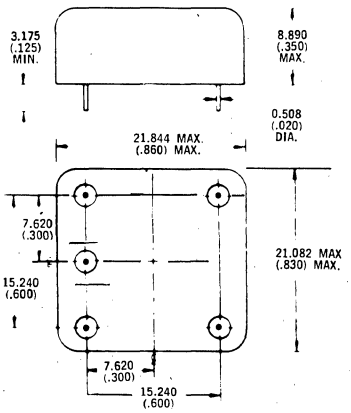


FIG. 28
JKVXO-100
HYBRID DESIGN

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

JKSC-127 FAST WARM-UP SC CUT OCXO

The JKSC-127 offers ultra fast warm-up with excellent long term, short term and phase noise characteristics. The design utilizes a 10 MHz Coldweld Sealed SC cut overtone crystal along with a uniquely designed proportionally controlled double oven which minimizes stabilized power consumption. The JKSC-127 is available fully militarized with an MTBF of greater than 100,000 hours in ground mobile and airborne environments.

GENERAL SPECIFICATIONS

FREQUENCY: 10.0 MHz or 10.230 MHz

INPUT VOLTAGE: Oven +28 VDC ±5%
Oscillator +15 VDC ±5%

INPUT CURRENT:

Oven @ turn-on	1.2 Amps Maximum
Oven @ 25°C	125 mA Typical
Oven @ −55°C	240 mA Typical
Oscillator	20 mA Maximum

FREQUENCY STABILITY VS. TEMPERATURE: $\pm 2 \times 10^{-9}$ from −55°C to +71°C

FREQUENCY STABILITY VS. TIME:
$\pm 5 \times 10^{-12}$ RMS/SEC
$\pm 5 \times 10^{-10}$/DAY **AT SHIPMENT**
$\pm 3 \times 10^{-8}$/YEAR

FREQUENCY STABILITY VS. VOLTAGE: $\pm 5 \times 10^{-10}$ for ±5% Change

WARM-UP: Referenced to 30 minutes

@ −55°C	$< 5 \times 10^{-9}$ in 7 minutes
@ −32°C	$< 5 \times 10^{-9}$ in 5 minutes
@ +25°C	$< 5 \times 10^{-9}$ in 3 minutes

RETRACE: 48 hours off Ta = +25°C < 5×10^{-9} in 15 minutes referenced to the turn off frequency.

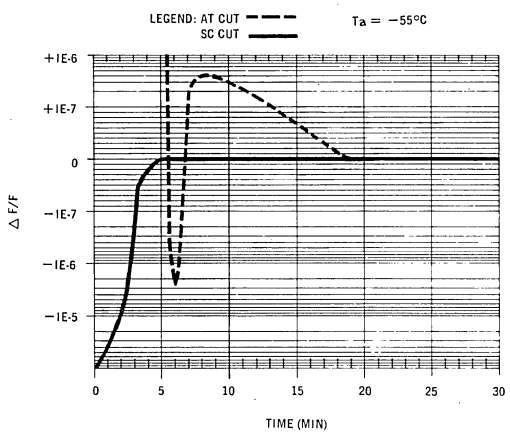
PHASE NOISE (1 HzBW):

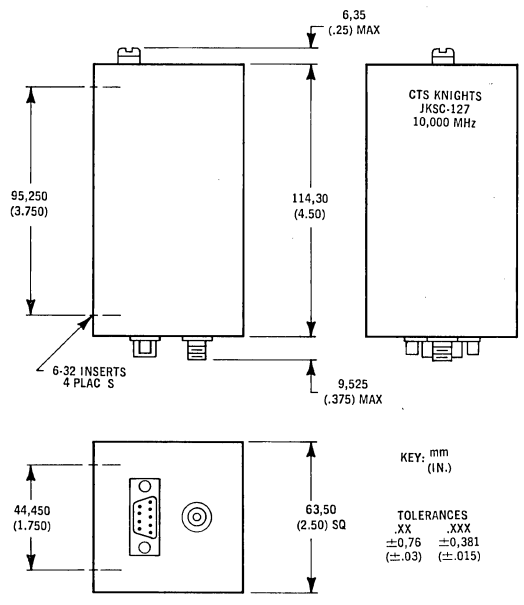
@ 10 Hz offset	−120 dbc
@ 100 Hz offset	−140 dbc
@ 1 KHz offset	−150 dbc
@ 100 KHz offset	−150 dbc

RF OUTPUT: +5 dbm Minimum into 50 Ohms

HARMONICS: −25 dbc

FREQUENCY ADJUSTMENT:
Coarse (Mechanical) $\pm 5 \times 10^{-7}$ Minimum
Fine (Electrical) $\pm 5 \times 10^{-8}$ Minimum for ±5 VDC





MODIFICATIONS OF THE JKSC-127 AVAILABLE — CONSULT FACTORY

DATA SUBJECT TO CHANGE WITHOUT NOTICE.

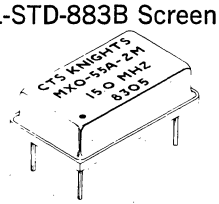
CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

HYBRID CLOCK OSCILLATORS

MXO-55 SERIES

Fully Hermetic Resistance Weld Package
TTL Compatible
Available with MIL-STD-883B Screening



FREQUENCY STABILITY

±.0025% to ±.1%, inclusive of calibration tolerance @ 25°C, oper. temperature range, environmental conditions, input voltage, aging and load change (See Ordering Table).

PIN CONNECTIONS

Pin 1 N/C, Enable or Output
Pin 7 Ground and/or Case Ground
Pin 8 Output
Pin 14 +5 VDC

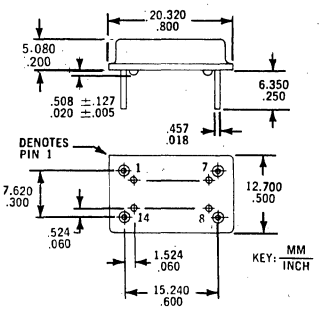


FIG. 29

ORDERING INFORMATION

MXO-55 [ ] – [ ] [ ] – [ ] ● [ ]
OUTPUT FREQUENCY

FREQUENCY & MODEL and OPTION	CODE
4.9152 MHz to 100 MHz Basic Oscillator with No Enable	A
4.9152 MHz to 70 MHz Basic Oscillator with Enable Option	AE
19.2 KHz to 4.9152 MHz Basic Oscillator with Dividers	B
2.4576 MHz to 24 MHz with Complementary Outputs	C
Any of the above with case connected to pin 7	GA GAE GB GC

FREQUENCY TOLERANCE (NOTE 1)	CODE
±.1% (1000 PPM)	1
±.01% (100 PPM)	2
±.005% (50 PPM)	3
±.05% (500 PPM)	4

OPERATING TEMPERATURE RANGE	CODE
0°C to +70°C	C
−40°C to +85°C	I
−55°C to +105°C	P
−55°C to +125°C	M

(MXO-50 SERIES: Same as above except .285 max. seated height)

ELECTRICAL SPECIFICATIONS

SPECIFICATION	MODEL	FREQUENCY RANGE	TEMPERATURE RANGE	SYMBOL	MINMUM	TYPICAL	MAXIMUM	UNITS
Operating Voltage	A, B, C	20 KHz to 110 MHz	−55°C to +125°C	Vcc	4.75	5.00	5.25	V
			−40°C to +85°C		4.50	5.00	5.50	
Maximum Supply Voltage			−55°C to +125°C	Vcc Max.			7.00	
Input Current	A	4.9152 to 25 MHz	−55°C to +125°C	Icc		20	30	mA
		>25 to 110 MHz				33	55	
	B	2.4576 to <4.9152 MHz				30	50	
		310 KHz to <2.4576 MHz				45	75	
		20 KHz to <310 KHz				70	125	
	C	>12 to 24 MHz				22	30	
		2.4576 to 12 MHz				30	50	
Output Voltage - High	A, B, C	20 KHz to 110 MHz	−55°C to +125°C	Voh	2.40	3.80		V
Output Voltage - Low				Vol		30	40	
Rise & Fall Time (Measured Between 0.5V and 2.4V)	A	4.9152 to 25 MHz	−55°C to +125°C	t_R & t_F		3	5	nS
		>25 to 110 MHz				2	4	
	B	2.4576 to <4.9152 MHz				3	5	
		20 KHz to <2.4576 MHz				8	15	
	C	2.4576 to 24 MHz				3	5	
Start-Up Time	A, B, C	20 KHz to 25 MHz	−55°C to +125°C			2	5	mS
	A	>25 to 110 MHz				5	15	
Duty Cycle (Uptime) (Measured @ 1.5V)	A	4.9152 to 25 MHz	0°C to +70°C		45	50	55	%
			−55°C to +125°C		40	50	60	
		>25 to 110 MHz	−55°C to +125°C		40	50	60	
	B	20 KHz to <4.9152 MHz			45	50	55	
	C	2.4576 to 12 MHz			45	50	55	
		>12 to 24 MHz	0°C to +70°C		45	50	55	
			−55°C to +125°C		40	50	60	
Phase Delay (Measured @ 1.5V)	C	>12 to 24 MHz	0°C to +70°C	$t_{\delta 1}$ & $t_{\delta 2}$		6	10	nS
		2.4576 to 12 MHz				3	5	
		>12 to 24 MHz	−55°C to +125°C			6	12	
		2.4576 to 12 MHz				3	8	
Enable Input Load Factor	A	4.9152 to 70 MHz	−55°C to +125°C	F_I			1	S-TTL Gates
Fanout (per output)	A, B, C	2.4576 to 110 MHz		Fo			10	TTL Gates
	A	20 KHz to <2.4576 MHz					10	

MIL-O-55310 PRODUCTS
A wide variety of clock oscillators manufactured per MIL-O-55310 are now available in TO-5, TO-8 and Dual-In-Line packages. (See MIL-O-55310).

CTS KNIGHTS

SPECIALISTS IN FREQUENCY MANAGEMENT

HYBRID CLOCK OSCILLATORS

MXO-65 SERIES
Microprocessor Driver
MOS Levels
High Capacitance Load Capability (Up to 500 pf)
Compatible with Motorola K1160 Series *
Frequency Range:
2.45 MHz to 12 MHz
Supply Voltage:
5.0V ±10%

CXO-55 SERIES
CMOS Compatible
Low Supply Current
Pin Connections:
Pin 1 Internal Connection
Pin 7 Ground
Pin 8 Output
Pin 14 + Supply Voltage
Frequency Range:
200 Hz to 12 MHz
Supply Voltage:
4.5 VDC to 15 VDC

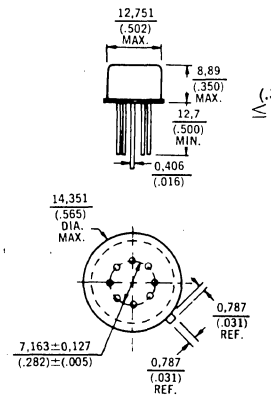
EXO-55 SERIES
10K ECL Compatible
Pin Connections:
Pin 1 N/C
Pin 7 B—
Pin 8 Output
Pin 14 Ground
Frequency Range:
8 MHz to 115 MHz
Supply Voltage:
−5.2V ±10% or
−5.0V ±10%

MXO-35 SERIES
Programmable Baud Rate Generator
Resistance Weld Package
Compatible With Motorola K1135 Series *
Military Screening Available

* Motorola, K1160, K1135 are trademarks of Motorola, Inc.

JKTO-79 SERIES
Electrically Similar to MXO-55
Fully Hermetic Welded TO-8 Style Package
Sine Wave Output Option

OUTLINE DIMENSIONS & PIN ASSIGNMENTS



ORDERING INFORMATION

JKTO-79 [ ] – [ ] [ ] – [ ] ● [ ]
OUTPUT FREQUENCY

FREQUENCY & MODEL and OPTION	CODE
8.0 MHz to 60.0 MHz Basic Oscillator No Enable	A
4.0 MHz to 8.0 MHz Oscillator with Divider No Enable	B
4.0 MHz to 12.0 MHz Oscillator with Complementary Output No Enable	C
Any of the Above with Enable Option (Note 4)	AE BE CE
1.0 MHz to 12.0 MHz Oscillator with Dual Divider Outputs & Enable Output A = ÷2 Output B = ÷8	D28E
1.0 MHz to 6.0 MHz Oscillator with Dual Divider Outputs & Enable Output A = ÷4 Output B = ÷8	D48E

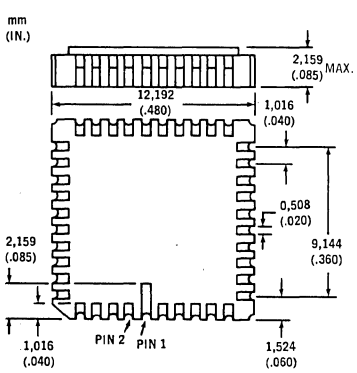
FREQUENCY TOLERANCE (NOTE 1)	CODE
±.1% (1000 PPM)	1
±.01% (100 PPM)	2
±.005% (50 PPM)	3
±.05% (500 PPM)	4

OPERATING TEMPERATURE RANGE	CODE
0°C to +70°C	C
−40°C to +85°C	I
−55°C to +105°C	P
−55°C to +125°C	M

PIN	CONNECTION
1	Enable/Disable Option (Otherwise NC)
2	Internal Connection
3	Output A (Q_A) (Otherwise NC)
4	Ground
5	Output B (Q_B)
6	Internal Connection
7	NC (Model A) Internal Connection (Model B, C, D) Crystal Frequency (Model C, D)
8	Vcc

CCXO-140 SERIES
TTL oscillators in surface mount, hermetic chip carrier package
Frequency Range: 1.0 MHz to 30.0 MHz (CMOS and High Frequency TTL under development)

OUTLINE DIMENSIONS & PIN ASSIGNMENTS



ORDERING INFORMATION

CCXO-140 [ ] – [ ] [ ] – [ ] ● [ ]
OUTPUT FREQUENCY

FREQUENCY & MODEL	CODE
14.0 MHz to 30.0 MHz Basic Oscillator	A
1.0 MHz to <14.0 MHz Oscillator with Divider	B

FREQUENCY TOLERANCE (NOTE 1)	CODE
±.1% (1000 PPM)	1
±.01% (100 PPM)	2
±.005% (50 PPM)	3
±.05% (500 PPM)	4

OPERATING TEMPERATURE RANGE	CODE
0°C to +70°C	C
−40°C to +85°C	I
−55°C to +105°C	P
−55°C to +125°C	M

NOTES:
1. NC — internally connected. No external electrical connections.
2. All other pins may have external electrical connections. These pins may also be used as optional connections. Consult factory for possible pin connection options.

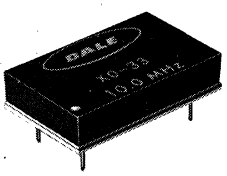
All part types are available with MIL-STD-883 screening. Consult factory or sales representatives for detailed data sheets and custom requirements.

STANDARD PIN CONNECTIONS

PIN	FUNCTION FOR FREQUENCY		
	1-7 MHz	7-14 MHz	14-30 MHz
1			OUTPUT
4	+5 VDC	+5 VDC	+5 VDC
5	NC	NC	NC
10	+5 VDC	+5 VDC	+5 VDC
15	NC	NC	NC
25	NC	NC	NC
31	GND	GND	GND
35	NC	NC	NC
37	GND	GND	GND
39	OUTPUT	NC	NC
40		OUTPUT	NC

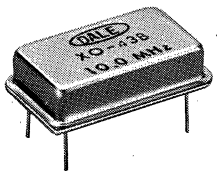
DALE®

CLOCK OSCILLATORS



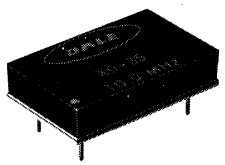
XO-33
250 KHz to 60 MHz

Hybrid, low profile. Standard frequencies: 1.0, 1.2288, 2.0, 2.4576, 4.0, 4.9152, 5.0, 5.0688, 6.0, 8.0, 10.0, 12.0, 16.0, 16.384, 18.432, 19.6608, 20.0, 24.0, 25.0, 30.0, 32.0, 40.0, 50.0 MHz.



XO-43
250 KHz to 60 MHz
RESISTANCE WELDED METAL PACKAGE

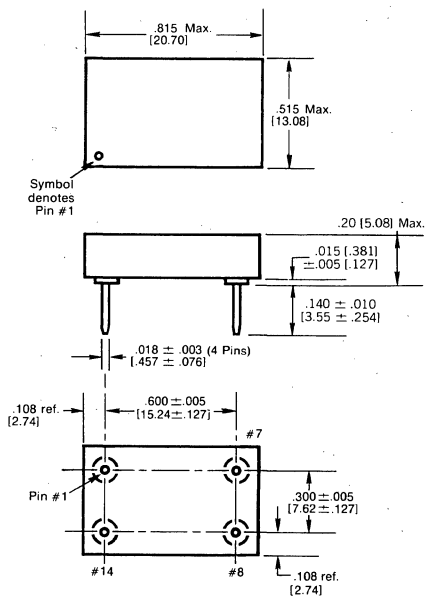
Hybrid, low profile. Standard frequencies: 1.0, 1.2288, 2.0, 2.4576, 4.0, 4.9152, 5.0, 5.0688, 6.0, 8.0, 10.0, 12.0, 16.0, 16.384, 18.432, 19.6608, 20.0, 24.0, 25.0, 30.0, 32.0, 40.0, 50.0 MHz.

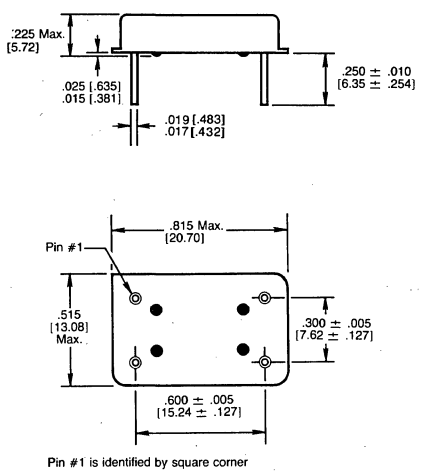


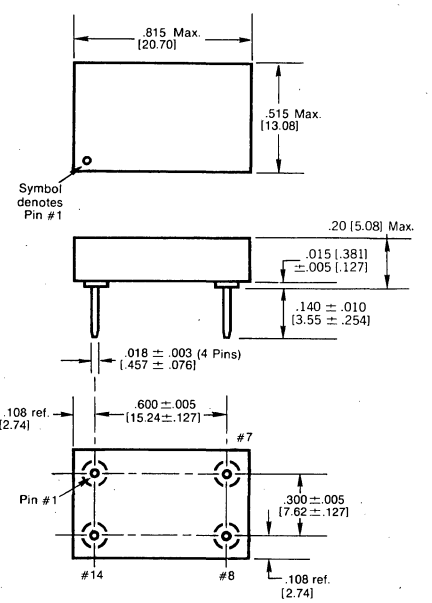
XO-35
4.0 MHz to 12.0 MHz
DUAL COMPLEMENTARY OUTPUTS*

Hybrid, low profile. Standard frequencies: 4.0, 4.9152, 5.0, 5.0688, 8.0, 10.0 MHz.

DIMENSIONS







SPECIFICATIONS	Model XO-33	Model XO-43	Model XO-35
Output Freq. as Specified	From 250 KHz to 60 MHz	From 250 KHz to 60 MHz	From 4.0 MHz to 12.0 MHz
Frequency Accuracy and Stability all Conditions	XO-33A ±.005% XO-33B ±.01% XO-33C ±.05% XO-33D ±.1% XO-33H ± 1%	XO-43A ±.005% XO-43B ±.01% XO-43C ±.05% XO-43D ±.1% XO-43H ± 1%	XO-35A ±.005% XO-35B ±.01% XO-35C ±.05% XO-35D ±.1%
Operating Temperature	0°C to +70°C	0°C to +70°C	0°C to +70°C
Supply Voltage	+5Vdc ± 0.5V	+5Vdc ± 0.5V	+5Vdc ± 0.5V
Input Current	Below 4.0 MHz: 65 mA max. 4.0 MHz to 15.9 MHz: 40 mA max. 16 MHz to 25.0 MHz: 70 mA max. 25.1 MHz to 60.0 MHz: 50 mA max.	Below 4.0 MHz: 65 mA max. 4.0 MHz to 24.99 MHz: 40 mA max. 25.0 MHz to 60.0 MHz: 50 mA max.	All Frequencies: 70 mA max.
Symmetry at 1.4 VDC Level	60/40 or better	**1	60/40 or better
Rise and Fall Time	Below 16 MHz: 15 nS max. 16 MHz and above: 10 nS max.	Below 4.0 MHz: 15 nS max. 4.0 MHz to 24.99 MHz: 10 nS max. 25.0 MHz to 60.0 MHz: 6 nS max.	All Frequencies: 3 nS Typ./10 nS max.
"Zero" Level Sinking 16 mA	Below 16 MHz: 0.4V max. 16 MHz and above: 0.5V max.	0.4V max.	All Frequencies: 0.5V max.
"One" Level Sourcing 0.4 mA	2.4V min.	2.4V min.	2.4V min.

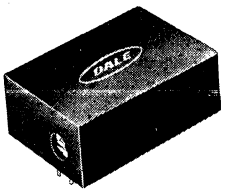
*Outputs are complementary within ±10 nSec phase difference at +1.4V level
**1 250 KHz to 3.99 MHz: 55/45 or better, 4.0 MHz to 60.0 MHz: 60/40 or better

For additional information, contact
DALE ELECTRONICS, INC., 1155 West 23rd Street, Tempe, AZ 85282 • Phone 602-967-7874

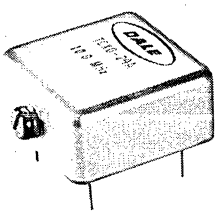
DALE®

TEMPERATURE COMPENSATED, CRYSTAL OSCILLATORS

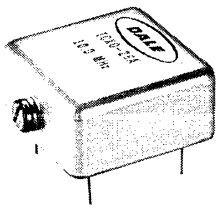
Stock frequencies include: 4.0, 5.0 and 10.0 MHz



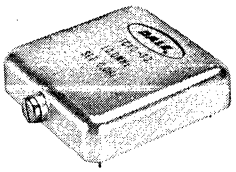
TCXO-22



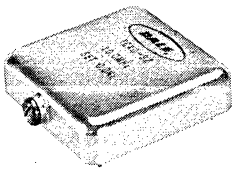
TCXO-24



TCXO-26



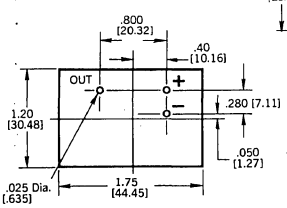
TCXO-30

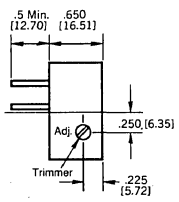


TCXO-32

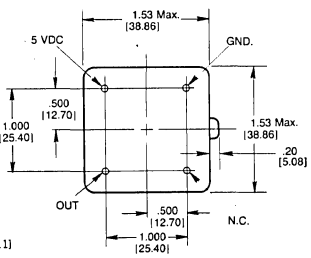
DIMENSIONS

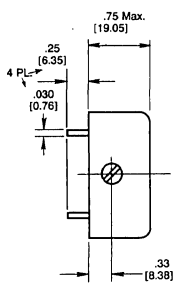
Model TCXO-22



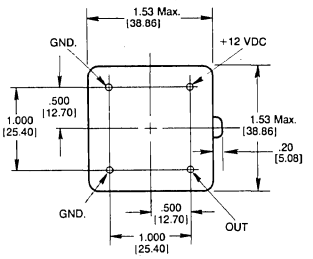


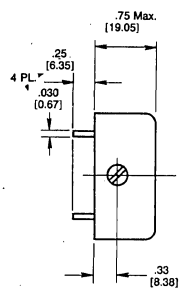
Model TCXO-24



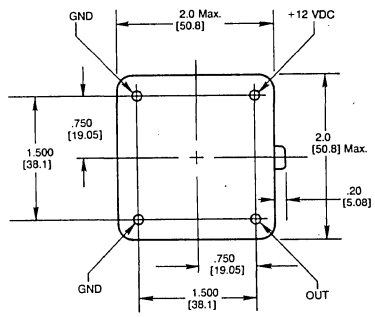


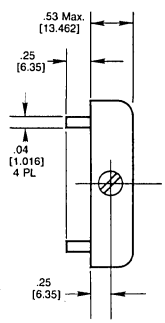
Model TCXO-26





Model TCXO-30 and Model TCXO-32





SPECIFICATIONS	Model TCXO-22 and Model TCXO-24 (A, B or C)	Model TCXO-26	Model TCXO-30 and Model TCXO-32
Frequency Range	4 to 15.0 MHz	4 to 15.0 MHz	3 to 15.0 MHz
Accuracy at +25°C	±1 PPM (Adjustable)	±1 PPM Adjustable with Trimmer	±1 PPM Adjustable with Trimmer
Stability vs. Input Voltage	±0.2 PPM for ±10% Volt. Change	±0.25 PPM for ±5% Volt. Change	±0.10 PPM for ±5% Volt. Change
Stability vs. Temp.	TCXO-22A, TCXO-24A ±1 PPM 0 to +55°C TCXO-22B, TCXO-24B ±1 PPM +15 to +50°C TCXO-22C, TCXO-24C ±5 PPM 0 to +55°C	±1 PPM 0 to 70°C	±1 PPM −40°C to +85°C for TCXO-32 ±3 PPM −40°C to +85°C for TCXO-30
Stability vs. Time	1 PPM/Year Max.	1 PPM/Year Max.	1 PPM/Year Max.
Stability vs. Loading	±0.1 PPM for ±20% Load Change	±0.1 PPM for ±20% Load Change	±0.1 PPM for ±20% Load Change
Input Power	V = 5VDC ±10%/Current 16 mA Max.	12VDC ±5%/Current 26 mA Max.	12VDC ±5%/Current 15 mA Typ.
Output Signal	TTL Compatible, Drives 10 Loads	TTL Compatible, Drives 10 Loads	TTL Compatible, Drives 10 Loads
Rise and Fall Time	20 nS Max.	20 nS Max.	20 nS Max.
Symmetry	60/40 or Better at 1.4V Level	60/40 or Better at 1.4V Level	60/40 or Better at 1.4V Level

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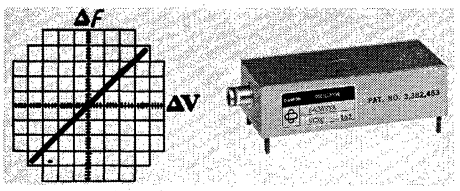
DAMON *THE FORM FACTOR SPECIALISTS*

VCXOs — 1 KHz to 500 MHz

Damon VCXOs provide high stability over a broad range of center frequencies. An optional square wave or pulse output signal compatible with I. C. logic circuits is available.

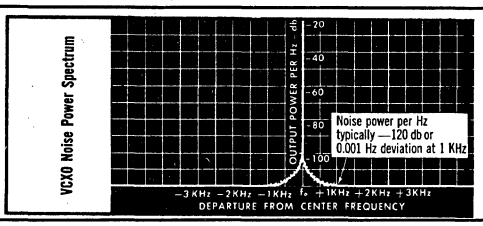


VCXO CHARACTERISTICS:

Center Frequency .. 1 KHz to 500 MHz
Deviation ..... .01% to 0.5% of Center Frequency
Linearity 1% to 5% of Peak Deviation
Frequency Stability .... Determined by Peak Deviation and Operating Temp.
Modulation Rates ..... DC to 2 MHz

Low Noise VCXOs

Damon low noise miniaturized VCXOs are all solid state quartz crystal stable oscillators whose frequencies can be varied linearly by an external DC or AC modulating signal. Only a source of power and control signal are required . . . no auxiliary compensating circuitry.

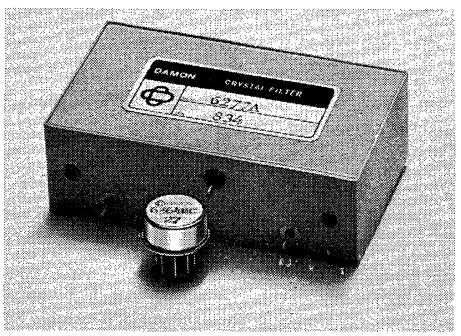


TYPICAL CHARACTERISTICS:

Center Frequency 10.000 MHz ±1 KHz
Deviation ..... ±10 KHz
Linearity ..... ±1%
Modulation Rate ..... Flat to 4 KHz
Output Power ..... >1 MW

Gaussian Crystal Filters

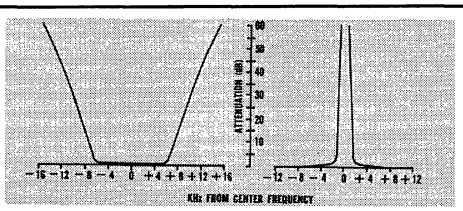
Gaussian Crystal Filters of either conventional or monolithic design. Useful in FM communications or radar systems where flat time delay is required. In a coherent pulsed radar, it can minimize return-pulse overshoot. Eliminates ringing problems in swept spectrum analysis. Available in 2 to 8 pole designs.



Center Frequency
Conventional ..... 10 KHz - 35 MHz
Monolithic ..... 3 - 30 MHz
3 dB Bandwidth ..... 100 Hz - 30 KHz
Shape Factor, 30 dB to 3 dB 3:1 to 7:1
Ringing, Pulse or Impulse 25 - 50 dB down
Phase Linearity ..... ±2%
No. of Poles
Conventional ..... 2 - 8
Monolithic ..... 2 - 4
Volume
Conventional ..... 1 - 6 cu. in.
Monolithic ..... 0.016 - 0.4 cu. in.

Band-Pass/Reject Crystal Filters

A wide variety of conventional crystal filters are produced at Damon. Standards designs such as Butterworth, Chebyshev, Gaussian, Bessel, and Legendre, as well as custom tailored designs are available.

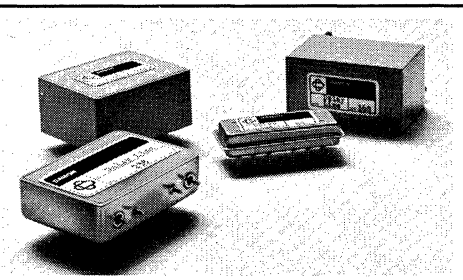


RANGE OF PARAMETERS:

Center Frequency .... 10 KHz - 75 MHz
Bandwidth ..... .01% - 3% of C.F.
Shape Factor ..... Down to 1.2:1
Differential Phase Shift ..... ±2°
Group Delay Uniformity ..... ±5%

Surface-Wave Delay Lines

With signal transfer **across** the surface instead of through the body (a state-of-the-art development), the new Surface-Wave concept results in substantially smaller packages, lower cost in production quantities and superior performance over a 20 MHz to 300 MHz range.

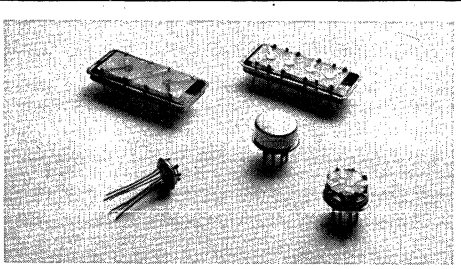


RANGE OF PARAMETERS:

Frequency Range .. 20 MHz - 300 MHz
Time Delay Range 0.5 - 20 Microsecs.
Bandwidth at −3 dB ..... 3% - 30% of Center Frequency
Insertion Loss ..... 10 - 20 dB
Spurious Responses 25 - 30 dB below Desired Response
Environment ..... Full Military Temp., Shock, Vibration Available
Typical Size ..... < 1 cu. in.

Monolithic Crystal Filters

Damon Monolithic Filters utilize a single quartz plate for multiple resonators and the coupling medium between them. Advantages over conventional crystal filters include smaller size, superior stability, and lower cost. Available in a wide variety of computer-assisted designs from Chebyshev to Gaussian characteristics and from 2 to 8 poles.



MONOLITHIC CHARACTERISTICS:

Center Frequency ..... 2.5 - 30 MHz
3 dB Bandwidth ..... 0.3 - 30 KHz
No. of Coupled Resonators ..... 2 - 6
Insertion Loss ..... 1 - 6 dB
Ripple ..... 0.5 dB Max.
Terminations .. 50 Ohms to 20 Kohms
Size ..... TO-5, TO-8, or Flat-Pack

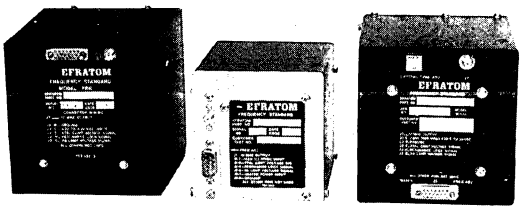
Write for technical bulletins.

DAMON/ELECTRONICS DIVISION
DEPT. EM, 80 WILSON WAY, WESTWOOD, MASS. 02090, TEL: (617) 449-0800, TWX (710) 348-6222

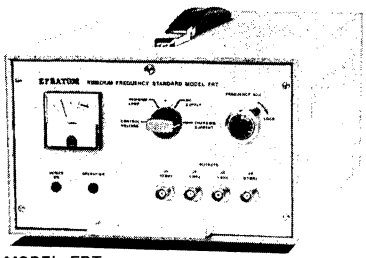
time and frequency systems

EFRATOM
A DIVISION OF Ball CORP

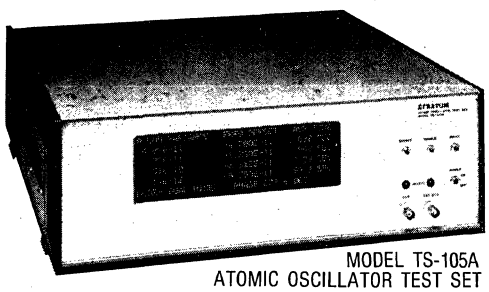
RUBIDIUM OSCILLATORS



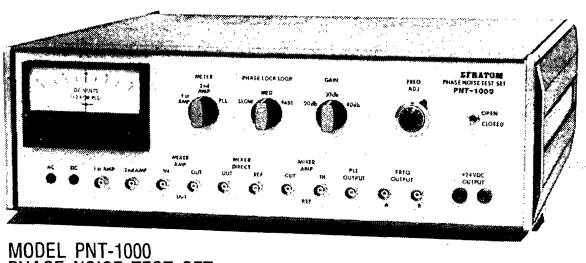
FRK M-1000 M-100



MODEL FRT
RUBIDIUM FREQUENCY STANDARD



MODEL TS-105A
ATOMIC OSCILLATOR TEST SET



MODEL PNT-1000
PHASE NOISE TEST SET

EFRATOM is the recognized world leader in precision time and frequency systems for military/aerospace and commercial applications. Utilizing state-of-the-art atomic oscillator technology, EFRATOM has conceived and developed a family of time and frequency references that find valuable application in navigation, communications and laboratory environments. The ever increasing demands for precision time base hardware to perform in the harsh environments of space, military theatres and mobile communication platforms, have provided the impetus for the development of EFRATOM's range of atomic oscillators and time base generators.

EFRATOM's Model M-1000 is the world's smallest atomic oscillator measuring just 3.25in x 3.25in x 4.5in (83mm x 83mm x 114mm), yet this instrument provides long term stability performance of better than 1 x 10^{-11}/month. Developed specifically for military use, the Model M-100 and M-1000 rubidium oscillators offer unparalleled performance in the toughest of airborne and ground environment including radiation, EMI, and high G conditions.

Complimentary to its range of precision oscillators EFRATOM offers the Model FRT ultra-stable atomic frequency standard for laboratory and field calibration of time and frequency references. More recently, EFRATOM introduced its' Atomic Oscillator Test Set Model TS-105A which provides for fast and accurate determination of frequency stability (Allan Variance), frequency offset and phase measurement of atomic and high performance crystal oscillators.

EFRATOM's scientists are currently working in conjunction with NBS in the development of a Compact Passive Hydrogen Maser for commercial production. They are also actively engaged in research and development of a future generation of laboratory and mobile time and frequency standards.

MODEL	FRK—L	FRK—H	FRT—L	FRT—H	M—100	M—1000	CPHM
Output Frequency	10 MHz		2 ea10; 5; 1; 0.1 MHz		10 MHz	10 MHz	5 MHz
Long Term Drift/mo	$4x10^{-11}$	$1x10^{-11}$	$4x10^{-11}$	$1x10^{-11}$	$6x10^{-11}$ $1x10^{-11}$	$3x10^{-11}$ $1x10^{-11}$	$<1x10^{-15}$
Short Term (100s)	$3x10^{-12}$	$1x10^{-12}$	$3x10^{-12}$	$1x10^{-12}$	$4x10^{-12}$	$4x10^{-12}$	$1x10^{-13}$
Phase Noise (1 HzBW)	120 dB (100 Hz) 145 dB (1KHz) from carrier Low Noise Option 155dB (100 Hz)				>120 dB @ 100 Hz >135 dB @ 1 KHz	>140 dB @ 100 Hz >150 dB @ 1 KHz	-113 dB (1Hz) -155 dB (>100 Hz)
Warm-up	<10 minutes for $2x10^{-10}$				<10 min to $2x10^{-10}$	<2.5 min to $5x10^{-10}$	~ 24 Hrs
Temperature Operation	-40°C to +65°C	-25°C to +65°C	-10°C to +50°C		-55°C to +55°C Amb (+68°C Base Plate)	-55°C to 71°C Amb (+80°C Base Plate)	10°C to 35°C
Power	22 VDC to 32 VDC/13W		110/220 VAC/50W		22.5 to 32 VDC/18W	22.5 to 32 VDC/15W	< 70W
Dimensions	~ 4x4x4.5 inches		6x9x16 inches		~ 4x4x4.8 inches	3.25x3.25x4.5 inches	19x14x24 inches
Weight	2.9 lbs		27 lbs		4 lbs	2.5 lbs	~70 lbs

EFRATOM *USA/18851 Bardeen Ave./Irvine, CA 92715/Telephone (714) 752-2891/Telex 685-635*
Europe & W. Germany/8000 Muechen 90/Langobardenstr 7/Phone (089) 647-138/Telex 529701

electronic research company

7618 Wedd, Overland Park, Kansas 66204
TWX: (910) 749-6477
Telephone: (913) 631-6700

GENERAL

Electronic Research Company Model ER8001 is a Precision Ovenized Crystal Oscillator utilizing a 5MHz third overtone crystal manufactured by E.R.C. Model ER8002 uses the same crystal except the output frequency is multiplied to 10MHz. These oscillators are ideal for applications where a precision time base is to be multiplied or synthesized requiring a low phase noise source.

SPECIFICATIONS

Output Frequency: Model ER8001, 5MHz; Model ER8002, 10MHz
Output Level: 1Vrms Minimum into a 50 ohm load
Waveform: Sine-Wave
Harmonic Distortion: 40dB below rated output
Frequency Adjustment: ±2.5PPM Min. course mechanical; ±2.0 x 10^{-7} Min. fine mechanical; ±1.0PPM Min. electrical option 3 only; By D.C. Voltage (−10 to +10V)
Input Voltage: +12VDC ±10%, Current at Turn-on 340MA Max. Note input terminals No. 2 & 4 may be connected together externally.
Frequency Stability vs. Input: ±3 x 10^{-9} for a ±10% change in input
Frequency Stability vs. Load: ±1 x 10^{-9} for a ±10% change in load
Frequency Stability vs. Temperature: ±5 x 10^{-9} from −20°C to +65°C ambient
Warm-up Time: 1 x 10^{-7} in 15 Min.; ±1 x 10^{-8} in 20 Min.
Aging Rate: 1 x 10^{-9}/24 hours, after 72 hours on time
Short Term: 3 x 10^{-11} RMS for one second averaging time
Retrace: ±1 x 10^{-8} after 60 Min. warm-up following a 24 hour off time
Input Power: At turn-on 340MA — After warm-up operating at +25°C 135MA, After warm-up operating at −20°C 225MA
Frequency Stability vs. Orientation: 1.5 x 10^{-9} worst case
Size: Model ER8001 and Model ER8003 2″ x 2″ x 4″ H
Model ER8005 2.25″ x 2.25″ x 4.25″ H

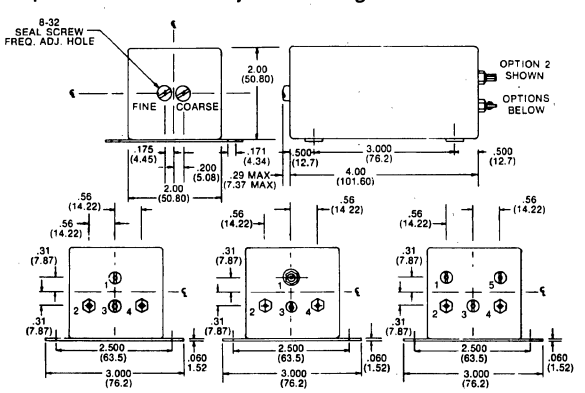
PHASE NOISE S.S.B. 1Hz BW

Offset From Carrier	S/N
10Hz	124dB
100Hz	135dB
1000Hz	145dB
5000Hz	150dB

OPTIONS AVAILABLE

Output Voltage: T.T.L.
Input Voltage: ±12VDC, +15VDC, +24VDC, +30VDC
Mechanical: Various please specify
Long Term Stability: 5 x 10^{-10}/24 hours
Output Frequencies: 1MHz to 15MHz
Tuning: Electrical fine tune options

Technical specifications are subject to change without notice.



OPTION 1
PIN CONNECTIONS
1. OUTPUT RF
2. OSC. INPUT
3. GROUND + CASE
4. OVEN INPUT

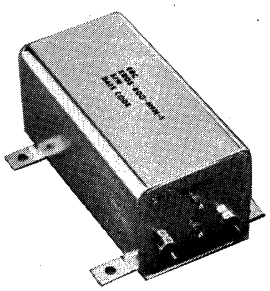
OPTION 2
PIN CONNECTIONS
1. OUTPUT RF
2. OSC. INPUT
3. GROUND + CASE
4. OVEN INPUT

OPTION 3
PIN CONNECTIONS
1. OUTPUT RF
2. OSC. INPUT
3. GROUND + CASE
4. OVEN INPUT
5. VCO INPUT

PINS 2 and 4
ERIE# 2499-008-502Z
PINS 1 and 3
104 - LOOP

PINS 2 and 4
ERIE# 2499-008-502Z
PIN 1
SELECTRO
P/N 51-043-4300
PIN 3
104 - LOOP

PINS 2 and 4
ERIE# 2499-008-502Z
PINS 1, 3 and 5
104 - LOOP



PRECISION CRYSTAL OSCILLATORS

SERIES 8000

Standard Frequency: 5.0MHz
Aging Rate: Model ER8001 1 x 10^{-9}/day
Model ER8003 1 x 10^{-10}/day
Model ER8005 5 x 10^{-11}/day
Phase Noise: SSB 1Hz BW at 10Hz offset
Model ER8001, 124dB
Model ER8003, 135dB
Input Voltage: 12VDC ±10% standard
Output: Sine-wave 1VRMS into 50 ohm load
Size: Model ER8001 and Model ER8003 2″ x 2″ x 4″ H
Model ER8005 2.25″ x 2.25″ x 4.25″ H
Options: Many options are available to interface with your requirements

Electronic Research Company Series 8000 precision ovenized crystal oscillators are the ultimate choice where proven reliability and frequency stability is required. These oscillators are ideal for applications where a precision time base is to be multiplied or synthesized requiring a low phase noise source. All Electronic Research Company's oscillators utilize quartz crystals manufactured by ERC for maximum control on all parameters to insure performance specifications. If your application requires superior oscillator performance call us or write for our complimentary catalogue.

For information and prices, send your specifications to:

electronic research company

7618 Wedd, Overland Park, Kansas 66204
TWX: (910) 749-6477
Telephone: (913) 631-6700

QUARTZ CRYSTALS/TCXO/VCXO/OVENIZED OSCILLATORS

FREQUENCY CONTROL PRODUCTS

MODEL ER6001

GENERAL

Temperature Compensated Crystal Oscillator, Model ER-6001 is used in applications requiring low power and minimum seated height for printed circuit board mounting. Improved long term aging is achieved by using a 10MHz cold-weld crystal manufactured by E.R.C. A wide variety of options are available for applications requiring different specifications.

SPECIFICATIONS

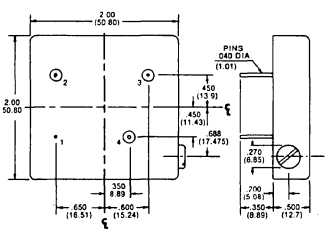
Output Frequency: 10.00 MHz
Output Level: TTL, 10 Loads
Output Waveform: Square Wave
Duty Cycle: 50% ±10%
Rise Time-Fall Time: 15 ns Maximum
"0" Level: .5V Maximum
"1" Level: 3V Minimum
Input Voltage: +5VDC ±10%
Input Current: 18mA @ +5.5V
Frequency Stability vs. Input Voltage: $\pm 1 \times 10^{-7}$
Frequency Stability vs. Load: $\pm 1 \times 10^{-7}$
Frequency Stability vs. Temperature: $\pm 1 \times 10^{-6}$ from 0°C to +60°C Ambient
Aging: Long Term 1×10^{-6}/Year
Short Term 1×10^{-8}/24 Hours
Frequency Adjustment: Sufficient for 10 years of aging

OPTIONS AVAILABLE

Output Waveform: Sine-Wave
Input Voltage: ±12VDC, +12VDC, +15VDC, +27VDC
Frequency Stability vs. Temperature:

Ambient Temperature	Frequency Stability
0°C to +55°C	± 3PPM
0°C to +70°C	± 1PPM
0°C to +70°C	±.5PPM
−30°C to +75°C	± 1PPM
−55°C to +105°C	± 1PPM

Frequency Range: 1Hz to 150MHz
Technical specifications are subject to change without notice.



Pin #	Function
1	CASE GND
2	OUTPUT
3	+Vcc
4	−Vcc, RF GND

MODEL ER6002

GENERAL

Model ER6002 is a Temperature Compensated Crystal Oscillator which is available at any frequency from 1Hz to 15MHz. By using a precision cold-weld crystal manufactured by ERC, improved long-term aging is realized. Applications are where reliable performance is required over a wide temperature range.

SPECIFICATIONS

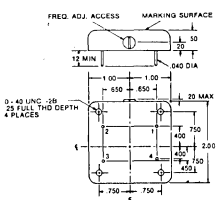
Output Frequency: Data applicable for frequencies from 3.2MHz to 15MHz
Output Level: Square wave, TTL compatible
Duty Cycle: 50% ±10%
Amplitude: Logic "0" 0.5V Max., Logic "1" 2.5V Min.
Rise-Time/Fall-Time: 15NS Maximum, Typical 10NS @ 6MHz
Load: 10 TTL Loads
Input Voltage: +15VDC ±5%, +5VDC ±5%
Current: +15VDC Supply 10MA, +5VDC Supply 20MA
Adjustment: Sufficient for 10 years of aging
Stability as a Function of Temperature: ±1PPM over a ambient temperature range −40°C to +70°C
Stability as a Function of Input: ±0.5PPM for ±5% voltage change
Stability as a Function of Time: 1PPM per year

ENVIRONMENTAL CHARACTERISTICS

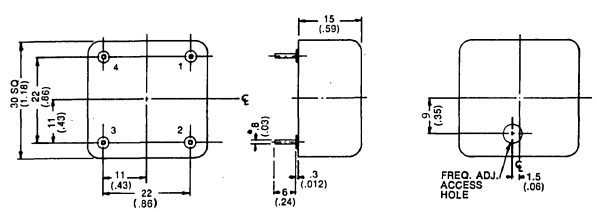
Operating Temperature: −40° to +70°C
Storage Temperature: −55°C to +125°C
Altitude: To 70,000 feet
Shock: MIL-STD-202E, Method 213, Test Condition G
Vibration: MIL-STD-202F, Method 211, Test Condition A
Terminal Strength: MIL-STD-202F, Method 211, Test Condition A

OPTIONS AVAILABLE

Output Waveform: Sine-Wave
Input Voltage: ±15VDC, +12VDC, +27VDC, +5VDC
Frequency Range: 1Hz to 15MHz
Temperature: −55°C to +105°C
Technical specifications are subject to change without notice.



Pin #	Function
1	+15Vdc
2	GND + CASE
3	+5Vdc
4	OUTPUT



PIN #	Function
1	B+
2	N/C
3	GND
4	O/P

MODEL ER6004

SPECIFICATIONS

Temperature Stability: ±1.0PPM 0°C to +55°C
Frequency: 5MHz or 10MHz are standard. Any frequency 50Hz to 20MHz available.
Output Level: TTL Standard, CMOS and Sine optional
Supply Voltage: +5VDC ±5% at 15mA typical
Aging Rate: 1PPM per year typical
Stability vs. Supply: ±0.2PPM typical
Rise/Fall Time: Less than 20 μsec.
Frequency Adjustment: ±5PPM Min.

electronic research company
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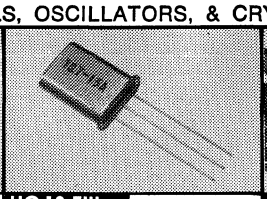
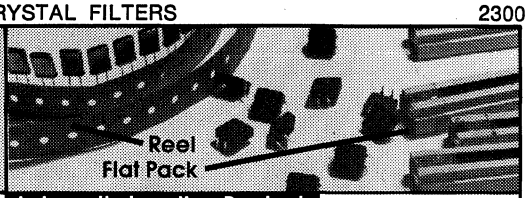
FOX ELECTRONICS

Clock Oscillator


HC-18 Filter



Automatic Insertion Products

Quartz Crystals

Fox offers the broadest line of crystal products in the industry: from standard products to volume automatic insertion to miniature crystals.

We carry a large stock of standard and special frequencies and feature fast delivery for large or small quantity orders. Our Distributors in your area also carry stock.

Fox also offers standard and custom holders in solder seal, resistance weld and cold weld. Send your drawings/specifications or call our Customer Service Department for assistance.

We are committed to give our customers a quality product at a competitive price, backed by excellent service.

WITH FOX, YOU GET THE BEST IN QUARTZ.

Standard Microprocessor

(Available from stock)

Frequency Mhz	Holder Type	Fox P/N	Circuit Calibration Condition
1.0000	HC-43	FOX010S	series
1.0000	HC-33	FOX010	13pF
1.8432	HC-33	FOX018	13pF
1.8432	HC-18	FOX018S	13pF
2.0000	HC-33	FOX020	20pF
2.0000	HC-18	FOX020S	20pF
2.097152	HC-33	FOX021	20pF
2.097152	HC-18	FOX021S	20pF
2.4576	HC-33	FOX024	32pF
2.4576	HC-18	FOX024S	32pF
3.0000	HC-33	FOX030	32pF
3.0000	HC-18	FOX030S	32pF
3.2768	HC-33	FOX032	18pF
3.2768	HC-18	FOX032S	18pF
3.579545	HC-33	FOX036	18pF
3.579545	HC-18	FOX036S	18pF
3.6864	HC-18	FOX0368S	series
4.0000	HC-18	FOX040A	series
4.0000	HC-18	FOX040	20pF
4.0320	HC-18	FOX0432	22pF
4.194304	HC-18	FOX041	12pF
4.433619	HC-18	FOX0443	20pF
4.91520	HC-18	FOX049	series
4.9562	HC-18	FOX0495	series
5.0000	HC-18	FOX05A	20pF
5.0688	HC-18	FOX050	series
5.1850	HC-18	FOX051	20pF
6.0000	HC-18	FOX060	series
6.1440	HC-18	FOX061	30pF
6.4000	HC-18	FOX064	20pF
6.5536	HC-18	FOX065	20pF
7.3728	HC-18	FOX073	series
8.0000	HC-18	FOX080	series
10.0000	HC-18	FOX100	series
10.738635	HC-18	FOX107	series
11.0000	HC-18	FOX111	series
12.0000	HC-18	FOX120	series
13.5168	HC-18	FOX135	series
14.31818	HC-18	FOX143	series
15.0000	HC-18	FOX150	series
16.0000	HC-18	FOX160	series
18.0000	HC-18	FOX180	series
18.4320	HC-18	FOX184	series
19.6608	HC-18	FOX196	series
20.0000	HC-18	FOX200	series
22.1184	HC-18	FOX221	series
24.0000	HC-18	FOX240	series
27.0000	HC-18	FOX270	series
32.0000	HC-18	FOX320	series
36.0000	HC-18	FOX360	series
48.0000	HC-18	FOX480	series
100.0000	HC-18	FOX1000	series

Automatic Insertion

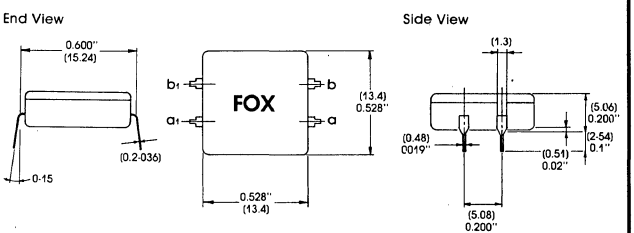
Flat Pack

The FX-1 series line of low cost crystals feature a molded plastic package with dual in-line pin spacing for automatic insertion. The FX-1 utilizes a special crystal technology in crystal packaging while maintaining the FOX quality.

The standard plastic tube houses 25 crystals ready for insertion.

Frequency range ± 3.5 MHz to 15 MHz
Frequency tolerance ± 700ppm @ 25°C
Standard load capacitance 16pf
Operating temperature range – 10 to +60@C

Package Dimensions



Tape and Reel

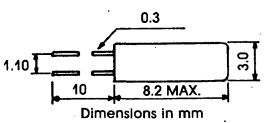
The Fox Tape and Reel crystals are the industry's First line of automatically insertable HC18 crystals for large volume applications.

Available in standard 12 inch reels with .200" pin spacing and up to 1500 crystals per reel of frequencies from 1MHz to 175MHz.

Miniatures

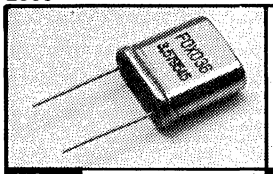
The Fox line of miniature crystals provides the designer with the ultimate in size, performance and economic trade offs. Featured are tuning fork and "AT" cut crystals packaged in a tubular cold weld metal design that features low power, long term stability, tight tolerances and low resistance.

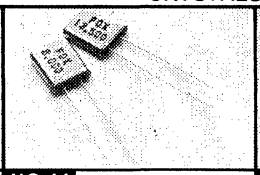
Dimensions

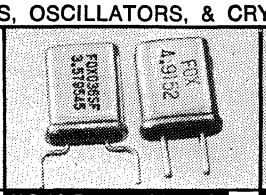


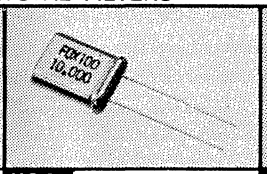
Electrical Specifications

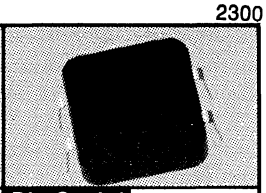
	Part No.	Frequency
Low Frequency tuning forks	NC 38S —	16 KHz-163 KHz
Frequency stability		± 30 PPM
Watch crystal	NC 38 —	32.768 KHz
Frequency stability		± 20 PPM
High Frequency "AT" Cut	FX-3	4.19 MHz-18.0 MHz
Frequency stability		± 30 PPM


HC-33


HC-44


HC-18 Formed Leads


HC-18

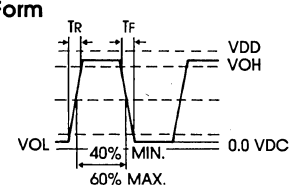

Dip Crystal

Crystal Clock Oscillators

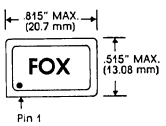
Fox Oscillators feature a high quality metal welded package that offers a hermetic seal to provide excellent resistance to extremes of heat/humidity. With pin 7 case ground, the metal package also includes shielding to minimize RF radiation, helping to meet FCC emit EMI specifications. The Fox Oscillators can be soldered in standard wave line operations without damage. High insulated stand-offs permit good de-fluxing.

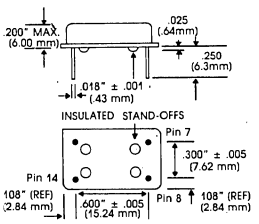
The Fox Oscillators include state of the art thick film hybrid devices for generating TTL, CMOS and special output characteristics.

Output Wave Form



Package Dimensions





(TTL) F1100 Series

Fox TTL Oscillators use standard +5V dc input and drives up to 10 TTL loads. Fox offers product line of stabilities, tailored for your specific needs and designed to be cost effective.

The F1100 series is interchangeable with Motorola K1100 AM and similar models.

Electrical Specifications

Freq. Range:	250 KHz -80 MHz
Freq. Stability:	±0.001- 1.00% over optg. temp. & voltage
Optg. Temp. Range:	0 to +70°C
Input Voltage:	+5 VDC ± 0.5 V
TTL Output:	
Symmetry:	60/40 to 40/60 @ 1.4 VDC Level
Rise & Fall Times:	15 ns Max. for 250 kHz to 25 MHz, 7 ns Max. for 25 MHz to 60 MHz
"O" Level:	+0.4 Volts
"I" Level:	+2.4 Volts
Output Load:	1 to 10 TTL gates

Standard Product Line

Model	Stability	Frequency	Remarks
F1100	± .01%	.250-80 MHz	TTL Clock
F1114	± .05%	.250-80 MHz	TTL Clock
F1115	± .10%	.250-80 MHz	TTL Clock
F1116	±1.0 %	.250-80 MHz	Economy Clock
F1142	± .001%	.250-80 MHz	Precision Clock
F1144	± .0025%	.250-80 MHz	Precision Clock
F1145	± .005%	.250-80 MHz	Precision Clock
F1158	± .01%	.250-80 MHz	Extended Temp.

Standard TTL Frequencies (Available from stock)

Freq. (MHz)	Freq. (MHz)
1.0000	10.0000
1.8432	12.0000
2.0000	16.0000
2.4576	18.4320
4.0000	19.6608
5.0000	20.0000
5.0688	22.1184
6.0000	24.0000
6.1440	32.0000
8.0000	40.0000

(CMOS) F1152 Series

Fox CMOS Oscillators generate a compatible output at any frequency specified from 25KHz to 12 MHz. The extremely low power consumption makes it perfect for driving CMOS MPU's or where battery backup is required. As with all CMOS circuits, power consumption and frequency range are dependent upon the selected input voltage.

The CMOS compatible output uses +5Vdc to +15Vdc.

Specifications

Frequency Range: 25 KHz -12.000 MHz

Frequency Stability: +0.01% (Inclusive of calibration tolerance at 25°C, operating temperature range, input voltage change, load change, aging, shock, and vibration.)

Temperature Range: Operating: 0°C to 70°C
Storage: −55°C to +125°C

Input Voltage: +5V to +15V dc

Input Current:	+5V	+10V	+15V
25kHz—3.199 MHz	2.5 mA	6 mA	14 mA
3.200—6.499 MHz	2 mA	6 mA	14 mA
6.500—8.999 MHz		9 mA	17 mA
9.000—12.000 MHz			18 mA

Output:

Symmetry:	40/60% to 60/40% (CL = 15 pF @ VO = ½ Vdd)		
"1" Source Current:	120 mA		
"0" Sink Current:	360 mA		
	+5V	+10V	+15V
VOH (Logic "1") min.	4.5	9.0	13.5
VOL (Logic "0") max.	.5	1.0	1.5
RISE & FALL TIMES (10% to 90% VOD CL = 15 pF)	100 ns	55 ns	35 ns

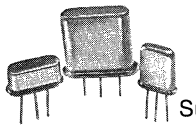
Mil Equivalent F-550 Series

Fox offers a commercial equivalent to mil. 0-55310. If your oscillator needs match those of a mil spec in general parameters, but your application does not demand the exhaustive testing and administration, you can order a mil equivalent Fox oscillator. The Fox mil equivalent oscillator is designed to meet the mil spec. Marking will be standard commercial marking.

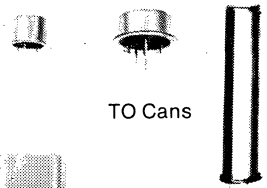
Contact the Fox Customer Service Department for assistance.

FOX ELECTRONICS ■ Sales Department ■ P.O. Box 1078 ■ Cape Coral, Florida 33910 ■ 813/482-7212 ■ TWX 510-951-7386

FREQUENCY CONTROL PRODUCTS, INC. Crystals / 1 kHz to 185 MHz

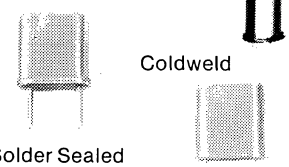


Resistance Welded Subminiature

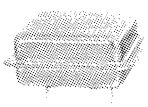


TO Cans

Coldweld



Solder Sealed



Flatpacks

Clock Oscillators

SOME **FCP** SPECIALS

Microprocessor Crystals. Over 50 standard models for the frequencies from 1 to 48 MHz cover the most widely used microprocessors, clocks and ICs. All available in Coldweld HC-18 cans, some also in HC-33.

Crystals for Filters and Oscillators. Matched sets and high stability.

High Qs. Better than 1×10^6 in some ranges, also spurious mode suppressions from 20 to 65dB.

Special Environments. High shock and radiation hardened.

Small Packages. 10 MHz in TO-5 (HC-35/U) can, .700 to 1.5 MHz in .215" high HC-18 coldweld.

Clock Oscillators. Feature crystal stability, printed circuit board on dual in-line mounting and outputs directly compatible with DTL or TTL loads. Full line—Military and Industrial Clock Oscillators.

For more than 25 years **FCP** has been a major supplier of crystals for MIL Spec, general industrial and special applications. A wide variety of packages are available in coldweld and solder seal. Strong on engineering as well as production, Frequency Control Products can often be of assistance to the circuit designer.

1 kHz to 1.5 MHz

Cuts: JT • H (+5° Flexural) • NT
E (+5° Extensional) D • DT Bar

THERMAL COMPRESSION BONDED LEADS

Model 110 H .700 to 1.5 MHz
(mini only 0.215" high)

Model 128 250 to 700 kHz
(high Q mini, superior temp. tracking)

Model 200 .900 to 1.5 MHz
(submin. resistance welded only 0.039 in.²)

Typical Performance

		E	DT	DT Bar	JT	H	NT
Temp. Range	-40° +85° C (MIL)	±.015%	±.01%	±.01%	±.02%	±.1%	±.01%
	-10° +60° C (Com.)	±.008%	±.005%	±.005%	±.01%	±.05%	±.005%
Drive Level in Milliwatts		1	1	1	.1	.1	.1
Freq. Stability P.P.M./mo.							
Coldweld		0.5	0.1	0.1	0.5	0.5	0.1
Solder Seal		2.0	1.0	1.0	2.0	1.0	1.0

STANDARD HOLDERS

Cuts	Frequency Range, kHz	Bulova No.	Mil No.	Seal[2]
JT	1-15	71	HC-13/U	S
	3-15	73	HC-13/U	S
	4-15	124	HC-37/U(1.5")	C
	4-15	118	HC-35/U(1.5")	C
	4-15	131	HC-41/U	C
	10-15	122	HC-37/U(.6")	C
	10-15	117	HC-35/U(.6")	C
H +5° Flexure Mode	10-90	71	HC-13/U(1")	S
	15-90	73	HC-13/U	S
	15-90	124	HC-37/U(1.5")	C
	15-90	118	HC-35/U(1.5")	C
	15-90	131	HC-41/U	C
	45-90	117	HC-35/U(1")	C
	45-90	122	HC-37/U(.6")	C
NT	8-200	71	HC-13/U	S
	15-200	73	HC-13/U	S
	20-200	124	HC-37/U(1½")	C
	20-200	118	HC-35/U(1½")	C
	20-200	131	HC-41/U	C
	45-200	117	HC-35/U(1")	C
	45-200	122	HC-37/U(.6")	C
	85-200	70	HC-6/U	S
	85-200	78	HC-33/U	S
	85-200	113	HC-36/U	C
E +5° Extensional Mode	50-300	71	HC-13/U (1.75 to 3.50)	S
	85-300	73	HC-13/U	S
	100-300	118	HC-35/U(1½)	C
	100-300	131	HC-41/U	C
	162-300	117	HC-35(1")	C
	185-300	70	HC-6/U	S
	185-300	78	HC-33/U	S
	235-300	113	HC-36/U	C
	240-300	130	HC-39/U	C
DT	80-400	90	HC-21/U	S
	150-400	70	HC-6/U	S
	150-400	78	HC-33/U	S
	200-400	113	HC-36/U	C
	200-400	130	HC-39/U	C
	325-400	116	HC-35/U(.6")	C
DT Bar	150-1000	73	HC-13/U	S
	180-1000	131	HC-41/U	C
	250-1000	122	HC-37/U(.6")	C
	285-1000	70	HC-6/U	S
	285-1000	78	HC-33/U	S
	300-1000	113	HC-36/U	C
	300-1000	130	HC-39/U	C
	440-1000	75	HC-32/U	S
	450-1000	116	HC-35/U(.6")	C
	800-1050	115	HC-35/U	C
	700-1300	110	HC-18(.215")	C

1 MHz to 185 MHz
AT Cuts

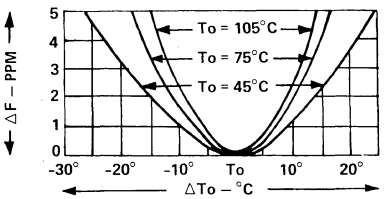
TYPICAL PERFORMANCE

Frequency tolerance: as tight as ± .002% from -55°C to +105°C, .0003% from -10°C to +60°C with reference to +25°C

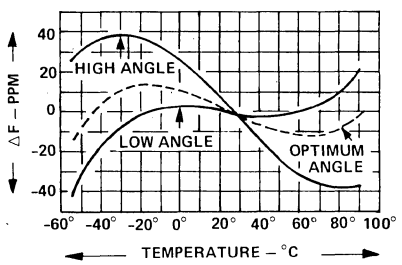
Frequency Stability: Aging, 5 parts in 10^6/30 days to 4 parts 10^8/30 depending upon package, frequency and temperature

Drive Level: 0.01mW to 10mW

AT CUT, ΔF vs. To FOR OVEN UNITS
To = Zero Temperature Coefficient Point



AT CUT, ΔF IN PPM vs. Δ°C
Coefficients, Non-ovenized Applications



STANDARD HOLDERS

FCP No.	Mil No.	Seal[2]
70	HC-6/U	S
75	HC-32/U	S
78	HC-33/U	S
79	HC-17/U	S
80	HC-18/U	S
83	HC-25/U	S
91	HC-11A/U	S
92	—	S
95	—	S
110	HC-43/U	C
111	HC-24/U	C
112	HC-47/U	C
113	HC-36/U	C
115	HC-35/U	C
120	HC-37/U	C
121	—	C
130	HC-39/U	C
77	HC-27/U	G

Notes 1. *Numbers in parentheses after MIL type number indicates height or height range of modified can. For configuration and dimensions see illustrations.*

2. *Seals. "S" = solder sealed, "C" = coldweld.*

FREQUENCY CONTROL PRODUCTS, INC.
61-20 Woodside Avenue, Woodside, New York 11377
Tel: (212) 458-5811 TWX 710-5822637
(Formerly Bulova Electronics Division)

NEED MORE INFO?
Call or Write
for Full Spec Bulletin

FREQUENCY CONTROL PRODUCTS, INC.

Oscillators / CRYSTAL and FORK

FCP is unique among oscillator suppliers in that it has complete in-house capability for the production of all types of oscillator packages, TCXOs, PCOXOs and XOs. We make our own crystals and tuning forks. We have a large foundation of standard models to draw on and can respond speedily with custom units to fit precise specifications. NOTE! FOR CLOCK OSCILLATORS, SEE OUR AD UNDER CRYSTALS.

XOs—Crystal and Fork Oscillators, not Temperature Compensated

Overall Stability Percent	Temperature Range, °C	Frequency Range	Supply Voltage d.c.[2]	Model No. (Letter suffix indicates physical configuration)
±0.0005	+25	50 Hz to 1 kHz	5 to 40	FS32-25-005-H
±0.001	+25	50 Hz to 1 kHz	5 to 40	FS32-25-010-H
		1 Hz to 1 MHz	5 to 40	FS32-1535-020-H
		4 kHz to 20 kHz	5 to 28	FS11-1535-020-I
		360 Hz to 1200 Hz	10 to 28	FS27-1535-020-J
±0.002	+15 to +35	4 kHz to 1 MHz	5 to 28	FS11-1-1535-020-I
		50 Hz to 1 MHz	5 to 28	FS11-2-1535-020-I
		50 Hz to 1 MHz	5 to 40	FSOA-1535-020-L
		4 kHz to 20 kHz	5 to 28	FS23-1535-020-K
		1 Hz to 1 MHz	5 to 40	FS32-050-050-H
		4 kHz to 20 kHz	5 to 28	FS11-050-050-I
		4 kHz to 1 MHz	5 to 28	FS11-1-050-050-I
±0.005	0 to +50	50 Hz to 1 MHz	5 to 28	FS11-2-050-050-I
		360 Hz to 1200 Hz	10 to 28	FS27-050-050-J
		50 Hz to 1 MHz	5 to 40	FSOA-050-050-L
		4 kHz to 20 kHz	5 to 28	FS23-050-050-K
		1 Hz to 1 MHz	5 to 40	FS32-060-100-H
		400 to 20 kHz	5 to 28	FS11-060-100-I
		400 to 1 MHz	5 to 28	FS11-1-060-100-I
±0.01	0 to +60	1 Hz to 1 MHz	5 to 28	FS11-2-060-100-I
		360 Hz to 1200 Hz	10 to 28	FS27-060-100-J
		50 Hz to 1 MHz	5 to 40	FSOA-060-100-L
		400 Hz to 1 MHz	5 to 28	FS23-060-100-K
		1 Hz to 1 MHz	5 to 40	FS32-5585-200-H
		4 kHz to 20 kHz	5 to 28	FS11-5585-200-I
		4 kHz to 1 MHz	5 to 28	FS11-1-5585-200-I
+0.02	−55 to +85	50 Hz to 1 MHz	5 to 28	FS11-2-5585-200-I
		360 Hz to 1200 Hz	10 to 28	FS27-5585-200-I
		50 Hz to 1 MHz	5 to 40	FSOA-5585-200-L
		4 kHz to 1 MHz	5 to 28	FS23-5585-200-K
		1 Hz to 1 MHz	5 to 40	FS32-5585-500-H
		400 Hz to 20 kHz	5 to 28	FS11-5585-500-I
		400 Hz to 1 MHz	5 to 28	FS11-1-5585-500-I
±0.05	−55 to +85	50 Hz to 1 MHz	5 to 28	FS11-2-5585-500-I
		360 Hz to 1200 Hz	10 to 28	FS27-5585-500-J
		50 Hz to 1 MHz	5 to 40	FSOA-5585-500-L
		4 kHz to 1 MHz	5 to 28	FS23-5585-500-K
	−55 to +85	400 Hz to 1 MHz	5 to 28	FS23-5585-1000-K
		1 Hz to 1 MHz	5 to 40	FS32-55125-1000-K
		4 kHz to 1 MHz	5 to 28	FS11-55125-1000-K
±0.1	−55 to +125	4 kHz to 1 MHz	5 to 28	FS11-1-55125-1000-K
		50 Hz to 1 MHz	5 to 28	FS11-2-55125-1000-K
		360 Hz to 1200 Hz	10 to 28	FS27-55125-1000-K
		50 Hz to 1 MHz	5 to 40	FSOA-55125-1000-K
		4 kHz to 1 MHz	5 to 28	FS23-55125-1000-K

TCXOs—Temperature Compensated Crystal Oscillators

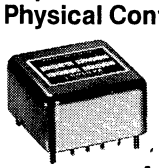
Stability vs. Temperature	Temperature Range, °C	Frequency	Supply Volt. d.c.[2]	Model No. (Letter suffix indicates physical configuration)
±0.2 pp 10^6	−40 to +75	3 to 5 MHz	12	TCXO-2-475-020-A
±0.25 pp 10^6	0 to +70	10 MHz	12	TCXO-70-070-025-E or F
	−40 to +70	3 to 12 MHz	18	TCXO-1A-470-050-B
	−40 to +70	3 to 12 MHz	12	TCXO-1B-470-050-B
	−40 to +75	3 to 5 MHz	12	TCXO-5-475-050-A
±0.5 pp 10^6	−40 to +70	3 to 5 MHz	18	TCXO-6-470-050-A
	−40 to +75	3 to 5 MHz	12	TCXO-54-475-050-D
	0 to +70	10 MHz	12	TCXO-70-070-050-E or F
	−55 to +105	3 to 5 MHz	18	TCXO-18-505-100-A
	−55 to +85	3 to 5 MHz	12	TCXO-7-585-100-A
	−55 to +85	3 to 5 MHz	18	TCXO-8-585-100-A
	−40 to +70	3 to 12 MHz	18	TCXO-1-470-100-B
±1.0 pp 10^6	−40 to +75	3 to 5 MHz	12	TCXO-1B-475-100-B
	−40 to +75	3 to 10 MHz	12	TCXO-4-475-100-A
	−40 to +75	3 to 10 MHz	18	TCXO-4-475-100-A
	−40 to +75	3 to 13 MHz	12	TCXO-54-475-100-D
	0 to +70	10 MHz	12	TCXO-70-070-100-E or F
	−55 to +105	3 to 5 MHz	18	TCXO-18-505-200-A
	−55 to +85	3 to 5 MHz	12	TCXO-7-585-200-A
	−55 to +85	3 to 5 MHz	18	TCXO-8-585-200-A
	−40 to +75	3 to 12 MHz	18	TCXO-1-475-200-B
±2.0 pp 10^6	−40 to +75	3 to 12 MHz	12	TCXO-1B-475-200-B
	−40 to +75	3 to 10 MHz	12	TCXO-3-475-200-A
	−40 to +75	3 to 10 MHz	18	TCXO-4-475-200-A
	−40 to +75	3 to 13 MHz	12	TCXO-54-475-200-D
	0 to +70	10 MHz	12	TCXO-70-070-200-E or F

1. Other frequencies available as special units
2. Other voltages available as special units

PCOXOs—Highly Accurate Ovenized Units

±1 pp 10^8 Temp Range ±3 × 10^9/day Aging	−55 to +70	1 to 10 MHz	+28	PCOXO-102-G
±2.5 pp 10^8 Temp Range ±5ppm10^9/day Aging	−55 to +70	1 to 10 MHz	+28	PCOXO-103-G
±4pp10^{10}/°C Temp Range ±5pp10^9/day Aging	0 to +60	1 to 10 MHz	+28	PCOXO-3-G
±4pp10^{10}/°C Temp Range ±10pp10^9/day Aging	0 to +60	1 to 10 MHz	+28	PCOXO-4-G

Representative Physical Configurations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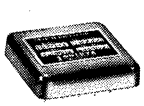
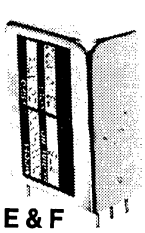
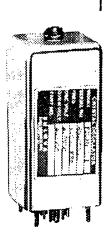
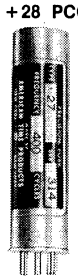

B & D


E & F


G

H

I & L


J

K

Package Dimensions

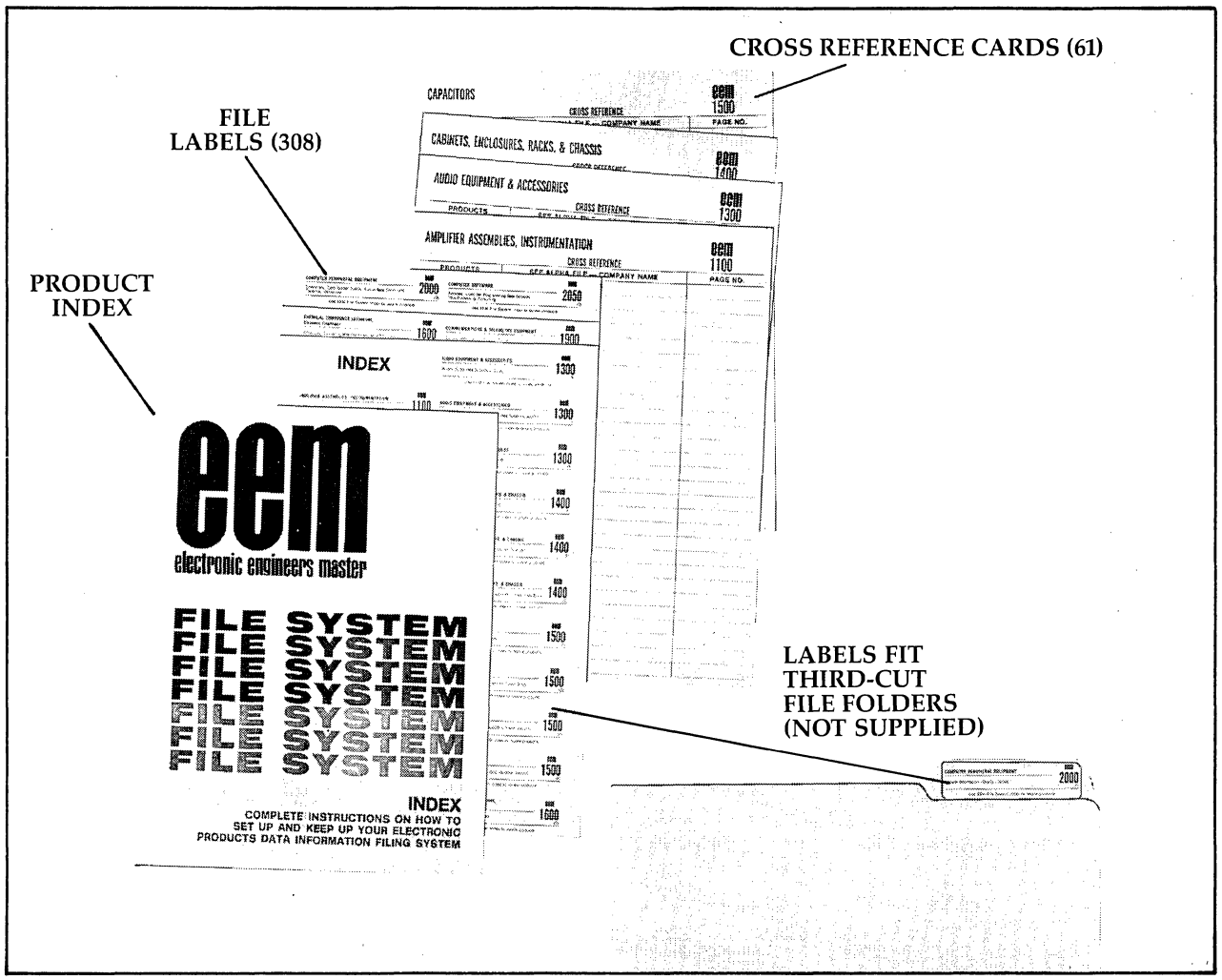
A. 2″ × 2″ × 1″	**E.** 1.8″ × 1.35″ × 0.75″	**H.** 1.5″ × 1.5″ × 1.2″	**K.** 1.875″ × 1.5″ dia.
B. 2″ × 2″ × 0.5″	**F.** (Horizontal version of E)	**I.** 1.5″ × 1.5″ × n*	**L.** 1.5″ × 1.5″ × n*
D. 1.5″ × 1.5″ × 0.5″	**G.** 2″ × 2″ × 4″	**J.** 3″ × 0.72″ dia.	*n = 0.375″ × the number of pc boards required, 0.375″ minimum.

FREQUENCY CONTROL PRODUCTS, INC.
61-20 Woodside Avenue, Woodside, New York 11377
Tel: (212) 458-5811 TWX 710-5822637
(Formerly Bulova Electronics Division)

NEED MORE INFO?
Call or Write for Full Spec Bulletin

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

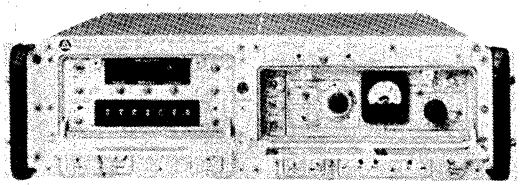
Frequency Electronics' capability is from the basic quartz crystal to complete time and frequency systems.

Timekeeper for Outer Space... Ask anyone who knows anything about this nation's deep space probe and satellite programs to mention any 10. Our instruments or equipment are aboard at least 8.

Cesium Beam Primary Frequency Standards.

Models FE-5450A (TD-1335/V)
FE-5440A (TD-1251/U)

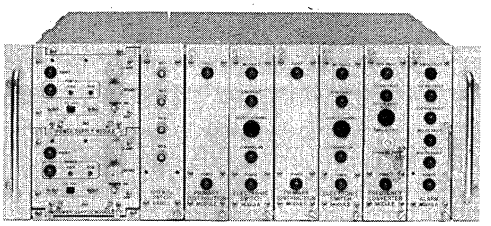
High Reliability, Militarized Cesium Beam Frequency Standards for aerospace, shipboard, laboratory and mobile applications.



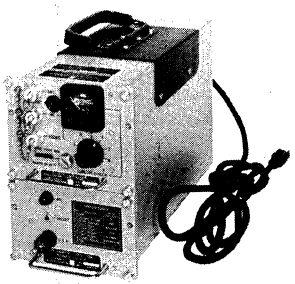
Frequency Distribution Systems

Models FE-798A/FE-799A

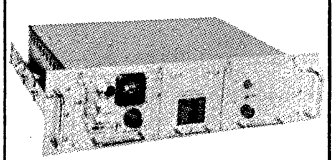
A militarized, high reliability RF distribution system for satellite ground stations and shipboard, mobile, and laboratory applications.



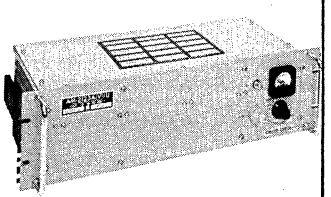
INSTRUMENTS



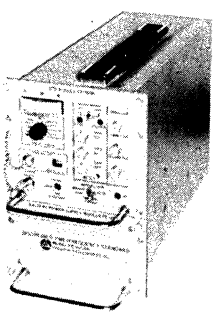
Model FE-1000Q
(AN/URQ-10A)
High Stability
Frequency Standards



Model FE-1100A
High Stability
Frequency Standards



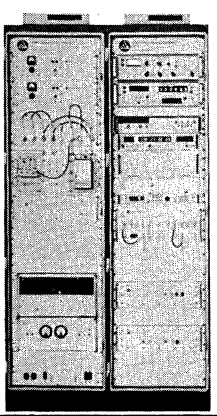
Model FE-70Q
(AM-2123A(V)/U)
Distribution
Amplifier

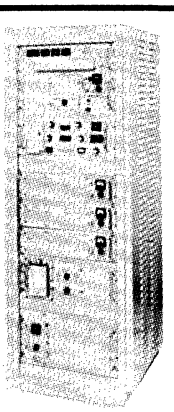


Model FE-1050A
(AN/URQ-23)
Disciplined Time
Frequency Standard

SYSTEM CAPABILITY

Model FE-5054A
(CTFS)
Communication
Time and Frequency
Standards





Model AN/FRQ-16
Frequency - Time
Standard Set

INSTRUMENTS
Disciplined Time Frequency Standards
High Stability Frequency Standards
Frequency Standard Carrying Cases
Digital Phase Comparators
Frequency Error Analyzers
Distribution Amplifiers
RF Switchovers
Passive Combiners
Digital Clocks
Microwave Frequency Multipliers
High Frequency Amplifiers
UHF Down-Converters
UHF Up-Converters

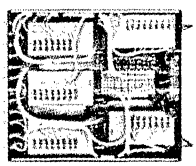
SYSTEMS
Time & Frequency Control Systems
UHF Synthesizers
Frequency Generators
Coherent Microwave Synthesizers
RF Switching Systems

FREQUENCY ELECTRONICS, INC.

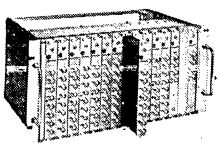
55 Charles Lindbergh Blvd.,
Mitchel Field, N.Y. 11553
TEL: (516) 794-4500
TWX: 510-223-0418

BROAD BAND MODULAR SWITCHING SYSTEMS

Complete systems with power supplies, digital interface converters, I/O equipment, control panels, and various other functions are available.



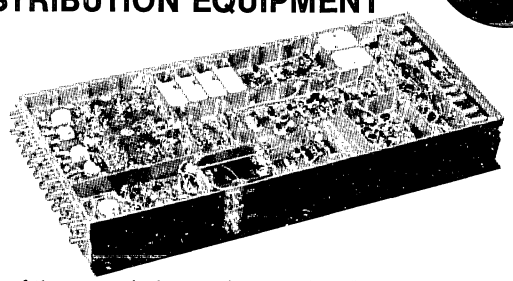
Solid-State Matrices
FE-7650A
8 × 50 Matrix



Solid-State Switches
FE-7642D
4 × 92 Switch

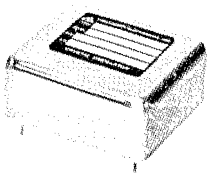
Reed Switches
FE-7735A
1×8 Switch

SATELLITE FREQUENCY GENERATION AND DISTRIBUTION EQUIPMENT

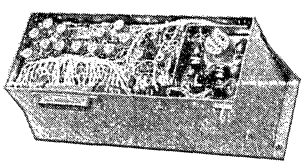


State-of-the-art techniques pioneered by FEI for frequency synthesis, processing, and distribution of low noise reference signals have been applied to the development of high reliability hardware for satellite applications. FEI systems consisting of precision oscillators and distribution equipment configured as redundant assemblies are presently being used on a wide variety of space programs resulting in performance capabilities previously unrealizable. The equipment incorporates FEI's high reliability hybrid techniques and results in light weight and low power consumption; considerations of primary importance in satellite applications.

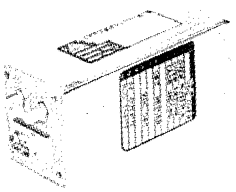
OSCILLATORS



(TCXO and TCVCXO) Temperature Compensated/ Voltage Controlled Crystal Oscillators

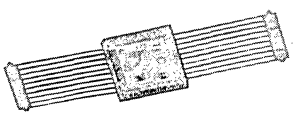


Space Application High Stability Remotely Settable Crystal Oscillator.



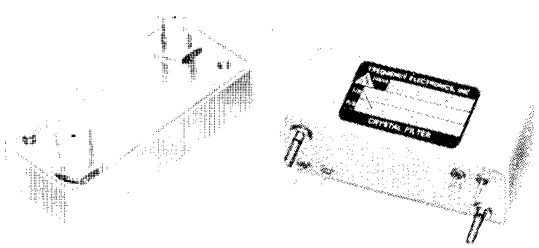
Proportionately Controlled Ovenized Oscillator

Miniature Hybridized Oscillator

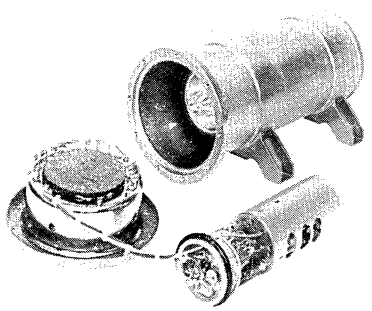


MIL-M-38510 MIL-STD-883B Level "S" or Level "B"

CRYSTAL FILTERS AND DISCRIMINATORS



HIGH RELIABILITY PRODUCTS



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CRYSTAL FILTERS AND DISCRIMINATORS
Narrow Band Crystal Filters
Intermediate Wide Band Crystal Filters
Band Reject Crystal Filters
Single Side Band Crystal Filters
Discriminators

OSCILLATORS
Ovenized Crystal Oscillators
Ovenized Voltage Controlled Crystal Oscillators
Temperature Compensated Voltage Controlled Crystal Oscillators
Temperature Compensated Crystal Oscillators
Non-Ovenized Crystal Oscillators
LC Voltage Controlled Oscillators
Precision Low Power Oscillators
High Stability Proportional Ovens
Custom Engineered Oscillators

Low Phase-Noise Frequency Sources To 10 GHz

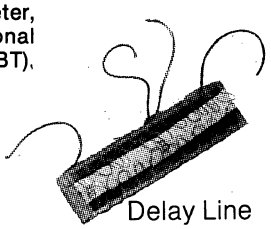
Filters and Networks

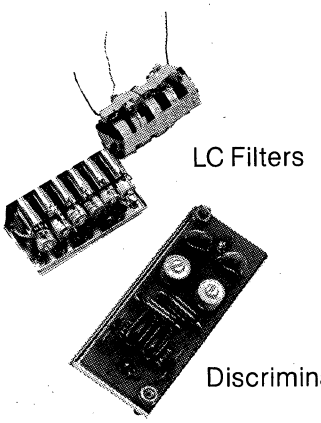
LC Filters • Crystal Filters Delay Lines • Discriminators from FSN FREQUENCY SELECTIVE NETWORKS, INC.

FSN is a filter and network house. We are strong in engineering. We are able and willing to work with system designers to apply state-of-the-art filter technology to optimize not just the filter but the application of filters to help our customers optimize their systems.

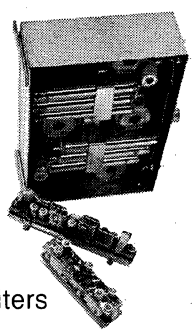
Use us as your filter specialist. We are knowledgeable in and have experience with all classes of filters, whether crystal or LC. We can select the proper type for best performance while optimizing the cost-vs-performance trade-off. We design and manufacture **all** the families such as: Butterworth, Chebyshev, Legendre, Cauer (elliptical), General Parameter, Gaussian, Bessel, Transitional Butterworth-Thompson (TBT), Bode, Lerner and others.

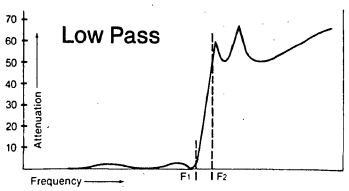
We also design and manufacture such other networks as delay lines, attenuators, phase and delay equalizers, discriminators, matching networks, etc.



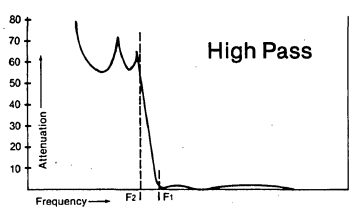


Representative Network Packages

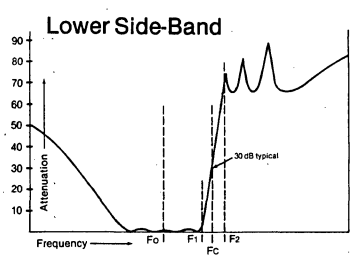




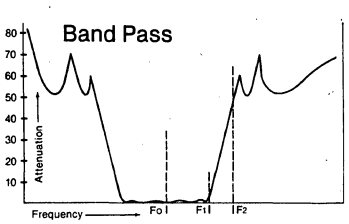
Shape Factor = $\frac{F_2}{F_1}$ As Low as 1.03



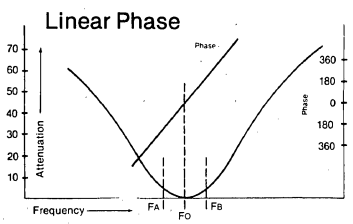
Shape Factor = $\frac{F_1}{F_2}$ As Low as 1.03



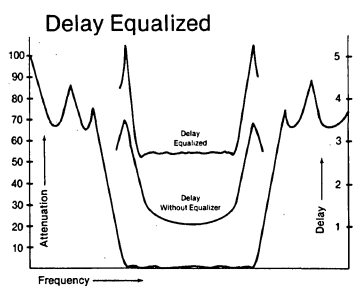
Shape Factor = $\frac{F_2 - F_o}{F_1 - F_o}$ As Low as 1.05



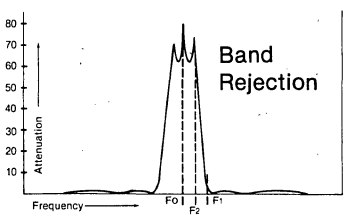
Shape Factor = $\frac{F_2 - F_o}{F_1 - F_o}$ As Low as 1.05



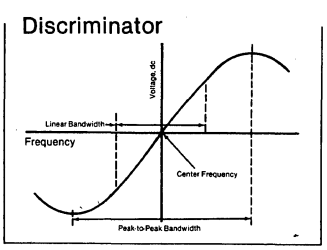
Phase Linearity better than 1°



Shape Factors better than 1.10
Delay Variation better than 2%



Shape Factor = $\frac{F_1 - F_o}{F_2 - F_o}$ As Low as 1.20



Wide and Narrow Band Linearity ± 1%

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(212) 424-7500

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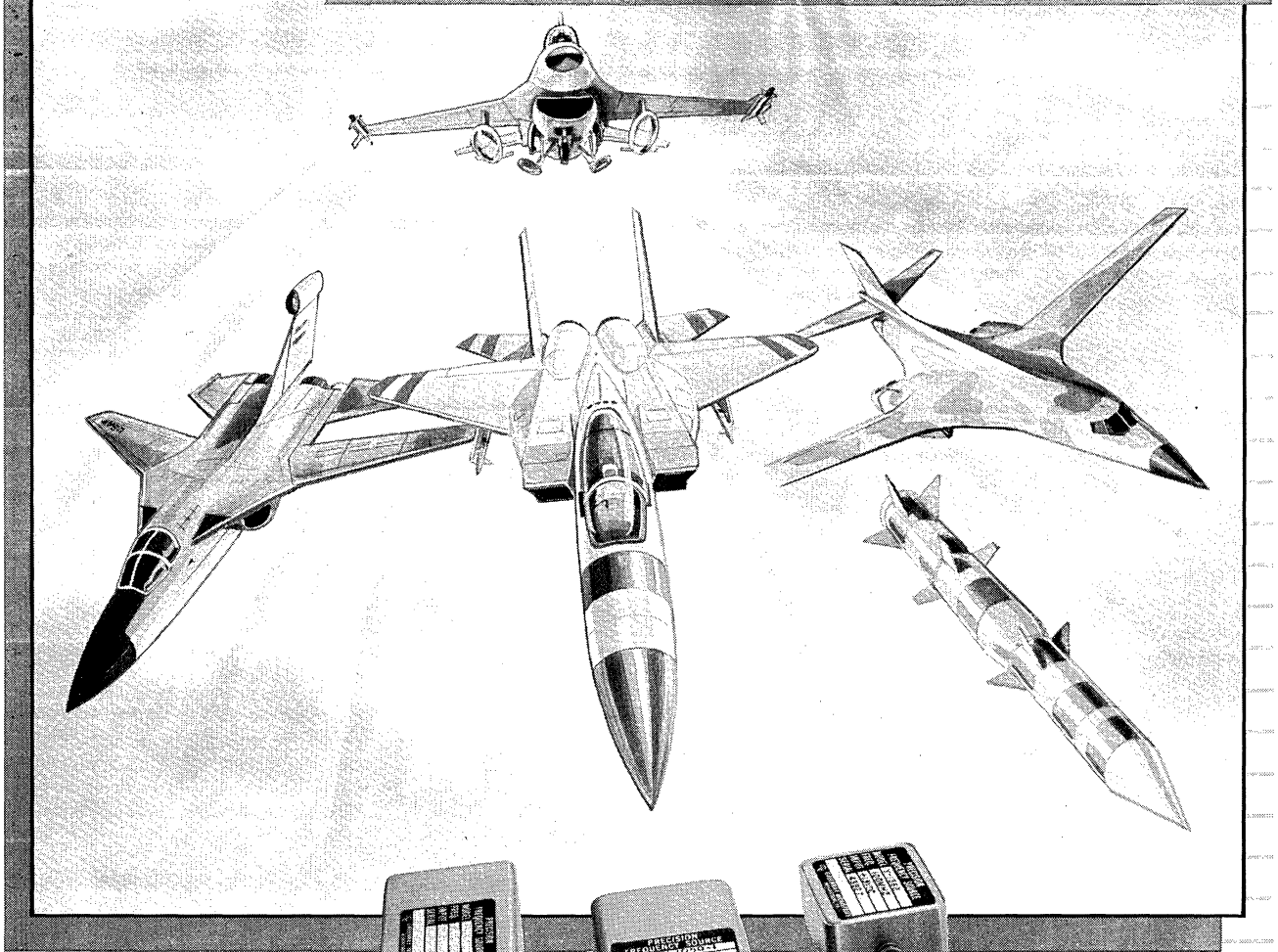
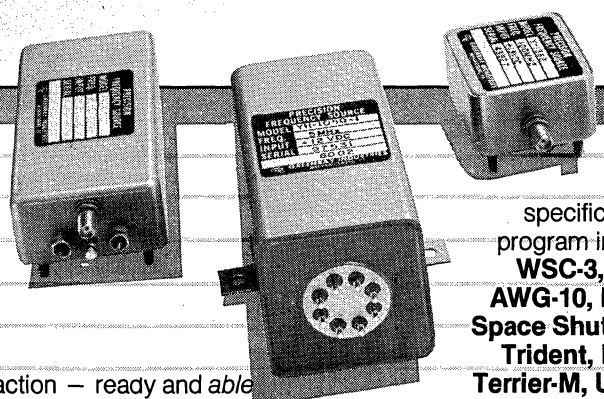
LC Filters • Crystal Filters • Delay Lines • Discriminators

GREENRAY OSCILLATORS

RESPONSIVE TO YOUR NEEDS FOR OVER 20 YEARS





HIGH TECHNOLOGY OSCILLATORS

- **Crystal Oscillators**
- **Voltage Controlled Oscillators**
- **Frequency Standards**
- **Temperature Compensated Oscillators**
- **.01 Hz to 2000 Hz**

At Greenray we're ready for action – ready and *able* to solve all of your oscillator problems...and we'll go to any length to prove it. Whatever your program – military, industrial or commercial – our Application and Engineering Design Teams will develop and build custom oscillators to meet *your* specialized needs... we've been doing just that for over 20 years.

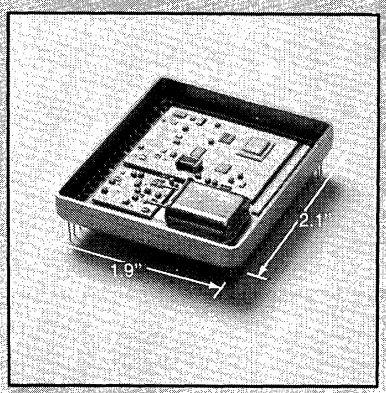
But there's more to Greenray than custom designs; we also have the broadest line of standard, high quality oscillators with guaranteed specifications and significant major program involvement, eg., **GRC-144, WSC-3, ALQ-99, ALQ-119, F-111, AWG-10, Patriot, Pershing, Apollo, Space Shuttle, Sparrow, Cutty-Sark, Trident, Landsat D, AYK-14, B-1B, Terrier-M, USM-464, TRC-97, MK-86, F-15, F-16.**

Plus, our comprehensive quality program per MIL-I-45208A and MIL-STD-45662 yields reliable performance. And we assist you both before and after delivery.

We're here to meet your specific needs...call or write for our new catalog or send us your requirements and request a quotation. 840 W. Church Rd., Mechanicsburg, Pa. 17055 Telephone 717-766-0223

GREENRAY Industries, Inc.

Hughes Custom Hybrid Oscillators



Digitally Compensated Crystal Oscillators

For portable or remote equipment requiring low power and high stability, the Hughes Digitally Compensated Crystal Oscillator (DCXO) provides the following advantages over conventional ovenized oscillators:

- lower power (less than 250 mW)
- faster warm-up time (less than 250m sec.)
- smaller size (1 cubic inch)
- remote synchronization capability

In addition, the compensation data is stored in an Electrically Erasable Programmable Read-Only-Memory (EEPROM) which allows the DCXO to be recompensated or programmed a number of times.

Features

Frequencies available: 1 to 30 MHz
Frequency stability:
±0.20 ppm, −45 to +85°C
±0.08 ppm, 0 to + 70°C
Low power dissipation: 250 mW
Power supply: +5 and −5V$_{DC}$
Small package: 1 cubic inch
Low aging rate
Thin-film hybrid construction
MIL STD 883B screening available

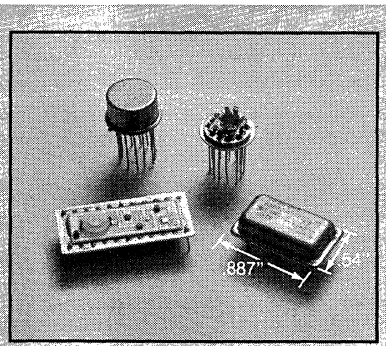
Custom Design Options

Output logic options: TTL, CMOS, ECL
Package Options: Various
Supply voltage: Single 5 volt supply
Other voltage levels
Digital Frequency Adjustment for aging correction or for system synchronization.
Temperate range: −55 to +125°C
Stability: Optimized for specified temperature range

For other design variations contact Hughes Solid State Products.

Electrical Specification

PARAMETER	CONDITIONS	MIN	TYPICAL	MAX	UNITS
Temperature Stability HXO-356-001	−45 to 85°C		0.16	0.20	ppm
HXO-356-002	0 to + 70°C		0.05	0.08	ppm
Short-Term Stability	1 sec average		.01		ppm
Long-Term Stability	1 year average		1.00		ppm
Frequency Shift due to voltage variation	both supplies +/−10%		.10		ppm
Frequency Shift due to load variation	1-10 LSTTL loads		.10		ppm
Waveform Symmetry		45	.50	.55	%
Rise/Fall Time			.10	.20	nsec
Fanout		1		.10	LSTTL loads
Warm-up Time			1.00		msec
Power Consumption			2.50		mW



Hybrid Oscillators

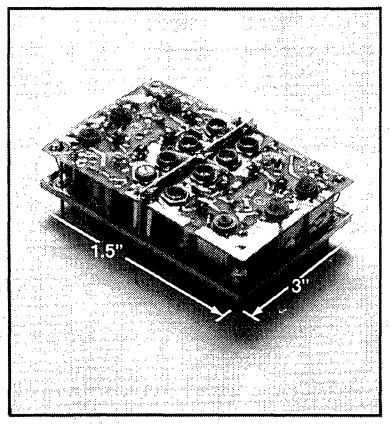
Hughes Hybrid Oscillators are available in a variety of packaging options including: TO-8, DIP, Flatpack and leadless chip carriers. MIL STD 883B screening is available on all hybrid oscillators.

OUTPUT	TTL	CMOS	ECL
Frequency Range:	1Hz to 100MHz	0.1Hz to 10MHz	1MHz to 100MHz
Temperature Range:	−55 to +125°C	−55 to +125°	−55 to +125°C
Frequency Stability:	±.005%	±.005%	±.005%
Input Voltage:	+5V$_{DC}$±5%	5V$_{DC}$ to 15 V$_{DC}$	−5.2V$_{DC}$±5%
Frequency Accuracy @ 25°C	±0.001%	±0.001%	±0.001%

HUGHES SOLID STATE PRODUCTS
HUGHES AIRCRAFT COMPANY

Contact:
HUGHES SOLID STATE PRODUCTS
FREQUENCY CONTROL DEVICES
500 Superior Avenue
Newport Beach, California 92663
Telephone (714) 759-2430 Telex: 910-596-1374

Hughes Custom Oscillators & Filters



Crystal Filters

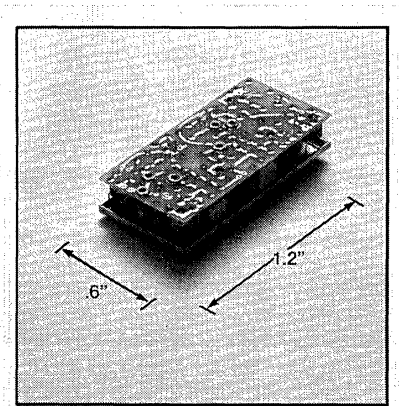
Hughes has over 20 years of experience with all standard types of bandpass filters, including Butterworth, Chebychev, Elliptical, Gaussian and Bessel types, as well as band reject filters and crystal discriminators.

Characteristics

Hughes filters are designed using advanced computer-aided network synthesis and analysis techniques resulting in filters with sharp selectivity, controlled group delay or phase response, non-ringing pulse response and low insertion loss over broad temperature ranges. Hughes has also developed proprietary designs which permit tight control of phase and group delay characteristics or time domain response characteristics such as peak overshoot and ringing in response to pulsed RF signals. Hughes Frequency Control Devices meet the most stringent military standards, when required.

Applications

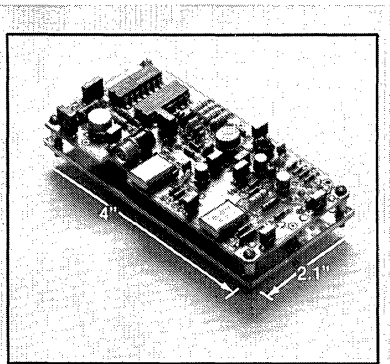
Hughes Frequency Control Devices are in use in satellites, radar systems, missiles, military and commercial communications and avionics systems.



TCXOs

Hughes Temperature Compensated Crystal Oscillators (TCXOs) are designed using computer-aided techniques. Performance is insured with automated component test and selection and fully automated testing of the finished product.

OUTPUT	SINE	TTL	CMOS	ECL
Frequency Range:	100Hz to 60MHz	1Hz to 100MHz	0.1 Hz to 10MHz	1 MHz to 100MHz
Temperature Range:		−55 to +125°C		
Short Term Stability:		$\pm 1ppl0^{8}$/sec		
Long Term Stability:		$\pm 1ppl0^{6}$/year		
Frequency Stability:		$\pm 5ppl0^{7}$/(−40 to +85°C)		
		$\pm 1ppl0^{6}$(−55 to +85°C)		
		$\pm 5ppl0^{6}$(−55 to +125°C)		
Supply Voltage:		Any supply voltage 5-27 VDC available		
Size:		As small as 1"xl"x0.5"		
		Smaller hybrid versions available		



VCXOs

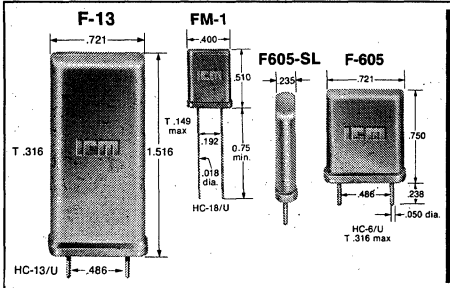
Hughes Voltage Controlled Crystal Oscillators (VCXOs) are noted for their exceptionally low frequency drift characteristics. Frequency deviations of up to ±0.3% of the nominal oscillator frequency are available.

OUTPUT	SINE/TTL
Frequency Range:	100 Hz to 100 MHz
Temperature Range:	0 to +70°C
Deviation:	± .3%
Linearity:	± 1% of max deviation
Modulation Frequency:	DC to 0.2 MHz
Spurious:	−80 dbc
Supply voltage:	10-27VDC available
Size:	As small as 2"x 2"x .5"
	Smaller hybrid versions available

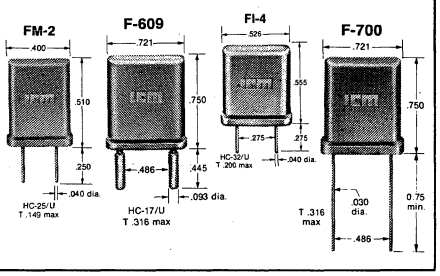
HUGHES SOLID STATE PRODUCTS

HUGHES AIRCRAFT COMPANY

Contact:
HUGHES SOLID STATE PRODUCTS
FREQUENCY CONTROL DEVICES
500 Superior Avenue
Newport Beach, California 92663
Telephone (714) 759-2430 Telex: 910-596-1374



International CUSTOM CRYSTALS



LOW FREQUENCY CRYSTALS 70 KHz - 999.9 KHz

Frequency Range/Mode of Vibration
70-200 KHz Length Shear Fund.
200-599 KHz Edge Shear Fund.
600-999 KHz Shear Fund. AT Cut

Shunt Capacitance (Co) 7 pf Max.

Resistance (Measured at Series Resonance)
70-200 KHz 10,000 to 7,000 Ohms Max.
200-500 KHz 7,000 to 1,100 Ohms Max.
500-999 KHz 1,100 to 550 Ohms Max.

Drive Level
70-499 KHz 2 Milliwatts Max.
500-999 KHz 10 Milliwatts Max.

Holders
F-605, F-609, F-700 specify lead length. F-13 fq. below 150 KHz in F-13 holder only. Note: Solder Seal or Cold Weld Sealing Method. Crystals can be supplied for oven or nonoven use.

FREQUENCY	General Purpose	Commercial Standard
	Calibration Tolerance	Calibration Tolerance
70-99.9 KHz	within ± .02%	*within ± .01%
100-499.9 KHz	within ± .02%	within ± .01%
500-599.9 KHz	within ± .02%	within ± .01%
600-849.9 KHz	within ± .02%	**within ± .0025%
850-999.9 KHz	within ± .02%	within ± .0025%

*Below 600 KHz within ± .01% ** Above 600 KHz within ± .0025%

MEDIUM FREQUENCY CRYSTALS 1 MHz - 30 MHz

Frequency Range/Mode of Vibration
1-30.0 MHz Shear Fundamental AT Cut

Resistance (Measured at Series Resonance)
1.0-1.49 MHz 490 Ohms Max.
1.5-1.99 MHz 375 Ohms Max.
2.0-2.99 MHz 270 Ohms Max.
3.0-3.99 MHz 150 Ohms Max.
4.0-5.09 MHz 75 to 33 Ohms Max.
5.1-30.0 MHz 22 to 16 Ohms Max.

Drive Level
1.0- 9.99 MHz 10 Milliwatts Max.
10.0-22.00 MHz 5 Milliwatts Max.
22.0-30.00 MHz 1 Milliwatt Max.

Shunt Capacitance (Co) 9 pf Max.

Holders
F-605, F-605-SL available 2.0 MHz and above only. F-609, F-700 specify lead length. FI-4 available 4.0 MHz and above only. FM-1, FM-2 supplied standard above 6.0 MHz. 4.0 to 6.0 MHz can be supplied at additional cost. HA available 2.0 MHz and above only. Ground leads can be supplied at additional cost. Note: Solder Seal or Cold Weld Sealing Method. Crystals can be supplied for oven or nonoven use.

FREQUENCY	General Purpose	Commercial Standard		High Accuracy	
	Calibration Tolerance	Calibration Tolerance		Calibration Tolerance	
		CS	CS-1	HA	HA-5*
1.0-1.49 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	NA	NA
1.5-2.99 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	within ±.001%	NA
3.0-10.99 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	within ±.001%	within ±.001%
11.0-19.9 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	within ±.001%	within ±.001%
20.0-24.9 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	within ±.001%	within ±.001%
25.0-30.0 MHz Fund.	within ±.01%	within ±.0025%	within ±.001%	within ±.001%	within ±.001%

* HA-5 will maintain within .0005% of 25°C measured frequency, from −10°C to +60°C

HIGH FREQUENCY CRYSTALS 15 MHz - 200 MHz

Frequency Range/Mode of Vibration
15-75 MHz Shear 3rd Mechanical Overtone AT
50-119 MHz Shear 5th Mechanical Overtone AT
111-139 MHz Shear 7th Mechanical Overtone AT
140-200 MHz Shear 9th Mechanical Overtone AT

Shunt Capacitance (Co) 9 pf Max.

Resistance (Measured at Series Resonance)
15- 75.0 MHz 3rd O/T 40 Ohms Max.
50-119.9 MHz 5th O/T 60 Ohms Max.
111-139.9 MHz 7th O/T 80 Ohms Max.
140-200.0 MHz 9th O/T 100 Ohms Max.

Drive Level
15-65 MHz 2 Milliwatt Max.
65-200 MHz 1 Milliwatt Max.

Holders
F-605, F-605,SL, F-609, F-700 (specify lead length), FI-4, FM-1 (specify lead length), FM-2. Note: Solder Seal or Cold Weld Sealing Method. Crystals can be supplied for oven or nonoven use.

FREQUENCY MHz		General Purpose	Commercial Standard		High Accuracy *
		Calibration Tolerance	Calibration Tolerance		Calibration Tolerance
			CS	CS-1	
15-64.9	(3rd)	within ± .01%	within ±.0025%	within ±.001%	within ±.001%
65-75	(3rd)	within ± .01%	within ±.0025%	within ±.001%	within ±.001%
50-79.9	(3rd)	within ± .01%	within ±.0025%	within ±.001%	within ±.001%
80-119.9	(5th)	within ± .01%	within ±.0025%	within ±.001%	within ±.001%
111-139.9	(7th)	within ± .01%	within ±.0025%	within ±.001%	NA
140-159.9	(9th)	within ± .01%	within ±.0025%	within ±.001%	NA
160-200	(9th)	within ± .01%	within ±.0025%	within ±.001%	NA

* HA-5 will maintain within .0005% of 25°C measured frequency, from −10°C to +60°C

WHEN ORDERING — Specify the Following for Each Crystal
A. Crystal frequency
B. Type — GP, CS, or HA
C. Calibration tolerance —..0025% or .001% as specified for (CS) and (CS-1). Not required for GP as this type is supplied only in .01%
D. Calibration temperature — Calibration temperature to be specified by customer.
E. Holder (see above)
F. Circuit load and correlation data — Customer to give oscillator load and correlation data. Do not specify equipment types for GP crystals.

INTERNATIONAL CRYSTAL MFG. CO., INC.
10 North Lee, P.O. Box 26330, Oklahoma City, OK 73126

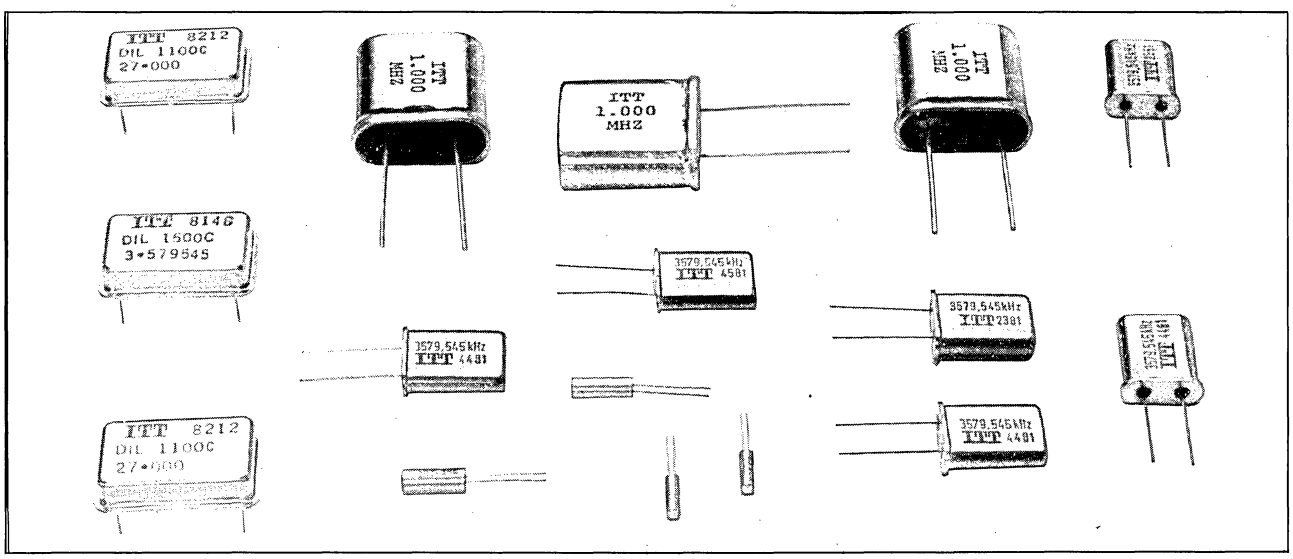
GENERAL
Contact ICM Sales Department for copy of custom crystal catalog and pricing information. All International crystals are made to order and are not stock items. If crystals are needed for commercially manufactured equipment, land mobile, amateur, marine, etc., ICM may have specific catalog numbers already assigned. All International crystals are guaranteed against defective materials and workmanship for an unlimited time when used in correct equipment or oscillator load.

Mail: International Crystal Mfg. Co., Inc., 10 N. Lee, P.O. Box 26330, Oklahoma City, Ok. 73126, Phone (405) 236-3741, TELEX 747-147, Cable Incrystal, Bell System TWX: 910-831-3177

ITT Components

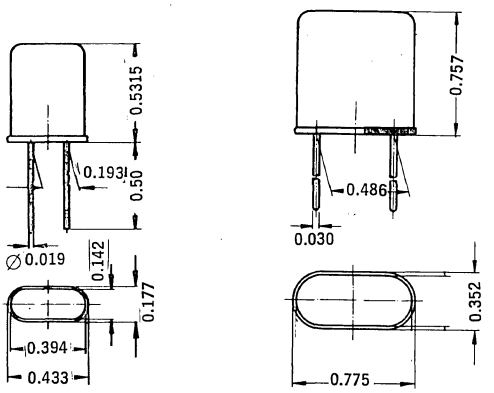
A Unit of International Telephone and Telegraph Corporation

Crystals and Oscillators



Quartz Crystal Units

- Microprocessor clock type crystals covering a frequency spectrum from 1MHz to 200MHz.
- HC18 and HC33 type holders, resistance welded or solder cold weld or solder sealed.
- Frequency tolerance from .002% to .35%.

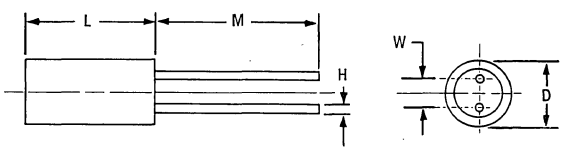


HC-18/U HC-33/U

ITT TF3 AND TF6

Tuning Fork Crystals

Used for microprocessors and micro computer real-time clock applications.



Type	L	M	H	W	D
TF3	.327 Max. (8.30 Max.)	.354 (9.00)	.012 ±.002 (0.30 ±0.05)	.043 ±.002 (1.10 ±0.05)	.118 ± .008 (3.00 ±0.08)
TF6	.260 ±.002 (6.70 ±0.05)	.295 (7.50)	.010 ±.001 (0.25 ±0.03)	.023 ±.004 (0.70 ±0.10)	.081 ±.002 (2.05 ±0.05)

Dimensions are in inches (millimeters)

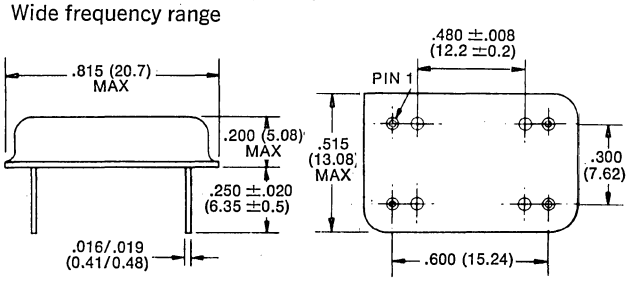
Quartz Crystal Oscillators

The ITT DIL oscillator series are miniature, low-profile, dual-in-line quartz crystal oscillators in a hermetic package. They are designed primarily, to meet the needs of the fast growing minicomputer and microprocessor markets, but are suitable for many other applications where a reliable, accurate clock input is required.

Frequency tolerances ranging from 1000ppm to 25ppm are available.

FEATURES

TTL compatible
Dual-in-Line pin spacing
Low profile — 5.8mm maximum seated height including insulating stand-offs
Hermetic welded metal package
Wide frequency range



Pin Connections
1 NC
7 Ground
8 Output
14 +5V

FREQUENCY RANGE: 250KHz — 90MHz

Family		Frequency	Tolerance
DIL 1000C		1000ppm	0.1%
DIL 1500C		500ppm	0.05%
DIL 1100C	SH1100	100ppm	0.01%
DIL 1050C	SH1050	50ppm	0.005%
DIL 1025C		25ppm	0.0025%

ISOTEMP RESEARCH, INC.

Telephone (804) 295-3101
P. O. Box 3389 Charlottesville, Virginia 22901

Isotemp specializes in custom design crystal oscillators for all applications. High stability, low power ovenized oscillators are our specialty. Wide temperature range, tight tolerance TCXOs are standard fare. Sinusoid and square wave (TTL and/or C/MOS) are available in most models. Call us for help in determining your oscillator needs.

– PRODUCT DIRECTORY –

TCXO'S	Frequency Range	Major Feature	Stability Class	Supply Voltage	Output	Typical Current	Figure No.
TCXO30 Series	2 to 12 MHz	Low Cost	1 ppm	+5 VDC	TTL	15 ma	1
TCXO39 Series	.125 to 20 MHz	Precision Parts, High Performance	5 x 10^{-7} to 2 ppm	+12 VDC	TTL	20 ma	2
TCXO40 Series	2 to 10 MHz	Precision Parts, High Performance	1 ppm to 5 ppm	+15 VDC	Sine	20 ma	2
TCXO41 Series	10 to 30 MHz	3rd Overtone TCXO	1 ppm to 5 ppm	+15 VDC	Sine	20 ma	2
NCXO'S							
NCXO37 Series	2 to 60 MHz	Low Cost, High Performance	5 ppm to 30 ppm	+5 VDC	TTL	10 to 30 ma	Sim. to 1
NCXO46 Series	5 to 20 MHz	Lowest Cost	.01% to .05%	+5 VDC	TTL	15 to 30 ma	3
OCXO'S							
OCXO31 Series	10 MHz	Low Power	1 x 10^{-7} to 5 x 10^{-7}	+5 VDC	TTL	<1 watt	4
OCXO33 Series	10 MHz	Low Power	1 x 10^{-7} to 5 x 10^{-7}	+5 VDC	TTL	<1 watt	Sim. to 2
OCXO36 Series	8 to 15 MHz	High Stability	1 x 10^{-7} to 5 x 10^{-7}/year	+20 & +5 VDC	TTL	2 watts	5

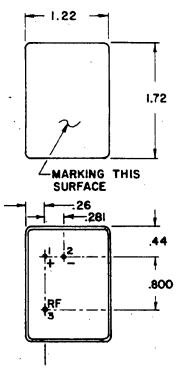


Figure 1

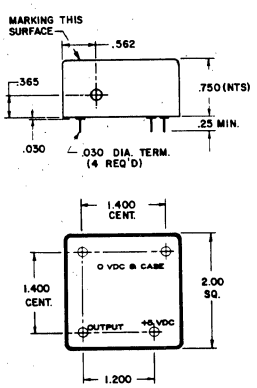


Figure 2

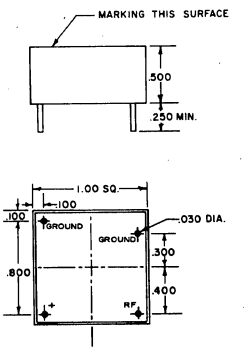


Figure 3

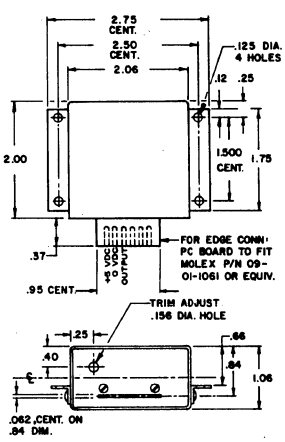


Figure 4

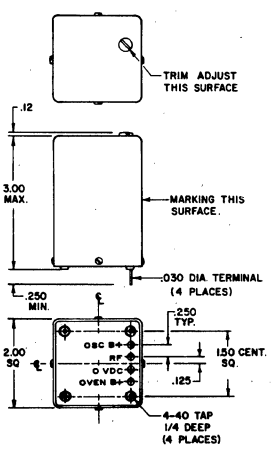


Figure 5

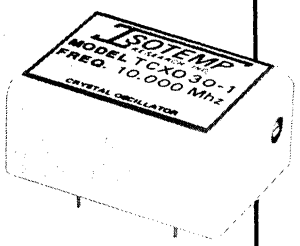
Note: Measurements are in inches.

inches	mm	inches	mm
.025	.635	.660	16.764
.030	.762	.750	19.050
.040	1.016	.800	20.320
.062	1.587	.840	21.336
.100	2.540	.950	24.130
.120	3.048	1.000	25.400
.125	3.175	1.060	26.924
.156	3.962	1.200	30.480
.250	6.350	1.220	30.988
.260	6.604	1.400	35.560
.281	7.143	1.720	43.688
.300	7.620	1.750	44.450
.315	8.001	2.000	50.800
.370	9.398	2.060	52.324
.400	10.160	2.500	63.500
.440	11.176	2.750	69.850
.500	12.700	3.000	76.200

Oscillators

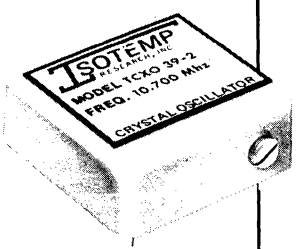
TCXO30 SERIES

Frequency (MHz)		10	10	2 to 12	2 to 12
Temperature range		0° to 50°C	0° to 55°C	0° to +50°C	0° to 55°C
Voltage stability (±5% change)		±2 x 10^{-7}	±2 x 10^{-7}	±2.5 x 10^{-7}	±2.5 x 10^{-7}
		MODEL NUMBERS			
Ambient stability	±1 ppm	TCXO30T-1	TCXO30T-3	TCXO30T-5	TCXO30T-7
Reference to +25°C	±2 ppm	TCXO30T-2	TCXO30T-4	TCXO30T-6	TCXO30T-8



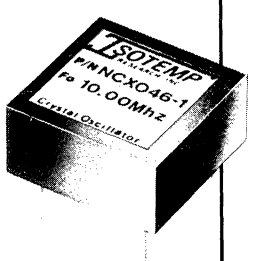
TCXO39 SERIES

Frequency range (MHz)		.125 to 2	2 to 12	12 to 20	2 to 6
Aging (after 60 days operation)		±1 ppm/year	±1 ppm/year	±1 ppm/year	±5x10^{-7}/year
Short term stability (10 sec rms)		2 x 10^{-9}	2 x 10^{-9}	3 x 10^{-9}	1 x 10^{-9}
Voltage stability (per 5% change)		3 x 10^{-7} typical	2 x 10^{-7} typical	3 x 10^{-7} typical	1.5 x 10^{-7} typical
Trim range		±4 ppm min.	±4 ppm min.	±6 ppm min.	±3.5 ppm min.
Typical current drain		30 ma	20 ma	20 ma	20 ma
		MODEL NUMBERS			
Ambient stability	±5 x 10^{-7}	TCXO39-1	TCXO39-2	N.A.	TCXO39-3
0°C to +55°C	±1 ppm	TCXO39-4	TCXO39-5	N.A.	TCXO39-6
Reference to +25°C	±2 ppm	TCXO39-7	TCXO39-8	TCXO39-9	TCXO39-10



NCXO46 SERIES

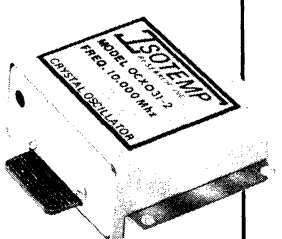
Frequency range (MHz)		10 MHz	5 to 8	8 to 12	12 to 17	17 to 25
Current drain (typical)		17 ma	15 ma	17 ma	20 ma	30 ma
				Model Numbers		
Stability	±0.01%	NCXO46-1	NCXO46-2	NCXO46-3	NCXO46-4	NCXO46-5
All effects	±0.05%	NCXO46-6	NCXO46-7	NCXO46-8	NCXO46-9	NCXO46-10



OCXO31 SERIES

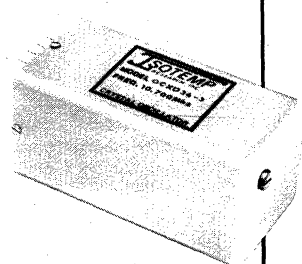
Model number	OCXO31-1	OCXO31-2	OCXO31-3	OCXO31-4
Temperature stability (0°C to 65°C) *	±5 x 10^{-8}	±1 x 10^{-7}	±2 x 10^{-7}	±3 x 10^{-7}
Aging (per year after 60 days)	±5 x 10^{-7}	± 1 ppm	±1.5 ppm	±2 ppm
Short term stability (per 10 second count)	2 x 10^{-10} rms	5 x 10^{-10} rms	1 x 10^{-9} rms	2 x 10^{-9} rms
Voltage stability (+5 VDC ±10 %)	±3 x 10^{-8}	±5 x 10^{-8}	±1 x 10^{-7}	±1.5 x 10^{-7}
Trim range (at time of shipping)	±3 ppm	±4 ppm	±5 ppm	±6 ppm

*Reference to +25°C



OCXO36 SERIES

Model number	OCXO36-1	OCXO36-2	OCXO36-3	OCXO36-4
Frequency (MHz)	10	10	8 to 15	8 to 15
Aging (per week at time of shipping)	±3 x 10^{-9}	±5 x 10^{-9}	±1 x 10^{-8}	±1.5 x 10^{-8}
Aging (per year after 21 days)	±1 x 10^{-7}	±2 x 10^{-7}	±3 x 10^{-7}	±5 x 10^{-7}
Retrace (4 hours on after 24 hours off)	2 x 10^{-9} typ.	5 x 10^{-9} typ.	1 x 10^{-8} typ.	1.5 x 10^{-8} typ.
Ambient stability (0°C to +65°C)	1 x 10^{-10}/°C	2 x 10^{-10}/°C	5 x 10^{-10}/°C	1 x 10^{-9}/°C
Voltage stability (per 5% change)	7 x 10^{-10}	2 x 10^{-9}	2 x 10^{-9}	4 x 10^{-9}
Phase noise (100 Hz offset 1 Hz BW)	-143 db min.	-140 db min.	-130 db min.	-125 db min.
Short term (10 second counts)	2 x 10^{-11} rms	3 x 10^{-11} rms	1 x 10^{-10} rms	5 x 10^{-10} rms
Trim range (minimum)	±6 x 10^{-7}	±1.5 ppm	±2.5 ppm	±3 ppm



To order: Specify model number and frequency or contact factory for options.
Phone (804) 295-3101 P. O. Box 3389 Charlottesville, Virginia 22901

ISOTEMP RESEARCH, INC.

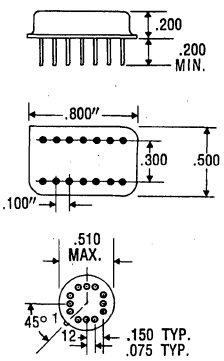
LEACH® CORP. ■ **CONTROL PRODUCTS DIVISION**
6900 Orangethorpe Avenue, Buena Park, California 90620
Telephone: (714) 739-0770 TWX 910-596-2867

LEACH HYBRID FREQUENCY PRODUCTS

MILITARY • AEROSPACE • CUSTOM

ALL PRODUCTS MANUFACTURED IN THE U.S.A.

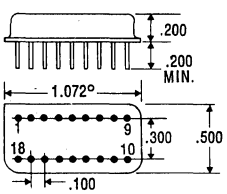
HYBRID OSCILLATORS
MIL-O-55310 PROCESSING



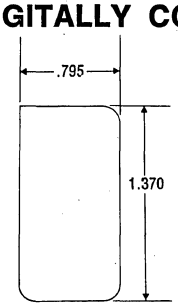
Output Waveform:	C-MOS, TTL/LSTTL, ECL, Sine Wave
Frequency Range:	.1 Hz-300 MHz
Packaging:	14 Pin D.I.P., Flat Packs, Leadless Carriers, TO5 and TO8
Typical Tolerance:	±10 ppm at R.T., ±50 ppm of R.T. from −55°C to +125°C
Typical Symmetry:	50/50% 1-30 MHz, 60/40% 31-300 MHz
Typical Processing:	883B, 38510, Burn In, Lot Traceable
Typical Testing:	Programmable Auto-Test Over Full Temperature Range With Data. All Units Serialized.
Environmental:	Gross/Fine Leak Detection, Centrifuge, Shock, Vibration, Acceleration and Radiation Exposure Available.

CRYSTAL CONTROLLED DUAL BAUD RATE GENERATOR
C5035 SERIES

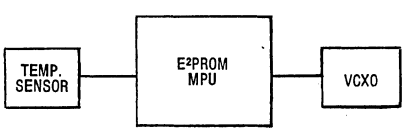
This Device Can Transmit and Receive Simultaneously on 2 Standard Baud Rates Which Are Manually or Soft Ware Selectable From 50 to 19,200 Baud. Fully Processed to MIL-O-55310, 38510 and 883B With Burn In Available. Packaged in 18 Pin D.I.P. or Flat Pack.



DCXO
DIGITALLY COMPENSATED XTAL OSCILLATOR

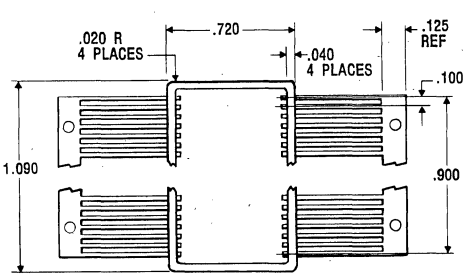


1 Hz to 60 MHz
±.3 ppm 0 to +70°C
±.5 ppm −40°C to +85°C
±1 ppm −55° to +125°C
±1 ppm/Year Aging
5 Volts ±10%
C-MOS, TTL, LSTTL
Flat Packs, Leadless Carriers and D.I.P. Packages



PRECISION TIMERS
CRYSTAL CONTROLLED GATE ARRAY TIMERS

Custom Gate Array Technology
Full MIL Temperature Range
±.01% to ±1% Accuracy
Crystal Controlled
Programmable Outputs
Hermetically Sealed
Flat Packs, Leadless Carriers and D.I.P. Packages



DIP CRYSTAL OSCILLATORS

The MF Guarantee

MF Electronics warrants each of its oscillators to be free from defects for one year from date of purchase.
Any oscillator found to be defective during this period may be returned to the factory, postage paid, for repair or, at our option, replacement without charge.
MF Electronics limits its liability to the repair and/or replacement of the returned MF oscillator.

MF ELECTRONICS CORP.
10 Renewal Place, New Rochelle, N.Y. • 10801 • (914) 576-6570

The Broadest line in the industry.

- Units use overtone crystals from 20 MHz to 65 MHz, very stable electrically and more reliable mechanically.
- All units guaranteed for one year to operate within specifications.
- Units specified at temperatures exceeding 0 to 70°C are individually recorded 100% for frequency vs temperature-insuring compliance.

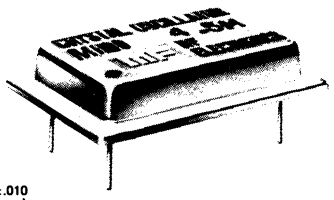
HYBRID TTL GUARANTEED CRYSTAL CLOCK OSCILLATORS • 250 KHz-50 MHz SERIES M1100

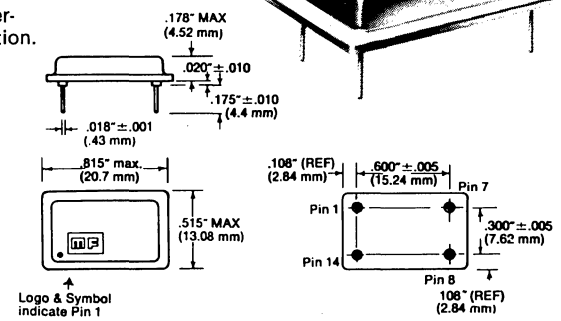
Frequency: Any specified frequency from **250 KHz** to **50MHz**
Frequency Stability: Including calibration at 25°C, operating temperature, change of input voltage, change of load, shock and vibration.

Series	Stability
M1100	± .01%
M1114	± .05%
M1115	± .10%
M1116	± 1.0 %
M1144	± .0025% (25 ppm)
M1145	± .0050% (50 ppm)
M1148	± .05% (economy)

Temperature: Operating 0 to 70°C
Storage −55 to +125°C
Input voltage: +5 ±.5 VDC
Input current: 60 ma., maximum, under all conditions
TTL output: All units, 0 to 70°C

Symmetry	60/40 @ 1.4 VDC
Rise and Fall time	6 ns. maximum from 0.5 to 2.4V
"O" Level	+0.5V, maximum
"I" Level	24V minimum
Loads	10 TTL Loads, standard or Shottky





HOW TO ORDER:
For Part Number... Add frequency to the Series M1100 thru M1145

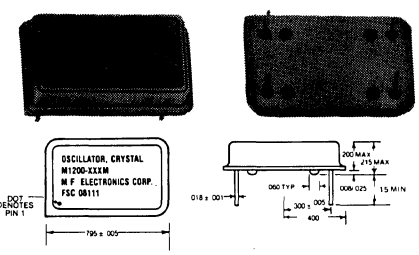
For example:
Series M1100, 01% 10 MHz frequency
M1100-10M

CRYSTAL CLOCK OSCILLATORS FOR MOS MICROPROCESSORS SERIES M1160, M1159

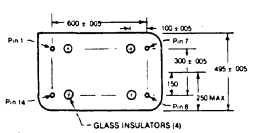
Same dimensions as M1100 Series above

- 4 MHz drives Z80A and Z8000, Mostek MK 3880-4, Sharp LH0080A, AMD AMz8000, NEC 780C-1
- 2 times TTL frequency on M1159-4 M
- MOS output drives 200 pf.
- Other frequencies available from 2 MHz thru 10 MHz

RESISTANCE-WELD CRYSTAL CLOCK OSCILLATORS • 250 KHz to 50 MHz IN ALL METAL CASE



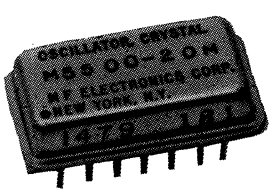
Series	Stability
M1200	± .01%
M1244	± .0025% (25 ppm)
M1245	± .0050% (50 ppm)

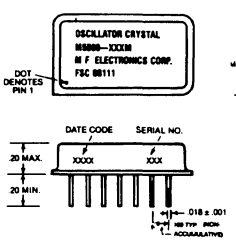


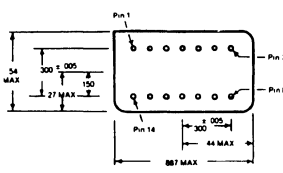
- All metal welded package with standoff insulator
- Area on PC board is one true TTL space—0.500" × 0.800" max.
- Seated height less than 0.215, including insulator
- Frequency from 250 KHz to 50 MHz
- TTL Compatible
- Stability options from .01% to .0025%
- Units at 4 MHz and higher are simple and reliable using the exclusive MF Clock-chip ™

Metal Package—Unit is hermetically sealed by resistance weld, with glass-to-metal seal connector which may be soldered or plugged into socket.

HIGH REL MILITARY CRYSTAL OSCILLATORS • IN HERMETICALLY SEALED CASE SERIES M5500 • 250 KHz-50 MHz







- Hermetically sealed resistance welded package
- Crystal specifically manufactured for oscillator with angle of cut controlled within ± 1 minute
- 168 hour Class B burn-in
- Simplified design with proprietary IC
- Capacitors to MIL-C-55681
- Extensive environment testing

ELECTRONICS CORP.
10 Renewal Place, New Rochelle, N.Y. • 10801 • (914) 576-6570

M-tron-more than just a responsible source for quality quartz crystals and oscillators!

In addition to providing you with products produced under superb quality control—with in-house test instrumentation including state-of-the-art TC equipment—we can offer you additional advantages: (1) provide engineering assistance with specifications to circuit applications . . . (2) make excellent delivery . . . (3) serve you anywhere in the world.

For OEMs we utilize computer design for efficient turnaround on prototypes. And, we can custom-produce clocks and AT-Cut Crystals to your specifications.

CRYSTAL OSCILLATORS

We utilize high-quality crystals to provide highly stable TTL and CMOS compatible logic signal sources in true hermetic, all-metal resistance welded modules. Custom-design capability.

	TTL	CMOS
Frequency range	250 Hz to 60 MHz	600 Hz to 12 MHz
Frequency stability	± .01%	± .01%
Temperature range	0 to 70°C	0 to 70°C
Input voltage	+5V ± 0.5 VDC	+4V to +12 VDC

Z80/Z8000 compatible and dual phase also available.

0.815 x 0.515 x 0.20 (20.7 x 13 x 5 mm), Lead length 0.25" (6.3 mm).

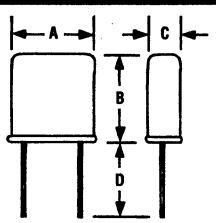
MICROPROCESSOR CRYSTALS

Frequencies listed are standard and available from stock in holders shown. Any frequency from 1 MHz to 100 MHz may be provided. Std. stability specifications are ± .0025% @ 25°C and ± .0035% of the 25°C reading from −20°C to +70°C.

Frequencies (MHz)

MP-2 (HC-33U)		MP-1 (HC-18U)					
1.000000	3.276800	3.276800	5.000000	5.714300	6.553600	14.318180	20.480000
1.843200	3.579545	3.579545	5.017600	5.990400	8.000000	16.000000	22.118400
2.000000	4.000000	4.000000	5.068800	6.000000	10.000000	18.000000	24.576000
2.097152	4.194304	4.194304	5.120000	6.144000	10.240000	18.432000	28.356900
2.457600		4.915200	5.185000	6.400000	11.000000	20.000000	48.000000

STANDARD HOLDERS inches (mm)



DIM.	HOLDER							
in. (mm)	HC-18/U 3-170 MHz	HC-49/U 3-170 MHz	HC-33/U 1-170 MHz	HC-51/U 1.5-170 MHz	HC-6/U 1-170 MHz	HC-48/U 1.5-170 MHz	HC-25/U 3-170 MHz	HC-50/U 3-170 MHz
A	.435(11.05)max.	.424(10.77)	.757(19.23)max.	.743(18.87)	.757(19.23)max.	.743(18.87)	.435(11.05)max.	.424(10.77)
B	.530(13.46)max.	.520(13.20)max.	.775(19.69)max.	.776(19.70)max.	.775(19.69)max.	.776(18.87)	.530(13.46)max.	.520(13.20)max.
C	.183(4.65)max.	.172(4.37)	.352(8.94)	.338(8.59)	.352(8.94)max.	.338(8.59)	.183(4.65)max.	.172(6.05)min.
D	.500(12.70)min.	.500(12.70)min.	.500(12.70)min.	.500(12.70)min.	.238(6.05)	.238(6.05)	.238(6.05)	.238(6.05)

OEM CRYSTALS

M-tron has the high quality, high volume production capability to produce for annual customer requirements. This can result in cost savings to you. Also, you are assured of delivery consistent with your production requirements. Initial deliveries can begin 6 to 8 weeks after receipt of your order.

Standard units, in quantities up to 200 units, are delivered from stock. Samples for new product applications can be delivered in just 4-5 weeks.

Frequency	1 MHz-170 MHz
Accuracy	±20 PPM @ 25°C
Stability	±25 PPM−20°C to +70°C
Load capacity	18pf
Resistance:	500−@ 1 MHz
	25−@ 15 MHz
	120−@ 170 MHz
Holder type	As specified in preceding

SCANNER/CB/WALKIE TALKIE CRYSTALS

M-tron is one of the country's largest suppliers of these crystals. We have 13,000 different types of units in stock.

MILITARY CRYSTALS

M-tron has maintained its military qualification and offers many QPL listed products. Write the factory for lists.

M-TRON ADVANTAGES

COMPUTER DESIGN, with programs for both crystals and oscillators, assures consistent, reliable designs. QUALITY CONTROL insures that we meet your specific requirements. ENGINEERING ASSISTANCE—Our engineering department is ready to assist in specifications of circuit analysis. WORLD-WIDE DISTRIBUTION adds up to on-time delivery—everywhere!

ASK ABOUT OUR "HI-LO" PRODUCT LINE—WATCH FOR "UNICEN-1"

M1-14-1

M-tron

a recognized leader in Quality Clock Oscillators and Quartz Crystals.

M-TRON INDUSTRIES, INC., P.O. Box 630, Yankton, S.D. 57078 • Phone 800/843-6842 • TWX 910-668-3603

McCOY CRYSTALS

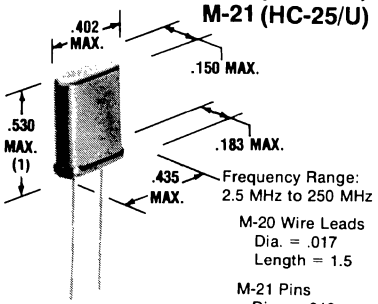
McCoy Electronics designs and manufactures the broadest frequency product devices offered to the market place. All items are custom, and are supported by the following critically important in-house operations: Photo fabrication facility, PC board manufacture, coil product, fabricated enclosure, thick film hybrid manufacture, complete environmental testing, including: Shock, Vibration (Sline and Random), X-ray, Humidity, Salt Spray, PIND, Gross and Fine Leaks, Precision Aging, and Acceleration.

Pride in product performance and quality has assured a prominent image for McCoy Electronics in today's market. For tomorrow, diligent effort in state-of-the-art technology, process optimization, and work ethic, comprise the solid foundation for which we will grow.

Products illustrated represent examples of our capability through past efforts, and are by no means a limit of our overall line. You are invited to discuss new applications with our design Engineering and Marketing staff.

SOLDER SEAL CRYSTALS

HOLDER SERIES M-20 (HC-18/U) M-21 (HC-25/U)



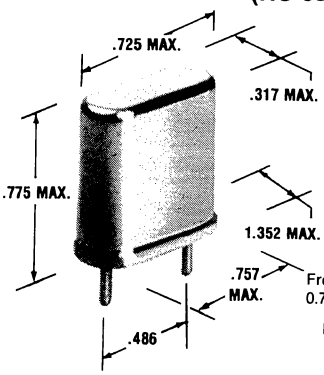
Frequency Range: 2.5 MHz to 250 MHz

M-20 Wire Leads Dia. = .017 Length = 1.5

M-21 Pins Dia. = .040 Length = .238

(1) Also available with short cans
"A" Height = .460 (5 MHz to 250 MHz)
"B" Height = .425 (5 MHz to 250 MHz)
"C" Height = .360 (10 MHz to 250 MHz)
"D" Height = .312 (10 MHz to 250 MHz)
"E" Height = .250 (15 MHz to 250 MHz)
"F" Height = .400 (10 MHz to 250 MHz)

HOLDER SERIES M-1 (HC-6/U) M-4 (HC-33/U)



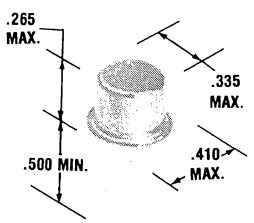
Frequency Range: 0.7 MHz to 250 MHz

M-1 Pins Dia. = .050 Length = .248

M-4 Wire Leads Dia. = .030 Length = 1.5

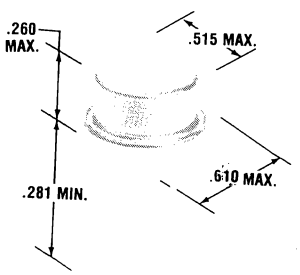
COLD WELD CRYSTALS

HOLDER SERIES W-6 (HC-35/U)



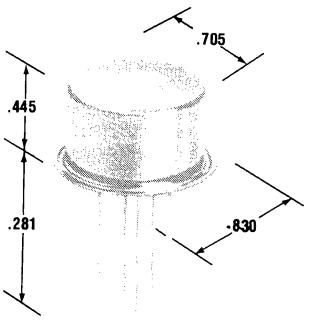
Frequency Range: 10 MHz to 250 MHz
Wire Lead Dia. = .018

HOLDER SERIES W-7 (HC-37/U)



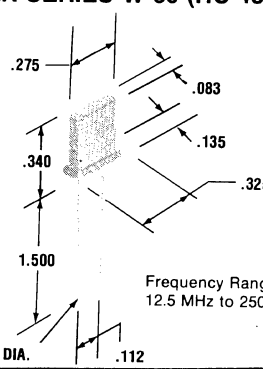
Frequency Range: 3 MHz to 250 MHz
Wire Lead Dia. = .018
Note: Pin version also available

HOLDER SERIES W-8



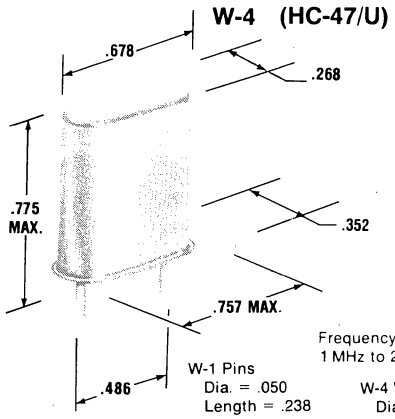
Frequency Range: 0.8 MHz to 250 MHz
Wire Lead Dia. = .018
Note: Pin version also available

HOLDER SERIES W-60 (HC-45/U)



Frequency Range: 12.5 MHz to 250 MHz

HOLDER SERIES W-1 (HC-36/U) W-4 (HC-47/U)



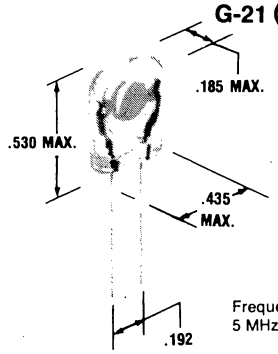
Frequency Range: 1 MHz to 250 MHz

W-1 Pins Dia. = .050 Length = .238

W-4 Wire Leads Dia. = .030 Length = 1.5

PRECISION GLASS CRYSTALS

HOLDER SERIES G-20 (HC-26/U) G-21 (HC-29/U)

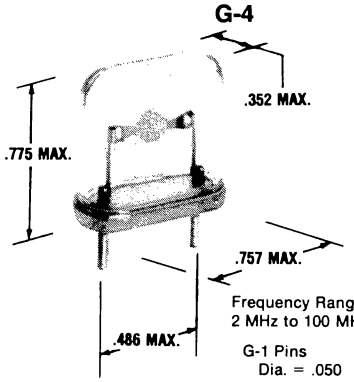


Frequency Range: 5 MHz to 100 MHz

G-20 Wire Leads Dia. = .017 Length = 1.5

G-21 Pins Dia. = .040 Length = .238

HOLDER SERIES G-1 (HC-27/U) G-4



Frequency Range: 2 MHz to 100 MHz

G-1 Pins Dia. = .050 Length = .238

G-4 Wire Leads Dia. = .030 Length = 1.5

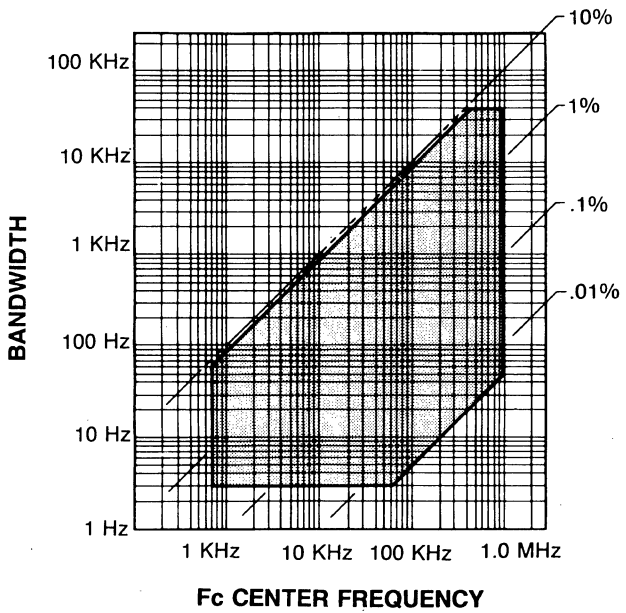
100 WATTS STREET, P.O. BOX B, MT. HOLLY SPRINGS, PA. 17065
717-486-3411 - TWX: 510-650-3548

McCOY ELECTRONICS COMPANY
a subsidiary of OAK Technology Inc.

McCOY LOW FREQUENCY CRYSTAL FILTERS

Low Frequency crystal filters between 1 KHz and 1 MHz are routinely produced utilizing advanced computer design technology. All filters are custom designed to customer requirements including unique package designs to fit unusual conditions. We invite your challenge. Call our Sales or Engineering Departments today with your application.

LOW FREQUENCY BANDWIDTH CHART



TYPICAL UNITS AVAILABLE

P/N	CENTRAL FREQUENCY	BANDWIDTH	BANDWIDTH	db I.L.	db RIPPLE	Ω IMPED.	SIZE
48B11	12 KHz	5 ldb Hz Min	40 db 1 KHz	7	1	1 K	3 X 1.56 X .922
48B15	450 KHz	3 db 200 Hz	60 db 1500 Hz	5	3	20 K	2.605 X .595 X .955
48B35	455 KHz	3 db ±1450 Hz	60 db ±1.96 KHz	4.5	0.5	2 K	3.031 X 1.438 X 1

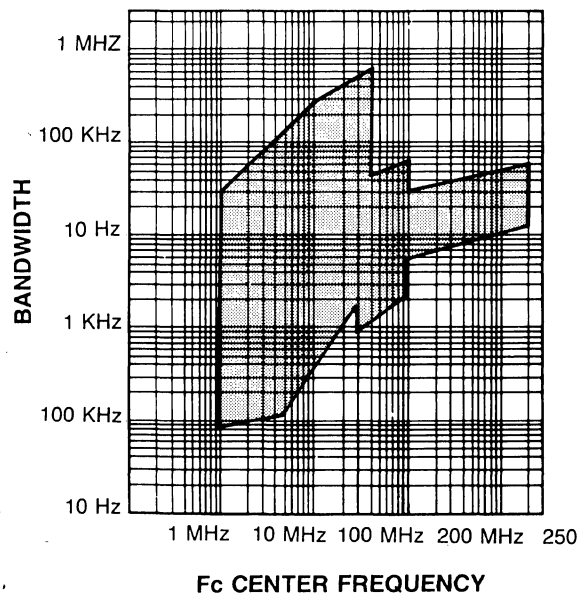
Only a few units are shown, write or call for complete catalog.

McCOY ELECTRONICS COMPANY
a subsidiary of OAK Technology Inc.
100 WATTS STREET, P.O. BOX B, MT. HOLLY SPRINGS, PA. 17065
717-486-3411 - TWX: 510-650-3548

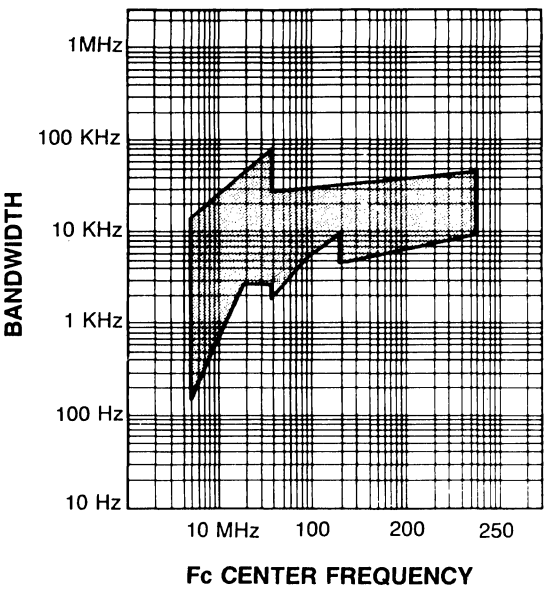
McCOY HIGH FREQUENCY CRYSTAL FILTERS

McCoy Electronics manufactures high frequency crystal filters from 1 MHz to over 250 MHz. Both descrete crystal design and monolithic filter designs are utilized to achieve the maximum in bandwidths, selectivity, miniaturization and competitive pricing.

DISCRETE FILTER BANDWIDTH



MONOLITHIC BANDWIDTH CHART



TYPICAL UNITS AVAILABLE

P/N	CENTER FREQUENCY MHz	NO. POLES	BANDWIDTH	BANDWIDTH	db I.L.	db RIPPLE	Ω IMPED.	SIZE
48B52	1.4	14	3 db ± 1.62 KHz	60 db 4.3 KHz	5	1	1K	2.975 × 1.63 × 1.18
48B30	10	6	1 db ± 15 KHz	60 db ± 58 KHz	5	0.5	500	1.87 × .5 × .475
48Q24	21.4	4	6 db 32 KHz	30 db 72 KHz	6	2	2.2K	.9 × .215 × .61
48Q19	25.5	6	6 db ± 34.5 KHz	60 db ± 80 KHz	5	1	3K	2.08 × .75 × .635
48Q06	30	8	3 db ± 15 KHz	60 db 60 KHz	4	1	1.5K	.73 × .47 × .59
48B45	50	6	6 db ± 9.5 KHz	55 db ± 25 KHz	8	1	50	2.73 × .64 × 1.085
48B40	70	8	1 db ± 20 KHz	45 db ± 70 KHz	6	1	50	.985 × .719 × .475
48B76	118 to 136	8	6 db ± 12 KHZ	90 db ± 75 KHZ	1	2	50	4.98 × .985 × .985
48Q2	156	2	3 db 15 KHz	30 db 60 KHz	2	1	5K	41 dia. × .265

Only a few units are shown, write or call for complete catalog.

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a subsidiary of OAK Technology Inc.

McCOY CRYSTAL OSCILLATORS

McCoy's line of custom designed Crystal Controlled Oscillators is unexcelled in the industry. From clocks, TCXO's, VCXO's, TCVCXO's thru oven controlled units, we have a unit to meet your requirements. A complete in-house thick film facility coupled with the industries best crystal facility gives you miniaturization capabilities and quality controls unavailable elsewhere. Our QPL approvals on MIL-0-55310 allows the use of military approved unit where the requirement exists.

MIL-0-55310 OSCILLATORS OFFERED BY McCOY ELECTRONICS

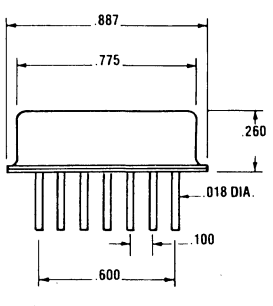
MIL-O-55310 SLASH SHEET NO.	CLASS # OF UNIT *	FREQUENCY RANGE COVERED	OUTPUT WAVEFORM	McCOY CORRESPONDING MODEL NUMBER	PACKAGE SIZE AND STYLE
4	3	750 KHz - 10 MHz	C-MOS	MC128A2-( )	1.5" X 1.5" X .5" PC MOUNT
5	3	1 MHz - 10 MHz	TTL	MC180X2-( )	2.0" X 2.0" X .7" PC MOUNT OR CHASSIS
6	3	15.7 KHz - 10 MHz	TTL	MC219A1-( )	1.55" X 1.015" X .7" PC MOUNT
7	3	10 MHz - 90 MHz	SINE	MC178X2-( )	2.0" X 2.0" X .7" PC MOUNT
8	1	50 Hz - 50 MHz	TTL	MC765A1-( )	.887" X .54" X .4" 14 PIN DIP
10	1	1 KHz - 30 MHz	TTL	MC708A1-( )	.565" dia. X .350" TO-8 PACKAGE
11	1	.05 Hz - 10 MHz	C-MOS	MC751A1-( )	.887" X .54" X .4" 14 PIN DIP
13	1	300 Hz - 10 MHz	C-MOS	MC714	.565" dia. X .350" TO-8 PACKAGE
14	1	.1 Hz - 25 MHz	TTL	MC755A1-( )	.887" X .54" X .2" 14 PIN DIP
15	1	.01 Hz - 10 MHz	C-MOS	MC752A1-( )	.887" X .54" X .2" 14 PIN DIP
16	1	.1 Hz - 50 MHz	TTL	MC741A1-( )	.887" X .54" X .2" 14 PIN DIP
17	1	250 KHz - 25 MHz	TTL	MC726A1-( )	.887" X .54" X .2" 14 PIN DIP

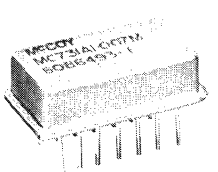
*MIL-O-55310 OCILLATOR CLASSIFICATIONS
CLASS 1: CRYSTAL OSCILLATOR (XO)
CLASS 3: TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR (TCXO)

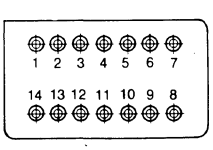
Only a few units are shown, write or call for complete catalog.

MODEL MC731A1

Standard Oscillator







Frequency Range: 250 KHz to 50 MHz

Stability (Options):	**Temperature Range:**
±50 PPM	0°C to +70°C
±50 PPM	–40°C to +85°C
±50 PPM	–55°C to +105°C
±70 PPM	–55° C to +125° C

Input: +5V DC ±10%

Output:

TTL: Fan out to 10 TTL Loads (250 KHz to 25 MHz)
TTL: Fan out to 6 TTL Loads (25 MHz to 50 MHz)

Pin Connections

1,2,3,5,6,9,10,12, & 13 N/C Internally
7. Common
8. R.F. Output
14. Oscillator B+
4 & 11 Connected Internally

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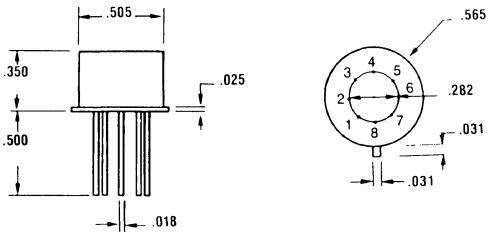
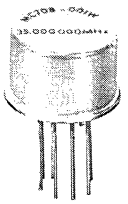
McCOY CRYSTAL OSCILLATORS

MODEL MC708

Standard Oscillator





Frequency Range: 250 KHz to 50 MHz

Stability (Options):	Temperature Range:
±50 PPM	0°C to +70°C
±50 PPM	−40°C to +85°C
±50 PPM	−55°C to +105°C

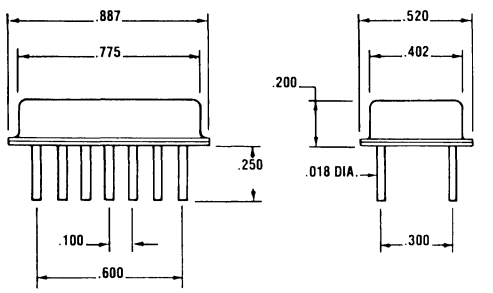
Input: +5V DC ±10%

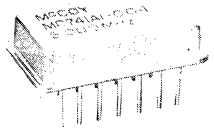
Output: TTL: Fan out 10 TTL Loads (156 KHz to 25 MHz)
TTL: Fan out 6 TTL Loads (25 MHz to 50 MHz)

Pin Connections
1,3,& 7 N/C Internally
2 & 6 Connected Internally
4. Common
5. R.F. Output
8. Oscillator B+

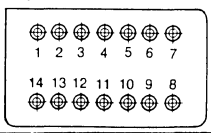
MODEL MC741A1

Standard Oscillator





Pin Connections
1,2,3,4,5,6,9,10,11,12, & 13 N/C Internally
7. Common
8. R.F. Output
14. Oscillator B+



Frequency Range: 250.0 KHz to 50 MHz

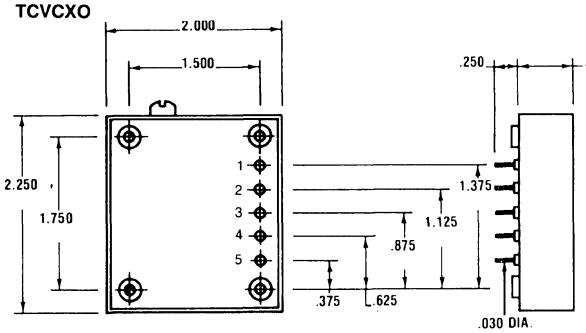
Stability (Options):	Temperature Range:
±50 PPM	0°C to +70°C
±50 PPM	−40°C to +85°C
±50 PPM	−55°C to +105°C
± 70 PPM	−55° C to +125° C

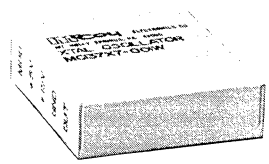
Input: +5V DC ±10%

Output:
TTL: Fan out to 10 TTL Loads (250 KHz to 25 MHz)
TTL: Fan out to 6 TTL Loads (25 MHz to 50 MHz)

MODEL MC137X7

TCVCXO





Pin Connections
1. Modulation Input
2. Logic B+
3. Oscillator B+
4. Common and Case
5. R.F. Output

Frequency Range: 180 KHz to 25 MHz

Stability	Temperature Range	Deviation
±1 PPM	−10°C to +70°C	±.001%
±5 PPM	−30°C to +70°C	±.0025%
±10 PPM	−40°C to +75°C	±.005%

Linearity: 5%

Output: TTL Compatible

Modulation Input Impedance: 10k Minimum

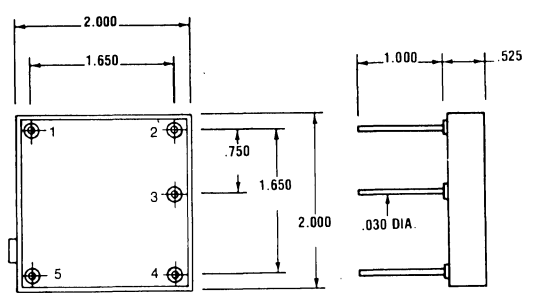
Control Voltage: ±2 Volts to ±10 Volts

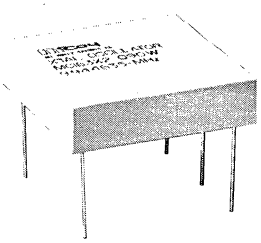
Negative Slope:

Input Voltage: +12 to +24V DC

MODEL MC163X2

TCXO





Frequency Range: 180 Hz to 150 MHz (depending upon output)

Stability Tr: ±0.5 PPM −20°C to +60°C
±1.0 PPM −55°C to +70°C
±5.0 PPM −55°C to +105°C
(Shown are typical specifications - this is a cost determining requirement and only actual needs should be specified)

Input Voltage Range: +12 VDC to +24V DC ±3% and +5V DC ±5% (TTL/DTL units only)

External Trim: 5 PPM Minimum

Aging: 1 PPM/Year Maximum

Output:

Sine Wave	
Freq Range 3-150 MHz Output 1-10 MW ohms Harmonics/ Sub-Harmonics −20 dB Minimum	
TTL/DTL	**CMOS**
187.5 KHz-25 MHz TTL/DTL Compatible	180 Hz-10 MHz CMOS Compatible

Frequency Range: 50 to 100 MHz

Input Voltage: ±12 to 24 DC ±3% and −5.2 VDC ±5%

Output: ECL Compatible

Sinewave
Pin Connections
1. Oscillator B+
2. N.C.
3. R.F. Output
4. Common and Case
5. Common and Case

TTL
Pin Connections
1. Oscillator B+
2. Common and Case
3. R.F. Output
4. Logic B+
5. Common and Case

CMOS
Pin Connections
1. Oscillator B+
2. N.C.
3. R.F. Output (CMOS)
4. Common and Case
5. Common and Case

ECL
Pin Connections
1. OSC B+ or B−
2. GND
3. R.F. Output
4. Logic −5.2 VDC
5. GND

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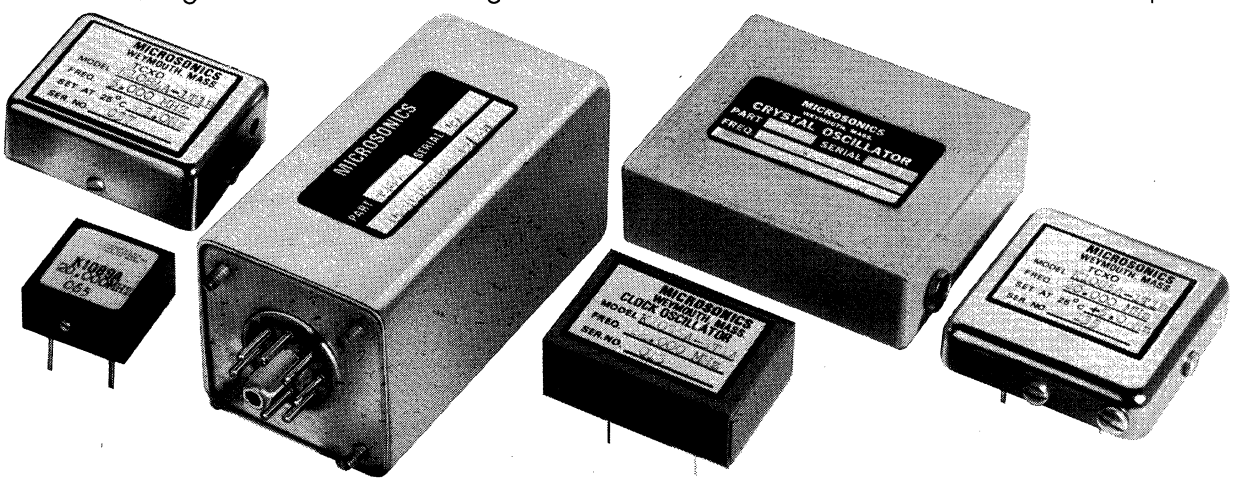
SPECIFY MICROSONICS

Go with a company that does it all.

In-house crystal manufacturing, producing up to 41 MHz fundamental frequencies. Computer optimized designs. Automatic testing and modern manufacturing facilities.

Engineering assistance and liaison. Special packaging. Customized and state-of-the-art devices. Quality assurance to MIL-I-45208A or MIL-Q-9858A if required.



CRYSTAL OSCILLATORS

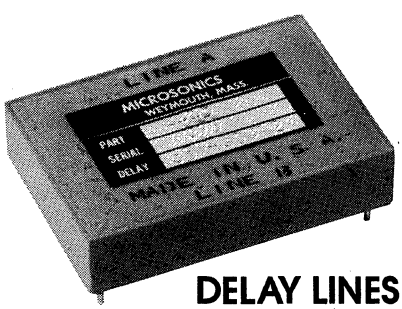
Ovenized (OC), clock (XO), temperature compensated (TCXO), and temperature compensated voltage controlled (TC/VCXO), crystal oscillators with sine wave, TTL, CMOS, and ECL compatibility. Many standard options available to insure fast delivery of quality oscillators to meet your large or small quantity needs. Plus, our ability to customize military and commercial designs provides you with the flexibility necessary to satisfy all your requirements.

FILTERS

Solving problems in the space, military, commercial and CATV fields. Filters available with center frequencies from 10 KHz to 200 MHz. Featuring wide bandwidths, phase matching, tracking and equalization. Call us for bandpass, band reject, comb, phase tracking and compensated Filters or Discriminators. Designs are available in L.C., or Crystal technologies.

We're available...

Microsonics' Sales and Engineering staff is available to assist you in your Delay Line, Filter and Oscillator requirements, covering the spectrum from high volume commercial production to high reliability space and military. We have the personnel, equipment and commitment to provide our customers with the products they need. Write or call now for bulletins and Engineering or Sales assistance.



DELAY LINES

We have nearly 25 years experience in delay lines, providing the military and television broadcast equipment markets with quality, high technology delay lines. Delay lines with delays of .5 to 5000 usec with center frequencies from 5 MHz to 200 MHz depending on application. Designs are available utilizing bulkwave in quartz or Zero Temperature Coefficient glass. We can help you solve your delay line problems.

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INCORPORATED

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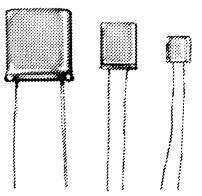
QUARTZ CRYSTALS



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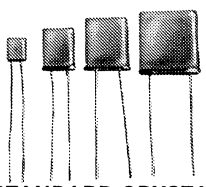
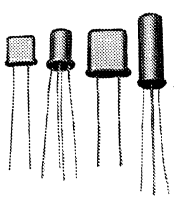
- U.S. MANUFACTURER AT OFFSHORE PRICING

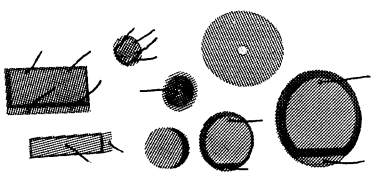
MICROPROCESSOR
Check our low prices and stock frequencies



STANDARD CRYSTALS
to MIL C-3098
16 KHz — 125 MHz

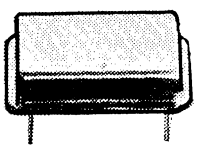


HI-ENVIRONMENTAL
Units to 20,000 G's

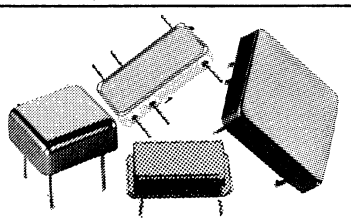


SPECIAL ULTRASONIC
Consult us for your requirements

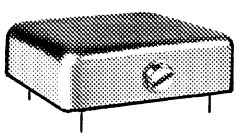
CRYSTAL OSCILLATORS



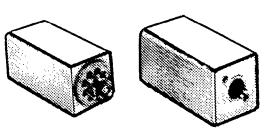
TTL, CMOS, ECL
TTL .2 — 60 MHz
CMOS 600 Hz — 9.0 MHz
ECL 40 MHz — 90.0 MHz
Economical DIP T0116 compatible



HI-REL MILITARY
MIL-STD 55310/883/NHB5300.4

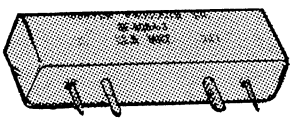


TCXO/ VCXO's
.2 — 70.0 MHz
Deviation to ±2000 PPM
Stabilities to .5 PPM

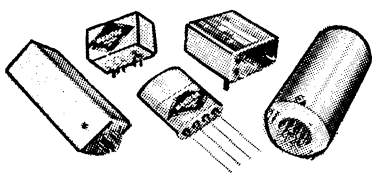


FREQUENCY STANDARDS
Stabilities to $\pm 1 \times 10^{9}$/day

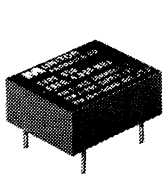
SPECIAL PRODUCTS*



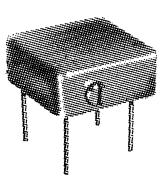
FILTERS
Crystal & LC



OVENS
Crystal & Component
Several hundred Special Designs



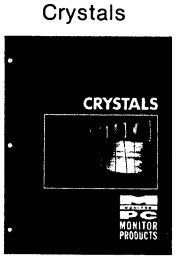
LOW FREQUENCY OSCILLATORS
Frequency to 1 Hz



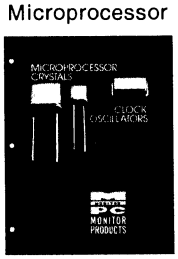
MULTI/OUTPUT & BAND RATE GENERATOR

These catalogs contain complete specifications... may we send them to you? *Designed to Customer Specifications

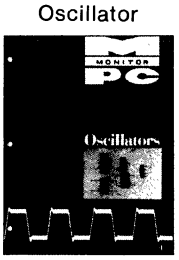
Crystals



Microprocessor



Oscillator



TCXO

Filter

Oven

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FIFTY SIX YEARS IN FREQUENCY CONTROL

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

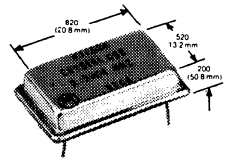
WPS word processing software

Y

YIG yttrium iron garnet

MOTOROLA INC.
Component Products

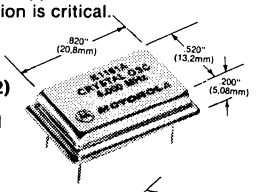
Crystal Clock Oscillators



(1)

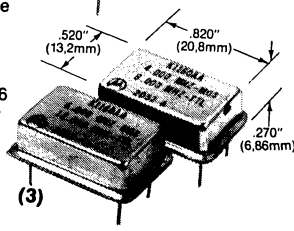
SPECIFICATION MODEL:	K1152A (1)	K1161A (2) K1163 (2)	K1160AA (3) DRIVES Z80A, Z80B, Z8000-TYPE MICROPROCESSORS
Frequency Range	.825 kHz-10 MHz	K1161A: 2.5 MHz-10 MHz K1163A: 10 MHz-15 MHz	2.5-6 MHz (MOS) TTL at 2X MOS
Frequency Stability: (Inclusive of calibration tolerance at 25°C. operating temperature, input voltage change, load change, aging, shock, and vibration.)	±.01%	±.01%	+0%, −0.020%
Temperature Range Operating: Storage:	0°C to +70°C −55°C to +125°C	0°C to +70°C −55°C to +125°C	0°C to +70°C −55°C to +125°C
Input Voltage: Input Current/Power:	+5 to 15V dc 3-11 mA (typical)	+5V dc ±0.5V dc 66 mA max.; 70 mA	+5V dc, ±0.5V dc 357 mW max.
Output: Square Wave: Levels: Symmetry: Output Load:	CMOS compatible "0"=Vss+.05V dc typ "1"=Vdd−.05V dc typ 60/40% @ 50% "1" 15pf	TTL compatible See description (2) "0"=0.5V dc max. "1"=2.4V dc min. 15 pf	Dual; MOS & TTL MOS: "0"=0.4V max. "1"=Vcc−0.4V min, Vcc max. TTL: "0"=−0.3V min, 0.5V max. "1"=2.5V min. MOS: 150 pf TTL: 15 pf
Environmental Shock	1,000 G's for 0.35 ms. 1/2 sine wave. 3 shocks each plane.		
Vibration:	10-55 Hz. 0.060" double amplitude; 55 Hz-2 kHz, 35 G's 12 hours duration		

The K1152A Low Power CMOS Crystal Clock Oscillators—Perfect for driving CMOS Microprocessors or in applications where low power consumption is critical.



(2)

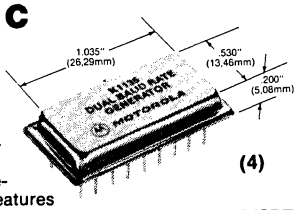
K1161A and K1163A are TTL compatible. The K1161A provides dual complementary outputs, while the K1163A has a second output at half the clock frequency.



(3)

K1160AA provides 2.5 to 6 MHz MOS output to drive Zilog or equivalent μPs, and TTL output at twice the processor frequency for systems timing.

Baud Rate Generator K1135A, B, C



(4)

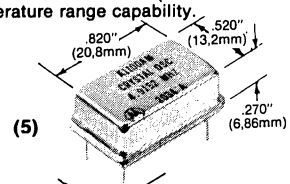
The K1135 is a complete functional baud rate generator which provides the stable reference frequencies needed by serial interface devices such as UARTs, Modems, Teletype, cassettes, etc. Features • Choice of 2 x 16 output frequencies • Direct UART/USRT compatibility • Full duplex communications • Pin compatible with SMC 5036 • Zero error available at 19,200 baud.

Xmit/Rcve Address D C B A	Baud Rate	Theor. Freq. 16X Clock (kHz)	K1135A, B (4) Actual Freq. 16X Clock (kHz)	% Error	Duty Cycle %	Divisor	K1135C (4) Actual Freq. 16X Clock (kHz)	% Error	Duty Cycle %	Divisor
0 0 0 0	50	0.8	0.8	—	50/50	6336	0.8	—	50/50	6144
0 0 0 1	75	1.2	1.2	—	50/50	4224	1.2	—	50/50	4096
0 0 1 0	110	1.76	1.76	—	50/50	2880	1.7589	-0.01	*	2793
0 0 1 1	134.5	2.152	2.1523	0.016	50/50	2355	2.152	—	50/50	2284
0 1 0 0	150	2.4	2.4	—	50/50	2112	2.4	—	50/50	2048
0 1 0 1	300	4.8	4.8	—	50/50	1056	4.8	—	50/50	1024
0 1 1 0	600	9.6	9.6	—	50/50	528	9.6	—	50/50	512
0 1 1 1	1200	19.2	19.2	—	50/50	264	19.2	—	50/50	256
1 0 0 0	1800	28.8	28.8	—	50/50	176	28.7438	-0.19	*	171
1 0 0 1	2000	32.0	32.081	0.253	50/50	158	31.9168	-0.26	50/50	154
1 0 1 0	2400	38.4	38.4	—	50/50	132	38.4	—	50/50	128
1 0 1 1	3600	57.6	57.6	—	50/50	88	57.8258	0.39	*	85
1 1 0 0	4800	76.8	76.8	—	50/50	66	76.8	—	50/50	64
1 1 0 1	7200	115.2	115.2	—	50/50	44	114.306	-0.77	*	43
1 1 1 0	9600	153.6	153.6	—	*48/52	33	153.6	—	50/50	32
1 1 1 1	19,200	307.2	316.8	3.125	50/50	16	307.2	—	50/50	16

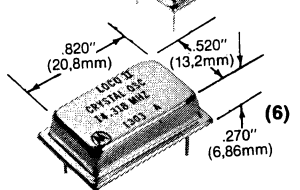
*When duty cycle is not exactly 50%, it is 50% ± 10%.

TTL Compatible Crystal Clock Oscillators

250 kHz to 70 MHz. All-metal welded package provides resistance to temperature/humidity extremes. Case ground minimizes E.M.I. Model K1100AM has ±0.01% all-inclusive stability—other models offer differing stabilities to suit application or budget requirements. K1158AM (1 to 30 MHz) offers extended temperature range capability.



(5)



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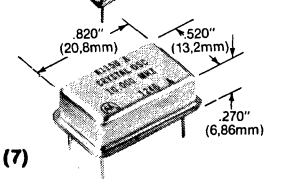

(7)

SPECIFICATION MODEL:	K1158AM (7) K1145AM (5) K1100AM (5) K1114AM (5) K1115AM (5) K1116AM (5)	LOCO II (6)
Frequency Range:	250 kHz to 70 MHz K1158A 1 MHz to 30 MHz	14.318 MHz; 16.000 MHz; 18.432 MHz; 19.6608 MHz.
Frequency Stability: (Inclusive of calibration tolerance at 25°C, operating temperature, input voltage change, load change, aging, shock, and vibration.)	K1145AM ±.005% K1114AM ±0.05% K1100AM ±0.01% K1115AM ±.1% K1158AM ±0.01% K1116AM ±1.0%	±.05%
Temperature Range Operating: Storage:	K1158A −40°C to +85°C 0°C to +70°C −55°C to +125°C	0°C to +70°C −55°C to +125°C
Input Voltage: Input Current, max. at 25°C:	+5V dc ±0.5V 105 mA (250-1,000 kHz) 90 mA (1-4 MHz) 40 mA (4-9 MHz) 60 mA (9-30 MHz) 70 mA (30-70 MHz)	+5V dc ±0.5V 60 mA
Output: Square Wave: Rise & Fall Time: Levels: Symmetry: (Worst Case) Fan Out:	TTL Compatible 15 nsec Maximum (.25 to 9 MHz) 10 nsec Maximum (9 to 30 MHz) 5 nsec Maximum (30 to 70 MHz) "0"=0.4V max., "1"=2.4V min. 60/40% at 1.4V dc level 1 to 10 gates, 1.6 mA/gate, 5 gates <20 MHz	TTL Compatible 10 nsec Maximum "0" = 0.4V max., "1" = 2.4V min. 60/40% at 1.4V dc level 1 to gates, 1.6 mA/gate
Environmental Shock:	1,000 G's for 0.35ms, ½ sine wave, 3 shocks each plane	LOCO II Ultra-Low Cost oscillator available only 14.318 MHz, 16.000 MHz, 18.432 MHz, 19.6608 MHz
Vibration:	10-55 Hz, 0.060" double amplitude; 55 Hz-2 kHz, 35 G's 12 hours duration	

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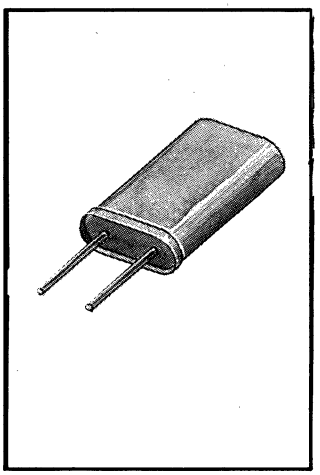
MOTOROLA INC.
Component Products
2553 N. Edgington, Franklin Park, Illinois 60131
Phone: (312) 451-1000
TWX: 910-227-0799 Telex: 4330067

crystals, crystal oscillators, crystal filters & ceramic resonators

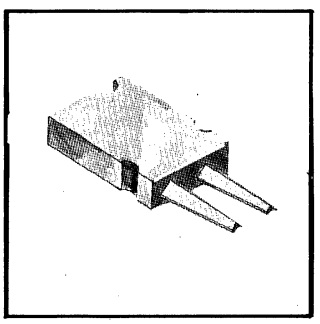
MURATA ERIE NORTH AMERICA, INC.



Crystals

Murata Erie North America, Inc. manufactures crystal cuts capable of handling the entire frequency spectrum from 1 KHz to 150 MHz. Specifications for crystals vary widely with regard to the equipment in which they are being used. Murata Erie manufactures to Military CR types and is qualified on the QPL list for most frequencies. It also manufactures crystals specifically to the customer's own specifications. Murata Erie welcomes the opportunity to quote on any type of crystal in solder seal, cold weld, and resistance weld holders.

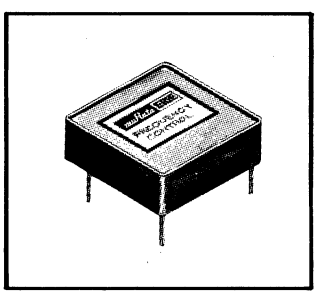
- Frequency Range: 1 KHz to 150 MHz
- Holders: HC-6, HC-13, HC-18, HC-25, HC-32, HC-35 (TO-5), HC-36, HC-39, HC-43, HC-44
- Seal: Cold Weld, Solder, Resistance Weld
- Microprocessor Types: 1 MHz to 100 MHz



Ceramic Resonators

Murata Erie's ceramic resonators derive their frequency selective capability from mechanical vibration resulting from a piezoelectric effect in the ceramic material. They are particularly useful in applications where extremely tight frequency tolerances are not required such as clock oscillators and audio tone generators. They are extremely reliable and low cost.

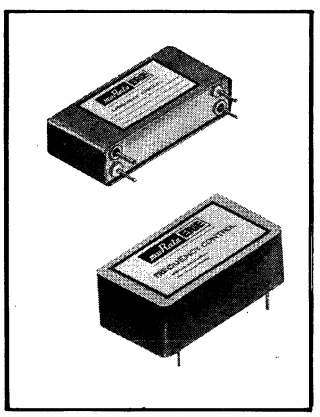
TYPE	CSA TYPE	CSB TYPE
Frequency Range	2.5 to 30 MHz	190 to 800 KHz
Vibration Mode	Thickness Vibration Fundamental	Area Vibration Fundamental
Frequency Tolerance	±0.3%	±0.3%
Temperature Stability (−20°C to +180°C)	±0.3%	±0.3%
Time Stability (10 years)	+0.5%	+0.5%
Equivalent Resistance	20 ohms max.	20 ohms max.



Crystal Oscillators

Murata Erie North America, Inc. manufactures a complete line of oscillators ranging from digital DIP clock oscillators to high stability, high reliability frequency sources. As a majority of our oscillators are custom designed, we welcome your inquiries and specifications. Write for our complete catalog.

- Frequency Range: 200 Hz to 600 MHz
- Size: .5″ x .8″ x .25″ to 2″ x 4″ x 1″
- Types: Clock (TTL, ECL, C/MOS or SINE). Integral Oven, Temperature Compensated, Voltage Controlled (VCO)
- Stability: From ±100ppm to ±3pp 10^9



Crystal Filters

Murata Erie North America, Inc. offers a complete line of sophisticated, discrete crystal filters ranging in frequency from 1 KHz to 100 MHz. In addition, we specialize in handling custom design specifications to fit your demanding applications. These high reliability units are rugged and compact, and can be designed to meet the environmental requirements of Mil-F-18327 in most cases.

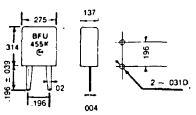
We invite your questions and encourage you to contact Murata Erie for your special design requirements.

- Center Frequency: 1 KHz to 100 MHz
- Bandwidth: .005% to 10% of F_o
- Shape Factor: As low as 1.25 to 1
- Ripple: Generally less than 1 dB
- Insertion Loss: Usually less than 3.0 dB
- Ultimate Attenuation: Up to 100 dB max
- Maximum Operating Temperature: −55°C to +105°C

MURATA ERIE NORTH AMERICA, INC. 1148 Franklin Rd., S.E. Marietta, Georgia 30067 Tel: (404) 952-9777 Telex: 54-2329 TWX: 810-766-1531

ceramic filters

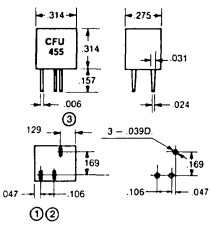
MURATA ERIE NORTH AMERICA, INC.



455 KHz Emitter Bypass

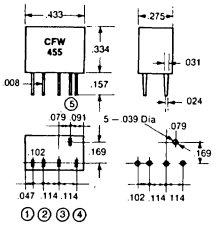
Model	Center Freq. (Fo)	3 dB Band Width	Resistance at Fo	Capacitance	Temperature Characteristics	Aging Stability	Withstanding Voltage
BFU455K	455 KHz ±2 KHz	8 KHz ±2 KHz	30 ohms Max.	550 pF ±20%	±0.4% Max. (−20°C~+80°C)	Within ±0.5% for 10 years	50 VDC

455 KHz Multielement Filters for Communications



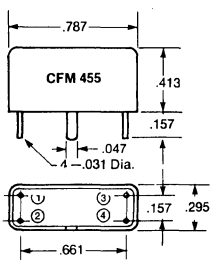
① = Input
② = Ground
③ = Output

Model	Center Frequency (KHz)	6 dB Band Width (KHz) min.	40 dB Band Width (KHz) Max.	50 dB Band Width (KHz) Max.	Attn. within 455 KHz ±100 Hz	Insertion Loss (dB) Max.	In, Output Impedance (Ω)
CFU455B2	455 ±2	±15	±30	—	27	4	1500
CFU455C2	455 ±2	±12.5	±24	—	27	4	1500
CFU455D2	455 ±1.5	±10	±20	—	27	4	1500
CFU455E2	455 ±1.5	± 7.5	±15	—	27	6	1500
CFU455F2	455 ±1.5	± 6	±12.5	—	27	6	2000
CFU455G2	455 ±1	± 4.5	±10	—	27	6	2000
CFU455H2	455 ±1	± 3	± 9	—	27	6	2000
CFU455I2	455 ±1	± 2	± 7.5	—	27	6	2000
CFW455B	455	±15	—	±30	35	4	1500
CFW455C	455	±12.5	—	±24	35	4	1500
CFW455D	455	±10	—	±20	35	4	1500
CFW455E	455	± 7.5	—	±15	35	6	1500
CFW455F	455	± 6	—	±12.5	35	6	2000
CFW455G	455	± 4.5	—	±10	35	6	2000
CFW455H	455	± 3	—	± 9	35	6	2000
CFW455I	455	± 2	—	± 7.5	35	7	2000

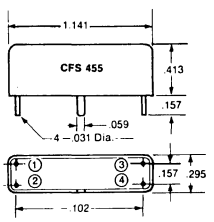


① = Input
② = Ground
③ = Ground
④ = Ground
⑤ = Output

Model	Center Frequency (KHz)	3 dB Band Width (KHz) Min.	6 dB Band Width (KHz) Min.	Ripple (dB) Max.	50 dB (CFM) 60 dB (CFR) Band Width (KHz) Max.	70 dB Band Width (KHz) Max.	Attn. within 455 KHz ±100 Hz	Insertion Loss. (dB) Max.	In, Output Impedance (Ω)
CFM455A	455	±13	±17.5	*	±30	—	50	3	1000
CFM455B	455	±10	±15	*	±25	—	50	3	1000
CFM455C	455	± 9	±13	*	±23	—	50	3	1000
CFM455D	455	± 7	±10	*	±20	—	50	3	1500
CFM455E	455	± 5.5	± 8	*	±16	—	45	5	1500
CFM455F	455	± 4.2	± 6	*	±12	—	45	5	2000
CFM455G	455	—	± 4	3	±10	—	45	5	2000
CFM455H	455	—	± 3	3	± 7.5	—	45	6	2000
CFR455A	455	±13	±17.5	*	±30	—	60	4	1000
CFR455B	455	±10	±15	*	±25	—	60	4	1000
CFR455C	455	± 9	±13	*	±23	—	60	4	1000
CFR455D	455	± 7	±10	*	±20	—	60	4	1500
CFR455E	455	± 5.5	± 8	*	±16	—	55	6	1500
CFR455F	455	± 4.2	± 6	*	±12	—	55	6	2000
CFR455G	455	—	± 4	3	±10	—	55	6	2000
CFR455H	455	—	± 3	3	± 7.5	—	55	7	2000
CFR455I	455	—	± 2	3	± 5	—	55	8	2000
CFS455A	455	±13	±17.5	*	—	±30	70	4	1500
CFS455B	455	±10	±15	*	—	±25	70	4	1500
CFS455C	455	± 9	±13	*	—	±23	70	4	1500
CFS455D	455	± 7	±10	*	—	±20	70	4	1500
CFS455E	455	± 5.5	± 8	*	—	±15	70	6	1500
CFS455F	455	± 4.2	± 6	*	—	±12	70	6	2000
CFS455G	455	—	± 4	3	—	± 9	70	6	2000
CFS455H	455	—	± 3	3	—	± 7.5	70	7	2000
CFS455I	455	—	± 2	3	—	± 5	70	8	2000
CFS455J	455	—	± 1.5	3	—	± 4.5	60	8	2000



① = Input ④ = Ground
② = Ground ③ = Output



① = Input
② = Ground
③ = Output
④ = Ground

10.7 MHz Ceramic Filters for FM-Stereo

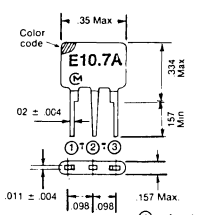


Fig. 3

① = Input
② = Ground
③ = Output

Model Specification	SFE 10.7MA5-Z	SFE 10.7MS2-Z	SFE 10.7MS3-Z	SFE 10.7MJ-Z	SFJ 10.7MA-Z	SFJ 10.7MA2-Z
Center Frequency	A:10.700 MHz ±30 KHz (Red) B:10.670 MHz ±30 KHz (Blue) C:10.730 MHz ±30 KHz (Orange)			D:10.640 MHz ±30 KHz (Black) E:10.760 MHz ±30 KHz (White)		
3 dB Band Width KHz	280 ±50	230 ±50	180 ±50	150 ±50	280 ±50	230 ±50
20 dB Band Width KHz Max.	650	570	520	500	—	—
50 dB Band Width KHz Max.	—	—	—	—	750	700
Insertion Loss	6 dB Max.	6 dB Max.	7 dB Max.	10 dB Max.	7 ±2 dB	7 ±3 dB
Spurious Response (8~12 MHz)	30 dB Min.	40 dB Min.	40 dB Min.	30 dB Min.	55 dB Min.	60 dB Min.
Input/Output Impedance	330 ohms	330 ohms	330 ohms	330 ohms	330 ohms	330 ohms
Temperature Range	−20~+80°C					
Withstanding Voltage	50 VDC					
Dimensions	< Fig. 1 >				< Fig. 2 >	

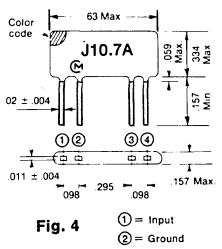


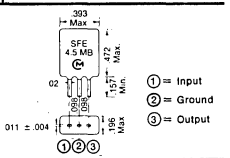
Fig. 4

① = Input
② = Ground
③ = Ground
④ = Ouptut

4.5 MHz Ceramic Filters for TV Sound

Specifications — SFE4.5MB

Nominal Center Frequency: 4.5 MHz. **3 dB Band Width:** ±60 KHz Min. **20 dB Band Width:** 530 KHz Max. **Insertion Loss:** 8.0 dB Max. **Spurious Response:** 20 dB Min. (within ±1 MHz). **Impedance:** 1000 ohms. **Temperature Range:** −20°C~+80°C. **Withstanding Voltage:** 50 VDC.



① = Input
② = Ground
③ = Output

CRYSTALS

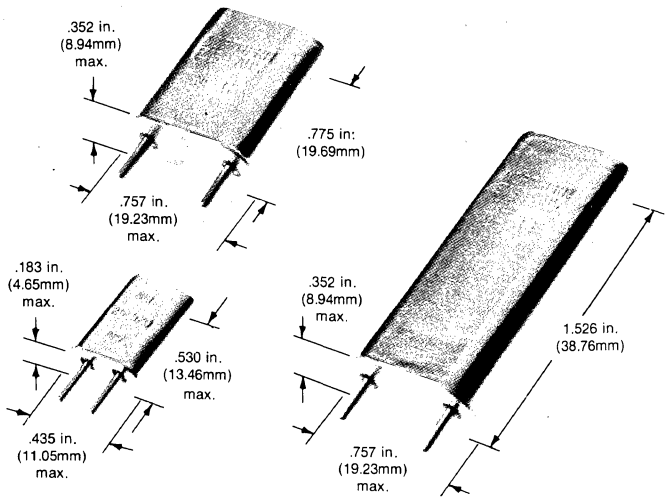
LOW & HIGH FREQUENCY CRYSTALS

Low Frequency Crystals
800 Hz — 900 KHz
High Frequency Crystals
1.0 MHz — 60 MHz

Full spectrum coverage from 1 KHz to 60 MHz in all popular metal MIL spec enclosures, including solder seal, resistance weld, and cold weld packaging. Controlled parameters for filter applications available in both glass and metal enclosures.

MICROPROCESSOR CRYSTALS

NEL offers complete in depth stocks of all popular microprocessor crystals in frequency range 1.0 MHz to 48 MHz. The popular microprocessors have been characterized to insure crystals supplied meet specifications. When ordering, please specify MPU device being used. All crystals are hermetically sealed in metal HC - 33/HC - 18 packages to insure product integrity.



AVAILABLE WITH P.C. HOLDDOWN PIN

OSCILLATORS

TTL

Frequency Range:
HS-100 - 3.5 MHz to 30 MHz
HS-200 - 225 KHz to 4.0 MHz
HS-500 - 25 MHz to 60 MHz

Frequency Tolerance:
± .01% Overall 0-70°C

CMOS

Frequency Range:
HS-300 - 3.5 MHz to 8.0 MHz
HS-400 - 600 Hz to 3.5 MHz

Frequency Tolerance:
±.01% Overall 0-70°C

Z80/8000

Frequency Range:
HS-180 - 3.5 MHz to 6.0 MHz
HS-280 - 500 KHz to 3.5 MHz

Frequency Tolerance:
(0 - 70°C)
+0.0%, - .02% at 2.5 MHz, 4.0 MHz, 6.0 MHz
+.02%, - 0.0% at 500 KHz
±.01% All other frequencies

DUAL OUTPUT (MOS/TTL)

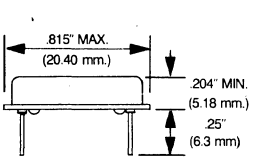
The HS-1820, HS-2820, and HS-2840 series of crystal clock oscillators, utilizing hybrid technology and DIP hermetic packaging, are now available to fill the need of the digital systems or microcomputer designer for a dual output clock that is both TTL and MOS compatible. They are particularly suited for Z80, Z80 A/B, and Z8000 microprocessors in system designs. Standard products are available.

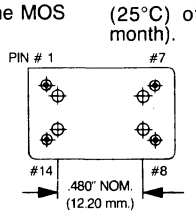
Resistance weld, all-metal, hermetically sealed package. DIP compatible.

HS-1820 — frequency range of 3.5 MHz to 12 MHz MOS/TTL, with the same frequency at each output.

HS-2820 — frequency range of .5 MHz to 3.5 MHz MOS/TTL, with the same frequency at each output.

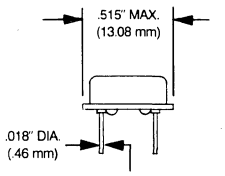
HS-2840 — frequency range of 4 MHz to 12 MHz TTL and .5 MHz to 6 MHz MOS with the TTL output frequency at 2n times the MOS output frequency (n = 1, 2, or 3).





REAL TIME CLOCK

The HS-306 low power clock oscillator, utilizing hybrid technology and DIP hermetic packaging, is intended to fill the need of the digital systems designer that requires both low power consumption for battery back-up and precise frequency control. The output frequency of 32.768 KHz is CMOS compatible with a tolerance at room temperature (25°C) of ±10ppm (±25 seconds per month).



DESIGN ASSISTANCE

For design assistance; samples and quotes; or your FREE copies of NEL's product catalog/design manual, Microprocessor Crystals Stock Catalog 8109-C, Microprocessor Oscillators Stock Catalog 8109-H, VALU I™ Clock Oscillator 8207A Data Sheet, and Dual Output Oscillator Catalog 8305, contact:

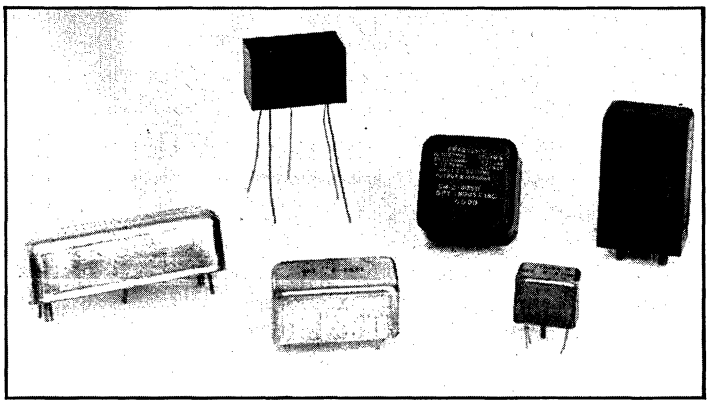
Midland-Ross Corporation
NEL Unit
357 Beloit Street
Burlington, WI 53105
414/763-3591 TWX 910-278-2450

MIDLAND ROSS

CUSTOM FILTERS ENGINEERING AND MANUFACTURING

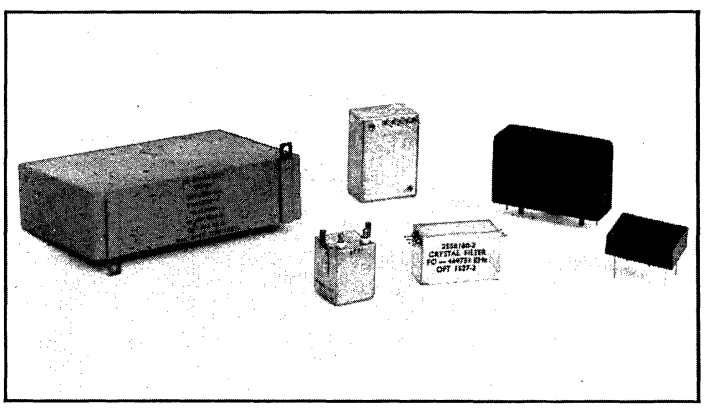
MONOLITHIC CRYSTAL FILTERS

Ranging from 4.0 MHz to 30 MHz with relative bandwidth from .04% to .3% of center frequency. Component stabilization procedures permit guaranteeing maximum stability with operating life. Areas of specialization include delay correction, phase matching and time domain synthesis.



DISCRETE CRYSTAL FILTERS

Ranging from 1 KHz to 70 MHz with relative bandwidths from .005% frequency and upwards.

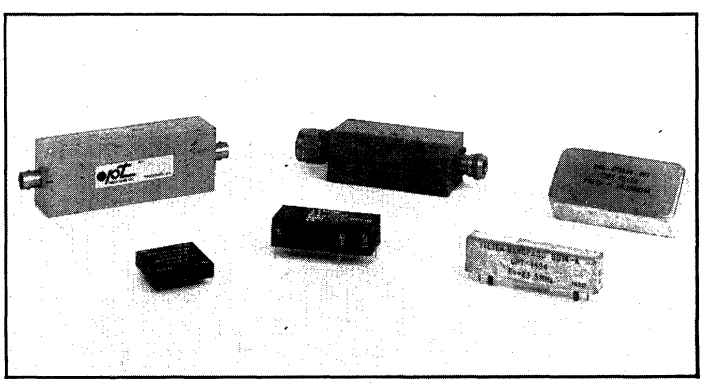


OPT has all engineering drawings and manufacturing rights from the following companies:

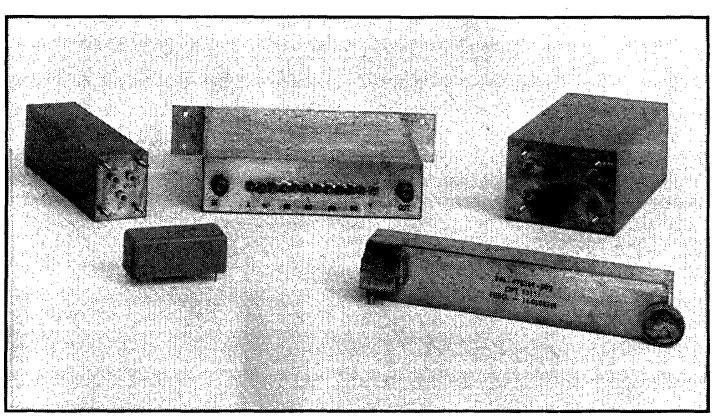
BULOVA FILTER CO.
BURNELL & CO.
FILTECH
NYTRONICS
OMNITEC
ORTHO FILTER

LC FILTERS AND NETWORKS

Low pass, band pass, high pass, band reject, amplitude and delay correcting, impedance matching ranging from DC to 400 MHz with relative bandwidths higher than .2% of center frequency where design permits. Computer synthesis, analysis and optimization, along with broad application experience, continued company sponsored research and development are reflected by our strong participation in many advanced military programs as well as high quality communication systems.



MILITARY COMPLIANCE TO MIL-F-18327



opt INDUSTRIES INC.

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(201) 454-2600 TWX 510-235-2920
Call or Write For Our Facilities and Capabilities Brochure

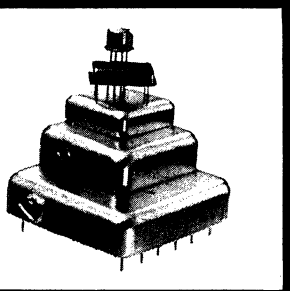
EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

OSCILLATEK CORPORATION

5755 FOXRIDGE DR., MISSION, KANSAS 66202
TEL: (913) 384-2710 TELEX: 437045

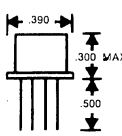
CRYSTAL CLOCK OSCILLATORS

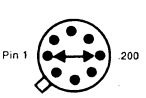


TCXO's

- Crystal controlled thick film hybrid oscillators (XO's).
- Baud rate generators and microprocessor drivers.
- Screening per MIL-0-55310 and MIL-STD-883B is available.
- QPL'd to MIL-O-55310/09/16
- Temperature compensated crystal oscillators (TCXO's).
- Custom designed oscillators to meet your specifications.
- Standard frequencies are available from stock.

TO5

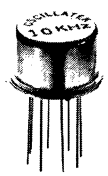


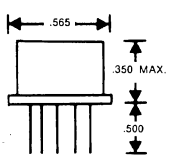


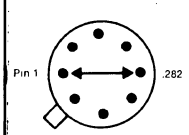
PIN 4 = GND
PIN 5 = OUT
PIN 8 = VCC
REST = NC/ITP

NOTE:
QPL'd to MIL-O-55310/09

TO8

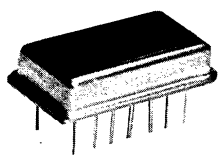




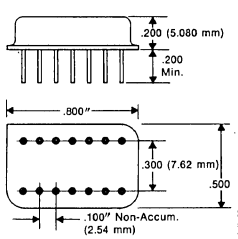


PIN 4 = GND
PIN 5 = OUT
PIN 8 = VCC
REST = NC/ITP

DIP M87/M80/M76

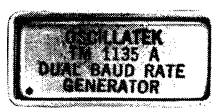


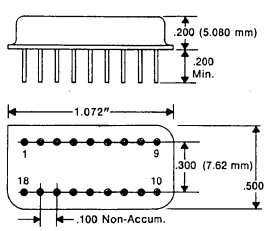
QPL'd to MIL-O-55310/16



PIN 14 = VCC
PIN 8 = OUT
PIN 7 = GND
REST = NC/ITP
Military Pinouts are Available
Note: M87 = .87", M80 = .80", M76 = .76" Length

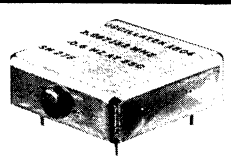
BAUD RATE GENERATORS

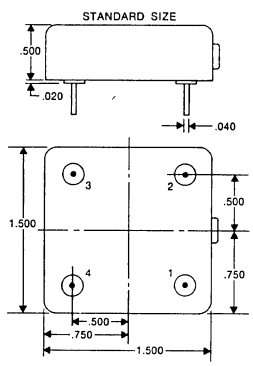




PIN FOR PIN COMPATIBLE TO THE STD. PARTS AVAILABLE IN THE MARKET
Request Brochure for Details

TCXO





PIN 1 = GND
PIN 2 = VCC
PIN 3 = OUT
PIN 4 = N-C
Non Std. Pinouts and Custom Designing is Available

NOTE:
(1) Very low current CMOS output at low frequency and at high frequency of up to 12 MHz is available specially at 5 Volts.

(2) Non-standard custom designing with multiple outputs, gated outputs, ECL outputs, very low frequency or very high frequency outputs is available. Consult factory.

TCXO's

STABILITY:
1. $\pm 1 \times 10^{-7}$ (0°C to 50°C)
2. $\pm 2 \times 10^{-7}$ (−20°C to 70°C)
3. $\pm 5 \times 10^{-7}$ (−40°C to 85°C)
4. $\pm 1 \times 10^{-6}$ (−55°C to 125°C)

VCXO's

STABILITY: ±.0001% to ±.01%
LINEARITY: ±1% to ±10%
DEVIATION: ±.001% to ±.1%

XO's

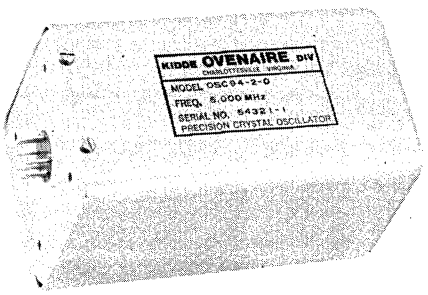
STABILITY:
1. $\pm 5 \times 10^{-6}$ (0°C to 50°C)
2. $\pm 10 \times 10^{-6}$ (−20°C to 70°C)
3. $\pm 20 \times 10^{-6}$ (−40°C to 85°C)
4. $\pm 45 \times 10^{-6}$ (−55°C to 125°C)

FREQUENCY RANGE: TTL = 1 Hz to 100 MHz; CMOS = .01 Hz to 30 MHz
ECL = 1 MHz to 100 MHz; SINEWAVE = 100 KHz to 100 MHz
SUPPLY: 5V to 30V (Current as low as 1.5 mA available)
STANDARD SIZES: 1" x 1" x .26", 1.5" x 1.5" x .5", 2" x 1" x .5", 2" x 2" x .5"
IN ADDITION TO OUR STANDARD PRODUCT LINE WE OFFER CUSTOM DESIGN CAPABILITY.

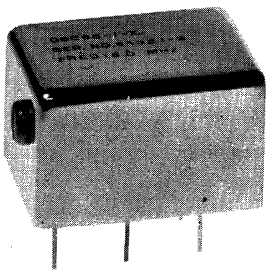
ovenaire oscillators

Ovenaire has the capabilities, experience and production techniques to meet the most exacting crystal oscillator requirements — from State-Of-The-Art Precision Crystal Oscillators to high volume, low cost TCXO's.
The following tables list condensed specifications on regular production models. For additional information on these and other crystal oscillators, call the Ovenaire factory.

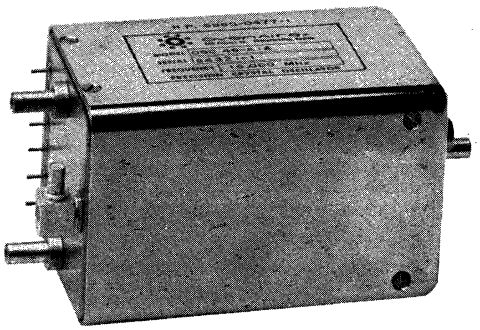
PRECISION AND OVENIZED CRYSTAL OSCILLATORS



OSC94 SERIES



OSC85-1 SERIES



OSC49 SERIES

PRECISION CRYSTAL OSCILLATORS

Model Series	Frequency MHz	Aging	Power @ 25°C	Supply Voltage	Output	Max. Size mm	Ambient Range	Ambient Stability
OSC46-1A	1	$2x10^{-8}$/WK	2.2 Watts	+25VDC	Sine	75x75x93	−10°C to +60°C	$2x10^{-10}$/°C
OSC46-2A	1	$2x10^{-8}$/WK	2.2 Watts	+30VDC	Sine	75x75x93	−10°C to +60°C	$2x10^{-10}$/°C
OSC49-3	3 or 10	$1x10^{-8}$/WK	2.2 Watts	+28VDC	Sine	41x114x53	−15°C to +60°C	$\pm7.5x10^{-9}$
OSC49-5	10	$4x10^{-9}$/WK	2.2 Watts	+20VDC	Optional	(A) 51x51x54 (B) 49x75x54	0°C to +60°C	$7x10^{-9}$
OSC58-1	8 to 12		2.0 Watts	+13.2VDC ±15%	TTL or C'MOS	69x48x41	−10°C to +60°C	$\pm1x10^{-8}$
OSC74	7.5 to 15	$1.5x10^{-8}$/WK	2.0 Watts	+15VDC	TTL	(A) 64x81x32 (B) 51x51x79	−15°C to +60°C	$3x10^{-10}$/°C
OSC75	10	$1x10^{-8}$/WK	2.2 Watts	+28VDC	TTL	37x44x90	−40°C to +70°C	$3x10^{-10}$/°C
OSC78-12	5	$2x10^{-8}$/WK	0.6 Watts	+15VDC	TTL	65x75x114	0°C to +50°C	$5x10^{-10}$/°C
OSC94	5 or 10	$7x10^{-9}$/WK	1.8 Watts	+12VDC	Optional	54x54x97		$\pm7x10^{-9}$

OVENIZED CRYSTAL OSCILLATORS

Model Series	Frequency MHz	Aging	Power @ 25°C	Supply Voltage		Max. Size mm	Ambient Range	Ambient Stability
				OSC	Oven			
OSC11-3	1	$1.5x10^{-7}$/WK	3.5 Watts	+12 or +24VDC	115VAC	38x38x84	−20°C to +60°C	$5x10^{-9}$/°C
OSC11-5	1	$1.5x10^{-7}$/WK	1.9 Watts	+12 or +24VDC	+12 or +24VDC	57x57x93	−30°C to +60°C	$5x10^{-9}$/°C
OSC11-7A	1 thru 20	$5x10^{-7}$/WK	4.0 Watts	+12 or +24VDC	115VAC	38x38x84	−20°C to +60°C	$8x10^{-9}$/°C
OSC11-7B	3 thru 8	$5x10^{-8}$/WK	4.0 Watts	+12 or +24VDC	115VAC	38x38x84	−20°C to +60°C	$5x10^{-9}$/°C
OSC29-32	12 to 22	$8x10^{-7}$/YR	2.5 Watts	+24VDC	+24VDC	37x48x90	−20°C to +60°C	$\pm1x10^{-7}$
OSC29-1	10 to 25	$2x10^{-7}$/WK	2.2 Watts	+22.5VDC	+28VDC	37x48x83	−20°C to +60°C	$5x10^{-9}$/°C
OSC29-2	2 to 10	$1x10^{-7}$/WK	2.7 Watts	+22.5VDC	+28VDC	37x48x83	−20°C to +60°C	$2.5x10^{-9}$/°C
OSC32-1	2 to 10	$2x10^{-6}$/YR	.54 Watts	+12VDC	+24VDC	51x51x70	0°C to +55°C	$\pm2x10^{-8}$
OSC44-1	2 to 40	$1x10^{-6}$/YR	1.6 Watts	+9, +12 or +15VDC	+15, +20, +24 or +28VDC	Choice of 3 Compact Packages, Octal or Solder Pin Mounting	−20°C to +60°C	$\pm4x10^{-7}$
OSC44-2	2 to 40	$1x10^{-6}$/YR	1.6 Watts	+12 or +15VDC	+15, +20, +24 or +28VDC		−10°C to +60°C	$\pm4x10^{-7}$
OSC44-3	2 to 40	$1x10^{-6}$/YR	1.1 Watts	+9, +12 or +15VDC	+15, +20, +24 or +28VDC		−20°C to +55°C	$\pm3x10^{-7}$
OSC44-4	2 to 40	$1x10^{-6}$/YR	1.1 Watts	+12 or +15VDC	+15, +20, +24 or +28VDC		−20°C to +55°C	$\pm3x10^{-7}$
OSC45	2 to 12	$1x10^{-6}$/YR	1.8 Watts	+9 to +28VDC	+9 to +28VDC	(A) 43x64x33 (B) 32x44x70	0°C to +55°C	$\pm1x10^{-7}$
OSC55	10 to 55	$1x10^{-6}$/YR	1.4 Watts	+28VDC	+28VDC	33x67x19	−20°C to +50°C	$\pm1x10^{-6}$
OSC70	22 to 120	$2x10^{-6}$/YR	2.2 Watts	+28VDC	+28VDC	37x48x90	−20°C to +60°C	$\pm5x10^{-8}$
OSC73-1	9 to 15	$3.5x10^{-7}$/YR	2.0 Watts	+15VDC	+15VDC	33x79x54	−30°C to +65°C	$\pm7.5x10^{-8}$
OSC73-2	2 to 6	$5x10^{-7}$/YR	2.0 Watts	+15VDC	+15VDC	47x68x35	−10°C to +65°C	$\pm5x10^{-8}$
OSC73-3	12 to 25	$1.5x10^{-6}$/YR	2.3 Watts	+20VDC	+20VDC	36x75x41	−30°C to +65°C	$\pm1x10^{-7}$
OSC83	7.2 to 13.2	$1.5x10^{-6}$/YR	2.2 Watts	+28VDC	+28VDC	37x48x84	−10°C to +55°C	$\pm2x10^{-7}$
OSC85-1-1	1 to 16	$1x10^{-6}$/YR	1.8 Watts	+5VDC	+24VDC	27x32x45	0°C to +60°C	$\pm1x10^{-7}$
OSC85-6-1	10 to 40	$8x10^{-7}$/YR	1.1 Watts	+12.6VDC	+12.6VDC	37x48x54	0°C to +65°C	$\pm1x10^{-7}$

PCB MOUNT CRYSTAL OSOILLATORS

Model Series	Frequency MHz	Aging	Power	Supply Voltage	Output	Max. Size mm	Ambient Range	Ambient Stability
OSC51	1 to 60	N/S	300MW	+12VDC	Optional	38x38x13	0°C to +60°C	$\pm1x10^{-5}$
OSC52	10 to 150	N/S	300MW	+12VDC	Sine	38x38x25	0°C to +60°C	$\pm1x10^{-5}$
OSC69-2	5 to 20	$1x10^{-5}$/YR	75MW	+5VDC	TTL	25x38x13	−30°C to +85°C	$\pm5x10^{-5}$
OSC69-3	6 to 22	$8x10^{-6}$/YR	75MW	+5VDC	TTL	25x38x13	−30°C to +85°C	$\pm3.5x10^{-5}$

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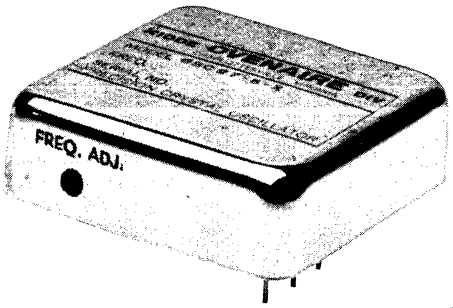
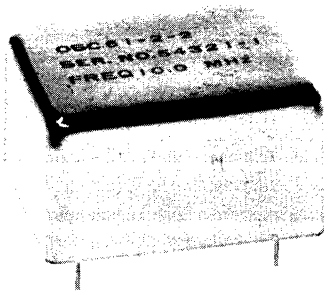
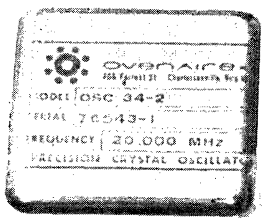
TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

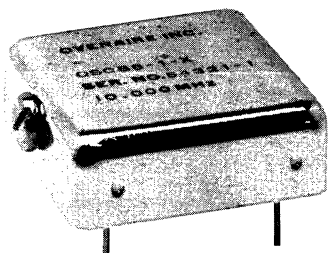


OSC27 SERIES

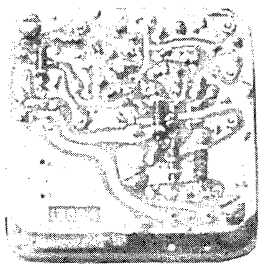




OSC61 SERIES



OSC88 SERIES



OSC34 SERIES

TCXO'S

Model Series	Frequency MHz	Aging	Power	Supply Voltage	Output	Max. Size mm	Ambient Range	Ambient Stability
OSC20-1	10 to 15	$3x10^{-6}$/YR	135MW	5 or 9VDC	Sine	26x15x54	−30°C to +75°C	$\pm5x10^{-6}$
OSC20-2	10 to 15	$3x10^{-6}$/YR	135MW	5 or 9VDC	Sine	26x15x54	0°C to +50°C	$\pm2x10^{-6}$
OSC27-5-1	2 to 12	$1x10^{-6}$/YR	300MW	+12VDC	TTL	51x51x15	0°C to +55°C	$\pm1x10^{-6}$
OSC27-5-2	2 to 12	$1x10^{-6}$/YR	300MW	+12VDC	TTL	51x51x15	0°C to +55°C	$\pm5x10^{-7}$
OSC27-5-3	2 to 5	$5x10^{-6}$/YR	300MW	+12VDC	TTL	51x51x15	0°C to +55°C	$\pm3x10^{-7}$
OSC27-6-1	2 to 12	$1x10^{-6}$/YR	360MW	+12VDC	TTL	51x51x15	−40°C to +85°C	$\pm1.5x10^{-6}$
OSC27-6-2	2 to 12	$1x10^{-6}$/YR	360MW	+12VDC	TTL	51x51x15	−30°C to +75°C	$\pm1x10^{-6}$
OSC27-6-3	2 to 6	$5x10^{-7}$/YR	360MW	+12VDC	TTL	51x51x15	−15°C to +70°C	$\pm5x10^{-7}$
OSC34-2	10 to 20	$7.5x10^{-7}$/YR	240MW	+12VDC	Sine	45x45x15	0°C to +50°C	$\pm1x10^{-6}$
OSC35-1-1	2.5 to 12	$1x10^{-6}$/YR	300MW	+12VDC	TTL	51x51x13	−5°C to +60°C	$\pm1x10^{-6}$
OSC35-1-2	2.5 to 12	$1x10^{-6}$/YR	300MW	+12VDC	TTL	51x51x13	−5°C to +60°C	$\pm5x10^{-7}$
OSC35-1-3	2.5 to 6	$5x10^{-7}$/YR	300MW	+12VDC	TTL	51x51x13	0°C to +55°C	$\pm3x10^{-7}$
OSC37-1-1	1 to 5	$1x10^{-6}$/YR	180MW	+12VDC	TTL	44x44x19	0°C to +55°C	$\pm2x10^{-6}$
OSC37-2-1	5.01 to 10	$2.5x10^{-6}$/YR	180MW	+12VDC	TTL	44x44x19	0°C to +55°C	$\pm2x10^{-6}$
OSC37-3-1	1 to 5	$1x10^{-6}$/YR	216MW	+12VDC	TTL	44x44x19	−5°C to +60°C	$\pm1x10^{-6}$
OSC37-1-2	1 to 5	$1x10^{-6}$/YR	180MW	+12VDC	TTL	44x44x19	−10°C to +65°C	$\pm1.5x10^{-6}$
OSC37-2-2	5.01 to 10	$2.5x10^{-6}$/YR	180MW	+12VDC	TTL	44x44x19	−10°C to +65°C	$\pm1.5x10^{-6}$
OSC39-1	2.5 to 12	$1x10^{-6}$/YR	125MW	+5VDC	TTL	48x31x17	0°C to +60°C	$\pm1x10^{-6}$
OSC40-1	4KHz to 1MHz	$1x10^{-6}$/YR	504MW	−18VDC	AC Square	57x51x21	0°C to +55°C	$\pm8x10^{-6}$
OSC61-2-2	6 to 16	$1x10^{-6}$/YR	180MW	+12VDC	Clipped Sine	37x28x19	−20°C to +70°C	$\pm2x10^{-6}$
OSC67-1-1	2 to 8	$1x10^{-6}$/YR	275MW	+12 & +5VDC	TTL	51x41x17	0°C to +55°C	$\pm2x10^{-6}$
OSC67-1-2	2 to 8	$1x10^{-6}$/YR	275MW	+12 & +5VDC	TTL	51x41x17	0°C to +55°C	$\pm1x10^{-6}$
OSC88-1-1	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	0°C to +55°C	$\pm3x10^{-6}$
OSC88-1-2	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	0°C to +55°C	$\pm1x10^{-6}$
OSC88-1-3	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	0°C to +55°C	$\pm5x10^{-6}$
OSC88-1-4	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−5°C to +70°C	$\pm3x10^{-6}$
OSC88-1-5	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−5°C to +70°C	$\pm1x10^{-6}$
OSC88-1-6	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−5°C to +70°C	$\pm5x10^{-7}$
OSC88-2-1	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−40°C to +75°C	$\pm2x10^{-6}$
OSC88-2-2	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−40°C to +75°C	$\pm1x10^{-6}$
OSC88-2-3	10	$.75x10^{-6}$/YR	230MW	+12VDC	TTL	38x38x14	−55°C to +105°C	$\pm5x10^{-6}$
TCX0101	.0075Hz to 10MHz	$\pm2x10^{-8}$/DAY	Freq Dep	+12VDC	12V Square	Pkg B	0°C to +50°C	$\pm1x10^{-6}$
TCX0101A	.0075Hz to 10MHz	$\pm2x10^{-8}$/DAY	Freq Dep	+12VDC	12V Square	Pkg B	−55°C to +75°C	$\pm5x10^{-6}$
TCX034	.0005Hz to 40MHz	$\pm2x10^{-8}$/DAY	Freq Dep	+5VDC	4V Square	Pkg B	0°C to +50°C	$\pm1x10^{-6}$
TCX056	100KHz to 30MHz	$\pm2x10^{-8}$/DAY	Freq Dep	+5VDC	4V Square	Pkg A	0°C to +50°C	$\pm1x10^{-6}$
TCX0152	200Hz to 10MHz	$\pm1x10^{-8}$/DAY	Freq Dep	+15VDC	10V Square	Pkg OA	0°C to +50°C	$\pm1x10^{-7}$
TCX0152A	200Hz to 10MHz	$1x10^{-6}$/YR	Freq Dep	+15VDC	10V Square	Pkg OA	−40°C to +70°C	$\pm1x10^{-6}$

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PKG STYLE A
Printed ckt mount
Encapsulated
1.5″ x 2.0″ x .56″
(AX: Without mtg. hole)
(AC: 7 pin plug-in; stud mt.)

PKG STYLE B
Printed ckt mount
Encapsulated
1.9″ x 2.5″ x .5″
(BY: 1.9″ x 2.5″ x 1.0″)
(BZ: 1.9″ x 2.5″ x .375″)

PKG STYLE F & Q
Printed ckt mount
Encapsulated
F: 1.0″ x 1.25″ x .5″
Q: 2″ x 2″ x .6″

PKG STYLE G
I.C. plug-in
Encapsulated
.78″ x 1.125″ x .5″
(GX: .75″ x 1.5″ x .5″)

PKG STYLE H
Printed ckt mount
Encapsulated
.875″ x .875″ x .5″

PKG STYLE J
Printed ckt mount
Encapsulated
1.25″ x 1.25″ x .5″
(JX: 1.25″ x 1.25″ x .32″)

PKG STYLE L
Octal plug-in
Stud mount
Metal can
2″ x 2″ x .75″

PKG STYLE P
Special plug-in
Encapsulated metal can
.7″ x 1.3″ x 1.7″

PKG STYLE M, N, & O
Printed ckt mount
Encapsulated metal can
M: 2.5″ x 2.5″ x .625″
N: 2″ x 2″ x .75″
O: 2″ x 2.5″ x .75″
(stud mount)
OA: 2″ x 2.5″ x .65″

Model Series	Frequency Range	Stability	Temperature Range	PK-to-PK Output	Load	Supply Voltage	Pkg. Style
CRYSTAL CONTROLLED OSCILLATORS — NO OVEN REQUIRED							
X0128	7.5KHz to 85KHz	±.02%	0°C to +70°C	6.7V Sine	10K ohms	+15V	Q
X062	4KHz to 16MHz	±.01 to ±.025%[4]	−20°C to +70°C	5V Square	1.5K ohms	+12V	AX
X0110	4MHz to 10MHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	F
X0111	250KHz to 3.99MHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	J
X0112	63Hz to 249KHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	AX
X0123	7.5KHz to 60KHz	±.01%	0°C to +50°C	1.5V Sine	10K ohms	+5V	A
X0100	.005Hz to 3MHz	±.007%	−40°C to +85°C[2]	12V Square[5]	50 CMOS[5]	+12V	A
X096	5MHz to 16MHz	±.005%	0°C to +70°C	1V Square	3 ECL	−5V	JX
X032	12.5KHz to 5.99MHz	±.003 to ±.01%[4]	0°C to +75°C[2]	4V Square[3]	25 DTL	+5V	A
X032C	6MHz to 40MHz	±.003%	0°C to +75°C[2]	4V Square[3]	9 TTL	+5V	A
X033	.001Hz to 30MHz	±.003%	0°C to +75°C[2]	4V Square[3]	9 DTL/TTL	+5V	B
X082	190KHz to 30MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	F
X094	190KHz to 16MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	H
X0181	12Hz to 12.49KHz	±.003%	0°C to +75°C[2]	4V Square	1 TTL	+5V	GX
X081	12.5KHz to 199KHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	GX
X071	200KHz to 20MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	G
X081	20.1MHz to 30MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	GX
X045	1MHz to 5MHz	±.001%	+10°C to +50°C	.63V Sine	50 ohms	+15V	AC
LC AND RC OSCILLATORS							
LC035	70KHz to 5MHz	±.5%	0°C to +85°C	2V Sine	10K ohms	+12V	A
LC01028	733KHz to 5MHz	±1%	−50°C to +100°C	2V Sine	1K ohms	+12V	J
PS057	10Hz to 40KHz	±1%/±2%[4]	0°C to +50°C	6V Sine	10K ohms	+12V	A
RC036A	1Hz to 1MHz	±2%	−20°C to +85°C	4V Square[3]	9 DTL/TTL	+5V	A
RC036B	1Hz to 1MHz	±1%	0°C to +75°C	4V Square[3]	9 DTL/TTL	+5V	A
UJ039A	.1Hz to 100Hz	±2%	0°C to +50°C	3V Square	1.5K ohms	+12V	A
RC0109	1Hz to 1MHz	±1%	0°C to +50°C	2.5V Sine	600 ohms	+15V	B
RC0168	1.5Hz to 30KHz	±.5%	0°C to +75°C	4V Square[3]	9 DTL/TTL	+10V	B
SINE WAVE OPTIONS — ADD "S" VERSION TO MODEL NUMBER (MAY REQUIRE LARGER PACKAGE[4])							
S11/12[4]	10KHz to 40MHz	5% Distortion	0°C to +75°C	1 mw into 50 ohms	+12V		
S13	5Hz to 100KHz	5% Distortion	−55°C to +75°C	1.75V RMS into 600 ohms	+15V		
S14	10KHz to 1MHz	3% Distortion	−55°C to +125°C	2V pk-to-pk into 10K ohms	None	May be	
S17	20Hz to 200KHz	5% Distortion	0°C to +50°C	3V pk-to-pk into 10K ohms	+5V	Combined	
S18	5Hz to 100KHz	3% Distortion	−55°C to +75°C	2.5V pk-to-pk into 600 ohms	+15V	with	
S19/20[4]	10KHz to 40MHz	5% Distortion	0°C to +75°C	2mw into 50 ohms	+15V	Oscillator	
S21	20Hz to 200KHz	5% Distortion	0°C to +50°C	3V RMS into 10K ohms	+15V	Voltage[4]	
S23	10KHz to 1MHz	1% Distortion	0°C to +75°C	8V pk-to-pk into 10K ohms	+12V		
S24	100KHz to 15MHz	5% Distortion	0°C to +75°C	.5V RMS into 5K ohms	None		

VOLTAGE CONTROLLED OSCILLATORS — CRYSTAL AND NON-CRYSTAL TYPES

Model Series	Center Frequency Range	Minimum Deviation	Input[8]	Linearity	Stability	Temperature Range	PK-to-PK Output	Load	Voltage Supply	Pkg. Style
VC0114	300Hz to 10KHz	±60%	+1.5V to +9V	±10%	±5%	+10°C to +44°C	3V Sine	125 ohms	+6V	B
VC0137	1Hz to 30MHz	±10%	−5V to +5V	±10%	±.5%	0°C to +50°C	4V Square[3]	9 TTL	+5V	B
VC047	1Hz to 75MHz	±10%	0V to −7V	±10%	±3%	0°C to +75°C	4V Square[3]	9 TTL	+5V	B
VC068	5Hz to 15KHz	±10%	0V to −7V	±1%	±.5%	0°C to +75°C	4V Square[3]	9 TTL	+15V	B
VC01019	.5MHz to 5MHz	±2%	+5V to −5V	±5% to ±10%[4]	±.5%	+55°F to +95°F	4V Square	5 TTL	+12V	A
VC01160	100KHz to 30MHz	±1.25%	−5V to +5V	±5%	±.5%	0°C to +50°C	.8V Sine	50 ohms	+12V	BM
VCX01095B	35MHz to 85MHz	±0.03%	−5V to +5V	±5%	±.01%	−40°C to +90°C	1V Square	3 ECL	+5V & −5.2V	BY
VCX0103	1Hz to 20MHz	±.01% to ±10%	±3V or 0V to +6V	±5% to ±10%	±.0001% to ±1%	0°C to +50°C	4V Square[3]	5 TTL	+5V	BY
VCX0255	1Hz to 40MHz	±.005%	0V to +6V	±5%	±.003%	0°C to +75°C	4V Square[3]	9 TTL	+5V	B

CRYSTAL AND RC CONTROLLED TIMERS — CYCLE TYPE WITH PUSH BUTTON RESET

Model Series	Time Intervals	Accuracy	Temperature Range	Output	Load	Supply Voltage	Size
TMX271B	15-30-60 Min.	±30 Sec. per day	−30°F to +130°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″
TMX272	1 Min. to 12 Hr.[7]	±10 Sec. per day	−30°F to +130°F	SPDT Contacts	.5 Amp.	+7.5 V	6.9″ x 3.5″ x 2.6″
TMX83	15-30-60 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″
TMX83A	5-15-30 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″
TMX183A	5-15-30 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+8.3V	7″ x 4″ x 2½″
TMX145	5-15-30-60 Min.[7]	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	5.6″ x 3.1″ x 1.53″
TMC37	5 to 30 Sec. Adj.	±10%	+20°F to +150°F	SPST Contacts	5 Amp.	6V or 12V	4″ x 2¼″ x 2¼″

[2] For ±.01% over −55°C to +125°C add "A" to Model Number.

[3] Sine wave options listed above, S11/12/19/20 not available for voltage control ranges greater than ±1%.

[4] Depending on frequency.

[5] TTL option available.

[7] Includes time display.

[8] For minimum frequency to maximum frequency.

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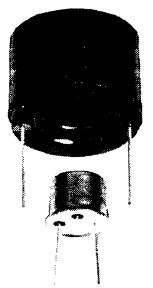
ovenaire ovens

Ovenaire's Circuit Design Technology is providing State-Of-The-Art Electronic Proportional Control Miniature Crystal and Component Ovens. Space-saving packages for PCB mount, low power consumption, low cost. A representative few of many available designs are shown. Most models are available with temperature setting from +35°C to +95°C, voltage from 5VDC to 36VDC. Ovenaire also offers a complete range of other ovens for commercial and military applications.

MODEL PCL1-43

For HC-18/U, HC-25/U, HC-42/U or HC-43/U crystals. 0.750″ dia., 0.562″ high. Temperature stability ±3°C over −30°C to +60°C typical. Also available with temperature adjustability of ±5°C of nominal.

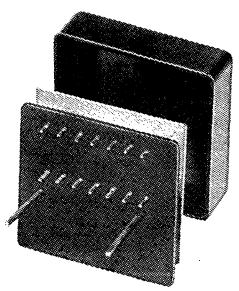


MODEL TO5P

For TO5 crystal, transistor or IC. 0.750″ dia., 0.500″ high. Temperature stability ±3°C over −30°C to +60°C ambient typical. Available with temperature adjustability of ±5°C nominal.

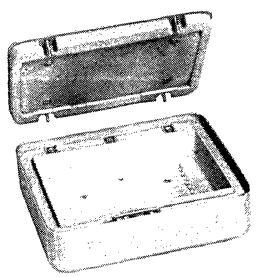
MODEL TO5C

For crystal, transistor or IC with TO5 case. Access to cavity by removing top cover. .750″ dia., .550″ high. Temperature stability ±3.0°C over −30°C to +60°C ambient typical.



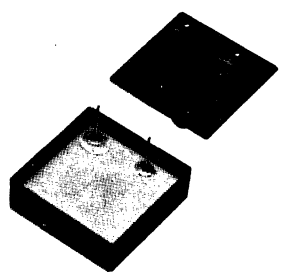
MODEL PC1-25

For 14 pin or 16 pin DIP IC or .375″ x .875″ x .156″ component. Overall size .312″ x 1″ x 1″. Temperature stability ±4°C over −30°C to +60°C ambient typical.



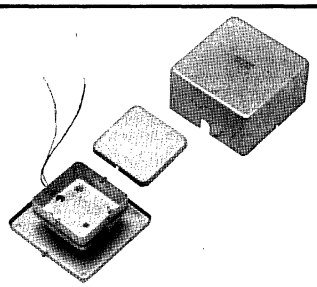
MODEL CO2001

High stability proportional control component oven. Temperature stability ±1°C over 0 to +60°C ambient. Cavity area 2.75″ x 3.93″ x .78″ high. Feed-thru pins for internal connections. O.D. 3.94″ x 4.63″ x 1.25″ high. 24VDC.



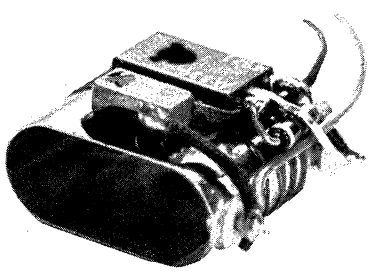
MODEL PC1-34

For 1 or 2 DIP's. Component area 1.45″ Sq. x .250″ tall. Overall dimensions 1.5″ Sq. x .50″ tall. Temperature stability is ±3°C over an ambient range of −30°C to within 10°C of the set-point. Various combinations of set-point temperature and DC operating voltage are available.



MODEL CO2106

Component oven with customer-adjustable set-point from 50°C to 90°C. Nominal operating voltage is 19-24 VDC. Heated cavity sizes available from 2″ Sq. x .75″ tall to 6″ Sq. x 1.75″ tall. Control is solid-state, proportional.



MODEL PCL1-21

Slip-on oven for HC-6/U crystal. Size .97″ x .53″ x .83″ high. Temperature stability ±3°C over −30°C to +60°C ambient typical. Models also available for HC-25/U crystal.

MODEL PC2-10

Low cost proportional control oven for 2 HC-6/U crystals. Temperature stability ±2°C over −30°C to +60°C ambient. Size 1.25″ dia. x 1.75″ seated height. Octal plug base.

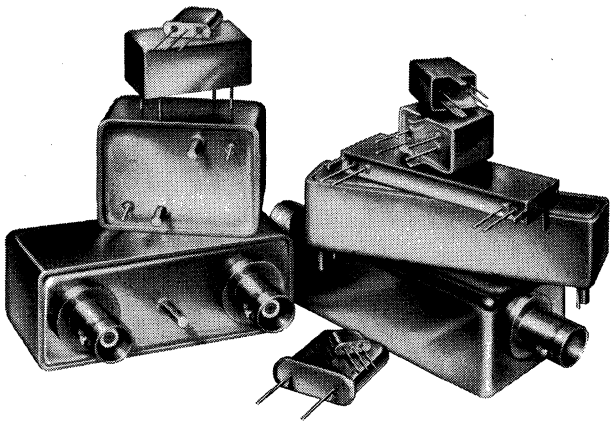
OVENAIRE-AUDIO-CARPENTER

Division of Kidde, Inc. 706 FORREST STREET – CHARLOTTESVILLE, VIRGINIA 22901
TELEPHONE 804-977-8050 TWX 510-587-5461 CABLE "OVENS"

KIDDE

Piezo Technology, Inc.

The standard in monolithic crystal filters



As the technology leader since 1965, Piezo Technology has set the standard in monolithic and discrete crystal filters. The standard in performance. The standard in size. The standard in cost. The standard in quality.

From raw quartz processing through automated testing, our unmatched, fully-integrated manufacturing facility gives us total control over every process step and assures you of on-time delivery.

If you've got crystal filter production requirements, find out why the world's foremost commercial and military equipment producers — those who set the standards — depend on PTI for leading-edge filter performances.

And now we offer the latest technology in ovenized and temperature-compensated crystal oscillators. Contact your local PTI representative for this new standard in performance and value.

Standard Monolithic Filters

PTI offers a complete line of over 100 standard models from 5 to 200 MHz, including our new ultraminiature "A" series. These off-the-shelf filters are designed to meet the most popular requirements and give you maximum performance per dollar as well as quick delivery.

Custom Crystal Filters

PTI can supply custom monolithic and discrete crystal filters for your commercial and military production requirements from below 5 MHz to over 300 MHz. We are experienced with a wide range of special requirements, including: tough environmental specs, high reliability, controlled group delay, low IM, low phase noise and amplitude linearity.

Crystal Oscillators

PTI can supply custom ovenized oscillators and temperature-compensated crystal oscillators for high-performance applications from 2 MHz to 500 MHz. Conventional AT-cut, SC-cut, low power, fast warm-up, and low phase noise are just some of the features available.

State-of-the-art Technology

Once again, PTI is advancing the state-of-the-art in quartz products. Radically new wafer processing techniques allow us to make quartz resonators at fundamental frequencies to 100 MHz — 300 MHz on third overtone.

These are available in oscillator crystals and in custom oscillators, where their low impedance leads to simple circuitry. They are also available in crystal filters, where higher fundamental frequencies allow wider bandwidths and greater selectivity than previously possible.

For fast and knowledgeable applications assistance, contact Piezo Technology, or your local PTI representative.

Piezo Technology, Inc.
P.O. Box 7859 • Orlando, Florida 32854
(305) 298-2000 • TWX 810-850-4136

Piezo Technology, Inc.

The standard in monolithic crystal filters

SPECIFICATION SUMMARY: 10.7 MHz FILTERS

MODEL NUMBER/CASE STYLE			No. Poles	Channel Spacing (kHz)	Attenuation Boundaries						Spurious Response (dB Min)	Ultimate Attenuation (dB Min)	Termination Ohms//pF[b]
Unpackaged Tandem Sets[a]	Upright Type	Flatpack Type			dB	kHz	dB	kHz	dB	kHz			
2194/F...	.....		2	20	3	± 6.5	20	±30.0	—	—	15	50	2700//0
2195/F...	.....		2	25	3	± 7.5	20	±35.0	—	—	15	50	3000//0
2196/F...	.....		2	50	3	±15.0	20	±70.0	—	—	10	35	5000//0
5580/F	1463/UMB	1466/FPA	4	20	3	± 6.5	30	±15.0	—	—	35	75	3100//0
5581/F	1464/UMB	1467/FPA	4	25	3	± 7.5	30	±17.5	—	—	35	75	3500//0
5582/F	1465/UMB	1468/FPA	4	50	3	±15.0	30	±35.0	—	—	30	60	5000//0
5583/F	1469/UMB	1472/FPB	6	20	6	± 6.5	60	±19.5	—	—	60	90	3100//0
5584/F	1470/UMB	1473/FPB	6	25	6	± 7.5	60	±22.5	—	—	60	90	3500//0
5585/F	1471/UMB	1474/FPB	6	50	6	±15.0	60	±45.0	—	—	60	90	5000//0
5586/F	1475/UMC	1478/FPC	8	20	6	± 6.5	60	±13.0	80	±17.5	80	100	3100//0
5587/F	1476/UMC	1479/FPC	8	25	6	± 7.5	60	±15.0	80	±20.0	80	100	3500//0
5588/F	1477/UMC	1480/FPC	8	50	6	±15.0	60	±30.0	80	±40.0	80	100	5000//0
	1433/SCR		8	20	6	± 6.5	60	±12.5	100	±21.0	100	100	850//2
	1434/SCR		8	25	6	± 7.5	60	±15.0	100	±25.0	100	100	1000//2
	1435/SCR		8	50	6	±15.0	60	±28.0	100	±50.0	100	100	2000//2

SPECIFICATION SUMMARY: 21.4 MHz HIGH-PERFORMANCE "A" SERIES FILTERS

MODEL NUMBER/CASE STYLE			No. Poles	Channel Spacing (kHz)	Attenuation Boundaries						Spurious Response (dB Min)	Ultimate Attenuation (dB Min)	Termination Ohms//pF
Unpackaged Tandem Sets[a]	Upright Type	Flatpack Type			dB	kHz	dB	kHz	dB	kHz			
6602/A	6600/AMB	6601/APA	4	12.5	3	±3.75	40	±14.0	—	—	40	75	850//5.0
6622/A	6620/AMB	6621/APA	4	20.0	3	±6.0	40	±20.0	—	—	40	75	1200//2.5
6642/A	6640/AMB	6641/APA	4	25.0	3	±7.5	40	±25.0	—	—	40	75	1500//2.0
6605/A	6603/AMB	6604/APB	6	12.5	3	±3.75	45	±8.75	—	—	70	90	850//5.0
6625/A	6623/AMB	6624/APB	6	20.0	3	±6.0	45	±14.0	—	—	70	90	1200//2.9
6645/A	6643/AMB	6644/APB	6	25.0	3	±7.5	45	±17.5	65	±25.0	70	90	1500//2.0
6608/A	6606/AMC	6607/APC	8	12.5[c]	3	±3.75	65	± 9.0	90	±12.5	90	100	850//5.0
	6609/AMB		8	12.5[c]	3	±3.75	65	± 9.0	90	±12.5	90	100	850//5.0
	6610/CSE		8	12.5[c]	3	±3.75	65	± 9.0	90	±12.5	90	100	470//15
6628/A	6626/AMC	6627/APC	8	20.0	3	±6.0	65	±14.0	90	±20.0	90	100	1200//2.5
	6629/AMB		8	20.0	3	±6.0	65	±14.0	90	±20.0	90	100	1200//2.5
	6630/CSE		8	20.0	3	±6.0	65	±14.0	90	±20.0	90	100	470//15
6648/A	6646/AMC	6647/APC	8	25.0	3	±7.5	65	±17.5	90	±25.0	90	100	1500//2.0
	6649/AMB		8	25.0	3	±7.5	65	±17.5	90	±25.0	90	100	1500//2.0
	6650/CSE		8	25.0	3	±7.5	65	±17.5	90	±25.0	90	100	470//15

SPECIFICATION SUMMARY: 21.4 MHz STANDARD "F" AND "A" SERIES FILTERS

MODEL NUMBER/CASE STYLE						No. Poles	Channel Spacing (kHz)	Attenuation Boundaries						Spurious Response (dB Min)	Ultimate Attenuation (dB Min)	Termination Ohms//pF[b]
Unpackaged Tandem Sets[a]		Upright Type		Flatpack Type				dB	kHz	dB	kHz	dB	kHz			
F Series	A Series	F Series	A Series	F Series	A Series											
	2879/A	.....	.....	.....	.....	2	12.5	3	± 3.75	20	±18.0	—	—	15	50	850//6.0
	2880/A	.....	.....	.....	.....	2	20.0	3	± 6.0	20	±25.0	—	—	15	50	1200//3.0
2249/F	.....	.....	.....	.....	.....	2	20.0	3	± 6.5	20	±30.0	—	—	15	45	1400//0
	2881/A	.....	.....	.....	.....	2	25.0	3	± 7.5	18	±28.0	—	—	15	50	1500//2.5
2250/F	.....	.....	.....	.....	.....	2	25.0	3	± 7.5	20	±35.0	—	—	15	45	1600//0
	2882/A	.....	.....	.....	.....	2	50.0	3	±15.0	15	±45.0	—	—	15	45	1500//1.0
2251/F	.....	.....	.....	.....	.....	2	50.0	3	±15.0	20	±90.0	—	—	10	40	3000//0
	6000/A		6012/AMB		6024/APA	4	12.5	3	± 3.75	30	±12.5	—	—	40	75	850//5.0
5589/F	6001/A	1617/UMB	6013/AMB	1620/FPA	6025/APA	4	20.0	3	± 6.5	30	±22.5	—	—	40	75	1400//0
5590/F	6002/A	1618/UMB	6014/AMB	1621/FPA	6026/APA	4	25.0	3	± 7.5	30	±25.0	—	—	40	75	1600//0
5591/F	6003/A	1619/UMB	6015/AMB	1622/FPA	6027/APA	4	50.0	3	±15.0	30	±45.0	—	—	25	60	3000//0
	6004/A		6016/AMB		6028/APB	6	12.5	6	± 3.75	60	±12.5	—	—	70	90	850//5.0
5592/F	6005/A	1623/UMB	6017/AMB	1626/FPB	6029/APB	6	20.0	6	± 6.5	60	±22.5	—	—	70	90	1400//0
5593/F	6006/A	1624/UMB	6018/AMB	1627/FPB	6030/APB	6	25.0	6	± 7.5	60	±25.0	—	—	70	90	1600//0
5594/F	6007/A	1625/UMB	6019/AMB	1628/FPB	6031/APB	6	50.0	6	±15.0	60	±45.0	—	—	50	90	3000//0
	6008/A		6020/AMC		6032/APC	8	12.5[c]	6	± 3.75	60	±10.0	80	±12.5	100[d]	100	850//5.0
5595/F	6009/A	1629/UMC	6021/AMC	1632/FPC	6033/APC	8	20.0	6	± 6.5	60	±17.5	80	±22.5	100[d]	100	1400//0
5596/F	6010/A	1630/UMC	6022/AMC	1633/FPC	6034/APC	8	25.0	6	± 7.5	60	±20.0	80	±25.0	100[d]	100	1600//0
5597/F	6011/A	1631/UMC	6023/AMC	1634/FPC	6035/APC	8	50.0	6	±15.0	60	±33.0	80	±43.0	80	100	3000//0
—	—	—	6036/CSE	—	—	8	12.5	6	± 3.75	60	±10.0	80	±12.5	90	90	470//15
—	—	—	6037/CSE	—	—	8	20.0	6	± 6.5	60	±17.5	80	±22.5	90	90	470//15
—	—	—	6038/CSE	—	—	8	25.0	6	± 7.5	60	±20.0	80	±25.0	90	90	470//15
—	—	—	6039/CSE	—	—	8	50.0	6	±15.0	60	±33.0	80	±43.0	80	90	470//15

[a] A tandem set consists of two 2-pole units for 4-pole response, three 2-pole units for 6-pole response, and four 2-pole units for 8-pole response.

[b] Parallel termination capacitance is adjusted for optimum filter response (nominal value ±2.0 pF)

[c] Flat loss is 4.5 dB Max.

[d] For "A" holder filters, spurious responses are 90 dB min.

General Specifications

All specifications subject to change without notice.

Operating Temperature Range: −30°C to + 80°C for "F" Series, − 20°C to + 70°C for "A" Series

	2 Pole	4 Pole	6, 8 Pole
Maximum Ripple Over Temperature (dB):	1	2	2
Maximum Insertion Flat Loss Over Temperature (dB):	2	2.0	3.0

Piezo Technology, Inc.
P.O. Box 7859 • Orlando, Florida 32854
(305) 298-2000 • TWX 810-850-4136

Piezo Technology, Inc.

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VHF Filters

The models listed below consist of 2-pole monolithic and 4-pole tandem monolithic filters designed for use as front-end filters in low-band and high-band VHF custom applications. They are also suitable for HF up-conversion, first IF filtering and spectrum clean-up in frequency systhesis. Nominal operating frequency is specified by the customer in the 25 MHz to 200 MHz range.

All models (except 2133A) operate over a temperature range of −20° to + 70°C. Filters are matched to 50 ohms with convenient phono-jack, BNC, or a variety of other connectors. Model 2133A operates from −30° to +80°C and is supplied in the ultraminiature "A" package. See table below for detailed specifications.

Model No.	No. Poles	Center Frequency Range (MHz)	Attenuation Boundaries		Passband Ripple (dB Max)	Ultimate Atten. (dB Min)	Flat Loss (dB Max)	Termination (Ohms)	Case Style
			3 dB Max kHz	20 dB Min kHz					
2131	2	25-35.99	±6.5	±40	1	30	3	50	VB*
2132	2	36-50	±6.5	±40	1	30	3	50	VB*
2133	2	138-170	±6.75	±60	1	30	4	50	VB*
2133A[a]	2	140-170	±6.75	±60	1	30[b]	3	note[c]	A
4131	4	25-35.99	±6.5	note[d]	1	—	5	50	VB*
4132	4	36-50	±6.5	note[d]	1	—	5	50	VB*
4133	4	138-170	±6.75	±30[e]	1	—	6	50	VB*

[a] Unwanted Response from f_{on} to f_{on} +200 kHz: 15 dB (Min)

[b] Attenuation from f_{on} −100 kHz to f_{on} −5000 kHz to f_{on} +200 kHz to f_{on} +5000 kHz.

[c] R_o = 3100 ohms (depends on f_{on})

[d] ±20 kHz at 15 dB (Min): ±40 kHz at dB (Min)

[e] ±60 kHz at 45 dB (Min)

*See connector chart, next page.

Special Four-pole Monolithic Filters

Piezo Technology, Inc., manufactures high-performance, four-pole monolithic crystal filters at standard 30, 45, and 75 MHz frequencies. All are housed in a single "F" style holder. Custom frequencies are also available.

The filter design utilizes four resonators on a single quartz wafer to provide four-pole response. These models offer wider passband values than two-pole inductorless tandem-set units. Their reduced size makes them ideal for high-density packaging requirements.

Models	4102F	6570	4371F	5889	4171F	5786
Nominal Center Frequency (F_{on})	30 MHz		45 MHz		75 MHz	
Attenuation Boundaries: 3 dB	F_{on} ±50 kHz Min.		F_{on} ±7.5 kHz Min.		F_{on} ±13 kHz Min.	
35 dB			F_{on} ±25 kHz Max.			
50 dB			F_{on} ±50 kHz Max.			
60 dB	F_{on} +800 kHz to +10 MHz F_{on} −400 kHz to −10 MHz				F_{on} ±300 kHz Max.	
Ripple (dB Max.)	2.0		1.0		2.0	
Operating Temperature (°C)	−20 to +60		−30 to +60		−55 to +85	
Flat Loss (dB Max.)	4	5	3	4	6	7
Termination Impedance: Ohms	7000	50	7000	50	4000	50
Parallel Capacitance‡ (pF)	−1	0	−1	0	−1	0
Package	F	MVB	F	MVB	F	MVB

‡ On models without 50-ohm terminations, the parallel capacitance should be adjustable ± 2 pF for best passband response.

Piezo Technology, Inc.

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Special Two-pole Monolithic Filters

Models 2843A and 2844A. Ultra-miniature 2-pole monolithic crystal filters designed for use as first IF filters in 800 MHz land-mobile radios. Both models have a nominal center frequency of 45 MHz and offer high rejection at the second IF image frequency. They are supplied in case style "A". Contact Piezo Technology, Inc. for a data sheet.

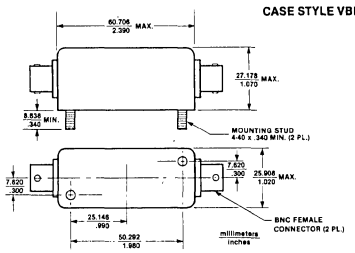
Monolithic Crystal Discriminators

Models 2283F and 2378F. 2-pole monolithic crystal filters designed for use as frequency discriminators in conjunction with a suitable quadrature detector such as the CA 3089E (RCA). These models are designed for narrow-band FM applications at 10.7 MHz (2283F) and 21.4 MHz (2378F). For data sheets and information concerning other frequencies, contact Piezo Technology, Inc.

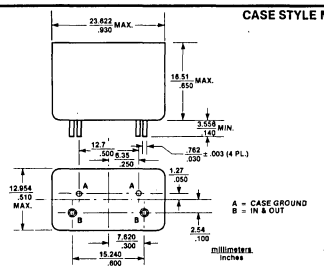
Packages

PTI Model	Connector
VBB	BNC
VBC	UHF
VBM	SMA
VBN	N
VBP	Phono Jack
VBF	PC Board Mount

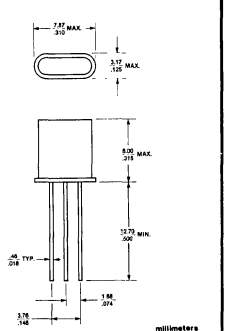
CASE STYLE VBB



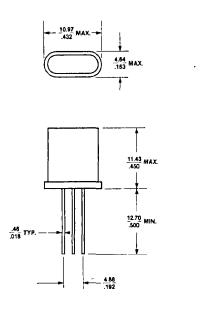
CASE STYLE MVB



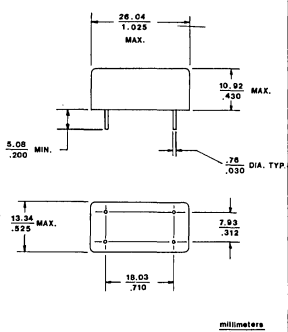
CASE STYLE A



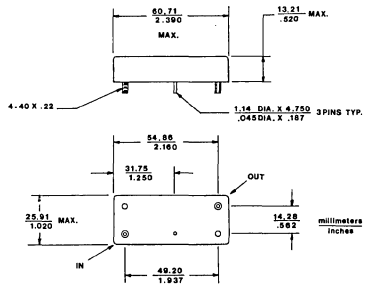
CASE STYLE F



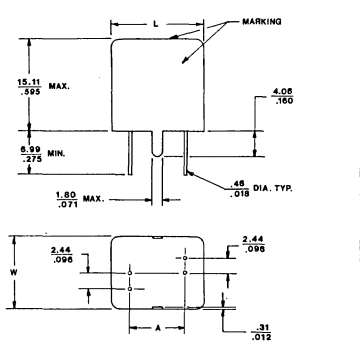
CASE STYLE CSE



CASE STYLE SCR

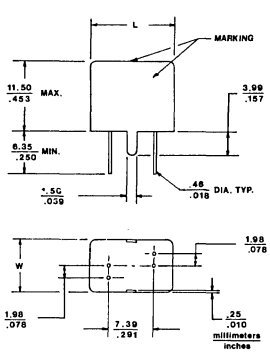


UPRIGHT PACKAGE



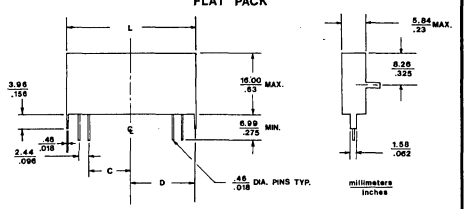
CASE STYLE	L (MAX.)		W (MAX.)		A	
	in	mm	in	mm	in	mm
UMB	.590	14.99	.470	11.94	.354	8.99
UMC	.745	18.92	.496	12.60	.528	13.41

MINIATURE UPRIGHT PACKAGE



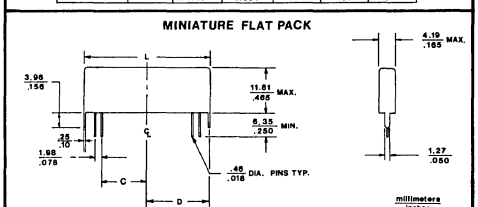
CASE STYLE	L (MAX.)		W (MAX.)	
	in	mm	in	mm
AMB	0.43	10.00	0.335	8.51
AMC	0.53	13.57	0.344	8.74

FLAT PACK



CASE STYLE	L (MAX.)		C		D	
	in	mm	in	mm	in	mm
FPA	0.890	22.61	0.216	5.49	0.435	11.05
FPB	1.320	33.53	0.435	11.05	0.650	16.51
FPC	1.750	44.45	0.654	16.61	0.865	21.97

MINIATURE FLAT PACK



CASE STYLE	L (MAX.)		C		D	
	in	mm	in	mm	in	mm
APA	0.665	16.89	0.147	3.73	0.325	8.26
APB	0.985	25.02	0.307	7.80	0.485	12.32
APC	1.305	33.15	0.467	11.86	0.645	16.38

Q-Tech Corporation

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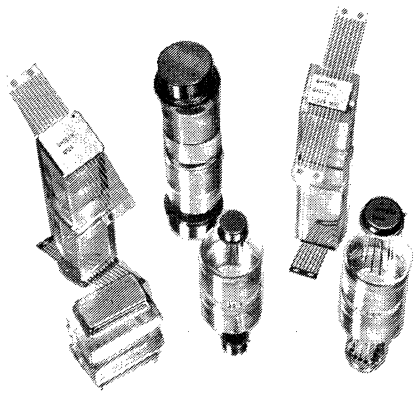
STATE OF THE ART DEVELOPMENT

MINIATURE CRYSTAL CLOCK OSCILLATORS QPL-MIL-O-55310

CLOCK OSCILLATORS

Request Bulletin CO-3

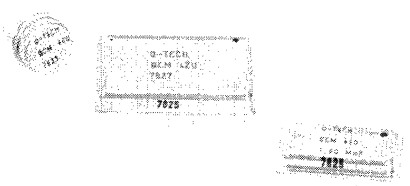


MICROPROCESSOR DRIVERS

Request Bulletin MD-3

BAUD RATE GENERATORS

Request Bulletin BR-1



Q-Tech crystal controlled clock oscillators integrate crystal and semiconductor technology to produce a completely hybrid device. This results in a product of the highest reliability at attractive prices. Oscillators produced to MIL-O-55310 requirements, MIL-M-38510 procedures and screened to MIL-STD-883B, Level S or B, meet the highest high reliability requirements of military and space use.

SPECIAL PACKAGING: Q-Tech oscillators can also be obtained in special package configurations. Examples of this include leadless carrier packages; a miniature package capable of operating in an environment of 10,000 P.S.I., and other unusual configurations.

Q-TECH clock oscillators are available in 4 types: TO-5 (8 lead), TO-8 (8 or 12 lead), DIP (14 or 16 lead), and FLATPACK (QT21 and QT22). The TO5 and flatpack units cover limited frequency ranges, while the TO-8 and DIP both have an extremely wide output frequency range for an extensive variety of applications. The tables below provide full details.

STANDARD STABILITIES

2 x 10^{-6}	For 10% change of Vcc
1 x 10^{-6}	For 20% change of Load
5 x 10^{-6}	Aging — 30 days
1 x 10^{-5}	Aging — 1 year

TYPICAL TOLERANCES

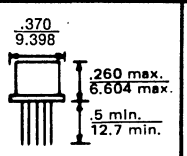
±.005% *±.0005%	0 to 50°C
*External Trimmer Required	
±.005% ±.01%	0 to 70°C
±.0025%	−20 to +70°C
±.005%	−55 to +105°C
±.005% ±.01%	−55 to +125°C

OPTIONS AVAILABLE

• GATED OUTPUT • MULTIPHASE OUTPUTS • MULTIPLE OUTPUTS • PRECISE PROGRAMMED OUTPUTS • VCXO's • FINE FREQUENCY ADJUSTMENT • SPECIAL PACKAGING • ECL OUTPUTS • HIGHER FREQUENCIES WITH MORE OPEN TOLERANCES • UHF OUTPUTS

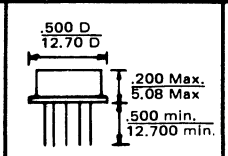
UPPER DIMENSIONS IN INCHES, LOWER DIMENSIONS IN MILLIMETERS.

QT1



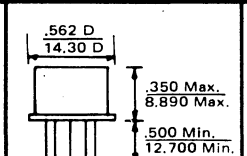
1, 2 & 6	ITP
4	GND
5	OUT
8	VCC/VDD

QT2



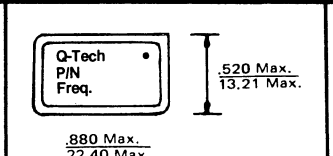
3, 9 & 10	ITP
5	OUT
6	GND
12	VCC/VDD

QT3



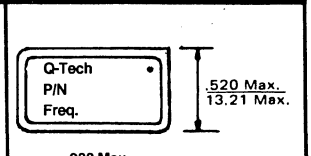
2, 6 & 7	ITP
4	GND
5	OUT
8	VCC/VDD

QT4 & QT6



QT4		QT6	
3, 11, 12	ITP	4, 10, 11	ITP
4	VCC/VDD	7	GND
5	OUT	8	OUT
7	GND	14	VCC/VDD

QT5 & QT7



QT5		QT7	
3, 13, 14	ITP	4	OUT
4	VCC/VDD	5, 6, 11	ITP
5	OUT	8	GND
8	GND	16	VCC/VDD

2201 CARMELINA AVE. • LOS ANGELES, CALIFORNIA 90064 • PHONE (213) 820-4921 • TELEX 69-6140

Q-Tech Corporation

PIONEERS IN HYBRID TECHNOLOGY
STATE OF THE ART DEVELOPMENT

MINIATURE CRYSTAL CLOCK OSCILLATORS

C-MOS CLOCK OSCILLATORS

Frequencies available in the C-MOS line of oscillators are related to input voltage. It is essential, therefore, when ordering a C-MOS unit to specify the input voltage.

Power requirements of C-MOS units are related to both frequency and input voltage. Most of the power is dissipated within the crystal oscillator portion of the device, and buffering, division, or other logic requirements within the unit contribute little to the total power consumption.

ECL/VHF/UHF CLOCKS AND SOURCES

ECL and sine wave clocks and sources are available to 400 MHz.

Q-Tech can work with you to hybridize high stability and synthesized sources up to 3gHz.

Phase noise and G-Sensitivity data are taken when required. Full temperature range, −55°C to +125°C, available for these clocks and sources.

FREQUENCY RANGES AVAILABLE

Package Type	Package Size	C-MOS Frequency Range	TTL Frequency Range
TO-5	QT1	50KHz to 15MHz	20KHz to 30MHz
TO-8	QT2 or QT3	300Hz to 15MHz	100Hz to 25MHz
14 Pin DIP	QT4 or QT6	.1Hz to 15MHz	.1Hz to 75MHz
16 Pin DIP	QT8	.1Hz to 6MHz	.1Hz to 75MHz
EC-7	QT9	.1Hz to 3MHz	—
20 Lead Flat Pack	QT21	1.0Hz to 15MHz	1Hz to 75MHz
16 Lead Flat Pack	QT22	50KHz to 15MHz	25KHz to 75 MHz

QUALITY CONFORMANCE AND RELIABILITY ASSURANCE

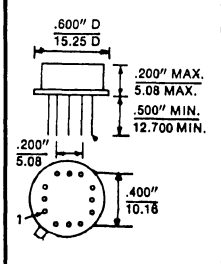
Q-Tech's facilities are qualified to MIL-I-45208 and are well equipped to perform the screening, quality conformance and reliability assurance requirements of MIL-M-38510A and MIL-STD-833. Q-Tech is a QPL source for all hybrid MIL-O-55310 oscillators.

SPECIAL PACKAGES AND ENCLOSURES

Q-TECH can provide units to unusual package requirements including miniature units withstanding 10,000 PSI and Flat Packs with less than .100 inch thickness. Ultra-thin (.065) ceramic packages available with frequencies to 60 MHz.

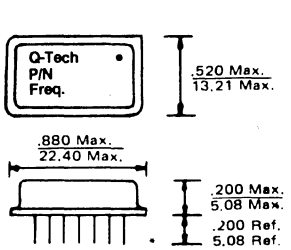
UPPER DIMENSIONS IN INCHES, LOWER DIMENSIONS IN MILLIMETERS.

QT8



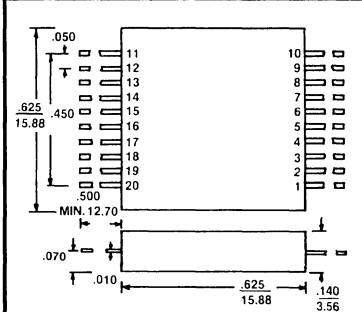
3,9 & 10	ITP
5	OUT
6	GND
12	VCC/VDD

QT10



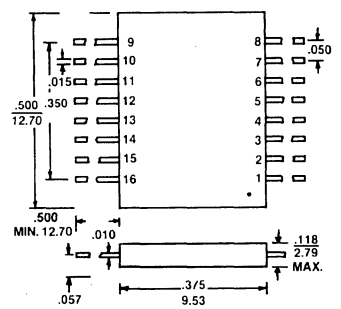
1	OUTPUT
2	CASE
8	GND
14	VCC/VDD

QT21



7 & 16	ITP	10	GND
11	OUT	13	VCC/VDD

QT22



4 & 13	ITP	10	OUT
9	GND	8	VCC/VDD

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

REEVES-HOFFMAN

DIVISION, DYNAMICS CORPORATION OF AMERICA
400 W. North St., Carlisle, PA 17013 U.S.A.
Phone 717-243-5929 TWX: 510-650-3510

Crystal Oscillators

Custom oscillators from the leaders in frequency control

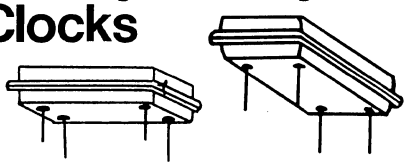
Forty years of superior performance—design, manufacture, and delivery of outstanding quartz crystal products—stand behind Reeves-Hoffman's new line of crystal oscillators.

Accustomed to high-volume production of out-of-the-ordinary orders, we take your custom requirements in stride—starting from a blank drawing board where necessary—and put our immense fund of experience, imagination, and manufacturing resources into each custom oscillator assignment.

The oscillator types described on this page are only representative of a capability which can give you just the right product (including RC and LC networks) for your application.

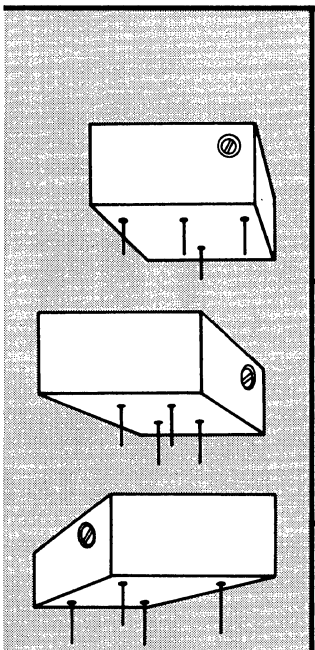
Complete control of our manufacturing is in-house, from the raw crystal to the hermetic seal. This freedom from outside suppliers lets us promise delivery without fear of someone else's production problems. Call us to discuss your oscillator needs: (717) 243-5929.

Coldweld-Packaged TTL Hybrid Crystal Clocks



The superiority of coldweld sealing is well known: A good coldweld gives a better vacuum, and therefore a higher Q, and also leaves no microsplashes of metal inside the package. Reeves-Hoffman's many years of experience and volume production capability in coldweld sealing are important considerations in the choice of a supplier of quality hybrid crystal clocks. Request Data Sheet 02-020-0001.

Specifications	
Frequency range	16.0 kHz through 60.00 MHz
Output (0 to 10 TTL loads)	Square-wave TTL
Symmetry	40/60 to 60/40
Input voltage	+5.0 VDC ±5%
Input current	15 to 75 mA
Stability	+0.01% to ±0.01%
Temperature range	0°C to +70°C



Crystal Clocks

Request Data Sheet 02-001-0001

LOGIC FAMILY	TTL	CMOS	ECL
FREQUENCY RANGE	3.0 to 60.0 MHz	3.0 to 10 MHz	3.0 to 150 MHz

Stability		
Δf/Δ Temp	Standard	±0.01% (0°C to +70°C)
Option	1	±0.005% (0°C to +70°C)
Option	2	±0.001% (0°C to +70°C)
Option	3	±0.01% (−55°C to +125°C)
Option	4	±0.005% (−55°C to +125°C)
Option	5	±0.001% (−55°C to +50°C)
Option	6	±0.0005% (0°C to +50°C)

Crystal TCXO's

Request Data Sheet 02-003-0001

LOGIC FAMILY	TTL	CMOS	ECL
FREQUENCY RANGE	3.0 to 30.0 MHz	3.0 to 10 MHz	3.0 to 30 MHz

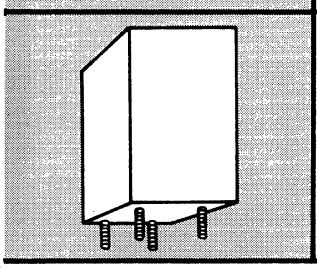
Stability		
Option	1	±0.5 ppm (+10 to +40°C)
Option	2	±1 ppm (0°C to +50°C)
Option	3	±2 ppm (−10°C to +60°C)
Option	4	±3 ppm (−15°C to +65°C)
Option	5	±4 ppm (−20°C to +70°C)
Option	6	±5 ppm (−25°C to +75°C)

Crystal VCXO's

Request Data Sheet 02-002-0001

LOGIC FAMILY	TTL	CMOS	ECL
FREQUENCY RANGE	3 to 20 MHz	3 to 10 MHz	3 to 30 MHz

Stability	
Δf/Δ Temp	±10 ppm (0°C to +70°C)
Δf/Δ Input Voltage	±1 ppm ±5%
Δf/Δ Load	±1 ppm ±5%
Δf/Δ Time	±3 ppm/yr



Crystal OCXO's

LOGIC FAMILY	TTL	CMOS	ECL
FREQUENCY RANGE	3.0 to 60.0 MHz	3.0 to 20 MHz	3.0 to 150 MHz

Output	Sine wave available P_0 up to +13dBm
Stability	To ±1 x 10^{-11}/°C
Frequency Range	Up to 500MHz for sine wave output

VCXO capability can be included

Multiple case and base arrangements are available on all models.

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REEVES-HOFFMAN

DIVISION, DYNAMICS CORPORATION OF AMERICA
400 W. North St., Carlisle, PA 17013 U.S.A.
Phone 717-243-5929 TWX: 510-650-3510

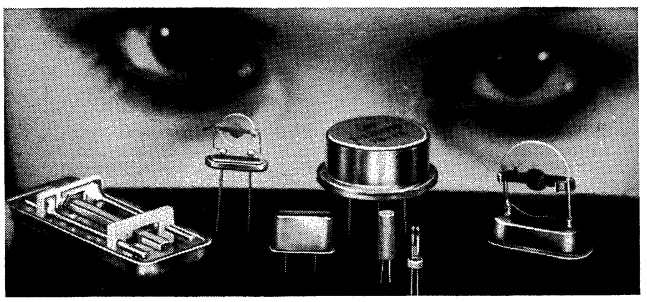
Crystals of proven reliability for military and industrial applications

For 40 years, Reeves-Hoffman has been a leader in the design and manufacture of quartz crystals for government and industry. We are the only company offering the improved stability of coldweld sealing at a lower cost than conventional solder-sealed units.

All Reeves-Hoffman crystals are cut, ground, polished, plated, and mounted at the factory to exacting specifications. Shock, vibration, and hermeticity characteristics all exceed Mil-Spec C-3098. Crystals for oscillator and filter applications are available from 1 kHz to 200 MHz, with varying temperature coefficients, effective resistance, electrical equivalents, and Q values dependent on physical limitations and circuit requirements.

The staff of crystal engineers at Reeves-Hoffman welcomes the opportunity to quote on and discuss your particular application.

Ask for our free booklet, "A Specifier's Guide to Quartz Crystals," written to reduce your design problems.



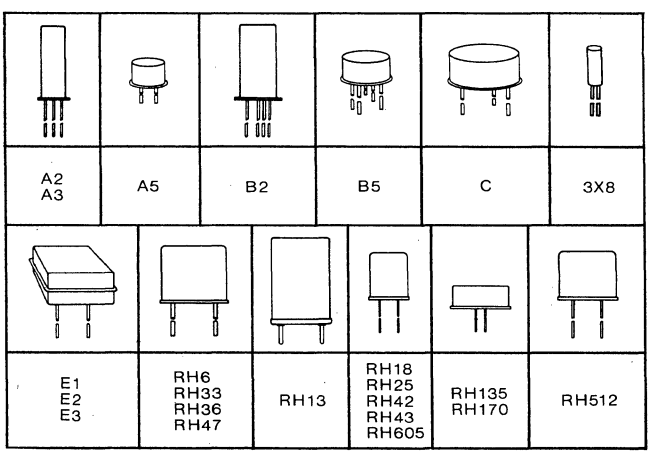
When specifying crystals, please supply the following:	Crystal Categories
1. Frequency required 2. Holder style 3. Calibration temperature/ tolerance 4. Oscillator load capacitance 5. Temperature range 6. Maximum series resistance 7. Stability over temperature	**Oscillator Crystals** • **Industrial** Aging: 5 to 25 x 10^{-6} per year • **Precision** Aging: Less than 5 x 10^{-6} per year or less than 5 x 10^{-8} per day after first 30 days. • **Military** (per Mil C-3098) **Filter Crystals** See facing page

Low-Frequency Crystals

1.0 to 1200 kHz in standard and miniature holders

Throughout our long history as a quality supplier of low-frequency crystals, Reeves-Hoffman has dedicated our efforts towards responding to the changing needs of the electronics industry. As miniaturization reduced the size of electronic equipment, the traditionally large low-frequency crystal became one of the largest components in the system. To respond to this, Reeves-Hoffman worked closely with the crystal users. As a result, miniature crystal holders such as the RH135, RH170, RH605, and RH3X8 were developed. This is just one example of Reeves-Hoffman's ingenuity and responsiveness to the needs of our most important asset...our customers.

Recommended Element for Frequency Range		Holder Style vs. Frequency	
Frequency Range	Element	Frequency	Holder
1-10 kHz	J	1-1.4 kHz	RH13
		1.4-1.8 kHz	RH13, E1, E2
10-100 kHz	NT, XY	1.8-20 kHz	RH13, E1, E2, B2
100-250 kHz	5° X	20-86 kHz	RH13, E1, E2, B2, RH170, RH135, A2, A3
250-500 kHz	DT	86-150 kHz	RH36, RH47, E1, E2, RH13, B2, A2, A3, RH6, RH33, RH170
500-1000 kHz	SL	150-300 kHz	RH36, RH47, A3, E2, RH13, A2, RH6, RH33, B2, E1, E3
		300-450 kHz	RH36, RH47, RH6, RH33, RH512, E3
The choice of element will vary. However, Reeves-Hoffman will choose the best element for your specific requirements based on cost and performance considerations.		450-900 kHz	RH42, RH43, RH18, RH25, RH36, RH47, RH512, RH6, RH33, E3
		900 kHz-1.2 MHz	RH42, RH43, A5, RH18, RH25, RH36, RH47, RH512, RH6, RH33, E3, RH605



High-Frequency Crystals

1.0 to 200.0 MHz

The use of high-frequency crystals has grown continually over the years as timing rates, tranmission frequencies, and data-processing speeds increased. Fortunately, Reeves-Hoffman is continually involved in this evolution to the extent that we possess the capabilities to respond to just about any requirement for high-frequency AT-cut crystals. In the past, many challenges have been presented to our engineering and manufacturing personnel. We are extremely proud of their response record, and look forward to working with you to continue this trend.

Frequency	Recommended overtone	Holder Style vs. Frequency	
		Frequency	Holder
1-30 MHz	AT, fundamental	1.0-2.5 MHz	RH36, RH47, E3, RH6, RH33, RH512, C
20-60 MHz	AT, third overtone	2.5-10 MHz	RH36, RH47, RH42*, RH43*, RH18*, RH25*, A5*, RH6, RH33, E3, RH512, B5, C
60-125 MHz	AT, fifth overtone	10-100 MHz	RH42, RH43, RH18, RH25, A5, B5, E3, RH512
125-160 MHz	AT, seventh overtone	100-200 MHz	RH42, RH43, RH18, RH25, A5, E3, RH512
160-200 MHz	AT, ninth overtone		

*Contact factory for details.

Holder Specifications

Holder Type	Seal*	Max. Height	Max. Length	Max. Width	Pin Dimensions Dia.	Pin Dimensions Spacing
A-2	CW	1.550		.400 dia.	.0185	.200
A-3	CW	1.000		.400 dia.	.0185	.200
A-5	CW	.260		.400 dia.	.0185	.200
B-2	CW	1.550		.600 dia.	.0185	.282
B-5	CW	.260		.600 dia.	.0185	.282
C	CW	.350		.830 dia.	.0185	.375
RH3X8		.327		.118 dia.	.012	.043
E-1	CW	.360	2.100	.730	.020	1.000
E-2	CW	.360	1.595	.730	.020	1.000
E-3	CW	.360	.770	.770	.020	.375
RH-6	SS	.775	.757	.352	.050	.486
RH-13	SS	1.526	.757	.352	.050	.486
RH-18	SS	.530	.435	.183	.0185	.192
RH-25	SS	.530	.435	.183	.040	.192
RH-33	SS	.775	.757	.352	.030	.486
RH-36	CW	.775	.757	.352	.050	.486
RH-42	CW	.530	.435	.183	.040	.192
RH-43	CW	.530	.435	.183	.017	.192
RH-47	CW	.775	.757	.352	.030	.486
RH-135	CW	.135	.500	.135	.010	.080
RH-170	CW	.170	.500	.135	.010	.080
RH-512	SS	.650	.564	.234	.030	.275
RH-605	CW	.261	.435	.183	.017	.192

*CW=coldweld
SS=solder seal

Alternate pin configurations and locations are available.

7708

REEVES-HOFFMAN

DIVISION, DYNAMICS CORPORATION OF AMERICA
400 W. North St., Carlisle, PA 17013 U.S.A.
Phone 717-243-5929 TWX: 510-650-3510

DISCRETE OR MONOLITHIC CRYSTAL FILTERS

- CUSTOM computer-aided design to your specifications saves development time and assures optimum performance during production.
- Experience in supplying devices for military radar and communications applications.
- All crystals designed and built in Reeves-Hoffman's own plant, pre-aged and temperature-tested for improved stability.
- Packaged to meet your most exacting requirements.
- Modern equipment automatically measures critical parameters over the specified temperature range to assure top performance.
- Complete environmental testing facilities: MIL-F-18327, MIL-STD-202.

To order filters, please specify:

1. Center frequency and tolerance.
2. 3 or 6 dB bandwidth.
3. 40 or 60 dB bandwidth and frequencies at these points if asymmetric.
4. Minimum attenuation in stopband.
5. Passband ripple.
6. Insertion loss.
7. Phase or delay requirements.
8. Input and output impedance (tolerance).
9. Operating temperature range.
10. Packaging details.
11. Additional electrical and environmental specifications as required.

TYPICAL FILTERS

EQUALIZED DELAY FILTERS

frequency range:
100 kHz—30 MHz
typical delay distortion
<200 μs
typical shape factors <1.2:1
impedance level to specifications. Meets Mil. Std. 188.

SINGLE SIDEBAND FILTERS

frequency range:
10 kHz–30 MHz
symmetrical—use for either sideband
regular—specify upper or lower
shape factor: from 1.1:1
typical carrier attenuation
>30 dB

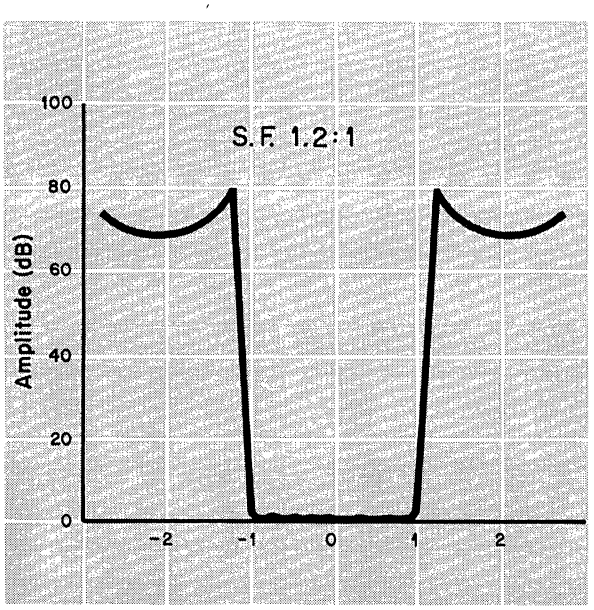
VERY NARROW BANDWIDTH FILTERS

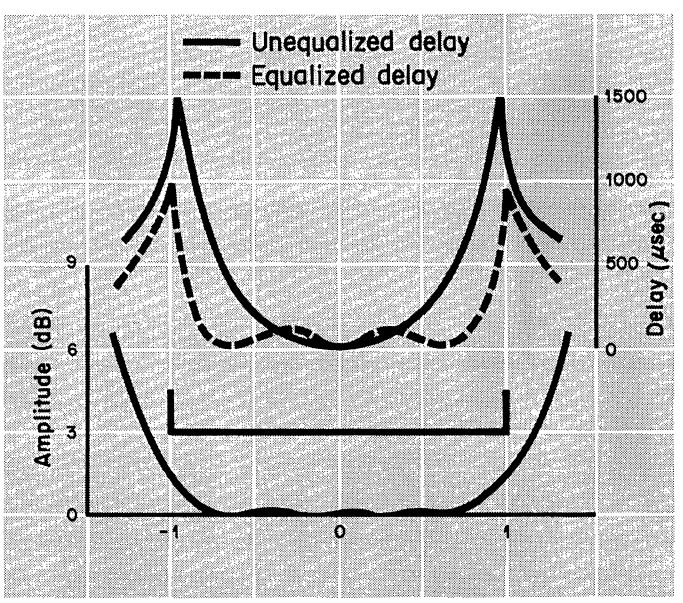
designs: Bessel, Butterworth, Gaussian, Chebyshev
frequency range:
10 kHz–30 MHz
typical shape factor <6:1
impedance level to specifications

COMB FILTERS

frequency range:
10kHz—30 MHz
typical bandwidth <0.2%
typical shape factor <6:1

NORMALIZED CHARACTERISTICS





Many designs over the 10 kHz-80 MHz frequency range have already been constructed. Call to determine whether one of these will satisfy your requirements, or to receive a custom design and quotation to your particular specifications.

7709

..SaRonix....

NYMPH™

Quartz Crystal Units
- Microprocessors
- Communications
- Telecommunications
- Toys & games
- Computers & peripherals
- Instruments

Tuning Fork Crystals
- Clocks & watches
- Computer circuits
- Timers
- Pacemakers

Quartz Crystals

SaRonix offers a broad line of crystal products with the best combination of price, quality, delivery, and service available. We carry a large stock of commonly used crystals, and feature rapid turnaround time on special units and large production runs.

In addition to the industry standard holders, many special configurations and a wide range of miniature units are available. We provide back-up stock for all scheduled orders.

Send your drawings and specifications, or call our Customer Service Department for ordering assistance and availability. Toll free (800) 227-8974

Standard Microprocessor

The accompanying selection chart lists NYMPH AT-cut quartz crystals for most common microprocessor applications. Frequencies, configurations, and circuit calibration conditions shown are those in general industry usage or are as recommended by the various microprocessor manufacturers.

FREQUENCY MHZ	NYMPH PART NUMBER
HC-33/U	
1.000000	NYP010-13
1.000000	NMP010
1.843200	NYP018-13
1.843200	NMP018
2.000000	NYP020-20
2.000000	NMP020
2.097152	NYP021-20
2.457600	NYP024-32
2.457600	NMP024
3.579545	NYP035-18
3.579545	NYP035-18S*
HC-18/U	
1.000000	NMP010A
1.843200	NMP018A
2.000000	NYP020A-20
2.000000	NMP020A
2.097152	NYP021A-20
2.457600	NYP024A-20
2.457600	NMP024A
3.000000	NYP030A-30
3.000000	NMP030A
3.276800	NYP032A-15
3.276800	NMP032A
3.330000	NMP033A
3.579545	NYP035A-18
3.579545	NMP035A
3.600000	NYP036-30
3.600000	NMP036
3.686400	NYP037-20
3.686400	NMP037
3.932160	NYP039-12
3.932160	NMP039
4.000000	NYP040-20
4.000000	NMP040
4.194303	NYP041-12
4.433619	NYP044-20
4.915200	NMP049
5.000000	NYP050-20
5.068800	NMP051
5.185000	NYP052-20
5.714300	NMP057
5.990400	NMP059
6.000000	NMP060
6.144000	NYP061-30
6.400000	NYP064-20
6.553600	NMP065
7.000000	NMP070
7.159090	NYP071-20
7.372800	NMP073
8.000000	NYP080-18

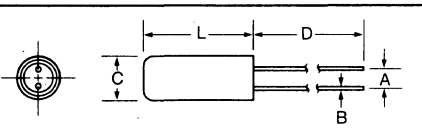
*Special .375" lead spacing

FREQUENCY MHZ	NYMPH PART NUMBER
HC-18/U	
8.000000	NMP080
9.216000	NMP092
9.830400	NMP098
10.000000	NMP100
10.738635	NYP107-32
10.738635	NMP107
11.000000	NMP110
11.059200	NMP111
12.000000	NMP120
12.288000	NMP122
13.516800	NMP135
14.318180	NMP143
14.745600	NMP147
15.000000	NMP150
16.000000	NMP160
16.384000	NMP163
17.360000	NMP173
18.000000	NMP180
18.432000	NMP184
19.354000	NMP193
19.660800	NMP196
20.000000	NMP200
22.118400	NMP221
23.400000	NMP234
24.000000	NMP240
24.576000	NYP245-18
25.000000	NMP250
27.000000	NMP270
30.000000	NMP300
32.000000	NMP320
36.000000	NMP360
40.000000	NMP400
48.000000	NMP480
HC-44/U	
6.000000	44N060
8.000000	44N080
10.000000	44N100
12.000000	44N120
12.500000	44N125
14.318180	44N143
14.400000	44N144
15.000000	44N150
16.000000	44N160
18.000000	44N180
18.432000	44N184
19.354000	44N193
19.660800	44N196
20.000000	44N200
22.118400	44N221
24.000000	44N240
25.000000	44N250

Tuning Forks

The NYMPH tuning fork type quartz crystal provides the circuit designer with the ultimate in size, performance, and economic trade-offs. This highly reliable, stable, and accurate device is available in two micro-miniature sizes for time base applications operating from a 32.768 KHz reference frequency.

Dimensions



	Part Number	
	NTF3238	**NTF3226**
A	1.1±0.2	0.8±0.1
B	0.3±0.07	0.2±0.05
C	3.1 max	2.1 max
L	8.3 max	7.0 max
D	9.0 min	5.0 min

Dimensions in mm

Electrical Specifications

	Part Number	
	NTF3238	**NTF3226**
Freq. @ 25°C	32.768 KHz ± 20 ppm	
Turnover Temp.	25°C±5°C	
Temperature Characteristic-K	−0.038 ppm/°C² Typical ($\Delta f/f = K(T_o - T)^2$ where T=pt. of temperature comparison)	
Quality Factor	100,000, Typical	90,000 Typical
Load Cap.	9.5 to 15pF, Typical	
Series Resist.	30 K ohms max.	40 K ohms max.
Drive Level	10 μW Max	
Aging	First 30 Days: 3.0 ppm First Year: 5.0 ppm	
Optg. Temp.	−10 to +60°C	

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NYMPH™

Crystal Clock Oscillators

- TTL
- CMOS
- Baud Rate Generator
- MPU Clock Driver
- Special Output Characteristics
- Selectable Frequency Outputs

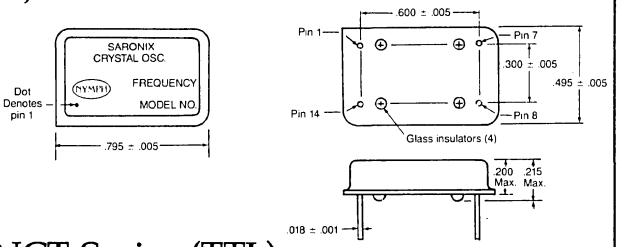
Physically and functionally interchangeable with all major manufacturers' devices.

Crystal Clock Oscillators

Fixed Frequency

The SaRonix NYMPH crystal clock oscillator family includes a wide variety of state-of-the-art thick film hybrid devices for generating TTL, CMOS, Baud Rates, and special output characteristics.

These devices are packaged in a 14 pin DIP compatible, all metal, resistance welded, hermetic unit. They are physically and functionally interchangeable with all major manufacturer's devices.



NCT Series (TTL)

Freq. Range:	250 kHz–60 MHz
Freq. Stability:	±0.0025 to ±1.00% over optg. temp. & voltage
Optg. Temp. Range:	0 to +70°C
Input Voltage:	+5 VDC ± 0.5 V
TTL Output:	
Symmetry:	60/40 to 40/60 @1.4 VDC Level
Rise & Fall Times:	15 ns Max. for 250 kHz to 25 MHz, 7 ns Max. for 25 MHz to 60 MHz
"O" Level:	+0.4 Volts
"I" Level:	+2.4 Volts
Output Load:	1 to 10 TTL gates

Standard TTL Frequencies

(Available from stock)

Part No.	Freq. (MHz)	Part No.	Freq. (MHz)
NCT040C	1.0000	NCT050C	10.0000
NCT040C	1.8432	NCT050C	12.0000
NCT040C	2.0000	NCT050C	16.0000
NCT040C	2.4576	NCT050C	18.4320
NCT050C	4.0000	NCT050C	19.6608
NCT050C	5.0000	NCT050C	20.0000
NCT050C	5.0688	NCT070C	22.1184
NCT050C	6.0000	NCT070C	24.0000
NCT050C	6.1440	NCT070C	32.0000
NCT050C	8.0000	NCT070C	40.0000

NCC Series (CMOS)

Freq. Range:	600 Hz–8 MHz
Freq. Stability:	±0.0025 to ±1.00% over optg. temp. & voltage
Optg. Temp. Range:	0 to +70°C
Input Voltage:	(V_{DD}) +4.5 VDC to +12 VDC
CMOS Output:	
Symmetry:	60/40 to 40/60 @ ½V_{cc}
Fall:	140 ns max. @ V_{DD} = +5 VDC R_L +200 KΩ 50 ns max. @ V_{DD} = +12 VDC C_L +50 pf
"O" Level:	+0.2 V 50 KΩ load to V_{DD}
"I" Level:	(V_{DD} −0.2)V 50 KΩ load to com.

Selectable Frequency

The 8600 Series is a unique family of hybrid oscillators which combines a quartz crystal unit with CMOS circuitry in a 16 pin DIP package. By appropriate selection of six leads, 57 different output frequencies may be generated from the base frequency of the crystal.

8640 Series

Frequency Characteristics

Output Freq. Range:	1 MHz ~ 0.0042 Hz
Freq. Tolerance:	±100 ppm
Aging:	±10 ppm/year
Volt. Coefficient:	Typical 10, max. 40 ppm/V
Turnover Temp.:	Min. 15, typical 30, max. 45°C
Temp. Coefficient:	Typical 0.03, max. 0.05 ppm/°C

Maximum Ratings

Supply Voltage:	−0.3 to +10 V
Operating Temp.:	−10 to +70°C
Storage Temp.:	−30 to +85°C

8650/8651 Series

Frequency Characteristics

Output Freq. Range:	130 KHz ~ 0.00025 Hz
Freq. Tolerance:	8650: ± 50 ppm 8651: ± 5 ppm
Aging:	± 3 ppm/year
Volt. Coefficient:	Typical 2 ppm/V
Turnover Temp.:	8650: Typical 25°C 8651: Min. 20, typical 25, max. 30°C
Temp. Coefficient:	Min. 0.03, typical 0.035, max. 0.04 ppm/°C²

Maximum Ratings

Supply Voltage:	−0.3 to +8 V
Operating Temp.:	8650: −10 to +70°C 8651: −10 to +60°C
Storage Temp.:	8650: −30 to +80°C 8651: −10 to +70°C

Selection Chart

Model	Output Frequency Range	Frequency Tolerance
8640-A	600 KHz—0.005 Hz	± 100 ppm
8640-B	1 MHz—0.0083 Hz	± 100 ppm
8640-C	768 KHz—0.0064 Hz	± 100 ppm
8640-O	Dividing IC Only	
8640-P	50,60 Hz Only	± 100 ppm
8650-A	60 KHz—0.0005 Hz	± 50 ppm
8650-B	100 KHz—0.00083 Hz	± 50 ppm
8651-A	60KHz—0.0005 Hz	± 5 ppm
8651-B	100 KHz—0.00083 Hz	± 5 ppm

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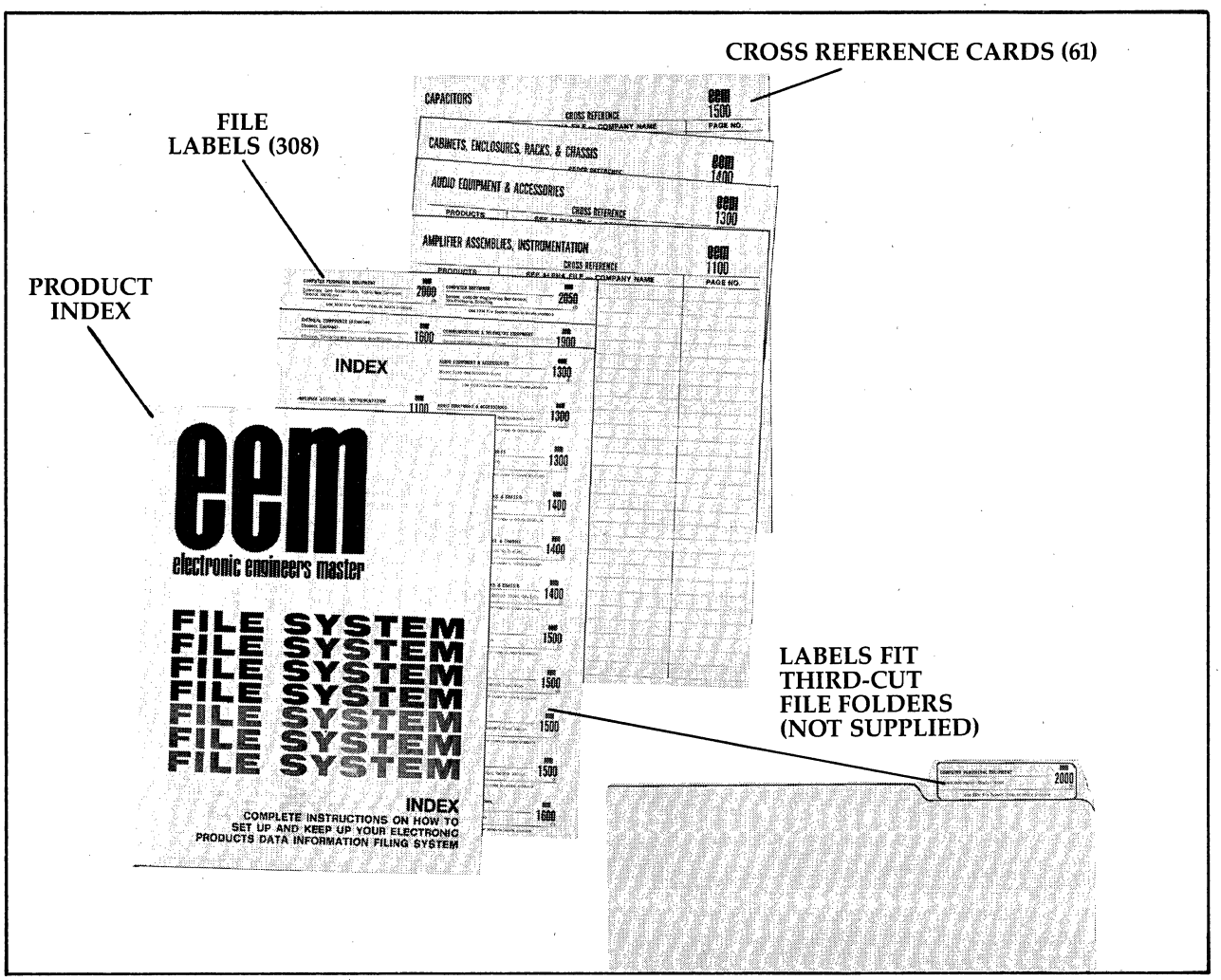


WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

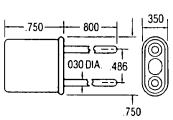
Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

SEIKO INSTRUMENTS

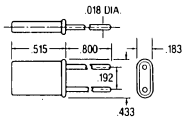
STANDARD CRYSTALS/OSCILLATORS

QUARTZ CRYSTALS

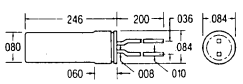
Seiko Instruments offers a wide range of high quality, competitively priced quartz crystals. These units are particularly well suited for microprocessors, peripherals, clocks, and other time-based applications where small size, temperature stability, and high reliability are required.



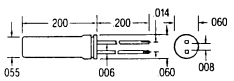
HC-33U
1.0 ~ 10.0 MHz



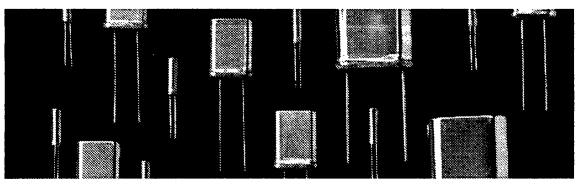
HC-18U
1.2 ~ 120.0 MHz



DS-VT-200
32.768 KHz



DS-VT-150
32.768 KHz



QUARTZ CRYSTAL SPECIFICATIONS

	HC-33U	HC-18U	DS-VT-150	DS-VT-200
Frequency Range	1—3 MHz	3—120 MHz	32.768 KHz	
Frequency Tolerance	±.002% at 25°C			
Temp. Stability	±.005%			
Temp. Range	0°C to 70°C		−10°C to +60°C	
ES Resistance	1 MHz Range 500Ω 2 MHz Range 300Ω	3 MHz Range 250Ω 4 MHz & above. 100Ω	30KΩ	50KΩ
Drive Level	50μW to 5mW		1.0μW Max.	0.4μW Max.
Shunt-Capacitance	7 pF Max.		0.86 pF Max.	
Storage Temp.	−55°C to 105°C		−30°C to +70°C	

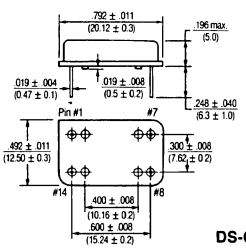
STANDARD FREQUENCY LIST

FREQ.	PART #	CASE	LOAD CAP.
1.000 MHz	DS-100	HC-33/U	16 pF
1.73	DS-173	IC-33/U	Series
1.8432	DS-184	HC-33/U	16 pF
2.00	DS-200	HC-33/U	16 pF
2.097152	DS-209	HC-33/U	16 pF
2.4576	DS-245	HC-33/U	32 pF
2.50	DS-250	HC-33/U	Series
3.00	DS-300	HC-18/U	16 pF
3.072	DS-307	HC-18/U	18 pF
3.12	DS-312	HC-18/U	12 pF
3.2768	DS-327	HC-18/U	16 pF
3.330	DS-333	HC-18/U	Series
3.330	DS-333A	HC-18/U	20 pF
3.579545	DS-357	HC-18/U	16 pF
4.00	DS-400	HC-18/U	Series
4.00	DS-400A	HC-18/U	16 pF
4.032*	DS-403	HC-18/U	22 pF
4.194304	DS-419	HC-18/U	16 pF
4.440	DS-444	HC-18/U	20 pF
4.550	DS-455	HC-18/U	20 pF
4.750	DS-475	HC-18/U	20 pF
4.9152	DS-491	HC-18/U	Series
4.9562	DS-495	HC-18/U	Series
5.000	DS-500	HC-18/U	20 pF
5.0688	DS-506	HC-18/U	Series
5.120	DS-512	HC-18/U	Series
5.1850	DS-518	HC-18/U	20 pF
5.5850	DS-558	HC-18/U	Series
5.5870	DS-558A	HC-18/U	20 pF
6.00 MHz	DS-600	HC-18/U	Series
6.144	DS-614	HC-18/U	30 pF
6.250	DS-625	HC-18/U	16 pF
6.400	DS-640	HC-18/U	16 pF
6.5536	DS-655	HC-18/U	16 pF
8.00	DS-800	HC-18/U	Series
8.00	DS-800A	HC-18/U	18 pF
8.33	DS-833	HC-18/U	Series
10.00	DS-1000	HC-18/U	Series
10.92	DS-1092	HC-18/U	10 pF
11.00	DS-1100	HC-18/U	10 pF
12.00	DS-1200	HC-18/U	10 pF
15.00	DS-1500	HC-18/U	10 pF
16.00	DS-1600	HC-18/U	Series
18.00	DS-1800	HC-18/U	Series
18.432	DS-1843	HC-18/U	Series
20.00	DS-2000	HC-18/U	Series
22.00	DS-2200	HC-18/U	Series
22.1184	DS-2218	HC-18/U	Series
23.40	DS-2340	HC-18/U	Series
24.00	DS-2400	HC-18/U	Series
25.00	DS-2500	HC-18/U	Series
27.00	DS-2700	HC-18/U	Series
32.00	DS-3200	HC-18/U	Series
36.00	DS-3600	HC-18/U	Series
48.00	DS-4800	HC-18/U	Series
32.768 KHz	DS-VT-200	6.2 × 2.0 mm (cylindrical)	6 pF
32.768 KHz	DS-VT-150	5.1 × 1.5 mm (cylindrical)	6 pF

*Special Spec.

CRYSTAL OSCILLATORS

Seiko Instruments clock oscillators provide all metal, hermetically sealed cases; notably low power consumption; and tight frequency stability for the most demanding applications and reliability. Units are TTL or CMOS compatible.



DS-C304A

SPECIFICATIONS

STANDARD	DS-C304A
Frequency Range	250 KHz to 50 MHz
Frequency Stability	±.007% @ 25°C
Temperature Stability	±.001%
Temperature Range	0°C to 70°C
Storage Temperature	−55°C to +125°C
Input Voltage	+5.0 ±0.5V dc
Input Current	90mA over temp. range
Symmetry	60/40% @ 1.4V dc
Rise and fall time	15 ns maximum (250 KHz–8.999 MHz) 10 ns maximum (9.0 MHz–31.999 MHz) 6 ns maximum (32 MHz–50 MHz)
Output Load	1 to 10 TTL gates

STANDARD FREQUENCY LIST

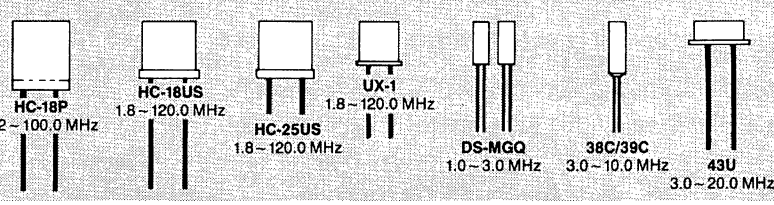
FREQ.	*	STOCK #	FREQ.	*	STOCK #
1.0		DSC100	10.000		DSC1000
1.2288		DSC122	12.000		DSC1200
1.8432		DSC184	16.000		DSC1600
2.0		DSC200	16.384		DSC1638
2.4576		DSC245	18.432		DSC1843
4.0		DSC400	19.6608		DSC1966
4.9152		DSC491	20.000		DSC2000
5.000		DSC500	22.1184		DSC2211
5.0688		DSC506	24.000		DSC2400
6.00		DSC600	25.000		DSC2500
6.144		DSC614	32.000		DSC3200
7.3728		DSC737	40.000		DSC4000
8.000		DSC800			

* Part No. DS-C304A.

CUSTOM CRYSTALS/OSCILLATORS

QUARTZ CRYSTALS

Seiko Instruments also offers the following custom cases for your special quartz crystal engineering needs. Plus, the smallest MHz quartz crystal units in the world...the DS-MGQ series with a frequency range of 1 to 3 MHz, and a temperature stability of ±5 ppm from −30 to +70°C.



HC-18P
3.2 ~ 100.0 MHz

HC-18US
1.8 ~ 120.0 MHz

HC-25US
1.8 ~ 120.0 MHz

UX-1
1.8 ~ 120.0 MHz

DS-MGQ
1.0 ~ 3.0 MHz

38C/39C
3.0 ~ 10.0 MHz

43U
3.0 ~ 20.0 MHz

CRYSTAL OSCILLATORS

Seiko Instruments also offers tight tolerance oscillators in the cases shown below. Call for complete details.

DS-C308
0.5 ~ 64.0 Hz
3.0 ~ 16.0 MHz

DS-C304
250KHz ~ 50.0 MHz

DS-C303
3.0 ~ 24.0 MHz

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SCP
Sokol
Crystal Products, Inc.

The Talk of the Universe

Our crystals and crystal filters are making talk wherever talk is being made — from space/com to computerized auto ignition systems. We pride ourselves on producing high reliability filters (withstanding high frequency vibrations to 3,000 HZ, and shock specs to 2,000 G's) with competitive pricing and performance that far surpasses imports in all parameters. We make it imperative to buy American.

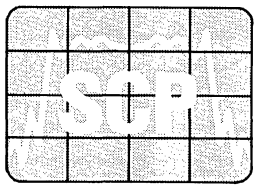
Today's engineering challenges become tomorrow's product line at Sokol. Although our specialties are monolithics, discretes, L-C's, time delays and crystals (in a fundamental frequency range of 1-45 MHZ, with 3rd, 5th, and 7th overtones to 200 MHZ,) we are pleased to supply engineering assistance with crystals and crystal filter design in any problematic circuit application or specification requirement you may encounter.

Technically we're good. For instance, we presently supply the smallest matched set of filters available in the industry. Our MIL qualifications include:

- Equipment calibration maintained according to MIL-C-45662
- Inspection procedures approved according to MIL-I-45208
- Quality approved according to MIL-Q-9858A
- Soldering approved according to WS 6536.

Our in-house test equipment is capable of testing to any MIL spec, and our production facilities handle both high volume commercial and high reliability space and military projects.

Why are we the talk of the universe? Because we make it possible.



Sokol Crystal Products, Inc.

"Where the Impossible Becomes the Ordinary."

121 Water Street, Mineral Point, Wisconsin 53565, Phone 608-987-3363, Telex 467581

2 POLE MONOLITHIC FILTERS

3.0 MHz to 200 MHz

Monolithics as fundamentals to 45 MHz and overtones to 200 MHz.

Center Freq in MHZ	3 db B.W. in KHZ	20 db B.W. in KHZ	Nominal Impedance in ohms
5.20	150	900	120
5.26	13	70	6000
9.00	15	80	4300
10.70	13	70	1800
10.70	30	165	4300
11.40	10.6	50	2000
15.1875	36	200	4700
16.90	13	70	390
17.90	15	80	2000
21.40	15	80	1400
25.50	70	400	5000
30.00	30	170	1000
43.50	13	85	3000
70.00	30	170	5000
156.00	13	70	3600

MULTIPOLE MONOLITHIC FILTERS 3.0 MHz to 200 MHz

Multipole Monolithics over a wide frequency range with varying bandwidths; up to 16 pole filters.

Center Freq in MHZ	3 db B.W. in KHZ	60 db B.W. in KHZ	Nominal Impedance in ohms
5.20	13.0	25	6000
5.26	13.0	25	6000
6.46	13.0	25	5000
9.00	15.0	40	4300
10.70	13.0	25	3300
10.70	30.0	60	5000
11.40	2.7	6	470
12.428	3.0	12	390
15.1875	36.0	150	6000
16.90	13.0	30	600
18.05	46.0	120	6000
21.40	15.0	30	1500
25.50	22.0	44	1800
29.00	30.0	75	1400
30.00	50.0	100	2100
45.00	15.0	70	2700
75.00	13.0	60	3000

PACKAGED MONOLITHIC FILTERS

Multiple Monolithics in standard and non-standard packages; 50 and 75 ohms as well as the filter characteristic impedances available.

Center Freq in MHZ	3 db B.W. in KHZ	60 db B.W. in KHZ	Nominal Impedance in ohms
5.201	3.4	5.5	1000
5.201	3.4	6.0	1500
5.26	13.0	25.0	50
9.00	2.7	5.2	1000
9.00	13.0	25.0	50
10.00	30.0	60.0	5000
10.70	22.0	40.0	4300
10.70	13.0	25.0	3300
10.70	14.0	20.0	3300
11.10	34.8	70.0	5000
11.50	36.0	90.0	50
15.1875	36.0	70.0	6000
16.025	36.0	70.0	6000
16.90	13.0	25.0	1000
21.40	22.0	42.0	2200
25.00	19.0	28.0	1300
30.112	25.0	50.0	50
75.00	26.0	90.0	50

WIDE BAND CRYSTAL and L-C Filters

Center Frequency	3 dB B.W.	60 dB B.W.	Insertion Loss	Characteristic Impedance	Size
3.0 MHz	3 KHz	3.4 KHz	6 dB	50 ohms	2.9x1x1
10.607 MHz	186 KHz	260 KHz	8 dB	50 ohms	2.4x1x.9
10.700 MHz	210 KHz	400 KHz	8 dB	50 ohms	2.4x1x.9
10.700 MHz	500 KHz	1000 KHz	8 dB	50 ohms	2.4x1x.9
21.400 MHz	250 KHz	450 KHz	7 dB	50 ohms	2.0x.9x.5
21.400 MHz	500 KHz	900 KHz	9 dB	50 ohms	2.4x1x.9
21.400 MHz	150 KHz	350 KHz	6 dB	50 ohms	2.0x.8x.5
30.000 MHz	500 KHz	1000 KHz	6 dB	50 ohms	2.4x1x.9

FOUR POLE ON ONE BLANK (Miniature Filters)

HC-18/u package with spurious greater than 40 dB below passband response.

Center Frequency	3 dB B.W.	60 dB B.W.	Insertion Loss	Characteristic Impedance
45.0 MHz	15 KHz	70 KHz	3 dB	4000 ohms
72.2 MHz	25 KHz	120 KHz	3 dB	3600 ohms
75.0 MHz	26 KHz	110 KHz	3 dB	4000 ohms
82.8 MHz	30 KHz	130 KHz	2 dB	3500 ohms
99.0 MHz	40 KHz	180 KHz	2 dB	3000 ohms
121.0 MHz	50 KHz	225 KHz	2 dB	3000 ohms

PACKAGED TIME DELAY FILTERS 3.0 MHz to 200 MHz

Time Delay Filters as narrowband monolithics and wideband uniwafers to minimize size and weight.

Center Freq in MHZ	3 db B.W. in KHZ	60 db B.W. in KHZ	Differential Delay over 3 db BW (in micro-seconds)
5.120	3.7	10	165
10.700	13.0	55	25
12.500	19.0	125	10
13.500	20.0	95	35
21.400	26.0	130	25
25.000	30.0	140	20
30.000	100.0	700	40

DISCRIMINATORS

Commerical and Military Discriminators from 1 MHz to 250 MHz to solve any demodulation problem.

C.F.	Distortion	B.W. in KHZ	Size
5.26	1.0%	28	HC-6
10.7	1.0%	28	HC-6
10.7	0.8%	34	HC-18
11.5	3.5%	50	1¾x1¾x½
16.9	1.2%	32	HC-18
21.4	0.8%	34	HC-18
25.0	1.5%	60	HC-18
30.0	1.2%	28	HC-18
34.9	1.5%	70	HC-18
45.0	1.5%	28	HC-18

MATCHED FILTER SETS

Phase and Amplitude matched sets along with minimized size and weight.

Center Frequency	No. of Filters in matched set	3 dB B.W.	60 dB B.W.	Nominal Impedance	Amplitude Match	Phase Match	Size
5.0 MHz	4	3.0 KHz	10 KHz	1000 ohms	0.2 dB	±1°	2.4x1x.9
5.6 MHz	3	4.5 KHz	13 KHz	50 ohms	0.2 dB	±1°	2.4x1x.9
10.7 MHz	2	25 KHz	100 KHz	50 ohms	0.1 dB	±2°	1.06x.5x.6
21.4 MHz	2	10 KHz	20 KHz	1000 ohms	0.2 dB	±2°	1.75x.6x.2
21.4 MHz	2	25 KHz	50 KHz	2500 ohms	0.2 dB	±2°	1.75x.6x.2
21.4 MHz	2	50 KHz	100 KHz	3000 ohms	0.5 dB	±3°	1.75x.6x.2
28.0 MHz	3	5 KHz	15 KHz	50 ohms	0.2 dB	±2°	1.06x.5x.5

MILITARY and AIRCRAFT RADIO CRYSTALS 1 MHz to 250 MHz

Solder seal, resistance weld and cold weld crystals to meet all military and aircraft radio requirements. Rugged versions for high shock and vibration requirements. Miniatures to meet all size requirements.

Freq in MHZ	Calibration Tolerance	Temp Range	Stability Over Temp
1.000	±.002%	−55 to +105°C	±.005%
3.200	±.002%	−55 to + 85°C	±.0025%
4.096	±.002%	−40 to +100°C	±.003%
5.600	±.002%	−55 to +105°C	±.005%
11.45	±.002%	−55 to +105°C	±.005%
20.958	±.003%	−20 to + 55°C	±.002%
46.850	±.002%	−55 to + 90°C	±.005%
64.300	±.002%	−40 to + 71°C	±.003%
64.998	±.002%	−20 to + 55°C	±.003%
70.000	±.001%	+80 to + 90°C	±.002%
92.500	±.001%	+80 to + 90°C	±.002%
121.500	±.002%	−40 to + 71°C	±.003%
160.500	±.0015%	−55 to + 85°C	±.005%
161.670	±0025%	−55 to + 85°C	±.005%

MICROPROCESSOR and SCANNER CRYSTAL 1 MHz to 250 MHz

Some standards are as follows:

Freq in MHZ	Clock IC	Case
1.0000	2650; 6800; 56860	HC-33
1.8432	MC14411	HC-33
2.0000	F8/CPU3850	HC-33
2.4576	34702	HC-18
3.5795	TV or GAME	HC-18
4.0000	4040/4201; 6800; 3870	HC-18
4.9152	COM 5026/5046	HC-18
5.0688	COM 5016/5036	HC-18
6.1440	8085	HC-18
8.0000	CP 1600; IM 6100	HC-18
10.0000	TTL Macrologic	HC-18
14.3188	Hughes-Toys	HC-18
18.4320	8080A/8224	HC-18
20.0000	AM 2900	HC-18
22.1184	8080A/8224	HC-18
48.0000	Special	HC-18

Spectrum Technology
P.O. BOX 948 GOLETA, CA 93116
TEL. (805) 964-7791 TWX 910-334-1163

Crystal Oscillators/IC Logic Clocks

14 PIN DIP PACKAGE, Resistance Weld Hermetically Sealed (Mfd. IAW MIL-STD-883)

Stabilities to ±.005%, Temperature Range −55 to +125°C

TTL — 7116/7114*/7117† — 1 Hz to 65 MHz, 5 Vdc

CMOS — 4116/4114*/4117† — .015 Hz to 15 MHz (Specify Vdc, +5 to +15)

Package, 14 pin DIP pattern: .87″x.50″x.20″

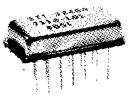
Std. Pin Conn.: 7, Com; 8, Output; 14, +Supply

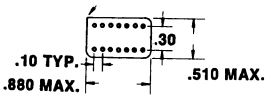
MIL-STD-883 Screening available. (Class "B" typical)

* 4-pin package † 7-pin package

Pins: .018″ dia.; .28″ min. length

SQUARE CORNER DESIGNATES PIN 1





.20 MAX HT **(.810 MAX available)**

TO-5/TO-8 PACKAGE, Resistance Weld Hermetically Sealed (Mfd. IAW MIL-STD-883)

Stabilities to ±.005%, Temperature Range −55 to +125°C

TTL — 7181/7180(TO-8) — 28 Hz to 65 MHz
7150(TO-5) — 625 KHz to 65 MHz

CMOS — 4181/4180(TO-8) — 3.5 Hz to 15 MHz (Specify Vdc)
4150(TO-5) — 80 KHz to 15 MHz (Specify Vdc)

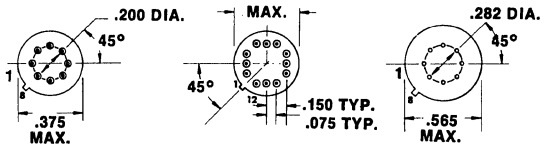
Std. Pin Conn.:
7150/4150, 7181/4181 — 4, Com; 5, Output; 8, +Supply
7180/4180 — 6, Com; 5, Output; 12, +Supply

MIL-STD-883 Screening available. (Class "B" typical)

(All pins .018″ dia.; .480 min. length)

7150/4150 **7180/4180** **7181/4181**

.20 MAX HT **.20 MAX HT** **.300 MAX HT**

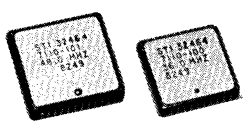


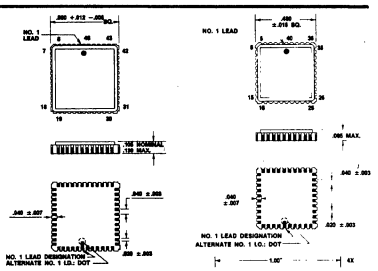
LEADLESS CHIP CARRIER (LCC) CRYSTAL OSCILLATOR/LOGIC CLOCK (Mfd. IAW MIL-STD-883)

Stabilities to ±.005%, Temperature Range −55 to +125°C

TTL — 7110, 39 Hz to 65 Hz

CMOS — 4110, 600 Hz to 15 MHz (Specify Vdc, +5 to +15)
.480″ sq. — Pin 37 Com; 39 Output; 4 Supply
.560″ sq. — Pin 44 Com; 47 Output; 5 Supply
MIL-STD-883 Screening Available (Class "B" typical)



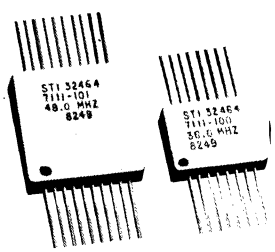


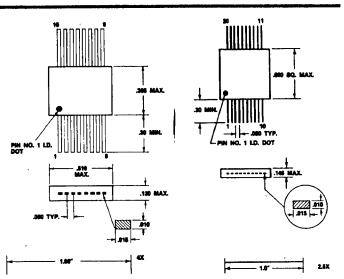
FLAT PACK CRYSTAL OSCILLATOR (Mfd. IAW MIL-STD-883)

Stabilities to ±.005%, Temperature Range −55 to +125°C

TTL — 7111, 28 Hz to 65 MHz

CMOS — 4111, 3.5 Hz to 15 MHz (Specify Vdc, +5 to +15)
16 Lead — Pin 8 Com; 9 Output; 16 Supply
20 Lead — Pin 10 Com; 11 Output; 20 Supply
MIL-STD-883 Screening Available (Class "B" typical)





QPL to MIL-O-55310: Spectrum Technology is a Qualified Supplier of crystal oscillators to MIL-O-55310/4 through /17 per QPL-55310. The /4 through /7 are TCXO types; /8 through /19 are hybrid units with general specifications as shown. Hybrid oscillators are available with Class S, Class B, or Class C screening.

M55310/xx	Spectrum Series		Package Type (7)	Frequency Type	Stability, PPM	Output Type	Pin Numbers			
	Generic	QPL					Out	Case	B−	B+
/08	7116-	5008-	14-pin DIP, .2″ H	50 Hz, 50 MHz	(3)	TTL	1	2	8	14
/09	7150-	5009-	TO-5	400 KHz, 30 MHz	(3)	TTL	5	4	4	8
/10	7181-	5010-	TO-8	1 KHz, 30 MHz	(3)	TTL	5	4	4	8
/11	4116/4400	5011-	14-pin DIP, .4″ H.	.05 MHz, 10 MHz	(3)	CMOS	1	2	8	14
/12	4150-	5012-	TO-5	.05 MHz, 10 MHz	(4)	CMOS	5	4	4	8
/13	4181-	5013-	TO-8	300 Hz, 10 MHz	(4)	CMOS	5	4	4	8
/14	7116-	5014-	14-pin DIP, .2″ H.	.1 Hz, 25 MHz	(3)	TTL	5	7	7	4
/15	4116-	5015-	14-pin DIP, .2″ H.	.01 Hz, 10 MHz	(3)	CMOS	1	2	8	14
/16	7116-	5016-	14-pin DIP, .2″ H.	.1 Hz, 50 MHz	(1)	TTL	8	7	7	14
/17 (5)	7116-	5017-	14-pin DIP, .2″ H.	250 KHz, 50 MHz	(1)	TTL	8	7	7	14 (5)
/18 (6)	4116-	5018-	14-pin DIP, .2″ H.	.01 Hz, 15 MHz	(1)	CMOS	8	7	7	14
/19 (6)	7110-	5019-	40-pin LCC, .085″ H.	1.0 MHz, 60 MHz	(2)	TTL	39	—	31/37	4/10

NOTES: STABILITY OPTIONS:

	(1)	(2)	(3)	(4)
A: −55 to +125°C;	±50 or 100 ppm	±100 or 200 ppm	±50 ppm	±100 ppm
B: −55 to +105°C;	±40 or 80 ppm	±75 or 150 ppm	±40 ppm	±70 ppm
C: −20 to +70°C;	±25 or 50 ppm	±50 or 100 ppm	±25 ppm	±55 ppm

(5) Gated Oscillator, Gate Input on pin 9.
(6) Pending approval.
(7) All package heights max.

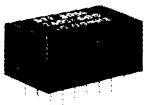
Spectrum Technology

LOW COST DIP PKG. CRYSTAL OSCILLATOR/LOGIC CLOCK

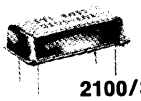
Stabilities to ±.005%, Temperature Range −55 to +105°C
7401/4401 — 14 pin DIP, .8″x.5″x .375″, Epoxy Case
2100/3100 — 4 pin DIP, .8″x.5″x.2″, Resistance Weld Sealed

TTL — 2100/7401 — 1 Hz to 65 MHz

CMOS — 3100/4401 — .015 Hz to 15 MHz (Specify Vdc, +5 to +15)
Std. Pin Conn.: 7, Com; 8, Output; 14, +Supply
Pins: .018 dia.; 7401/4401: .15″ min. length
2100/3100: .23″ min. length

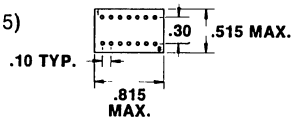


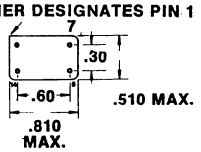
7401/4401



2100/3100

SQUARE CORNER DESIGNATES PIN 1





Temperature Compensated Crystal Oscillators

For applications requiring high stability, low power and zero warm-up time. Designed for P.C. Board mounting.

Input Voltage: +10 to +20 volt range - regulation to ±10%

Output Signal: TTL standard; CMOS, SINE-WAVE or ECL available

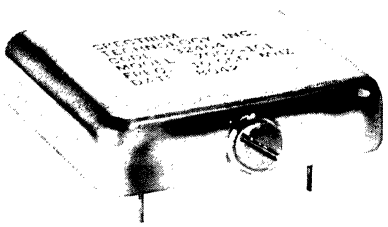
Temp Stability: ±2 x 10^{-7}, 0 to +50°C; ±5 x 10^{-7}, −20 to +65°C; ±1 x 10^{-6}, −55 to +85°C; ±5 x 10^{-6}, −55 to +125°C. Other ranges available

Freq Range:
7002: 10 KHz to 20 MHz; 1 Hz to 100 MHz available special
7006: 500 KHz to 20 MHz; 10 KHz to 100 MHz available special

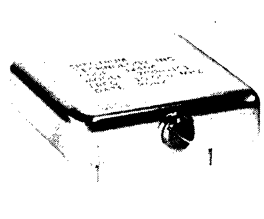
Trim Adjust: 5 to 10 years aging range

SPECIAL PACKAGES: Many special configurations are available including smaller packages, units with mounting studs, brackets, inserts, and special electrical characteristics. Contact Spectrum Technology for further information.

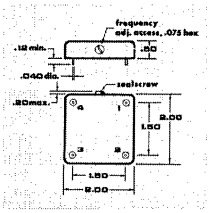
QPL TCXO's:
Spectrum is an approved QPL Supplier to M55310/4, /5, /6 & /7.

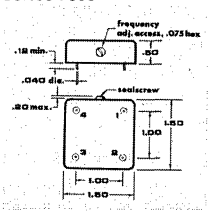


Series 7002



Series 7006





PIN CONNECTIONS
Series 7002
1 — Pos. Supply
2 — Com. and Case
3 — N/C
4 — Output

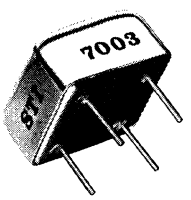
PIN CONNECTIONS
Series 7006
1 — Pos. Supply
2 — Com. and Case
3 — N/C
4 — Output

Standard (Alternate) Package Configurations

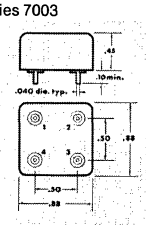
Spectrum Technology utilizes conventional P.C. Board or proven reliability Hybrid Circuits as required to supply most of the alternate oscillator packages previously designed into many commercial and military programs. Most packages can provide CMOS, TTL, Sinewave or ECL outputs from 1 Hz to 100 MHz.

PIN CONNECTIONS
Series 7003, 7042
1—Pos. Supply
2—Com. and Case
3—N/C
4—Output

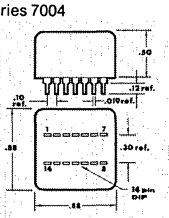
Series 7004, 7600, 7231, 5430
1—N/C
7—Com.
8—Output
14—Pos. Supply



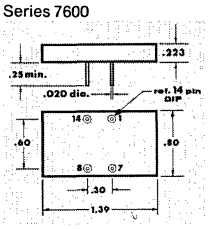
Series 7003



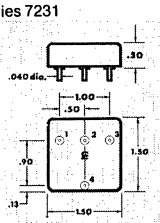
Series 7004



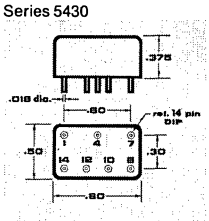
Series 7600



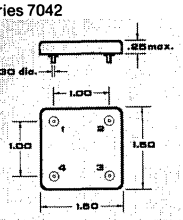
Series 7231



Series 5430



Series 7042



HIGH RELIABILITY oscillators use proven conservative designs and "ER" components. MIL-S-19500 transistors, JTX or JTXV; MIL-M-38510 I.C.'s or screened to MIL-STD-883. Soledring per N.H.B. 5300.4(3A) as specified.

QUALITY CONTROL exceeds requirements of MIL-I-45208A and MIL-C-45662A. Workmanship and soldering per Requirements 5 and 9 of MIL-STD-454F. Design and testing to MIL-O-55310. MIL-STD-883 or MIL-O-55310 screening.

Spectrum Technology Inc

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

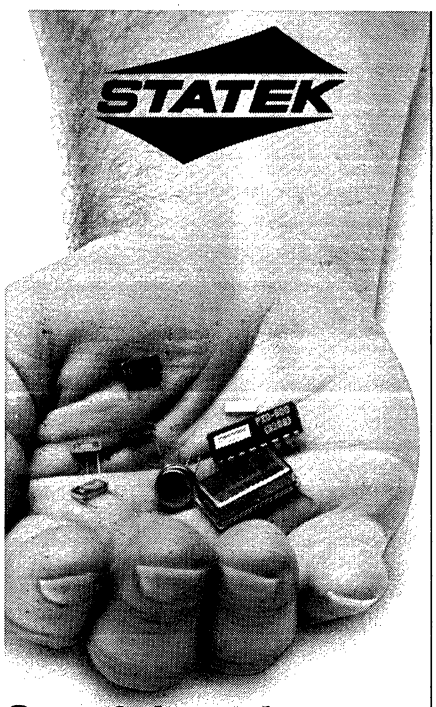
VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

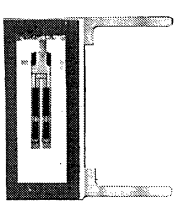


Statek has the most complete line of miniature, low-frequency quartz crystals and crystal oscillators in the world!

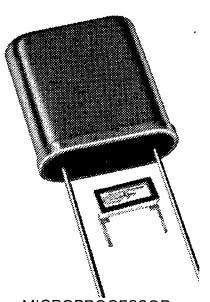
0.0006 Hz to 1.5 MHz

Quartz Crystals: 10kHz to 1.5MHz • High accuracy • Produced in volume by photolithography • Low aging • High Q • Rugged, hermetically sealed ceramic package • Designed for hybrid or PC board packaging.

Quartz Crystal Oscillators: Miniature (TO-5) series • Low power series • Programmable, multi-frequency series • CMOS/TTL compatible series • Very low frequency series.



Statek miniature CX crystal with proprietary tuning fork resonator in hermetic package. Magnified 3 times.



MICROPROCESSOR CRYSTAL
This Statek 1 MHz microprocessor crystal (bottom) is 48 times smaller in volume than the HC-33 industry-standard case (top).

Miniature Quartz Crystals CX Series

10 kHz to 1.5 MHz
Statek's CX Series crystals consist of a miniature quartz resonator, hermetically sealed in a rugged, ceramic package.

Types Available (See Table 1)
The CX Series is available in two case sizes: CX-1 and CX-2. The CX-1 is available from 10 kHz to 1.5 MHz and the CX-2 is available from 16 kHz to 1.5 MHz.

"H" models are designed for series (two cascaded inverters) oscillators. "V" models are designed for Pierce (single inverter) oscillator applications. See Table 1 for case size and configuration options and other special features.

TABLE 1: Miniature Low-Frequency Crystal Selection Chart: CX Series

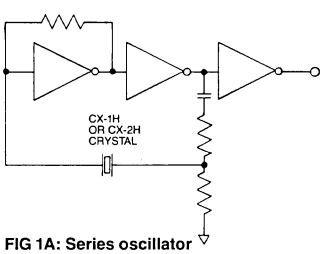
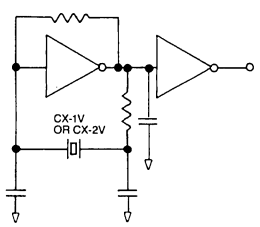
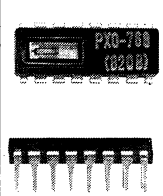
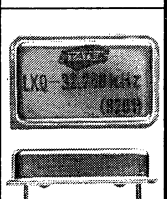
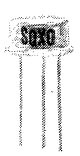
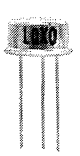
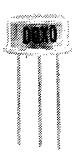
SERIES	CX-1H SERIES	CX-2H SERIES	CX-1V SERIES	CX-2V SERIES
PACKAGE AND LEAD CONFIGURATIONS AVAILABLE (Photos are actual size)	side leads; Leadless version for direct surface mounting; top bottom	end leads; side leads; side leads; Leadless version for direct surface mounting; top bottom	side leads; Leadless version for direct surface mounting.; top bottom	end leads; side leads; side leads; Leadless verson for direct surface mounting; top bottom
FREQUENCY RANGE	10kHz-1.5 MHz	16kHz-1.5 MHz	10kHz-1.5 MHz	16kHz-1.5 MHz
PRINCIPAL FEATURES	Standard IC lead spacing: 0.300 in. (7.62mm)	Smallest possible size for dense PC board or hybrid packaging	Standard IC lead spacing: 0.300 in. (7.62mm)	Smallest possible size for dense PC board or hybrid packaging.
OTHER SPECIAL FEATURES	• H Series designed for long service/ storage life • High reliability		• V Series designed for lowest possible power consumption • High stability • Ideal for battery-operated applications	
OSCILLATOR CIRCUIT	 FIG 1A: Series oscillator with CX-1H or CX-2H		 FIG 1B: Pierce oscillator with CX-1V or CX-2V	

TABLE 2: Low Frequency Crystal Oscillator Selection Chart

SERIES	PXO SERIES	LXO SERIES	SQXO-2 SERIES	LQXO-4 SERIES	DQXO-3 SERIES
PRINCIPAL FEATURES	Generates 57 discrete, programmable frequencies from one crystal	• High accuracy • Low aging • Low power	• TTL and CMOS compatible • TO-5 package	• Low power • CMOS compatible • TO-5 package	• Low frequency oscillator/timer • TO-5 package
PACKAGE STYLE (Photos are actual size)	 16-pin DIP	 4-pin metal case—pins on 14-pin DIP centers	 TO-5	 TO-5	 TO-5 MORE
FREQUENCY RANGE	0.002 Hz to 1.5 MHz	10 kHz to 1.5 MHz	10 kHz to 1.5 MHz	10 kHz to 1.5 MHz	0.0006 Hz to 10 kHz

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Miniature Low-Frequency Quartz Crystals

TABLE 3A: CX Series Specifications: 10 kHz to 600 kHz. (For specifications for 1.0 MHz, see Table 3B)

Specifications are typical at 25°C unless otherwise noted.
Specifications subject to change without notice.

Frequency (see Table 4)[1]	10 kHz to 600 kHz*
Frequency Calibration[2] (see Table 5)	A, B, or C Tolerance
Motional Resistance, R_1 (Maximum: 10–169 kHz, 2x typical;* 170–600 kHz, 2.5x typical)	Figure 4
Motional Capacitance, C_1	Figure 5
Quality Factor, Q (Minimum is 0.25 x typical)	Figure 6
Shunt Capacitance, C_0	1.4 pf typical
Drive Level ...10–25 kHz*	0.5 μw maximum
25–600 kHz	1.0 μw maximum
Turning Point, T_0	Figure 7
Temperature Coefficient, k	−0.035 ppm/°C[2]
Aging, first year	5 ppm maximum
Shock, survival	1,000 g, 1 ms, ½ sine
Vibration, survival	20 g rms, 10–2,000 Hz
Operating Temperature	
Industrial	−40 to +85°C
Military	−55 to +125°C
Storage Temperature	−55 to +125°C
Maximum Temperature	
Leads	150°C
Seal Rim	210°C

1. Flexure Mode
   10–169 kHz* ..... Fundamental
   170–600 kHz ..... First Overtone
2. Frequency specified for standard oscillator circuit. Tighter frequency calibration available.

*10–15.9 kHz not available in CX-2 case size.

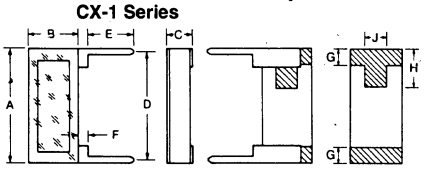
TABLE 3B: CX Series Specifications, 1.0 MHz

Specifications are typical at 25°C unless otherwise noted.
Specifications subject to change without notice.

Frequency Calibration	
Calibration A	±0.05%
Calibration B	±0.1%
Calibration C	±1.0%
Motional Resistance, R_1	
H Series	2 kΩ typical, 5 kΩ max.
V Series	750Ω typical, 1.5 kΩ max.
Motional Capacitance, C_1	1.8ff typical
Quality Factor, Q	
H Series	35,000
V Series	100,000
Shunt Capacitance, C_0	0.85 pf
Drive Level	3 μw maximum
Frequency Stability*	
0 to 70°C	−0.008%
−40 to +85°C	−0.025%
−55 to +125°C	−0.045%
Aging, first year	10 ppm maximum
Shock, survival	1,000 g, 1 ms, ½ sine
Vibration, survival	10 g rms, 10–2000 Hz

*Does not include calibration tolerance. Positive variations small compared to negative variations.

FIG 2A: Dimensions and case styles— CX-1 Series



DIM.	IN.	MM	NOTES
A	0.330	8.38	Max
B	0.155	3.94	Max
C	0.080	2.03	Max
D	0.300 ± 0.01	7.62 ± 0.25	
E	0.125	3.23	Min
F	0.040	1.02	Max
G	0.045	1.14	Nom
H	0.105	2.67	Nom
J	0.060	1.52	Nom

Leads 0.010" x 0.018" (0.25 x 0.46 mm) nom.

FIG 2B: Dimensions and case styles— CX-2 Series

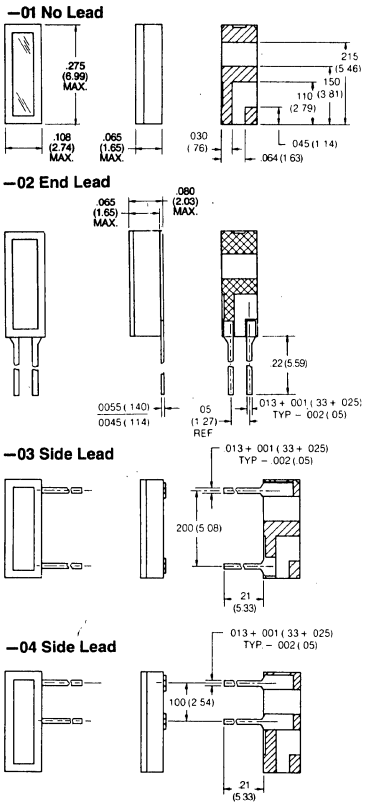


TABLE 4: Standard frequencies, CX Series

FREQUENCY (kHz)	COMMON DIVISION	APPLICATION
10*	10	1 kHz audio
12.8*	2^8	50 Hz time base
15.26*	2^8	60 Hz time base
16	2^4	1 kHz audio
16.384	2^{14}	1 Hz time base
18.641	2^{26}	1 cycle per hour
19.2	$2^{6,5,4}$	300, 600, 1200 baud modem
20.48	2^{12}	5 Hz clock motor
25	—	Ultrasonic alarm transducer
30.72	2^9	60 Hz time base
31.5	—	T.V. raster
32.768	2^{15}	1 second time base
38.4	$2^{6,5,4}$	600, 1200, 2400 baud modem
40	—	Ultrasonic alarm transducer
40.96	2^{12}	10 Hz clock motor
60	—	WWVB PLL
76.8	$2^{6,5,4}$	1200, 2400, 4800 baud modem
100	—	Calibrator
153.6	$2^{6,5,4}$	2400, 4800, 9600 baud modem
240	2^7	Motor control
307.2	$2^{7,6,5}$	2400, 4800, 9600 baud modem
500	—	Microprocessor
1000	—	Microprocessor

*CX-1 only

TABLE 5: Calibration tolerances at 25°C, CX Series

CALIBRATION	10–74.9 kHz	75–169 kHz	170–249 kHz	250–600 kHz	1.00–1.5 MHz
A	±0.003%	±0.005%	±0.01%	±0.02%	±0.05%
B	±0.01%	±0.01%	±0.02%	±0.05%	±0.1%
C	±0.1%	±0.1%	±0.2%	±0.5%	±1.0%

FIG 3: Equivalent circuit, CX Series

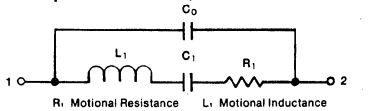


FIG. 4: Typical Motional Resistance R_1, CX Series (For 1.0 MHz, see Table 3B)

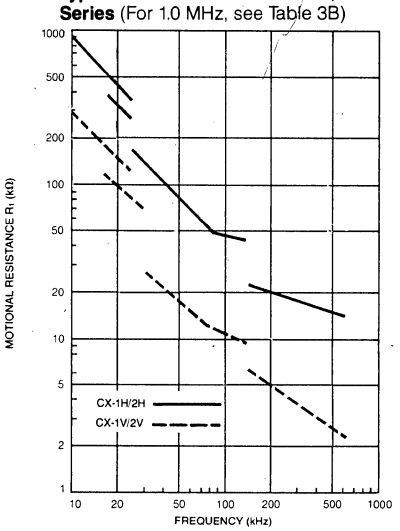


FIG. 5: Typical Motional Capacitance C_1, CX Series (For 1.0 MHz, see Table 3B)

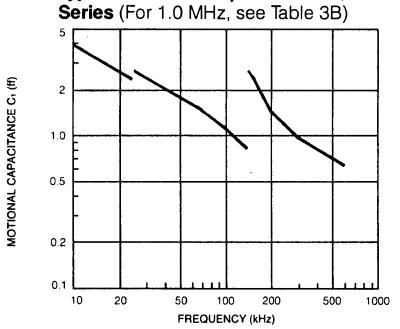


FIG. 6: Typical Quality Factor Q, CX Series (For 1.0 MHz, see Table 3B)

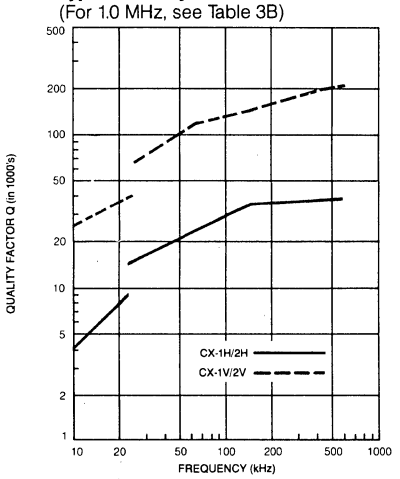
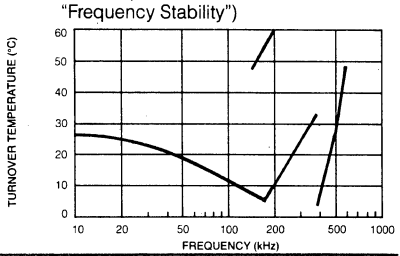


FIG. 7: Typical Turning Point Temperature, CX Series. (For 1.0 MHz, see Table 3B "Frequency Stability")



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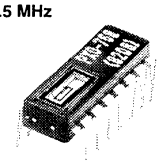
and Quartz Crystal Oscillators

Low-Frequency Quartz Crystal Oscillators

Programmable Crystal Oscillators PXO Series

0.002 Hz to 1.5 MHz



PXO-768

Generates 57 discrete, programmable frequencies from a single crystal • Packaged in standard 16-pin DIP • Low power • Low aging • TTL compatible. All frequencies generated are derived from a single built-in quartz crystal oscillator and exhibit the same high levels of accuracy and stability as those of the base frequency.

Standard calibration tolerance: ±100 ppm. Tighter tolerances available • Frequency stability: ±0.015%*, −10 to +70°C • Supply voltage: 4-6V • Supply current: 1 mA max • Rise time: 70 nsec typ • Fall time: 30 nsec typ • Aging: 10 ppm max first year.

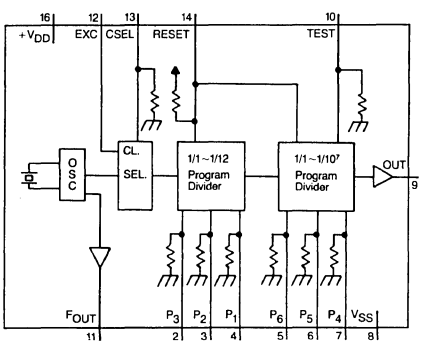
*Does not include calibration tolerance

Standard Frequency Ranges, PXO Series*

MODEL	BASE FREQUENCY	OUTPUT FREQUENCY RANGE
PXO-32768	327.68 kHz	0.00273 Hz to 327.68 kHz
PXO-600	600 kHz	0.005 Hz to 600 kHz
PXO-768	768 kHz	0.0064 Hz to 768 kHz
PXO-1000	1 MHz	0.0083 Hz to 1 MHz

*Other frequencies available. Consult factory.

Block Diagram, PXO Series



Pin Functions, PXO Series

Prog 1 through Prog 6 control divide ratio of base frequency.

P_1	P_2	P_3	DIVIDING RATIO	P_4	P_5	P_6	DIVIDING RATIO
0	0	0	1/1	0	0	0	1/1
0	0	1	1/10	0	0	1	1/10
0	1	0	1/2	0	1	0	$1/10^2$
0	1	1	1/3	0	1	1	$1/10^3$
1	0	0	1/4	1	0	0	$1/10^4$
1	0	1	1/5	1	0	1	$1/10^5$
1	1	0	1/6	1	1	0	$1/10^6$
1	1	1	1/12	1	1	1	$1/10^7$

OUT: Supplies programmed output frequency with rectangular pulse shape (50% duty cycle).

TEST: Setting this terminal Hi multiplies programmed output frequency by 1,000, except when programmed divide ratio is less than 1/1000.

FOUT: Supplies base frequency of internal crystal oscillator.

EXC: Input for counting external clock instead of internal clock.

CSEL: Clock select. Setting this terminal Hi causes the divider to count the frequency of an external clock instead of the internal clock.

RESET: Setting this terminal Lo resets all counters and sets output switches to Lo.

(All inputs except EXC and RESET have internal pull-down resistor. RESET has pull-up resistor.)

Output Frequencies, PXO Series

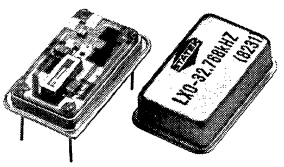
Example—Model PXO-1000
UNIT: Hz

PROGRAM PIN SETTINGS	P4	0	0	0	0	1	1	1	1
	P5	0	0	1	1	0	0	1	1
P1 P2	P6 P3	0	1	0	1	0	1	0	1
0 0	0	1M	100K	10K	1K	100	10	1	0.1
0 0	1	100K	10K	1K	100	10	1	0.1	0.01
0 1	0	500K	50K	5K	500	50	5	0.5	0.05
0 1	1	333.3K	33.3K	3.3K	333.3	33.3	3.3	0.33	0.033
1 0	0	250K	25K	2.5K	250	25	2.5	0.25	0.025
1 0	1	** 200K	20K	2K	200	20	2	0.2	0.02
1 1	0	166.6K	16.6K	1.6K	166.6	16.6	1.66	0.16	0.016
1 1	1	83.3K	8.3K	833.3	83.3	8.3	0.83	0.083	0.0083

*33% duty cycle **40% duty cycle

High Accuracy Crystal Oscillators LXO Series

10 kHz to 1.5 MHz



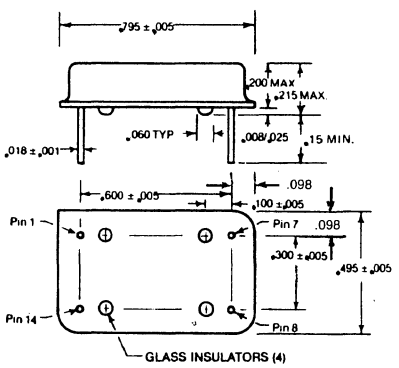
Laser tuned for high accuracy • Low aging • Low power • CMOS compatible • Low profile, hermetically-sealed package.

The LXO Series has the highest accuracy and stability of all Statek oscillators.
Specifications and characteristics of the LXO Series vary with frequency. Characteristics of the LXO-32.768 kHz model are presented below as an example. Contact factory for other frequencies.

Standard calibration tolerances: A: ±10 ppm; B: ±25 ppm; C: ±200 ppm. Tighter tolerances available • Frequency stability: −0.012%, −20 to +70°C* • Supply voltage: 3-6V • Rise time: 1.0 μsec max • Fall time: 1.0 μsec max • Supply current: 50 μA typical at 5V, 20 μA typical at 3V • Aging: 1 ppm/yr typical, 3 ppm max.

*Does not include calibration tolerance.

Package Dimensions (inches), LXO Series

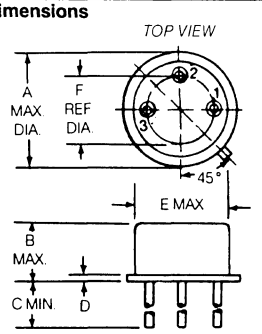


Miniature Quartz Crystal Oscillators

Statek manufactures three series of oscillators in TO-5 packages: SQXO-2 Series, LQXO-4 Series and DQXO-3 Series. They all have these features in common:
Laser tuning for high accuracy • hybrid construction • low aging • operating temperature: industrial: −40 to +85°C; military: −55 to +125°C • Shock (survival): 1000g. 1msec., ½ sine • vibration (survival): 10g rms, 10-2000 Hz.

TO-5 Dimensions

TOP VIEW



PIN	CONNECTION	DIM	INCHES	MILLIMETERS
1	V_{DD}	A	0.362	9.19
2	Output	B	0.185	4.70
3	Gnd.	C	0.500	12.70
		D	0.029	0.74
		E	0.326	8.28
		F	0.200	5.08

1. All metal parts are gold plated.
2. Leads are 0.019" (0.48mm) dia. max.

Miniature Quartz Crystal Oscillators SQXO-2 Series

10 kHz to 1.5 MHz

TTL and CMOS compatible • Standard calibration tolerances: A: ±0.01%, B: ±0.03%, • Frequency stability: ±0.02% typ., −40 to +85°C* • Supply voltage: 4-6V • Supply current: 200 μA-3mA • Standard frequencies: same as CX-1 crystal.

*Does not include calibration tolerance.

Miniature Quartz Crystal Oscillators: Low Power LQXO-4 Series

10 kHz to 1.5 MHz

Low power • CMOS compatible • Standard calibration tolerance: A: ±0.01%, B: ±0.03%, • Frequency stability: ±0.02% typ., −40 to +85°C* • Supply voltage: 4-6V • Supply current: 25-350 μA • Standard frequencies: same as CX-1 crystal.

*Does not include calibration tolerance

Miniature Quartz Crystal Oscillators/Timers: Low Frequency DQXO-3 Series

2 pulses/hr to 10 kHz*

CMOS compatible • Low power • Standard calibration tolerances: A: ±0.01%; B: 0.03% • Frequency stability: ±0.02% typ., −40 to +85°C** • Supply voltage: 4-6V • Supply current: 50 μA-3mA.

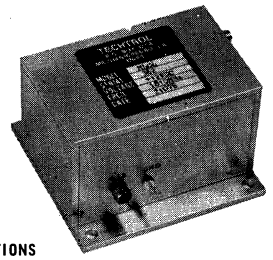
*Lower frequencies available
**Does not include calibration tolerance.

TECHTROL

815 MARKET STREET
NEW CUMBERLAND, PENNSYLVANIA 17070
(717) 774-2746

MICROWAVE FREQUENCY SOURCE

CRYSTAL CONTROLLED (±.001%) UP TO 8 GHz



SPECIFICATIONS

Fixed Frequency Output: Manufactured to your exact requirements.
Stability: ±.001% over temperature range.
Temperature Range: −20°C to +55°C.
Power Output: 100 mW, 20 mW, or, 5 mW min. as specified.
Harmonics and Subharmonics: −40 dBc for all sources with output frequency in range of 1 GHz to 8 GHz.
Harmonics and Subharmonics: −30 dBc for all sources with output frequency in range of .5 GHz to 1 GHz.
DC Input: 12 to 28 VDC Case ground plus or minus (as required).
Output Connectors: SMA.
All units have mechanical frequency adjustment to compensate for aging.
Spurious Levels: −60 dBc.

OPTIONS AVAILABLE

1. Secondary Standard (Oven Controlled)
±.001% frequency stability over temperature range of −20°C to +60°C.
Utilizes a small solid state oven enclosing the crystal only.
Phase noise same as standard unit.

Additional Requirements:
+24 VDC to +28 VDC oven power (may be unregulated).
Add 1.0″ to length.
Model number becomes MK.

2. Frequency Standard (Oven Controlled)
High Stability
±2 x 10^{-8} frequency stability over temperature range of −20°C to +55°C.
Utilizes a tight tolerance proportional type oven and AGC, crystal is designed for long term aging characteristics.

Additional Requirements:
+24 VDC to +28 VDC oven power (maybe unregulated).
Add 1.5″ to length.
Model number becomes MH.

3. Low Phase Noise
±.003% over temperature range of −20°C to +60°C.
Add 1.0″ to length.
Model number becomes MN.

4. Low Phase Noise/High Stability
±2 x 10^{8} over temperature range of −20°C to +55°C.

Additional Requirements:
+24 VDC to +28 VDC oven voltage (may be unregulated).
Add 1.5″ to length.
Model number becomes MHN.

5. Voltage Control Crystal Oscillator
÷ 3 options are available.
Tuning voltage ±3.
Modulation rate 100 KHz.
Linearity 5% best straight line.

Model MVA.
±.003% frequency swing.
±.002% frequency stability 0° to +50°C.
Add 1.0″ to length.

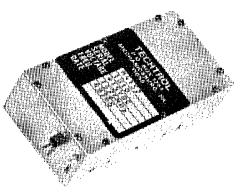
Model MVB.
±.01% frequency swing.
±.002% frequency stability 0°C to +50°C.
Add 1.5″ to length.

Model MVC.
±.1% frequency swing.
±.005% frequency stability 0°C to +50°C.
Add 2.0″ to length.

6. Multi-Channel Crystal Source
Up to 7 independent frequencies available.
TTL compatible frequency selection.
±.005% frequency stability.
Temperature range of −20°C to +50°C.
Add 2.6″ to length.
Model number becomes MM.

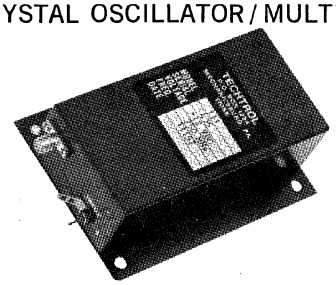
MODEL NUMBER	FREQUENCY	MIN. POWER OUTPUT	SIZE (IN.) L-W-H
M401	.5-1 GHz	5 mW	2.2-3.4-2
M402	.5-1 GHz	20 mW	2.2-3.4-2
M403	.5-1 GHz	100 mW	2.2-3.4-2
M404	1.01-2 GHz	5 mW	3.2-3.4-2
M405	1.01-2 GHz	20 mW	3.2-3.4-2
406	1.01-2 GHz	100 mW	3.2-3.4-2
407	2.01-4 GHz	5 mW	3.2-3.4-2
M408	2.01-4 GHz	20 mW	3.2-3.4-2
M409	2.01-3 GHz	100 mW	3.2-3.4-2
M410	3.01-4 GHz	100 mW	3.2-3.4-2
M411	4.01-8 GHz	5 mW	3.2-3.4-2
M412	4.01-8 GHz	20 mW	3.2-3.4-2
M413	4.01-8 GHz	100 mW	4.3-3.4-2
M414	8.01-12 GHz	5 mW	3.2-3.4-2
M415	8.01-12 GHz	20 mW	4.3-3.2-2
M416	8.01-12 GHz	50 mW	4.3-3.2-2

COMPACT MICROWAVE SOURCE/MODEL M4000



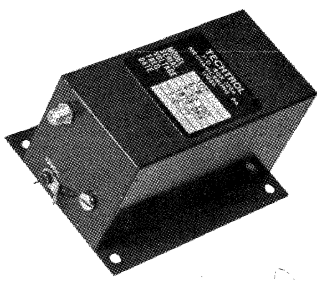
SPECIFICATIONS:
Frequency Range: 500 MHz to 3 GHz
±.003% −20°C to +65°C.
+15 VDC supply voltage.
60 dB spurious + harmonic rejection.
Excellent phase noise.
SMA output connector.
Filter-Con for DC supply input.
Design for high shock + vibration.
Size: 1″ x 1.5″ x 3″.

CRYSTAL OSCILLATOR/MULTIPLIER SOURCE/MODEL 111



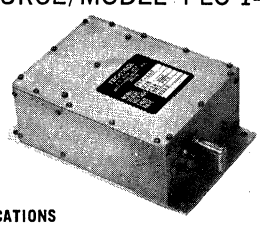
SPECIFICATIONS
Frequency Range: 300 MHz to 1 GHz.
±.001%, 0°C to +50°C; ±.003%, −20°C to +65°C.
12 VDC to 28 VDC operating voltage range (minus operating voltage available). Specify exact operating voltage.
30 dB spurious rejection.
SMA output connector standard (BNC, TNC, N, UHF connectors available).
Filter-con DC input solder pin).
Over voltage — reverse polarity protected.
Size (Approx): 4″L x 2″W x 1.375″H.

LOW COST CRYSTAL OSCILLATOR/MODEL 107



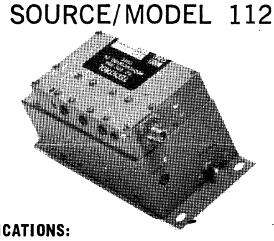
SPECIFICATIONS
Any discrete frequency between 1 GHz and 2.5 GHz.
±.001%, 0°C to +50°C; ±.003%, −20°C to +65°C.
50 ohms output impedance.
12 VDC to 28 VDC operating voltage range (minus operating voltage available). Specify exact operating voltage.
45 dB spurious rejection.
SMA output connector.
Filter-con DC input (solder pin)
Over voltage — reverse polarity protected.
Size (Approx): 4″L x 2″W x 2″H.
1 year warranty.
20 mW — 1 to 2.5 GHz, 15 mW — 2.5 to 3.5 GHz,

WIDE BAND PHASE LOCK SOURCE/MODEL PLC-140A



SPECIFICATIONS
Frequency Range: 400 MHz to 1500 MHz (Any 200 MHz Band).
Power Output: 20 mW.
Frequency Stability: ±.003%.
Temperature Range: 0°C to +50°C.
Subharmonic Rejection: −50 dBc.
Harmonic Rejection: −26 dBc.
Operating Voltage: +15 VDC.
Connector: SMA.
Size: 4″ x 3.375″ x 2″.

LOW COST MICROWAVE SOURCE/MODEL 112

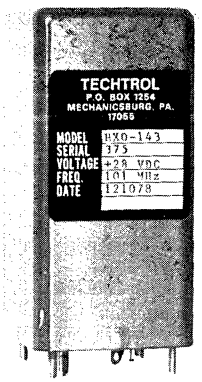


SPECIFICATIONS:
Frequency Range: 3 GHz to 6 GHz.
Frequency Stabiiity: ±.005%.
Temperature Range: 0°C to +50°C.
Power Output: 5 mW min., 10 mW typ.
Operating Voltage: +15 VDC.
Subharmonic Rejection: −35 dBc.
Harmonic Rejection: −50 dBc.
Size: 4″ x 2.1″ x 2″.

TECHTROL

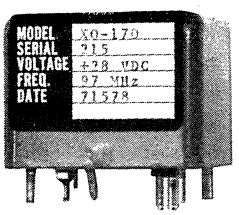
CRYSTAL OSCILLATORS

HIGH STABILITY/HXO-143



SPECIFICATIONS:
Frequency Range: 1 MHz to 600 MHz.
Power Output: +10 dBm, 50 ohms.
Frequency Stability: ±5 x 10^{-8}, 0°C to +55°C.
Aging Rate: ±1 x 10^{-7}/Day.
FM Noise: −105 dB, 100 Hz
−110 dB, 1 KHz
−140 dB, 10 KHz
−140 db, 100 KHz.
Harmonics: Less than 40 dBc.
Voltage: +15 VDC and +28 VDC.
Size: 2″ x 2″ x 4″.
Connector: SMA.

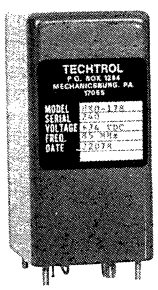
MODEL XO-170



SPECIFICATIONS:
Frequency Range: 1 MHz to 600 MHz.
Power Output: +10 dBm.
Frequency Stability: ±.003%, −20°C to +60°C
±.005%, −40°C to +70°C.
Harmonics: −40 dBc min.
Voltage: +5 VDC to +28 VDC (specify).
Size: 2″W x 2″L x 1.75″H.
Connector: BNC or SMA.

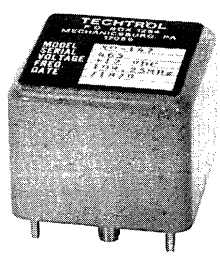
LOW PHASE NOISE

MODEL HXO-178



SPECIFICATIONS:
Frequency Range: 1 MHz to 600 MHz.
Power Output: +10 dBm.
Frequency Stability: ±5 x 10^{-8}, 0°C to +55°C.
Aging Rate: ±1 x 10^{-7}/Day.
FM Noise: −114 dB, 100 Hz
−135 dB, 1 KHz
−160 dB, 10 KHz
−169 dB, 100 KHz.
Harmonics: Less than −40 dBc.
Voltage: +15 VDC and +28 VDC.
Size: 2″ x 2″ x 4″.
Connector: SMA.

MODEL XO-147

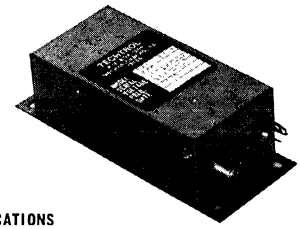


SPECIFICATIONS:
Frequency Range: 1 MHz to 600 MHz.
Power Output: +10 dBm min.
Frequency Stability: ±.003%, −20°C to +60°C
±.005%, −40°C to +70°C.
Harmonics: −20 dBc min.
Voltage: +5 VDC to +28 VDC (specify).
Size: 2″W x 2″L x 1.75″H.
Connector: BNC or SMA.

IF YOU HAVE SPECIAL REQUIREMENTS
CALL US.

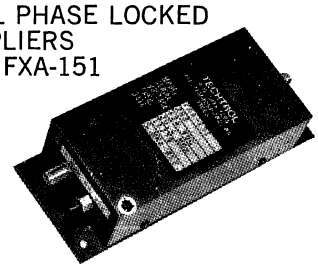
MULTIPLIERS

FREQUENCY MULTIPLIER USING DIRECT MULTIPLICATION MODEL FXA-217-1



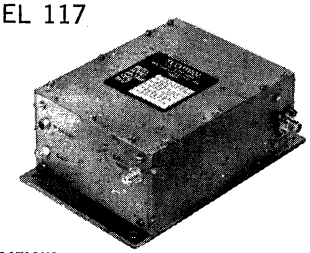
SPECIFICATIONS
Input Frequency: 10 MHz @ 0 dBm.
Output Frequency Range: X2 through X25.
Output Power: +10 dBm.
Power Stability: ±.5 dB, −20°C to +70°C.
Spurious Rejection: 60 dBc or greater.
Operating Voltage: +15 VDC @ 40 mA.
Size: 4″L x 2″W x 1.375″H.

DIGITAL PHASE LOCKED MULTIPLIERS MODEL FXA-151



Frequency Range: 10 MHz to 750 MHz.
Input Level: −20 dBc to +10 dBc, 50 ohms, 100 kHz to 10 MHz.
Power Output: +10 dBm min.
Lock Time: Approx. 50 ms.
Operating Temperature Range: 0°C to 50°C (−20°C to +75°C, optional).
Subharmonics: Less than −50 dBc (−70 dBc optional).
Harmonics: Less than −26 dBc (−60 dBc optional).
Output Impedance: 50 ohms.
VSWR: 1.5:1 max.
Output Connector: SMA.
Input Connector: SMA.
Operating Voltage: +15 VDC and +5 VDC.
DC Connector: Filter con.
Size: 4″L x 2″W x 1.375″H.
Mounting: Flange.

FREQUENCY MULTIPLIERS USING DIRECT MULTIPLICATION MODEL 117



SPECIFICATIONS
Frequency Range: 1 MHz to 8.0 GHz.
Band Width: Typically 1%, 1 dB; 3%, 3 dB.
Up to 10% available.
Power Input: 0 dBm ±3 dB. (Inputs from −10 dBm to +20 dBm ranges available).
Power Output: 0 dBm to +20 dBm.
Spurious Rejection: −60 dBc.
Harmonic Rejection: −40 dBc (Higher rejection available).
Subharmonic Rejection: −40 dBc (Higher rejection available).
Operating Voltage: +12 VDC to +28 VDC range (AC option available).
Header: Filter con — SMA.
Size: 4″L x 2″W x 1.375″H. Length depends on requirement.
Mounting: Flange

VECTRON

Clock Oscillators

TTL

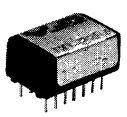
	PCB MOUNT	DIP COMPATIBLE		
Features:	*Broadest range of frequencies & options*	*14 pin DIP 0.35" high*	*14 pin DIP 0.28" high*	*Larger DIP but with freq. as low as 50 Hz*
Model:	**CO-231**	**CO-238A (B or T)**	**CO-234A (or B)**	**CO-235**
Frequency:	**CO-231:** 1 Hz-75 MHz **CO-231H:** 75.01-100 MHz	16 KHz thru 100 MHz	16 KHz thru 30 MHz	50 Hz thru 25 MHz
Output Level:	Drives 10 TTL loads (above 50 MHz drives 2 Schottky TTL loads)			
Supply:	5 VDC ±5%	5 VDC ±5%	5 VDC ±5%	5 VDC ±5%
Tuning Option Available:	*YES Models with "T" suffix include tuning adjustment with setability <.0001%	*YES (to 30 MHz)	NO	*YES
Accuracy: (at 25°C)	**CO-231:** ± .001% ***CO-231T:** ±.0001%	**CO-238A:** ± .005% **CO-238B:** ± .001% ***CO-238T:** ±.0001%	**CO-234A:** ±.005% **CO-234B:** ±.001%	**CO-235:** ± .001% ***CO-235T:** ±.0001%
Stability:	**Standard:** 0°C to + 70°C: ±.0025% Option 1: −55°C to + 85°C: ±.005% (−40/+85°C for CO-231-1 <60 Hz) Option 2: −55°C to +125°C: ±.005% (70 MHz max for CO-238-2) Option 3: 0°C to + 50°C: ±.0003% (24 KHz min for CO-238, CO-234) Option 4: 0°C to + 50°C: ±.0001% (only for CO-231 in 12 KHz-20 MHz range) Option 5: 0°C to + 50°C: ±.0005% (100 Hz min for CO-235) Option 6: 0°C to + 50°C: ±.001% Option 8: 0°C to + 70°C: ±.01% (includes initial accuracy; A, B & T are N/A) Option Y: Aging improved from 5 to 1 ppm/year typical			
Size:	1½" x 1½" x ½" 38 x 38 x 12.7 mm	.5" x .8" x .35" 12.7 x 20.3 x 8.9 mm	.5" x .8" x .28" 12.7 x 20.3 x 7.1 mm	1½" x 1½" x ½" 38 x 38 x 12.7 mm
Option C:	Fully sealed metal can for 100% r.h. requirements — results in slight height increase. Not available in CO-235. Not available with tuning option in CO-238.			

ECL

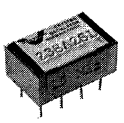
	PCB MOUNT		DIP COMPATIBLE
Features:	*To 200 MHz*	*To 500 MHz Sub-nanosecond*	*14 pin DIP*
Model:	**CO-233ME** **CO-233MEHA (or B)**	**CO-533KE** **CO-533ME**	**CO-633A (or B)**
Frequency:	**ME:** 5-149 MHz **MEH:** 150-200 MHz	150 MHz thru 500 MHz	5 MHz thru 200 MHz
Output Level:	ECL compatible	100K sub-nanosecond Complementary ECL	ECL compatible
Supply:	−5.2 VDC ±5%	**CO-533KE:** −4.5V **CO-533ME:** −5.2V	−5.2 VDC ±5%
Tuning Option Available:	*YES (to 150 MHz)	*YES	NO
	*Tuning setable to .0001% with "T" suffix		
Accuracy: (at 25°C)	**CO-233ME:** ±.001% ***CO-233MET:** ±.0001% **CO-233MEHA:** ±.005% **CO-233MEHB:** ±.001%	**CO-533KE/ME:** ±.001% ***CO-533KET/MET:** ±.0001%	**CO-633A:** ± .005% **CO-633B:** ± .001%
Stability:	**Standard:** 0/+ 70°C: ±.0025% **Option 1: −55/+ 85°C: ±.005% **Option 2: −55/+125°C: ±.005% ***Option 3: 0/+ 50°C: ±.0003% Option 5: 0/+ 50°C: ±.0005% Option 6: 0/+ 50°C: ±.001% Option 8: 0/+ 70°C: ±.01% (includes accuracy) Option Y: Aging improved from 5 to ppm/year typical **−30/+85°C limit for **CO-233ME(MEH)** or **CO-633** >125 MHz ** 0/+85°C limit for **CO-533KE/ME** ***Not available 150 MHz and above in **CO-233MEH** or **CO-633**		
Size:	1½" x 1½" x 5/8" (38 x 38 x 16 mm)	2" x 3" x ¾" (51 x 77 x 19 mm)	.5" x .8" x .42" (12.7 x 20.3 x 10.7 mm)
Option C:	Fully sealed metal can		

CMOS

	PCB MOUNT	DIP COMPATIBLE	
Features:	*Broadest range of frequencies and options*	*14 pin DIP*	*Larger DIP package but freq. as low as 60 Hz*
Model:	**CO-236**	**CO-636A (or B)**	**CO-536**
Frequency:	.01 Hz thru 15 MHz	3 MHz thru 15 MHz	60 Hz thru 15 MHz
Output Level:	Output derived from CMOS gate or divider with p-p >80% of Vcc (can furnish >95% of Vcc if required)		
Supply:	5-15 VDC for frequencies below 6 MHz; 10-15 VDC above 6 MHz 1-2 ma typical below 2 MHz		
Tuning Option Available:	*YES *Models with "T" suffix include tuning with setability <.0001%	NO	*YES
Accuracy (at 25°C):	**CO-236:** ± .001% ***CO-236T:** ±.0001%	**CO-636A:** ±.005% **CO-636B:** ±.001%	**CO-536:** ± .001% ***CO-536T:** ±.0001%
Stability:	**Standard:** 0/+ 70°C: ±.0025% Option 1: −40/+ 85°C: ±.005% Option 2: −55/+125°C: ±.005% Option 3: 0/+ 50°C: ±.0003% (6 MHz min for CO-636) Option 4: 0/+ 50°C: ±.0001% (only CO-236 >200 Hz) Option 5: 0/+ 50°C: ±.0005% (4 MHz min for CO-636) Option 6: 0/+ 50°C: ±.001% Option 8: 0/+ 70°C: ±.01% (includes accuracy) Option Y: Aging improved from 5 to 1 ppm/year typical		
Size:	1½" x 1½" x ½" 38 x 38 x 12.7 mm	.5" x .8" x .42" 12.7 x 20.3 x 10.7 mm	1½" x 1½" x ½" 38 x 38 x 12.7 mm
Option C:	Fully sealed metal can; results in slight height increase. Not available in CO-536.		



Standard DIP



Sealed DIP (Option "C")

PCB Mount

HOW TO SPECIFY MODEL NUMBER . . .

CO— □ □ □ □ — □ □ at ☐

- Basic Model
- Accuracy or tuning option (leave out if not applicable)
- "C" if metal sealed for 100% rh (leave out if not applicable)
- Stability option (leave out if "Standard")
- Frequency

If one of these standard models, with listed options, does not meet your requirements, please detail the differences from the closest standard model (e.g. CO-231 except for temperature stability of ±.002% over −10°C/+60°C). A unique part number will be assigned at time of order.

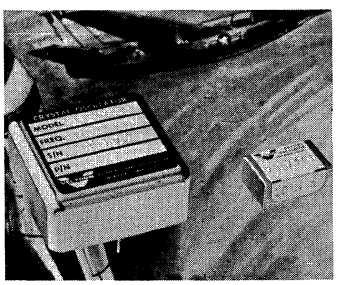
VECTRON

Screen Tested Clock Oscillators

Each of the Clock Oscillators described above (except for CO-235 and CO-536) are available in a full sealed metal can; simply add "C" to the Model No. (e.g. CO-238B-1C).

For those high reliability applications requiring Screen Tested components, Vectron offers the same oscillators:

- 100% Screen Tested as follows:
  - (A) Thermal Shock per MIL-STD-202 Method 107D, Test Condition A
  - (B) Seal Test per MIL-STD-202, Method 112B, Test Condition D
  - (C) Burn-in for 168 hours at maximum specified operating temperature
- Packaged in fully solder sealed metal housing
- Ruggedized for shock and vibration



HOW TO SPECIFY MODEL NUMBER . . .

□ □ □ □ — □ S — □ at ☐

- Basic Model
- Accuracy at 25°C
- Stability option
- S: Indicates sealed, screened model
- *Shock and vibration
- Frequency

*Code	Shock (MIL-STD-202, Meth 213B)	Vibration (MIL-STD-202)
"0"	30g, 11 msec per Test Cond J	10-55 Hz, .06" DA per Meth 201 and 5g to 500 Hz
"1"	100g, 6 msec per Test Cond C	10g to 500 Hz per Meth 204C, Cond A
"2"	100g, 6 msec per Test Cond C	20g to 2 KHz per Meth 204C, Cond D and 20 grms overall random to 2 KHz per meth 214, Cond I-F

QPL'd Clock Oscillators TTL per MIL-O-55310/16 CMOS per MIL-O-55310/18

	CMOS			
MHz	1 Hz - 15 MHz			
	8-15 VDC		5 VDC	
4 pin	4 pin	14 pin	4 pin	14 pin
-402A	CO-411A	CO-412A	CO-421A	CO-422A
-402C	CO-411C	CO-412C	CO-421C	CO-422C
-402D	CO-411D	CO-412D	CO-421D	CO-422D
-402E	CO-411E	CO-412E	CO-421E	CO-422E
itor (<20 MHz only)				

dard: ± 25 ppm over 0°C to + 70°C
on 1: ± 50 ppm over −55°C to + 85°C
on 2: ± 50 ppm over −55°C to +125°C
on 5: ± 5 ppm over 0°C to + 50°C
on 6: ± 10 ppm over 0°C to + 50°C
on 7: ±100 ppm over −55°C to +125°C
ons 2 and 7 not available over 70 MHz

netic per MIL-STD-883, 10⁻⁸ atm cc/second

to 2 KHz per MIL-STD-202, Method 204D, Cond. D

rms overall to 2 KHz per MIL-STD-202, Method 214

in base. Vectron TTL Type CO-401 is identical to the base; similarly Vectron CMOS Type CO-411 is it has a 4 pin base. All of these types meet requirements.

SCREEN TEST	MIL-STD-883 METHOD	Standard LEVEL X	Options LEVEL C	Options LEVEL D	Options LEVEL B
Internal Visual	2017	X	X	X	X
Stabilization Bake (24 Hours @ 150°C)	1008, Cond C	X	X	X	X
Seal Test (Gross and Fine)	1014	X	X	X	X
Temperature Cycling (Thermal Shock)	1010, Cond B		X	X	X
Burn-in, operating 168 hours @ 125°C	—			X	X
Acceleration (5000g in Y_1 axis)	2001, Cond A				X
			Complies with Class C Screen Test requirements of MIL-O-55310/16 & MIL-O-55310/18		Complies with Class B Screen Test requirements of MIL-O-55310/16 & MIL-O-55310/18

HOW TO SPECIFY MODEL NO. . . .

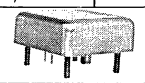
CO-4 [ ][ ][ ]–[ ][ ] at [ ]

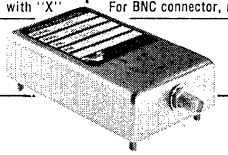
- TTL out/5 VDC in = 0
- CMOS out/8-15V in = 1
- CMOS out/5 VDC in = 2
- 4 pin base = 1
- 14 pin base = 2
- Initial Accuracy @ 25°C (A, C, D or E)
- Temperature Stability (0 for Standard, or option 1, 2, 5, 6, or 7)
- Screen Test Option (X, B, C or D)
- Frequency

VECTRON Sinewave Oscillators

(for higher stability see TCXO and Oven Sections)

	Low Frequency CO-281	VHF CO-233 SERIES	UHF CO-283W	VHF High Power CO-284W
Frequency:	50 Hz-4 MHz	4 MHz-500 MHz	500.1-1000 MHz	4-500 MHz
Output Level:	Std: 1 vrms/1KΩ Opt: 0.5 vrms/50Ω above 10 KHz	Standard: 0.5 vrms/50Ω (+ 7 dBm) Option R: 1 vrms/50Ω (+13 dBm)	Standard: 0.5 vrms/50Ω (+ 7 dBm) Option R: 1 vrms/50Ω (+13 dBm)	1 watt/50Ω (+30 dBm) to 250 MHz 0.5 watt/50Ω (+27 dBm), 250-500 MHz
Supply:	+15 VDC. Any supply in 15-28 VDC range optional; supply less than 15 VDC subject to reduced output level			+15 VDC (+24 VDC optional to 300 MHz)
Accuracy:	±10 ppm at 25°C. Add "T" to model number for tuning adjustment with setability of ±1 ppm			
Stability:	Standard: 0°C to + 70°C: ±.0025% Option 1: −55°C to + 85°C: ±.005% Option 2: −55°C to +125°C: ±.005% (N/A for CO-283W or CO-284W) Option 3: 0°C to + 50°C: ±.0003% (N/A for CO-284W) Option 4: 0°C to + 50°C: ±.0001% (only for CO-281) Option 5: 0°C to + 50°C: ±.0005% Option 6: 0°C to + 50°C: ±.001% Option Y: Aging improved from 5 ppm/year typical to 2 ppm/year			
Noise:		−125 dB/Hz at 1 KHz and −150 dB/Hz at 50 KHz, typical to 100 MHz. 6 dB degradation per octave above 100 MHz		
Size:	2″ x 2″ x ¾″ 51 x 51 x 19 mm pins for pcb mount	CO-233: 5-149 MHz, 1½″ x ½″ x ⅝″, pins for pcb mount CO-233H: 150-300 MHz, 1½″ x ½″ x ⅝″, pins for pcb mount CO-233FW: 4-500 MHz, 2″ x 2″ x ¾″, chassis mount with SMA output connector (SMC or BNC optional)	2″ x 3″ x ¾″ (51 x 76 x 19 mm) Chassis mount with SMA output connector For SMC connector, replace "W" with "U" For BNC connector, replace "W" with "X"	2″ x 3″ x ¾″ (51 x 76 x 19 mm) Chassis mount with SMA output connector For SMC connector, replace "W" with "U" For BNC connector, replace "W" with "X"





Environmental Characteristics of Vectron Oscillators

Operating Temperature: per temperature stability specification (from 0/50°C to −55/+125°C depending upon model/option selected)

Storage Temperature: −55°C to +85°C (to 125°C available)

Altitude: sea level to space

Orientation: any

Humidity: 100% for fully sealed models. 90% for non-sealed models, but these can either have internal boards conformally coated for 95% r.h., or be repackaged in fully solder sealed housings for 100% r.h.

Shock: 30g, 11 msec per MIL-STD-202, Method 213, Test Condition J, is standard. (100g shock optionally available in all models, and capability to withstand even more severe shock available in some models.)

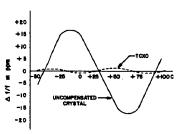
Vibration: 10-55 Hz, .06″ DA per MIL-STD-202, Method 201A, and 5g to 500 Hz is standard. (Vibration to 20g thru 2 KHz per MIL-STD-202, Method 204, Test Condition A, B, C or D optionally available in all models, and capability to withstand even more severe vibration, sinusoidal or random, available in some models.)

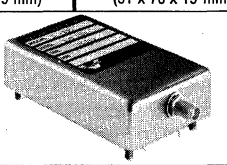
NOTE: Vectron has produced oscillators for airborne, shipboard, manpack, mobile, spacecraft, rocket and missile applications.

VECTRON **VECTRON LABORATORIES, INC.** The CRYSTAL OSCILLATOR COMPANY
166 Glover Avenue, Norwalk, CT 06850 • Telephone: 203/853-4433 • TWX: 710/468-3796

VECTRON TCXOs Temperature Compensated Crystal Oscillators

	50 Hz to 20 MHz		20+ MHz to 140 MHz	140 MHz to 400 MHz
	CO-251 SERIES Moderate Stability Lower Cost	**CO-252 SERIES** High Stability	**CO-254 SERIES**	**CO-255 SERIES**
Temperature Stability:				
(Temp. Range **A**) +15°C to +35°C:	**CO-251A57:** ±5 x 10-7 **CO-251A27:** ±2 x 10-7	**CO-252A17:** ±1 x 10-7 **CO-252A58:** ±5 x 10-8	**CO-254A57:** ±5 x 10-7 **CO-254A17:** ±1 x 10-7	**CO-255A57:** ±5 x 10-7 **CO-255A17:** ±1 x 10-7
(Temp. Range **B**) 0°C to +50°C:	**CO-251B16:** ±1 x 10-6	**CO-252B57:** ±5 x 10-7 **CO-252B27:** ±2 x 10-7 **CO-252B17:** ±1 x 10-7	**CO-254B16:** ±1 x 10-6 **CO-254B57:** ±5 x 10-7 **CO-254B27:** ±2 x 10-7	**CO-255B16:** ±1 x 10-6 **CO-255B57:** ±5 x 10-7 **CO-255B27:** ±2 x 10-7
(Temp. Range **C**) 0°C to +70°C:	**CO-251C36:** ±3 x 10-6	**CO-252C16:** ±1 x 10-6 **CO-252C57:** ±5 x 10-7 **CO-252C37:** ±3 x 10-7	**CO-254C36:** ±3 x 10-6 **CO-254C16:** ±1 x 10-6 **CO-254C37:** ±3 x 10-7	**CO-255C36:** ±3 x 10-6 **CO-255C16:** ±1 x 10-6 **CO-255C37:** ±3 x 10-7
(Temp. Range **D**) −20°C to +70°C:	**CO-251D56:** ±5 x 10-6	**CO-252D16:** ±1 x 10-6 **CO-252D57:** ±5 x 10-7	**CO-254D56:** ±5 x 10-6 **CO-254D16:** ±1 x 10-6 **CO-254D57:** ±5 x 10-7	**CO-255D56:** ±5 x 10-6 **CO-255D16:** ±1 x 10-6 **CO-255D57:** ±5 x 10-7
(Temp. Range **E**) −40°C to +75°C:	**CO-251E15:** ±1 x 10-5	**CO-252E56:** ±5 x 10-6 **CO-252E26:** ±2 x 10-6 **CO-252E16:** ±1 x 10-6	**CO-254E56:** ±5 x 10-6 **CO-254E26:** ±2 x 10-6 **CO-254E16:** ±1 x 10-6	**CO-255E56:** ±5 x 10-6 **CO-255E26:** ±2 x 10-6 **CO-255E16:** ±1 x 10-6
(Temp. Range **F**) −55°C to +85°C: (Higher temperature operation available)	**CO-251F25:** ±2 x 10-5	**CO-252F56:** ±5 x 10-6 **CO-252F26:** ±2 x 10-6 **CO-252F16:** ±1 x 10-6	**CO-254F56:** ±5 x 10-6 **CO-254F26:** ±2 x 10-6 **CO-254F16:** ±1 x 10-6	**CO-255F56:** ±5 x 10-6 **CO-255F26:** ±2 x 10-6 **CO-255F16:** ±1 x 10-6
Output Level & Frequency:	TTL: 50 Hz -20 MHz CMOS: 50 Hz -15 MHz SINE: 1 MHz-20 MHz		SINE: 20 MHz-140 MHz TTL: 20 MHz-100 MHz ECL: 20 MHz-140 MHz	SINE: 140 MHz-400 MHz ECL: 140 MHz-280 MHz
Supply:	Any supply voltage in 5-28 VDC range; current as low as 3 ma for some models			12-28 VDC
Frequency Adjustment:	Screwdriver adjustment, setable to 1 x 10-7. Electronic tuning (TC/VCXO) capability optional.			
Aging Rate:	5 x 10-7 to 1 x 10-6 per year		1 to 2 x 10-6/year	1 to 2 x 10-6/year
Size:	2″ x 2″ x ¾″ (51 x 51 x 19 mm) smaller size available		2″ x 2″ x ¾″ (51 x 51 x 19 mm)	2″ x 3″ x ¾″ (51 x 76 x 19 mm)

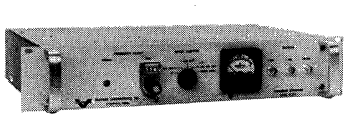




Selecting Basic Model:
1. Determine appropriate column by frequency desired.
2. Determine appropriate row by operating temperature range desired.
3. Select a basic model from those available at the desired frequency and temperature range.
4. Specify supply voltage, output level and whether pcb mount or chassis mount with rf connector.

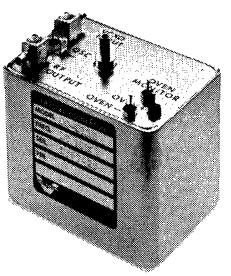
VECTRON Frequency Standards

Model:	**FS-321B**	**FS-323A**
Aging Rate:	3 x 10-10 per day at time of shipment 1 x 10-10 per day typical within 60 days "—1" OPTION 1 x 10-10 per day at time of shipment	
Frequencies:	5, 1 & 0.1 MHz	
Output Level:	1 vrms/50 ohms	
Temperature:	±5 x 10-10 over 0-50°C	
Noise Floor:	>150 db below 5 MHz output	
Oven Control:	Double proportional	
Supply:	115/230 VAC or 22-30 VDC	115/230 VAC or 22-30 VDC
Battery Life:	24 hours rechargeable	None
Size:	5¼″ x 19″ x 14″ (13.4 x 48.3 x 35.6 cm)	3½″ x 19″ x 14″ (8.9 x 48.3 x 35.6 cm)



VECTRON Replacement for Hewlett Packard Model 10811B

Vectron type CO-811B offers mechanical and electrical-interface interchangeability with discontinued HP10811B



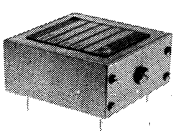
Aging:	5x10-10/day 1x10-7/year
0/+71°C: **−55/+71°C:**	2.5x10-9 p-p 4.5x10-9 p-p
Noise:	100 Hz: −140dBc/Hz 10 KHz: −160dBc/Hz
Crystal:	SC-cut for fast stabilization

VECTRON Hybrid Oven Low Profile Oscillator

- PCB Mounting
- Small (1″ high)
- Low power drain

CO-311 SERIES

Stability:	Same aging and temperature stability specs as CO-211 Series (see top of next page)
Output: **TTL** **CMOS** **SINE**	**Frequency Range** 250 KHz - 17 MHz 4-6 & 8-15 MHz 4-6 & 8-17 MHz
Supply:	15 VDC for oscillator 5 VDC also, if TTL out (5-28 VDC optional)
Input Power:	3 watts at turn-on 1.3 watts stabilized (25°C)
Frequency Adjust:	Mechanical; electronic optional
Size:	2¼″ x 2¼″ x 1″ (58 x 58 x 26mm)



VECTRON Oven Controlled Oscillators (with Ultra-Low Noise Options *)

High Frequency (to 25 MHz)

	HIGH STABILITY (to 5 x 10^{-10}/day)			ULTRA-STABLE (to 1 x 10^{-10}/day)	
	Most economical CO-211 SERIES	**Higher stability and output CO-200 SERIES**	**Superior temp. stability CO-244 SERIES**	**Best aging: single oven CO-206 SERIES**	**Best aging: double oven CO-246 SERIES**
Frequency:	1, 2, 4, 5 or 10 MHz standard (broad range of frequencies available)			.5 MHz standard (other frequencies available)	
Temperature: (Temp. Range A) +15/+35°C:	CO-21 ☐ A38: ±3 x 10^{-8} CO-21 ☐ A59: ±5 x 10^{-9}	CO-20 ☐ A39: ±3 x 10^{-9} CO-20 ☐ A19: ±1 x 10^{-9}	CO-24 ☐ A510: ±5 x 10^{-10}	CO-20 ☐ A39-V: ±3 x 10^{-9} CO-20 ☐ A510-V: ±5 x 10^{-10}	CO-24 ☐ A210-V: ±2 x 10^{-10}
(Temp. Range B) 0/+50°C:	CO-21 ☐ B58: ±5 x 10^{-8} CO-21 ☐ B18: ±1 x 10^{-8}	CO-20 ☐ B59: ±5 x 10^{-9} CO-20 ☐ B39: ±3 x 10^{-9}	CO-24 ☐ B19: ±1 x 10^{-9}	CO-20 ☐ B59-V: ±5 x 10^{-9} CO-20 ☐ B19-V: ±1 x 10^{-9}	CO-24 ☐ B510-V: ±5 x 10^{-10}
(Temp. Range D) −20/+70°C:	CO-21 ☐ D17: ±1 x 10^{-7} CO-21 ☐ D38: ±3 x 10^{-8}	CO-20 ☐ D18: ±1 x 10^{-8} CO-20 ☐ D59: ±5 x 10^{-9}	CO-24 ☐ D39: ±3 x 10^{-9}	CO-20 ☐ D18-V: ±1 x 10^{-8} CO-20 ☐ D39-V: ±3 x 10^{-9}	CO-24 ☐ D19-V: ±1 x 10^{-9} (−20/+60°C)
(Temp. Range G) −55/+75°C:	CO-21 ☐ G27: ±2 x 10^{-7} CO-21 ☐ G58: ±5 x 10^{-8}	CO-20 ☐ G38: ±3 x 10^{-8}	CO-24 ☐ G18: ±1 x 10^{-8}	CO-20 ☐ G38-V: ±3 x 10^{-8} CO-20 ☐ G18-V: ±1 x 10^{-8}	
Aging:	4: 1 x 10^{-8}/day 5: 5 x 10^{-9}/day 6: 3 x 10^{-9}/day 7: 1 x 10^{-9}/day *8: 5 x 10^{-10}/day	1: 1 x 10^{-8}/day 2: 5 x 10^{-9}/day 3: 3 x 10^{-9}/day 4: 1 x 10^{-9}/day *5: 5 x 10^{-10}/day	4: 1 x 10^{-9}/day *5: 5 x 10^{-10}/day	6: 3 x 10^{-10}/day 5 x 10^{-8}/year *7: 1 x 10^{-10}/day 3 x 10^{-8}/year	6: 3 x 10^{-10}/day 5 x 10^{-8}/year *7: 1 x 10^{-10}/day 3 x 10^{-8}/year
	*5 x 10^{-10}/day average aging rate models are only available at 1, 2, 4, 5 or 10 MHz			*1 x 10^{-10}/day models available only at 1, 5 and 10 MHz	
Output Level:	Standard: >1 vrms into 500Ω Optional: 0 or +7 dBm/50Ω; TTL or CMOS	Standard: >1 vrms into 50Ω Optional: TTL, CMOS, or ECL	Standard: >1 vrms into 500Ω Optional: 0, 7 or +13 dBm/50Ω; TTL, CMOS or ECL	Standard: >1 vrms into 50Ω Optional: TTL or CMOS	
Supply Voltage:	24 VDC standard (Operation from any voltage in 5-28 VDC range optional)			24 VDC standard (Operation from any voltage in 15-28 VDC range optional)	
Input Power:	<6 watts at turn-on (−20/+70°C); <3 watts stabilized (25°C) reduced power drain available			<6 watts at turn-on (−20/+70°C) <3 watts stabilized (25°C)	<11 watts at turn-on (0-50°C) <5 watts stabilized (25°C)
Frequency Adjustment:	Screwdriver adjustment settable to 1 x 10^{-8} nominal. Electronic tuning (VCXO) option "V"			Screwdriver adjustment and electronic tuning	
Size:	2" x 2" x 3" (51 x 51 x 76 mm)	2" x 2" x 4" (51 x 51 x 104 mm)	2¼" x 2¼" x 4¼" (57 x 57 x 110 mm)	2¼" x 2¼" x 4¼" (57 x 57 x 110 mm)	3" x 3" x 5½" (76 x 76 x 140 mm)

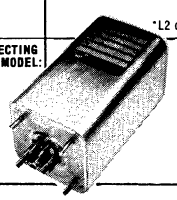
*** Phase noise (typical):** with sine output in 4-12 MHz range for "High Stability" Series and in 4-6 MHz range for "Ultra-Stable" Series

Offset from Carrier	Standard	Low Noise Option (L1)	*Ultra Low Noise Option (L2)
10 Hz	−110 dB/Hz	−115 dB/Hz	−125 dB/Hz
100 Hz	−130 dB/Hz	−135 dB/Hz	−145 dB/Hz
1 KHz	−140 dB/Hz	−145 dB/Hz	−155 dB/Hz
10 KHz	−143 dB/Hz	−148 dB/Hz	−160 db/Hz
50 KHz	−145 dB/Hz	−150 dB/Hz	−163 dB/Hz

*L2 option restricted to CO-200 Series with sine output of +10 dBm or less

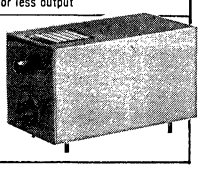
Offset from Carrier	Standard	*Ultra-Low Noise Option (L2)
10 Hz	−115 dB/Hz	−140 dB/Hz
100 Hz	−135 dB/Hz	−150 dB/Hz
1 KHz	−145 dB/Hz	−155 dB/Hz
10 KHz	−148 dB/Hz	−160 dB/Hz
50 KHz	−150 dB/Hz	−163 dB/Hz

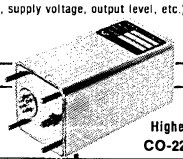
*L2 option restricted to +10 dBm or less output



SELECTING BASIC MODEL:

1. Select "Ultra Stable" if 3 x 10^{-10}/day aging or better is required; otherwise select "High Stability".
2. Select operating temperature range required (**A, B, D** or **G** from left column under "Temperature").
3. Select frequency stability desired over temperature, this determines the oscillator. (Temperature stability improves from left to right).
4. Select desired aging rate within Series to complete basic model number.
5. Determine whether you desired a low-noise option or any characteristic which is not standard (e.g., supply voltage, output level, etc.).





VHF (25-400MHz)

	Most economical CO-228/CO-229 SERIES		Higher level and frequency CO-223/CO-224 SERIES		Superior aging and stability CO-220/CO-225 SERIES	
Frequency:	25 MHz to 200 MHz		25 MHz to 400 MHz		25 MHz to 200 MHz	
Aging:	3 x 10^{-8}/day 5 x 10^{-6}/year	1 x 10^{-8}/day 3 x 10^{-6}/year	3 x 10^{-8}/day 5 x 10^{-6}/year	1 x 10^{-8}/day 3 x 10^{-6}/year	3 x 10^{-9}/day 1 x 10^{-6}/year	1 x 10^{-9}/day 3 x 10^{-7}/year
(Temp. Range A): +15°C to +35°C:	±3 x 10^{-8}: ±5 x 10^{-9}:	CO-228A38 CO-228A59	CO-229A38 CO-229A59	±3 x 10^{-8}: ±5 x 10^{-9}:	CO-223A38 CO-223A59	CO-224A38 CO-224A59	±1 x 10^{-8}: ±1 x 10^{-9}:	CO-220A18 CO-220A19	CO-225A18 CO-225A19
(Temp. Range B): 0°C to +50°C:	±5 x 10^{-8}: ±1 x 10^{-8}:	CO-228B58 CO-228B18	CO-229B58 CO-229B18	±5 x 10^{-8}: ±1 x 10^{-8}:	CO-223B58 CO-223B18	CO-224B58 CO-224B18	±5 x 10^{-8}: ±1 x 10^{-8}: ±2 x 10^{-9}:	CO-220B58 CO-220B18 CO-220B29	CO-225B58 CO-225B18 CO-225B29
(Temp. Range D): −20°C to +70°C:	±1 x 10^{-7}: ±3 x 10^{-8}:	CO-228D17 CO-228D38	CO-229D17 CO-229D38	±1 x 10^{-7}: ±3 x 10^{-8}:	CO-223D17 CO-223D38	CO-224D17 CO-224D38	±3 x 10^{-8}: ±1 x 10^{-8}: ±5 x 10^{-9}:	CO-220D38 CO-220D18 CO-220D59	CO-225D38 CO-225D18 CO-225D59
(Temp. Range G): −55°C to +75°C:	±2 x 10^{-7}: ±5 x 10^{-8}:	CO-228G27 CO-228G58	CO-229G27 CO-229G58	±2 x 10^{-7}: ±5 x 10^{-8}:	CO-223G27 CO-223G58	CO-224G27 CO-224G58	±1 x 10^{-7}: ±3 x 10^{-8}:	CO-220G17 CO-220G38	CO-225G17 CO-225G38
Output Level:	Standard: >0.5 vrms into 50Ω (+7 dBm) Optional: TTL to 100 MHz		Standard: >1 vrms into 50Ω (+13 dBm) Optional: ECL, higher sinewave level		Standard: >0.5 vrms into 50Ω (+7 dBm) Optional: +13 dBm ("R"), TTL, ECL	
Supply Voltage:	24 VDC standard. Operation from any specified voltage in 12-28 VDC range optional.					
Input Power:	<6 watts at turn-on (−20/ + 70°C); <3 watts stabilized (25°C)					
Frequency Adjustment:	Screwdriver adjust, settable to <1 x10^{-8} nominal. Electronic tuning (VCXO) option "V".					
Size:	2" x 2" x 3" (51 x 51 x 77 mm)		2" x 2" x 4" (51 x 51 x 104 mm)		2" x 2" x 4" (51 x 51 x 104 mm)	

*** Phase noise:** typical, with sine output in 75-125 MHz range

Offset from Carrier	Standard	
10 Hz	− 90 dB/Hz	Ultra-low noise option not available
100 Hz	−120 dB/Hz	
1 KHz	−135 dB/Hz	
10 KHz	−140 dB/Hz	
50 KHz	−145 dB/Hz	

Offset from Carrier	Standard	*Ultra Low Noise Option (L2)
10 Hz	− 90 dB/Hz	−100 db/Hz
100 Hz	−120 dB/Hz	−130 dB/Hz
1 KHz	−135 dB/Hz	−145 dB/Hz
10 KHz	−140 dB/Hz	−150 dB/Hz
50 KHz	−145 dB/Hz	−155 dB/Hz

*L2 option is restricted to 300 MHz with sine output of +10 dBm or less

Offset from Carrier	Standard	*Ultra Low Noise Option (L2)
10 Hz	− 85 dB/Hz	−100 db/Hz
100 Hz	−105 dB/Hz	−120 db/Hz
1 KHz	−115 dB/Hz	−130 dB/Hz
10 KHz	−120 dB/Hz	−135 dB/Hz
50 KHz	−125 dB/Hz	−140 dB/Hz

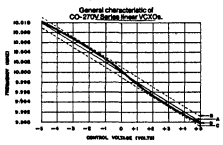
*L2 option is available to 125 MHz

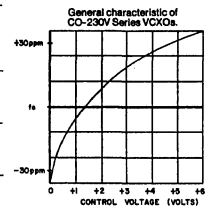
FOR PRICE OR TECHNICAL INFORMATION...CALL (203) 853-4433

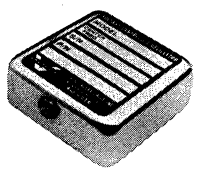
VECTRON LABORATORIES, INC. The Crystal Oscillator Company
166 Glover Avenue, Norwalk, CT 06850 • Telephone: 203/853-4433 • TWX: 710/468-3796

VECTRON VCXOs Voltage Controlled Crystal Oscillators

	WIDE DEVIATION AND/OR LINEAR APPLICATIONS				NARROW DEVIATION PHASE LOCK APPLICATIONS			
	BASIC MODELS		OVEN CONTROLLED	EXTRA WIDE DEVIATION	SINEWAVE OUTPUT	TTL OUTPUT	CMOS OUTPUT	ECL OUTPUT
Model:	CO-271V	CO-275V	a) CO-272V b) CO-276V	c) CO-273V d) CO-274V	CO-233V SERIES	e) CO-231V f) CO-231VH	CO-236V	CO-233MEV
Range of Available Center Frequencies:	2-20 MHz	20-400 MHz	a) 2-20 MHz b) 20-400 MHz	c) 0.5-8 MHz d) 8-80 MHz	*CO-233V: 5-149 MHz *CO-233VH: 150-200 MHz **CO-233VFW: 5-400 MHz ***CO-283VW: 401-600 MHz	e) 16 KHz-25 MHz f) 25.1 MHz-70 MHz	300 Hz-15 MHz	5-200 MHz
	(higher and lower frequencies available)							
Output Level:	1 vrms into 1K	0.5 vrms into 50Ω	a) 1 vrms into 1K b) 0.5 vrms/50Ω	c) 1 vrms into 1K d) 0.5 vrms/50Ω	0.5 vrms into 50Ω Option "R": 1 vrms into 50Ω	TTL compatible	CMOS compatible	ECL compatible
	(Option "R": 1 vrms into 50Ω; TTL, CMOS or ECL logic compatible output available on some models)							
Deviation:	±0.1%	±0.1%	±0.1%	±0.5%	>±.003%. This allows correcting to specified center frequency over 0-50°C for 5-10 years. Wider deviation optional; for significantly wider deviation, see models on left side of page).			
	(wider and narrower deviation available)							
Modulation Voltage:	±5 Volts, negative transfer function (either higher or lower sensitivity available)				0 to +6V (±3V to ±10V optional)	0 to +5V	0 to +5V	0 to −5V (±3 to ±10V optional)
Linearity:	±1% (For ±5% linearity, resulting in reduced cost, add "N" to Model No.)				±20% (±10% with bipolar input)	±20%	±20%	±20% (±10% with bipolar input)
					Smooth monotonic characteristic. For improved linearity see models on left side of page.			
Transfer Function:	Negative; frequency decreases with increasing modulation voltage.				Positive (frequency increases with increasing control voltage) (units with bipolar input have negative transfer function)			Negative
Stability 0-50°C:	CO-271VA: ± .01% CO-271VB: ±.001%	CO-275VA: ± .01% CO-275VB: ±.001%	±.0001%	±.025%	±.001%	±.001%	±.001%	±.001%
	(higher stability and wider temperature range optional)				(wider temperature range optional)			
Supply:	+24 VDC standard (operation from any specified voltage in +12 VDC to +32 VDC range optional)				+15 VDC standard	+5 VDC	+12 VDC standard	−5.2 VDC
Size:	2" x 2" x ¾" (51 x 51 x 19 mm)	2" x 3" x ¾" (51 x 77 x 19 mm)	2" x 2" x 4" (51 x 51 x 102 mm)	c) 2" x 3" x ¾" d) 3" x 3½" x ¾"	*1½"x1½"x⅝" **2"x2"x¾" ***2"x3"x¾"	e) 1½"x1½"x½" f) 1⅝"x1⅝"x½"	1½"x1½"x½"	2"x3"x½"
Mounting:	For P.C. Board mounting (rf connector optional)	For P.C. Board mounting (rf connector optional)	Octal plug-in or solder header and rf connector	For P.C. Board mounting (rf connector optional)	*For P.C. Board mounting **SMA output connector, studs for chassis mount	For P.C. Board mounting	For P.C. Board mounting	For P.C. Board mounting

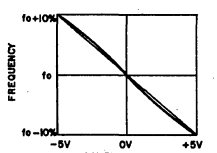


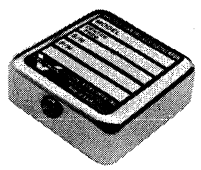




VECTRON VCOs Voltage Controlled Oscillators (Non-crystal)

	BASIC MODEL VC-371	OVEN CONTROLLED VC-372	LOW FREQUENCY VC-381
Range of available center frequencies:	500 KHz to 500 MHz		50 Hz to 500 KHz
Output Level:	>0.5 vrms into 50Ω (+7 dBm) Option "R": +13 dBm. TTL, CMOS and ECL also optional		>1 vrms into 1000Ω TTL and CMOS optional
Deviation:	±10% (Wider and narrower deviation optional; deviation as large as an octave). For deviation less than ±1%, consider a crystal controlled VCXO rather than a VCO.		±10%
Modulation Voltage:	±5V (both higher and lower sensitivity optional)		±5V
Linearity:	Standard: ±10% Option "A": ± 3% (only for deviation ≤±20%) Option "B": ± 1% (only for deviation ≤±10%) (smooth monotonic characteristics with no discontinuities)		±1%
Transfer Function:	negative		positive
Accuracy: Standard:	±0.5% at 25°C for units with deviation up to ±10%. For wider deviation units, accuracy is 10% of deviation.	Tuning adjustment setable to 0.1%.	±0.5% at 25°C for units with deviation up to ±10%. For wider deviation units, accuracy is 10% of deviation.
Optional:	"T": Tuning adjustment setable to 0.1%.		"T": Tuning adjustment setable to 0.1%.
	Standard: 0/+50°C: ±1% Option 1: −20/+70°C: ±2% Option 2: −55/+85°C: ±4% *Option 3: 0/+50°C: ±0.3% *Option 4: −20/+70°C: ±0.5% *Only for deviation ≤ ±10%	Standard: 0/+50°C: ±0.1% Option 1: −20/+70°C: ±0.2% Option 2: −55/+85°C: ±0.5% other temperature ranges available	Standard: 0/+50°C: ±1.5% Option 1: −20/+70°C: ±3% Option 2: −55/+85°C: ±6%
Supply Voltage:	+15 VDC (Operation from any supply in 12 to 28 VDC range is optional.)		+15 VDC
Size:	2" x 2" x ¾" (51 x 51 x 19 mm)	2" x 2" x 4" (51 x 51 x 104 mm)	2" x 2" x ¾" (51 x 51 x 19 mm)
Mounting:	Pins for p.c. board mounting, RF connector optional.	Chassis mount with SMA output connector. SMC or BNC optional	Pins for p.c. board mounting.





VECTRON LABORATORIES, INC. The CRYSTAL OSCILLATOR COMPANY
166 Glover Avenue, Norwalk, CT 06850 • Telephone: 203/853-4433 • TWX: 710/468-3796

XSIS ELECTRONICS

ADVANCED DESIGN MICROCIRCUIT CRYSTAL OSCILLATORS

- QPL To MIL-0-55310
- ± .0015% CALIBRATION ACCURACY
- HERMETICALLY SEALED METAL PACKAGE
- .200 SEATED HEIGHT
- LOW POWER CONSUMPTION
- WIDE FREQUENCY RANGE
- VARIETY OF STABILITIES
- MULTIPLE TEMPERATURE RANGE SELECTION
- TTL-CMOS-GATED SCHOTTKY-ECL
- CUSTOM PACKAGE CONSIDERATIONS
- DUAL-IN-LINE SPACING
- CUSTOM ELECTRICAL PARAMETERS

XSIS microcircuit crystal oscillators are not "JUST ANOTHER CLOCK OSCILLATOR" but are hi-rel devices using a premier design that is documented to be virtually without failure. Customers call it EXPERIENCED RELIABILITY.

XSIS microcircuit oscillators are manufactured to the electrical parameters of MIL-0-55310, workmanship standards are in accordance with MIL-M-38510, the quality system is as required by MIL-I-45208.

XSIS IS A QPL SOURCE FOR MICROCIRCUIT CRYSTAL OSCILLATORS TO MIL-0-55310/8,/11,/14,/15,/16,/17.

TYPICAL SPECIFICATIONS AVAILABLE

100 Series-TTL		200 Series-CMOS**
100Hz to 70MHz	Frequency Range	250Hz to 10MHZ
± .0015%	Frequency @ + 25°c	± .0015%

**Specify supply voltage when ordering

PACKAGE TYPE + PIN CONNECTIONS

OPTION 'X'	OPTION 'E'	OPTION 'M'	OPTION 'T' (4 PIN)
PIN 7 GRD 8 Output 14 B + 1 thru 6 N/C 9 thru 13 N/C Same As M55310/16	PIN 4 B + 5 Output 7 GRD/Case 1,2,3,6 N/C 8 thru 14 N/C Same As M55310/14	PIN 1 Output 2 Case 8 GRD 14 B + 3 thru 7 N/C 9 thru 13 N/C Same As M55310/8,/11,/15	PIN 1 N/C 7 GRD 8 Output 14 B + 2 thru 6 Missing 9 thru 13 Missing

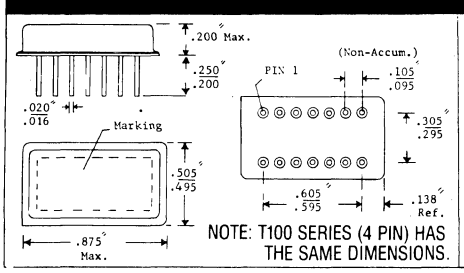
STABILITIES AVAILABLE

P/N	
1	± .1%
2	± .05%
3	± .01%
4	± .005%
5	± .0025% not available with -55 to + 125°c

TEMPERATURE RANGES

P/N	
1	0° to 70°c
2	-30° to + 85°c
3	-55° to + 125°c

PACKAGE DIMENSIONS



NOTE: T100 SERIES (4 PIN) HAS THE SAME DIMENSIONS.

PART NUMBER ORDERING EXAMPLE

X143 - 20.0 MHz
- 14 PIN with Option 'X' PINOUT
- TTL Compatible
- ± .005% Stability
- -55° to + 125° c Temperature Range

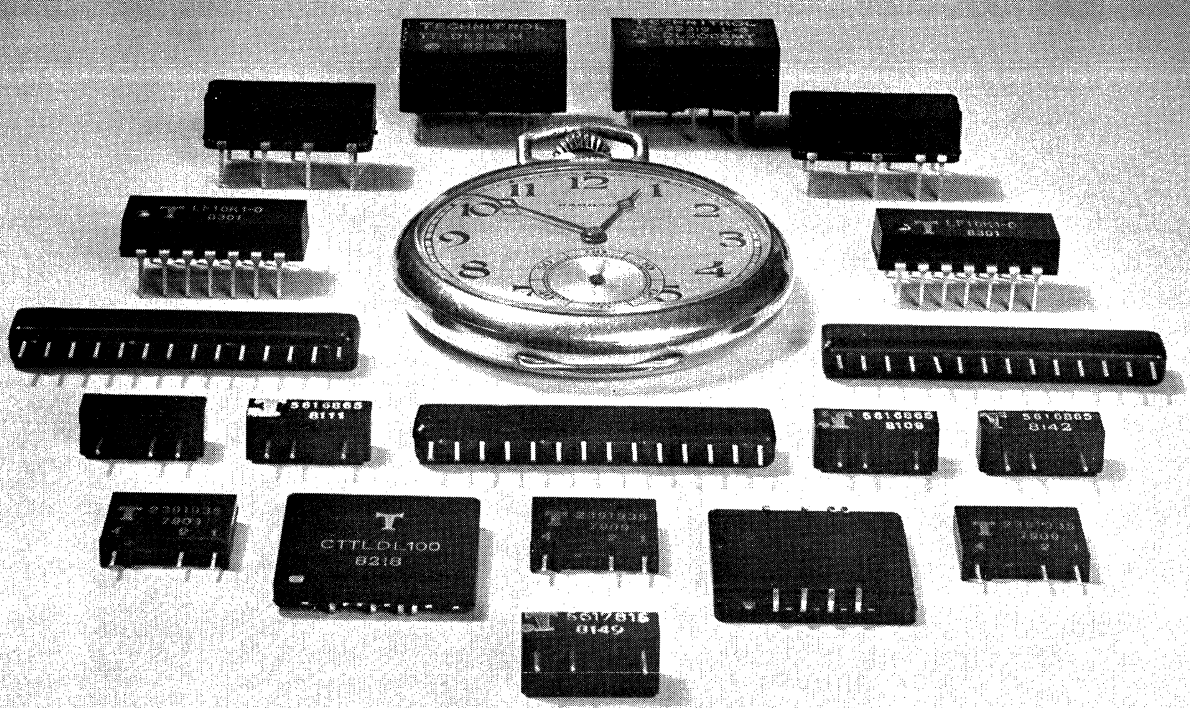
XSIS ELECTRONICS
12620 W. 63rd St.
Shawnee, Kansas 66216
913-631-0448
Telex: 437227

Time to order from the leader and pioneer in Delay Line Technology

Technitrol's three and one half decades of experience in designing and manufacturing delay line modules is recognized and appreciated throughout the world. This experience ranges from supplying the simplest commercial unit to the most rugged military chip carrier module. Manufactured in numerous compact configurations, these units provide timing applications with minimum or no interface requirements whatsoever.

When you order from Technitrol you will receive quality products from the pioneer and worldwide manufacturer of TTL and ECL chip carrier delay modules, as well as digital, slim pac, dual-in-line, single-in-line and low profile delay modules. All modules are designed to be used directly with Schottsky TTL, TTL, and low power Schottsky TTL logic circuits. All modules are designed to meet or exceed MIL-D-23859 as a minimum specification and all can be cascaded to get any combination of delay without degrading output rise time.

At Technitrol, reliability is built into all our delay line modules—not "screened in"—as is the case of many of our competitors. So remember, you can't go wrong if you specify Technitrol for your next commercial or military application requirement . . . you can't miss if you order from the #1 company in delay line technology.



Technitrol, Inc.

1952 East Allegheny Avenue • Philadelphia, Pennsylvania 19134
(215) 426-9105

Manufacturer	Passive				Digital		Video	Glass & Quartz	Other Types	
	Distributive Constant		Lump Constant		Tapped	Programmable			Trimmer	Magnetostrictive
	Fixed	Variable	Fixed	Variable						
Allen Avionics	1•1390, 1•1392	1•1391	1•1392, 1•1393	1•1393		1•1390, 1•1392	1•1391		1•1391	
Anderson Labs								1•1395		
Belfuse	1•1406, 1•1407	1•1405, 1•1407			1•1396-1•1404, 1•1407					
Computer Devices			1•1408	1•1408						
Control Electronics	1•1409	1•1409	1•1409	1•1409-1•1412			1•1409			1•1409
Data Delay Devices	1•1413			1•1414	1•1415-1•1417	1•1410-1•1412				
Engineered Components (EC²)			1•1419		1•1419-1•1427, 1•1432	1•1428-1•1431, 1•1433				
ESC Electronics			1•1445, 1•1446		1•1447-1•1450	1•1451, 1•1452				
Hytek					1•1453					
JBM Electronics					1•1454, 1•1455					1•1454, 1•1455
Kappa Networks	1•1459-1•1463		1•1462, 1•1463	1•1463	1•1456-1•1458, 1•1463		1•1463	1•1463		
Nytronics			1•1465, 1•1466		1•1464					
Technitrol					1•1388, 1•1469-1•1471	1•1388, 1•1469				
Valor Electronics			1•1473		1•1473					

ALLEN AVIONICS, INC.

224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

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SPIRADEL®* THE MOST COMPACT Highest Time Delay to Rise Time Ratio DISTRIBUTED DELAY LINE

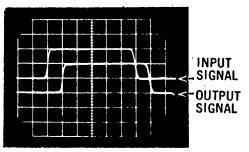
FOR IMMEDIATE DELIVERY!

SPIRADEL is a small diameter, distributed constant fixed delay line, featuring higher delay to rise time ratio and excellent pulse fidelity. Its new shape offers greater package design versatility than most other delay lines available, and the entire unit is encapsulated for maximum environmental protection.

SPIRADEL covers a delay range of 20 to 6000 nanoseconds. Any delay within this range may be selected.

Time delay to rise time ratios range up to 30 to 1. Any impedance from 50 to 1000 ohms is available. Standard delay tolerance is 5%, although tighter tolerances can be held.

SPIRADEL is designed for operation from −55°C up to +105°C. Temperature coefficient over this range is 150 parts/million/°C. Bandwidth is from DC to frequency f = .35/rise time.



TO ORDER SPECIFY PART NUMBER STANDARD HEIGHT OF ALL UNITS: 7/16"

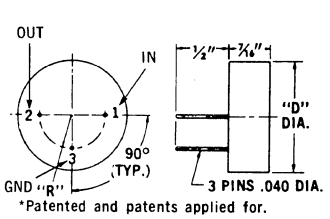
Part Number	Time Delay (Nanoseconds)	Rise Time (Nanoseconds) Maximum	Bandwidth Minimum (MHz)	Diam. Inches
IMPEDANCE 50 OHMS				
SP0050Z050	50	10.0	35.0	1.60
SP0100Z050	100	13.0	26.9	2.00
SP0150Z050	150	14.0	25.0	2.50
SP0200Z050	200	16.0	21.9	2.50
SP0250Z050	250	19.0	18.4	3.25
SP0300Z050	300	21.0	16.7	3.25
SP0350Z050	350	24.0	14.5	3.25
SP0400Z050	400	27.0	12.9	3.75
SP0450Z050	450	28.0	12.5	3.75
SP0500Z050	500	29.0	12.0	3.75
IMPEDANCE 75 OHMS				
SP0025Z075	25	4.5	77.7	1.20
SP0050Z075	50	6.0	58.3	1.20
SP0100Z075	100	9.5	36.8	1.60
SP0150Z075	150	11.5	30.4	2.00
SP0200Z075	200	13.0	26.9	2.00
SP0250Z075	250	14.0	25.0	2.50
SP0300Z075	300	16.0	21.8	2.50
SP0350Z075	350	18.0	19.4	2.50
SP0400Z075	400	20.0	17.5	3.25
SP0450Z075	450	21.9	15.9	3.25
SP0500Z075	500	24.0	14.5	3.25
SP0550Z075	550	26.0	13.4	3.75
SP0600Z075	600	28.0	12.5	3.75
SP0650Z075	650	30.0	11.6	3.75
SP0700Z075	700	32.0	10.9	3.75
IMPEDANCE 100 OHMS				
SP0050Z100	50	7.3	47.9	1.20
SP0060Z100	60	7.5	46.6	1.20
SP0070Z100	70	7.7	45.4	1.20
SP0080Z100	80	8.2	42.6	1.20
SP0090Z100	90	9.1	38.4	1.20
SP0100Z100	100	10.0	35.0	1.60
SP0150Z100	150	12.5	28.0	1.60
SP0200Z100	200	14.0	25.0	2.00
SP0250Z100	250	16.0	21.8	2.00
SP0300Z100	300	18.0	19.4	2.50
SP0350Z100	350	20.0	17.5	2.50
SP0400Z100	400	22.0	15.9	2.50
SP0450Z100	450	24.5	14.2	2.50
SP0500Z100	500	27.0	12.9	3.25
SP0550Z100	550	29.5	11.8	3.25
SP0600Z100	600	31.0	11.2	3.25
SP0650Z100	650	32.5	10.7	3.25
SP0700Z100	700	34.0	10.2	3.25
SP0750Z100	750	36.0	9.7	3.75
SP0800Z100	800	38.0	9.2	3.75
SP0850Z100	850	39.5	8.8	3.75
SP0900Z100	900	41.0	8.5	3.75
SP0950Z100	950	42.5	8.3	3.75
SP1000Z100	1000	44.0	7.9	3.75

Part Number	Time Delay (Nanoseconds)	Rise Time (Nanoseconds) Maximum	Bandwidth Minimum (MHz)	Diam. Inches
IMPEDANCE 150 OHMS				
SP0020Z150	20	5.0	70.0	1.20
SP0030Z150	30	6.5	53.8	1.20
SP0040Z150	40	7.5	46.6	1.20
SP0050Z150	50	7.7	45.4	1.20
SP0060Z150	60	7.9	44.3	1.20
SP0070Z150	70	8.0	43.7	1.20
SP0080Z150	80	8.2	42.6	1.20
SP0090Z150	90	8.5	41.1	1.20
SP0100Z150	100	9.0	38.8	1.20
SP0150Z150	150	12.0	29.1	1.60
SP0200Z150	200	14.0	25.0	1.60
SP0250Z150	250	15.0	23.3	2.00
SP0300Z150	300	17.5	20.0	2.00
SP0350Z150	350	19.0	18.4	2.00
SP0400Z150	400	20.0	17.5	2.00
SP0450Z150	450	22.0	15.9	2.50
SP0500Z150	500	24.0	14.5	2.50
SP0550Z150	550	25.6	13.6	2.50
SP0600Z150	600	27.0	12.9	2.50
SP0650Z150	650	28.6	12.2	2.50
SP0700Z150	700	30.0	11.6	2.50
SP0750Z150	750	31.6	11.0	3.25
SP0800Z150	800	33.0	10.6	3.25
SP0850Z150	850	34.5	10.1	3.25
SP0900Z150	900	36.0	9.4	3.25
SP0950Z150	950	38.0	9.2	3.25
SP1000Z150	1000	40.0	8.7	3.25
IMPEDANCE 325 OHMS				
SP0100Z325	100	12.0	29.2	1.20
SP0150Z325	150	14.0	25.0	1.20
SP0200Z325	200	17.0	20.6	1.20
SP0250Z325	250	19.0	18.4	1.60
SP0300Z325	300	21.0	16.7	1.60
SP0350Z325	350	23.0	15.3	1.60
SP0400Z325	400	24.0	14.6	1.60
SP0450Z325	450	26.0	13.5	2.00
SP0500Z325	500	28.0	12.5	2.00
SP0550Z325	550	29.0	12.1	2.00
SP0600Z325	600	31.0	11.3	2.00
SP0650Z325	650	33.0	10.6	2.50
SP0700Z325	700	34.0	10.3	2.50
SP0750Z325	750	35.0	10.0	2.50
SP0800Z325	800	37.0	9.5	2.50
SP0850Z325	850	39.0	9.0	2.50
SP0900Z325	900	41.0	8.5	2.50
SP0950Z325	950	43.0	8.1	2.50
SP1000Z325	1000	45.0	7.8	2.50
SP1100Z325	1100	49.0	7.1	3.25
SP1200Z325	1200	52.0	6.7	3.25
SP1300Z325	1300	55.0	6.3	3.25
SP1400Z325	1400	59.0	5.9	3.25
SP1500Z325	1500	62.0	5.6	3.25

Part Number	Time Delay (Nanoseconds)	Rise Time (Nanoseconds) Maximum	Bandwidth Minimum (MHz)	Diam. Inches
IMPEDANCE 500 OHMS				
SP0300Z500	300	33.0	10.6	1.20
SP0400Z500	400	40.0	8.7	1.60
SP0500Z500	500	44.0	7.9	1.60
SP0600Z500	600	50.0	7.0	1.60
SP0700Z500	700	55.0	6.3	2.00
SP0800Z500	800	57.0	6.1	2.00
SP0900Z500	900	60.0	5.8	2.00
SP1000Z500	1000	66.0	5.3	2.00
SP1500Z500	1500	87.0	4.0	2.50
SP2000Z500	2000	110.0	3.1	2.50
SP2500Z500	2500	120.0	2.9	3.25
SP3000Z500	3000	137.0	2.5	3.25
SP3500Z500	3500	154.0	2.2	3.25
SP4000Z500	4000	165.0	2.1	3.25
IMPEDANCE 600 OHMS				
SP0400Z600	400	46.0	7.6	1.20
SP0500Z600	500	48.0	7.2	1.60
SP0600Z600	600	54.0	6.4	1.60
SP0700Z600	700	58.0	6.0	1.60
SP0800Z600	800	60.0	5.8	1.60
SP0900Z600	900	65.0	5.3	2.00
SP1000Z600	1000	70.0	5.0	2.00
SP1500Z600	1500	85.0	4.1	2.50
SP2000Z600	2000	100.0	3.5	2.50
SP2500Z600	2500	115.0	3.0	2.50
SP3000Z600	3000	125.0	2.8	3.25
SP3500Z600	3500	140.0	2.5	3.25
SP4000Z600	4000	150.0	2.3	3.25
SP4500Z600	4500	165.0	2.1	3.75
SP5000Z600	5000	170.0	2.0	3.75
SP5500Z600	5500	185.0	1.8	3.75
SP6000Z600	6000	200.0	1.7	3.75
IMPEDANCE 1000 OHMS				
SP0500Z01K	500	58.0	6.0	1.20
SP0600Z01K	600	63.0	5.5	1.20
SP0700Z01K	700	72.0	4.8	1.20
SP0800Z01K	800	80.0	4.3	1.20
SP0900Z01K	900	87.0	4.0	1.60
SP1000Z01K	1000	95.0	3.6	1.60
SP1500Z01K	1500	116.0	3.0	1.60
SP2000Z01K	2000	126.0	2.7	2.00
SP2500Z01K	2500	147.0	2.3	2.00
SP3000Z01K	3000	158.0	2.2	2.00
SP3500Z01K	3500	182.0	1.9	2.50
SP4000Z01K	4000	203.0	1.7	2.50
SP4500Z01K	4500	220.0	1.5	2.50
SP5000Z01K	5000	240.0	1.4	3.25

"TAPPED" UNITS AVAILABLE IN IMPEDANCES FROM 50 TO 325 OHMS INCLUSIVE. CALL OR WRITE FOR COMPLETE CATALOG.

"D"	"R"
1.20"	.400"
1.60"	.600"
2.00"	.800"
2.50"	1.050"
3.25"	1.425"
3.75"	1.675"



*Patented and patents applied for.

ALLEN AVIONICS, INC.

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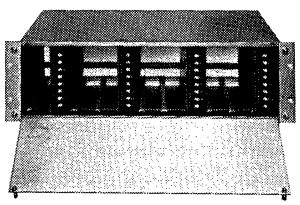
THE MOST COMPLETE LINE OF
VIDEO DELAY LINES AVAILABLE FROM STOCK!

Allen Avionics, an established leader in the design and manufacture of Electromagnetic Delay Lines and L-C Filters has now developed a specialized group of products for the video market.

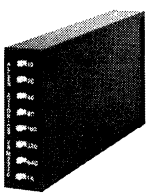
In color television broadcasting, accurate timing of signals is essential. This was initially achieved by the use of 75 ohm coaxial cable. The cost in time and materials to accomplish precise trimming and the lack of a rapid and convenient method of changing delays is currently responsible for the decline in cable usage. Television studios, studio equipment manufacturers and others engaged in the video industry are changing from 75 ohm cable to a more suitable method of achieving precise short delays. Allen Avionics now offers a line of Video Units for this purpose. Their use will result in a reduction of size, weight, installation cost and an overwhelming saving in time and effort to make delay changes.

RACK MOUNTABLE UNITS



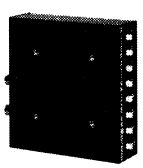
RACK MOUNT showing delay units with switches and terminals available for delay changes. Up to 10 delay units can be housed. Note hinged front panel.

This rack mountable series of video and pulse delay lines has the capability of replacing up to 1450 feet of cable.



Showing 8 individual slide switches for rapid delay changes.

Four variable slide switch units are being offered with total delays of 255, 637.5, 1275 and 2270 nanoseconds. Each unit contains 8 individual delay units. **Four strappable units** are also manufactured with total delays of 317.5, 635, 1270 and 2260 nanoseconds. The strappable units consist of 7 separate delay lines each having their own input and output terminals. The slide switches or terminal strapping provide methods for adding the individual lines together so that the output is always the summation of the individual lines. This eliminates most video distortions and assures good chrominance to luminance delay. Precision delay changes of as small as one nanosecond are easily accomplished. Low insertion loss, amplitude and delay flatness, along with excellent pulse fidelity, are characteristic of this series.



Units are rack mounted by attaching a durable plastic card to the large surface.

All units are manufactured to fit standard 19 inch racks and are provided with additional inserts to satisfy almost any mounting requirement. Delay units and racks can be purchased separately. The rack is manufactured with a hinged panel so that fast delay adjustments can be made. However, once adjustments are made, the front panel prevents further tampering with the slide switches or terminals.

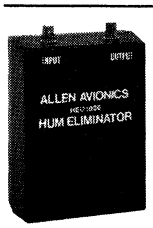
Models VP0635, VP1270 and VP2075 are padded to provide a flat loss at any setting. As a result of this padding, these units will exhibit a maximum variation of ±.2db at any delay setting.

Model VP0010 was designed specifically to be used as a delay trimmer in conjunction with our other delay units or any 75 ohm system. It offers .5 nanosecond switching resolution with excellent amplitude flatness up to 5.5 MHz.

These new delay units feature extremely flat amplitude response to 5.5 MHz, small increments of delay variation, low signal distortion and tight delay tolerance. The delay networks are ideal for pulse applications because of their fast rise times and low distortion. Amplitude equalization is employed to achieve excellent flatness over the video frequency range. The delayed output of any model in this group is the summation of individual lines. It is not the result of a tapped line. This feature insures that output pulse distortions are minimized. Units will match to any 75 ohm system and can be directly connected into the video signal path by means of BNC connectors.

Part No.	Delay Range (Nano-Sec.)	Delay Steps (Nano-Sec.)	Method of Variation	Maximum Insertion Loss @ 100 KHz (db)	Amplitude Flatness At Any Delay Setting 100 KHz to 5.5 MHz (db)	Max. Rise Time (Nano-Sec.)	Package Size (Inches)
VAR005	3-7	Continuous	Trimmer	.20	.2 Max.	N.A.	3⅝ x 1½ x 1¼
VAR011	0-11	Continuous	Trimmer & Toggle	.20	.25	N.A.	4⅜ x 2⅜ x 1 1/16
VP0010	0-10.5	.5	Toggle	.15	.2	3	4⅜ x 2⅜ x 1 1/16
VP0127	0-127	1.0	Toggle	.15	.3	14	4⅜ x 2⅜ x 1 1/16
VP0255	0-255	1.0	Toggle	.15	.3	16	4⅜ x 2⅜ x 1 1/16
VP0317	0-317.5	2.5	Toggle	.15	.3	20	4⅜ x 2⅜ x 1 1/16
VP0635	0-635	5.0	Toggle	* .50	.4	25	4 1/16 x 3 1/16 x 2 1/16
VP1100	0-1100	10.0	Rotary	1.25	.4	30	4 1/16 x 3 1/16 x 2 1/16
VP1270	0-1270	10.0	Toggle	*3.00	.4	30	4 1/16 x 3 1/16 x 2 1/16
VP2075	0-2075	25.0	Toggle	*3.00	.5	40	7⅜ x 4 1/16 x 2 3/16
VS0315	0-315	5.0	Strap	.25	.4	28	4 x 2 x 1¼
VS0635	0-635	5.0	Strap	.60	.5	33	5 x 2 x 1¼
VS1275	0-1275	5.0	Strap	1.25	.5	33	5 x 3 x 1¼
VS2075	0-2075	25.0	Strap	2.50	.5	40	6½ x 3½ x 2
RACK MOUNTABLE UNITS							
VRM0255	0-255	1.0	Slide Switch	.40	.4 Max.	20	1⅛ x 4⅛ x 4
VRM0637	0-637.5	2.5	Slide Switch	*1.00	.4	28	1⅛ x 4⅛ x 6
VRM1275	0-1275	5.0	Slide Switch	*3.00	.4	33	1⅛ x 4⅛ x 9
VRM2270	0-2270	10.0	Slide Switch	*3.00	.5	40	1⅛ x 4⅛ x 9
VRS0317	0-317.5	2.5	Strap	.40	.5	26	1⅛ x 4⅛ x 4
VRS0635	0-635	5.0	Strap	.75	.5	35	1⅛ x 4⅛ x 6
VRS1270	0-1270	10.0	Strap	1.50	.5	37	1⅛ x 4⅛ x 9
VRS2260	0-2260	20.0	Strap	3.00	.5	40	1⅛ x 4⅛ x 9

Impedance: 75 ohms. * ±.2 db variation at any delay setting.
Pulse Distortion: Less than 4% with an input pulse rise time of 20 nanoseconds.
Working Voltage: 50 volts maximum.
Return Loss: 20 db minimum.
Delay Tolerance: 5% or 1 nanosecond, whichever is greater.



HUM ELIMINATOR HEC1000

Eliminates Hum & other interference in Video Lines caused by differences in ground potential.

- FLAT-DC to 10 MHz.
- For Color and Black & White.
- No Low Frequency or High Frequency Roll-Off.
- No Differential Gain or Phase Distortion.
- Totally Passive Device — Failure Free.
- Reversible
- Compact Rugged Package.
- Low Price.

IN FIELD:
Between Remote Truck & Telco & between Truck & Microwave.
For Intertruck Hookup.
For VTR Units & Monitoring Lines.

IN STUDIO:
Between Buildings & Studios & Studios & Transmitter.
On incoming & outgoing Telco Circuits.

SPECIFICATIONS
Impedance: 75 ohms, unbalanced
Connectors: Type BNC
Bandwidth: DC to 10 MHz (0.6 dB @ 10 MHz)
Hum Reduction: to 50 dB depending on system
Dimensions: 5.3" x 4.0" x 2.0" (135 x 102 x 51 mm)
Weight: Approx. 3 lbs. (1.36 kg)
Insertion Loss: <0.2 dB

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224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

DUAL-IN-LINE "MIDI" SPIRADEL®*

These LOW COST units offer the same excellent pulse fidelity and phase linearity as Standard Spiradel. Low silhouette and dual-in-line mounting permit packaging with semiconductor and comparable components.

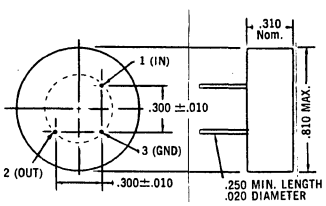
PART NO.	Time Delay (Nanoseconds)	Rise Time (Nanoseconds) Maximum	Bandwidth Minimum (MHz)	Impedance (Ohms)
MD005Z100	5	2.0	180.0	100
RD005Z125	5	2.0	180.0	125
MD010Z100	10	2.5	144.0	100
RD010Z125	10	2.5	144.0	125
MD015Z100	15	3.0	120.0	100
MD020Z100	20	4.0	90.0	100
RD020Z200	20	4.0	90.0	200
MD025Z100	25	5.0	72.0	100
MD030Z100	30	6.0	60.0	100
RD030Z250	30	6.0	60.0	250
MD040Z100	40	7.5	48.0	100
RD040Z300	40	8.0	45.0	300
MD050Z100	50	9.0	40.0	100
RD050Z350	50	10.0	36.0	350
MD060Z175	60	11.0	32.7	175
RD060Z400	60	12.0	30.0	400
MD070Z175	70	12.0	30.0	175
RD070Z400	70	14.0	25.7	400
MD080Z175	80	13.0	27.7	175
RD080Z475	80	16.0	22.5	475

PART NO.	Time Delay (Nanoseconds)	Rise Time (Nanoseconds) Maximum	Bandwidth Minimum (MHz)	Impedance (Ohms)
MD090Z175	90	14	25.7	175
RD090Z500	90	18	20.0	500
MD100Z175	100	15	24.0	175
RD100Z500	100	20	18.0	500
MD125Z500	125	25	14.4	500
MD150Z500	150	29	12.1	500
RD150Z01K	150	30	12.0	1000
MD175Z500	175	32	11.3	500
RD175Z01K	175	35	10.3	1000
MD200Z500	200	35	10.3	500
RD200Z01K	200	40	9.0	1000
MD250Z500	250	40	9.0	500
MD300Z01K	300	60	6.0	1000
MD350Z01K	350	67	5.4	1000
MD400Z01K	400	74	4.9	1000
MD450Z01K	450	78	4.6	1000
MD500Z01K	500	81	4.4	1000
MD550Z01K	550	83	4.3	1000
MD600Z01K	600	85	4.2	1000

TO ORDER SPECIFY PART NUMBER

STOCKED

Epoxy Encapsulated. Temperature Coefficient: Less than 200 PPM/°C from −55°C to +105°C.



DUAL-IN-LINE "MINI" SPIRADEL®* FOR IMMEDIATE DELIVERY!

STOCKED

*Patented and patents applied for.

EXCELLENT PULSE FIDELITY • FLAT DELAY OVER WIDE FREQUENCY RANGE

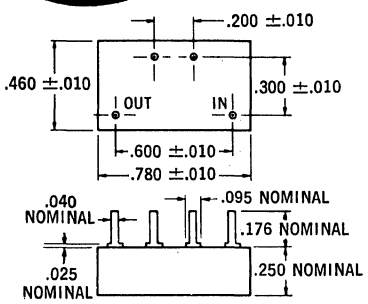
Operation from −55°C up to +105°C. Units exhibit a change of less than 175 parts/million/°C over this temperature range. Dual-in-line mounting. Compatible with integrated circuits. Maximum attenuation for all delays: 7%.

TO ORDER SPECIFY PART NUMBER

PART NO.	Time Delay (Nanoseconds)	Rise Time (Nanoseconds)	Impedance (Ohms)
MN005Z125	5	2.0	125
MN010Z125	10	2.5	125
MN020Z200	20	4.0	200
MN030Z250	30	6.0	250
MN040Z300	40	8.0	300
MN050Z350	50	10.0	350
MN060Z400	60	12.0	400
MN070Z400	70	14.0	400

PART NO.	Time Delay (Nanoseconds)	Rise Time (Nanoseconds)	Impedance (Ohms)
MN080Z475	80	16.0	475
MN090Z500	90	18.0	500
MN100Z500	100	20.0	500
MN125Z500	125	25.0	500
MN150Z01K	150	30.0	1000
MN175Z01K	175	35.0	1000
MN200Z01K	200	40.0	1000
MN250Z01K	250	50.0	1000

STANDARD DELAY TOLERANCE 10% (5% ON SPECIAL ORDERS)



"LC DIP 20" DUAL-IN-LINE 24 PIN TAPPED LUMPED CONSTANT DELAY LINE

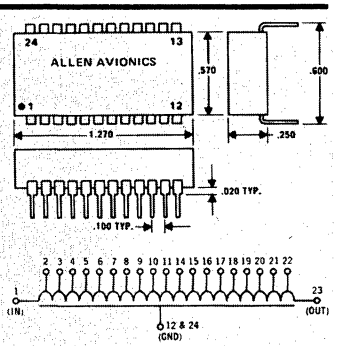
IMPEDANCE 100 OHMS

Part No.	Time Delay (Nanoseconds)	Rise Time (Nanoseconds)	Bandwidth Minimum (MHz)	Attenuation Maximum (%)
LCB010Z100	10	2.0	180.0	5
LCB020Z100	20	2.5	144.0	5
LCB030Z100	30	3.0	120.0	5
LCB040Z100	40	4.0	90.0	5
LCB050Z100	50	5.0	72.0	5
LCB060Z100	60	6.0	60.0	10
LCB070Z100	70	7.0	51.4	10
LCB080Z100	80	8.0	45.0	10
LCB090Z100	90	9.0	40.0	10
LCB100Z100	100	10.0	36.0	10
LCB150Z100	150	15.0	24.0	5
LCB200Z100	200	20.0	18.0	5
LCB250Z100	250	25.0	14.4	10
LCB500Z100	500	50.0	7.2	10
LCB750Z100	750	75.0	4.8	10
LCB01KZ100	1000	100.0	3.6	10

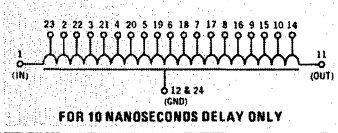
TO ORDER SPECIFY PART NUMBER

- Time delay to rise time ratios — 10 to 1.
- Temperature Coefficient — less than 100PPM/°C from 0°C to 80°C.
- Total delay tolerance 5% or 1 nanosecond, whichever is greater.
- 20 equal delay increments.
- TTL & DTL compatible.
- Low attenuation.
- Excellent pulse fidelity.
- Exceeds applicable portions of MIL-D-23859.
- Voltage rating 50 WVDC.

Where high bandwidths and low rise times are required in a small package, the "LC DIP 20" excels. It offers excellent pulse fidelity and low attenuation. Its compatibility with TTL & DTL along with its low profile makes for an extremely popular and adaptable unit for semiconductor and other related applications. Other delays and impedances are available on special order.



FOR DELAYS FROM 20 – 1000 NANOSECONDS



FOR 10 NANOSECONDS DELAY ONLY

THE ULTIMATE IN MINIATURIZATION

T05 SERIES LUMPED CONSTANT DELAY LINE

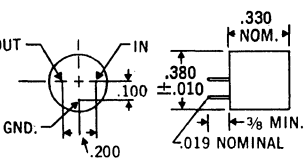
Lumped Constant, completely passive, delay lines housed in a commercial T05 package (.385 dia. x .330 high). Designed for compatibility with semiconductor and logic assemblies where space and good performance are prime considerations. Stocked in delays from 10 to 100 nanoseconds.

Delay Tolerance: ±5%.

Working Voltage: 50 volts DC.

Temp. Coefficient Over 0 to 80°C: 100 parts/million/°C.

Part No.	Time Delay (Nanoseconds)	Rise Time Max. (Nanoseconds)	Bandwidth (MHz)	Impedance (Ohms)	Attenuation (%)
T010	10	3	120.0	100	4
T020	20	4	90.0	100	5
T030	30	6	60.0	100	6
T040	40	8	45.0	100	7
T050	50	10	36.0	100	8
T060	60	12	30.0	50	8
T070	70	14	25.7	50	9
T080	80	16	22.5	50	10
T090	90	18	20.0	50	11
T01C	100	20	18.0	50	12



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"LC DIP" THE WORLD'S SMALLEST DUAL-IN-LINE 14 PIN TAPPED LUMPED CONSTANT DELAY LINE

The "LC DIP" represents the smallest delay line currently available. It is a lumped constant delay line offering the ultimate in high density packaging and tapping capabilities.

These units are excellent for high frequency applications. The availability of 10 equal delay increments and the dual-in-line packaging along with its low silhouette make for compatibility with semiconductor and other assemblies where circuit board height must be held to a minimum. The foregoing makes the "LC DIP" extremely adaptable for the computer and allied industries.

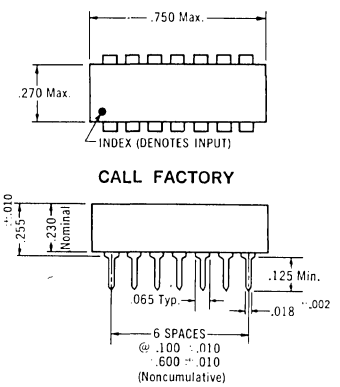
Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds)	Band-width (MHz)	Max. Atten-uation (%)
IMPEDANCE: 50 OHMS				
LC010Z050B*	10	3.0	120.0	3
LC020Z050B*	20	4.5	80.0	4
LC025Z050B*	25	5.0	72.0	5
LC030Z050 A or B	30	6.0	60.0	6
LC040Z050 A or B	40	8.0	45.0	7
LC050Z050 A or B	50	10.0	36.0	8
LC060Z050 A or B	60	12.0	30.0	10
LC070Z050 A or B	70	14.0	25.7	12
LC080Z050 A or B	80	16.0	22.5	14
LC090Z050 A or B	90	18.0	20.0	15
LC100Z050 A or B	100	20.0	18.0	16
LC150Z050 A or B	150	30.0	12.0	19
LC200Z050 A or B	200	40.0	9.0	22
LC250Z050 A or B	250	50.0	7.2	25
LC300Z050 A or B	300	60.0	6.0	28
LC400Z050 A or B	400	80.0	4.5	34
LC500Z050 A or B	500	100.0	3.6	40

To order specify Part No. followed by the letter "A" or "B".

* Units with asterisk available in "B" Lead Configuration only.

For Lead Configuration "A" or "B", call factory and request catalog.

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds)	Band-width (MHz)	Max. Atten-uation (%)
IMPEDANCE: 100 OHMS				
LC010Z100B*	10	2.5	144.0	4
LC020Z100 A or B	20	4.0	90.0	5
LC025Z100 A or B	25	5.0	72.0	5
LC030Z100 A or B	30	6.0	60.0	6
LC040Z100 A or B	40	8.0	45.0	7
LC050Z100 A or B	50	10.0	36.0	8
LC060Z100 A or B	60	12.0	30.0	9
LC070Z100 A or B	70	14.0	25.7	10
LC080Z100 A or B	80	16.0	22.5	11
LC090Z100 A or B	90	18.0	20.0	12
LC100Z100 A or B	100	20.0	18.0	12
LC150Z100 A or B	150	30.0	12.0	15
LC200Z100 A or B	200	40.0	9.0	23
LC250Z100 A or B	250	50.0	7.2	30
IMPEDANCE: 200 OHMS				
LC025Z200 A or B	25	5.0	72.0	3
LC050Z200 A or B	50	10.0	36.0	5
LC075Z200 A or B	75	15.0	24.0	8
LC100Z200 A or B	100	20.0	18.0	10
LC150Z200 A or B	150	30.0	12.0	14
LC200Z200 A or B	200	40.0	9.0	18



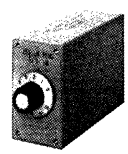
Delay Tolerance:

For delays less than 50 nanoseconds: ±10% or 1 nanosecond (whichever is greater).

For delays of 50 nanoseconds or more: ±5% or 4 nanoseconds (whichever is greater).

ATTN. COMMUNICATION FIELD: VARIABLE DELAY for RADIO PAGING

In recent years, the communication industries have directed a good deal of attention to the development of devices suitable for delay correction of signals sent to remote transmitters. Paging systems use this form of delay correction and are one of the popular fields to employ these delay units.



10 steps x 5 μs plus Fixed Delay	
Part No.	Fixed Delay Micro-seconds
AV400-0-50	0
AV400-50-50	50
AV400-100-50	100
AV400-150-50	150
AV400-200-50	200
AV400-250-50	250
AV400-300-50	300
AV400-350-50	350
AV400-400-50	400
AV400-450-50	450

10 steps x 10 μs plus Fixed Delay	
Part No.	Fixed Delay Micro-seconds
AV400-0-100	0
AV400-50-100	50
AV400-100-100	100
AV400-150-100	150
AV400-200-100	200
AV400-250-100	250
AV400-300-100	300
AV400-350-100	350
AV400-400-100	400

Total Delay Tolerance 5%.
Impedance 600 ohms unbalanced.
Bandwidth — greater than 3.2 KHz.
Units are supplied in metal can 2 x 3½ x 5 inches.
Four 8/32 inserts and the switch are located on one of the 2 x 3½ inch surfaces.
Four turret terminals (input, output and 2 grounds) are located on the opposite 2 x 3½ inch surface.

PART NO. AV-1031-0-1100

Total Delay Tolerances 5% — Insertion Loss 6db

This unit has two rotary switches. One rotary adjusts the delay in steps of one hundred microseconds for a total of 1000 microseconds. The second switch steps the delay up in 10 microsecond increments to 100 microseconds.

All delay outputs are the summation of individual lines. Impedance is 600 ohms unbalanced. Bandwidth for total delay of 1100 microseconds is greater than 3.2 KHz. Units are supplied in a metal can 2" x 11" x 4". Four inserts and 2 switches are located on one of the 11" x 2" surfaces. Four turret terminals (input, output and 2 grounds) are located on the opposite 11" x 2" surface.

PART NO. AV-1031R-0-1100

Same as above except designed for 2 adjacent units to be rack mounted. Size: 3" x 8" x 8".

SERIES "HF", "HR" & "VHR" LUMPED CONSTANT DELAY LINES HIGHEST $\frac{\text{TIME DELAY}}{\text{RISE TIME}}$ RATIO EVER BUILT!

These Delay Lines have the highest ratio of time delay to rise time that has ever been built in a Lumped Constant Line. Unlike other types of high ratio lines, the Lumped Constant Delay Line has a passband from D.C. to its cutoff frequency and maintains a constant delay over these frequencies. These lines are also unique in that they offer relatively low insertion loss. The units are characterized by tight time delay tolerances, low pulse distortion, excellent phase linearity and good temperature stability.

To calculate rise time in microseconds, divide the ratio into the delay. To calculate bandwidth, divide rise time in microseconds into .36. Answer will be in MHz. Attenuation range 9 to 20db.

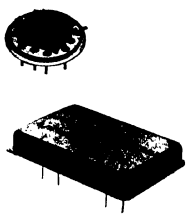
"HF"	"HR"	"VHR"
50/1 RATIO Delay Range .25 to 10 microseconds.	100/1 RATIO Delay Range 11 to 500 microseconds.	150/1 RATIO Delay Range 5 to 500 microseconds.
75/1 RATIO Delay Range .5 to 10 microseconds.	130/1 RATIO Delay Range 5 to 500 microseconds.	200/1 RATIO Delay Range 10 to 75 microseconds.
100/1 RATIO Delay Range 1 to 10 microseconds.		250/1 RATIO Delay Range 20 to 100 microseconds.

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

SAW Bandpass Filters:

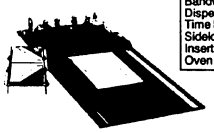
Optimum amplitude and phase characteristics for radar, ECM, ESM and communications filtering.



Range of Performance	
Center Frequency	20-600 MHz
1 dB bandwidth	100KHz to 40% f_o
Rejection bandwidth	Δf + 600 KHz min
Transition bandwidth	300 KHz min
Shape factor (1 dB to 40 dB)	1.1 min
Insertion Loss	10 dB to 30 dB, 20 dB typical
Rejection level	30 dB to 55 dB, 40 dB typical
Amplitude ripple	±.2 dB to ±.5 dB, ±.3 dB typical
phase deviation from linear	±2° to ±5°, ±3° typical

SAW and IMCON Dispersive Delay Lines:

The powerful signal processing tool for radar, ELINT, ESM receivers



	SAW ID	SAW RAC	IMCON
Center Frequency	1000 MHz	1000 MHz	30 MHz
Bandwidth	<50% f_o	<50% f_o	<50% f_o
Dispersion	<50 μs	< 100 μs	< 600 μs
Time Bandwidth Product	< 2000	< 4000	< 4000
Sidelobes	30 db	35 db	40 db
Insertion Loss	30-50 db	30-50 db	20-40 db
Oven	No	Yes	Yes

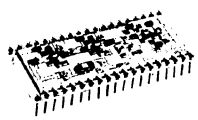
Frequency Synthesizers:

Unique design provides optimized programmable frequency source for today's most demanding applications including radar, radios, telecommunications, TACAN, telemetry, navigational equipment and satellite communications.

Frequency Output	.25 to 5 GHz
Stepping Bandwidth	600 MHz
Non Harmonic Spurious Harmonic Spurious	− 60 dBc − 35 dBc
Output Power	+ 23 dBm
Phase noise	− 60 dBc at 10 Hz
Compact/Cavity Free	

SAW Hybrid Oscillators:

Compact, rugged, alignment-free frequency sources available in standard industry packages for PC mounting. Two types available:



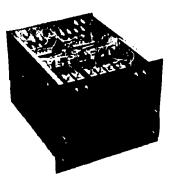
SAW Delay Line Voltage Control Oscillators SAW Resonator Stabilized Oscillators	
Fundamental Frequency Output	.1 to 1.1 GHz
Non Harmonic Spurious Harmonic Spurious	− 50 dBc − dBc
Output Power	+ 10 dBm min. into 2:1 load

Bulk Acoustic Wave (BAW) Delay Lines and Subsystems:

Practical and economical memory for radar, communications and TV signal processing.

Glass
Frequency 5 to 60 MHz
Bandwidth to 30 MHz
Delay 2 to 250 μs
Zero temperature coefficient

Quartz
Frequency 5 to 100 MHz
Bandwidth to 50 MHz
Delay 1 μs to 4.8 ms
Multiple channel assemblies



Radar MTI

Acousto-Optic Products:

Controlling laser energy in computer printing and semiconductor processing.

Modulators
UV, visible, near infrared
Modulation bandwidth to 20 MHz
Contrast ratio in excess of 1000 to 1
Deflection efficiency greater than 85%
Drivers available

Beam Deflectors
UV, visible, near infrared
Resolution to 300 spots
Access time 300 ns to 10 μs
Drivers available

Q-Switches
Available for all commercial YAG lasers
For up to 50 watt CW laser power output

ANDERSEN LABORATORIES

Andersen Laboratories, Inc., 1280 Blue Hills Avenue, Bloomfield, CT 06002 Telephone (203) 242-0761/TWX 710-425-2390

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series 0447 DIGITAL

14 PIN 5 TAP

TECHNICAL INFORMATION

Bel Fuse Digital Delay Lines Series 0447 features five equally tapped delay lines with total delays of 25 to 500 nanoseconds. The lines are compatible with TTL and DTL circuits. Either Logic "1" or Logic "0" inputs are accepted. Cascading of units causes no undesirable reflections. The reduced dimensions, with standard Dip Pin-Out permits dense packaging on your circuit board.
Special designs upon request.

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3.0 Nsec.
Supply Current	60 ma TYP
Pulse Width	Min. of 40% delay

ELECTRICAL CHARACTERISTICS

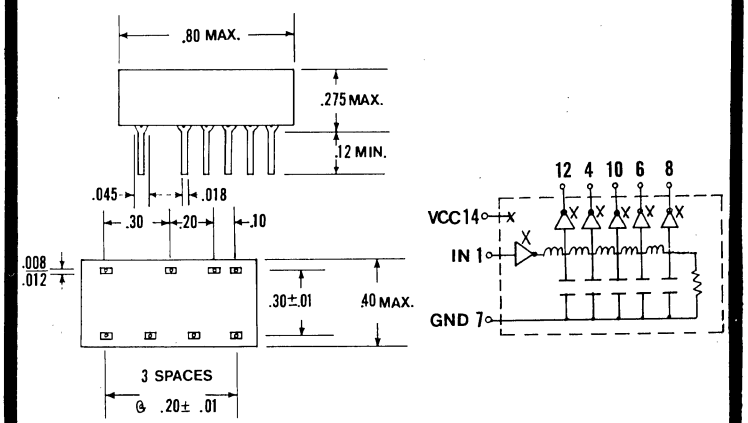
Supply Voltage Vcc	4.75 to 5.25 Volts
Logic 1 Input Current	50 Microamps Max.
Logic 0 Input Current	−2 Milliamps Max.
Logic 1 Output Voltage	2.6 Volts Min.
Logic 0 Output Voltage	.5 Volts Max.

All Measurements Made at VCC = 5.0 Volts @ 25°C

DRIVE CAPABILITIES

Logic 0 Output	10 TTL Loads/Tap Max. (20 TTL) Loads/Unit Max.)
Logic 1 Output	10 TTL Loads/Unit Max.

- COMPATIBLE WITH TTL AND DTL CIRCUITS
- DELAY TOLERANCE ± 2Nsec or 5% WHICHEVER IS GREATER OFF NOMINAL DELAY
- OPERATING TEMPERATURE RANGE 0°C TO 70°C
- OTHER DELAYS UPON REQUEST



Part Number	TD (1) (3)	TD Tap (1) (3)	Tr (2) (3)
0447-0025-02	25NS	5NS	4NS
0447-0050-02	50NS	10NS	4NS
0447-0100-02	100NS	20NS	4NS
0447-0150-02	150NS	30NS	4NS
0447-0200-02	200NS	40NS	4NS
0447-0250-02	250NS	50NS	4NS
0447-0300-02	300NS	60NS	4NS
0447-0350-02	350NS	70NS	4NS
0447-0400-02	400NS	80NS	4NS
0447-0450-02	450NS	90NS	4NS
0447-0500-02	500NS	100NS	4NS

(1) DELAYS MEASURED AT 1.5 Volt level on leading edge only.
(2) Rise times measured from .75 Volts to 2.4 Volts
(3) Measured with no loads on taps.
(4) Measured at 1.5 volts L-H and H-L.

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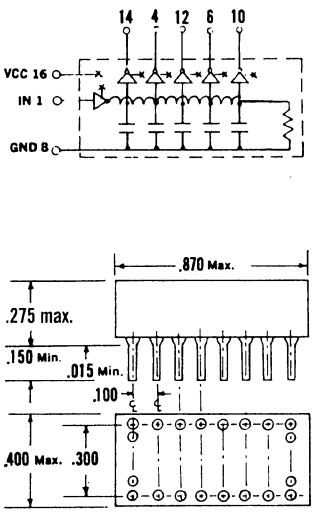
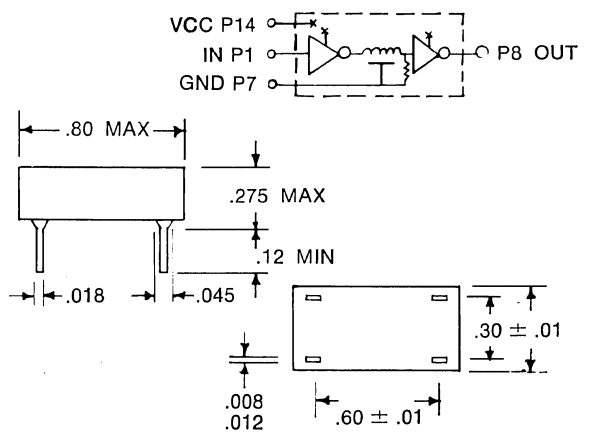
DELAY LINES

16 PIN - 5 TAP

FIXED DELAY



Part Number	TD (1) (3)	TD Tap (1) (3)	Tr (2) (3)
0447-0025-01	25NS	5NS	4NS
0447-0050-01	50NS	10NS	4NS
0447-0100-01	100NS	20NS	4NS
0447-0150-01	150NS	30NS	4NS
0447-0200-01	200NS	40NS	4NS
0447-0250-01	250NS	50NS	4NS
0447-0300-01	300NS	60NS	4NS
0447-0350-01	350NS	70NS	4NS
0447-0400-01	400NS	80NS	4NS
0447-0450-01	450NS	90NS	4NS
0447-0500-01	500NS	100NS	4NS



Part Number	TD (4) (3)	TR (2) (3)	Part Number	TD (4) (3)	TR (2) (3)
0447-0010-06	10NS	4NS	0447-0125-06	125NS	4NS
0447-0020-06	20NS	4NS	0447-0150-06	150NS	4NS
0447-0030-06	30NS	4NS	0447-0175-06	175NS	4NS
0447-0040-06	40NS	4NS	0447-0200-06	200NS	4NS
0447-0050-06	50NS	4NS	0447-0250-06	250NS	4NS
0447-0060-06	60NS	4NS	0447-0300-06	300NS	4NS
0447-0070-06	70NS	4NS	0447-0350-06	350NS	4NS
0447-0080-06	80NS	4NS	0447-0400-06	400NS	4NS
0447-0090-06	90NS	4NS	0447-0450-06	450NS	5NS
0447-0100-06	100NS	4NS	0447-0500-06	500NS	5NS

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DIGITAL DELAY LINE SERIES 0447

10 TAP

- Compatible with TTL and DTL circuits
- Delay tolerance ± 2NS or 5% whichever is greater off nominal delay
- Other delays upon request
- Operating temperature range 0°C to 70°C

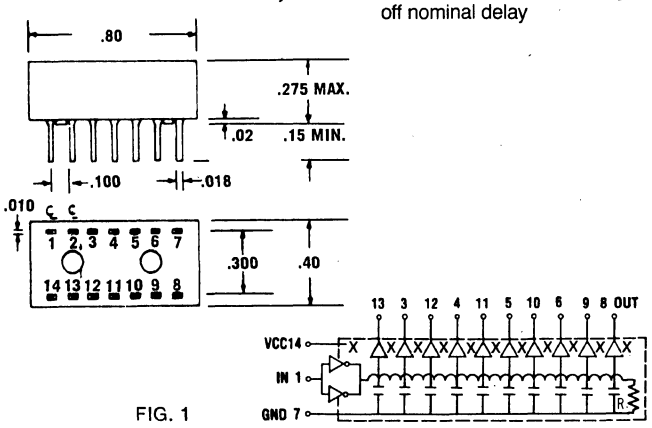

FIG. 1

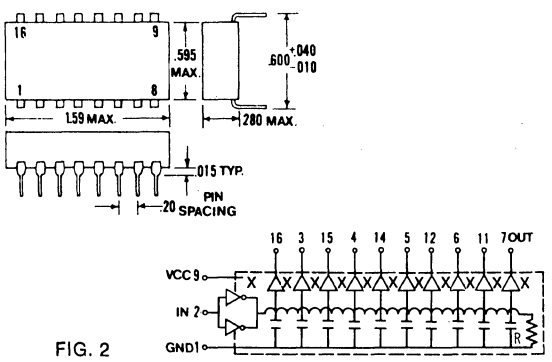

FIG. 2

FIG. 1 Part Number	(1) (3) Total Delay	(1) (3) Delay / Tap	(2) (3) Rise Time	FIG. 2 Part Number
0447-0050-10	50NS	5NS	4NS	0447-0050-05
0447-0100-10	100NS	10NS	4NS	0447-0100-05
0447-0150-10	150NS	15NS	4NS	0447-0150-05
0447-0200-10	200NS	20NS	4NS	0447-0200-05
0447-0250-10	250NS	25NS	4NS	0447-0250-05
0447-0300-10	300NS	30NS	4NS	0447-0300-05
0447-0350-10	350NS	35NS	4NS	0447-0350-05
0447-0400-10	400NS	40NS	4NS	0447-0400-05
0447-0500-10	500NS	50NS	5NS	0447-0500-05
0447-0750-10	750NS	75NS	5NS	0447-0750-05
0447-1000-10	1000NS	100NS	5NS	0447-1000-05

(1) Measured at 1.5 Volt level Leading edge
(2) Measured from .75V to 2.4 Volt
(3) Measured with no loads on taps.

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3.0 Nsec.
Supply Current	120 ma TYP
Pulse Width	Min. of 40% Delay

ELECTRICAL CHARACTERISTICS

Supply Voltage Vcc	**4.75 to 5.25 Volts**
Logic 1 Input Current	100 Microamps Max.
Logic 0 Input Current	−4 Milliamps Max.
Logic 1 Output Voltage	2.6 Volts Min.
Logic 0 Output Voltage	.5 Volts Max.
All Measurements Made at VCC = 5.0 Volts@ 25°C	

DRIVE CAPABILITIES

Logic 0 Output	10 TTL Loads/Tap Max. (20 TTL loads/Unit Max.)
Logic 1 Output	10 TTL Loads/Unit Max.

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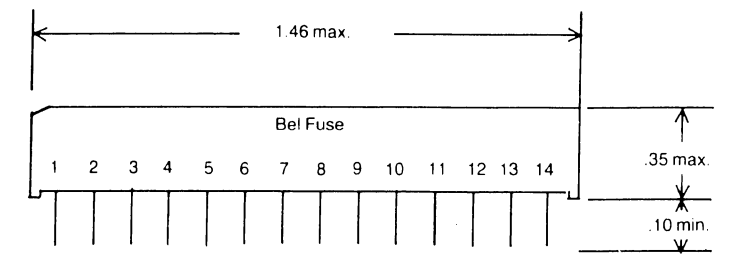
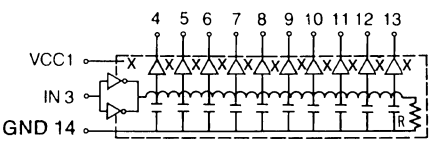
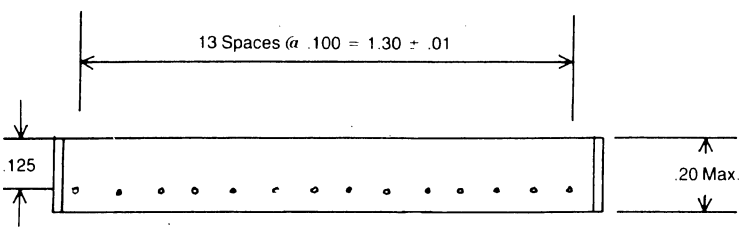
SINGLE-IN-LINE
DIGITAL DELAY LINE SERIES 0447

10 TAP

- Compatible with TTL and DTL circuits
- Delay tolerance ± 2NS or 5% whichever is greater off nominal delay
- Operating temperature range 0°C to 70°C
- Other delays upon request







Pins .012 × .020 flat lead
or 24 awg tinned copper

(1) Measured at 1.5 Volt level Leading edge
(2) Measured from .75V to 2.4 Volt
(3) Measured with no loads on taps.

Part Number	(1) (3) Total Delay	(1) (3) Delay/Tap	(2) (3) Rise Time
0447-0050-07	50NS	5NS	4NS
0447-0100-07	100NS	10NS	4NS
0447-0150-07	150NS	15NS	4NS
0447-0200-07	200NS	20NS	4NS
0447-0250-07	250NS	25NS	4NS

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3.0 Nsec.
Supply Current	120 ma TYP
Pulse Width	Min. of 40% Delay

ELECTRICAL CHARACTERISTICS

Supply Voltage Vcc	4.75 to 5.25 Volts
Logic 1 Input Current	100 Microamps Max.
Logic 0 Input Current	– 4 Milliamps Max.
Logic 1 Output Voltage	2.6 Volts Min.
Logic 0 Output Voltage	.5 Volts Max.

All Measurements Made at VCC = 5.0 Volts @ 25° C

DRIVE CAPABILITIES

Logic 0 Output	10 TTL Loads/Tap Max. (20 TTL loads/Unit Max.)
Logic 1 Output	10 TTL Loads/Unit Max.

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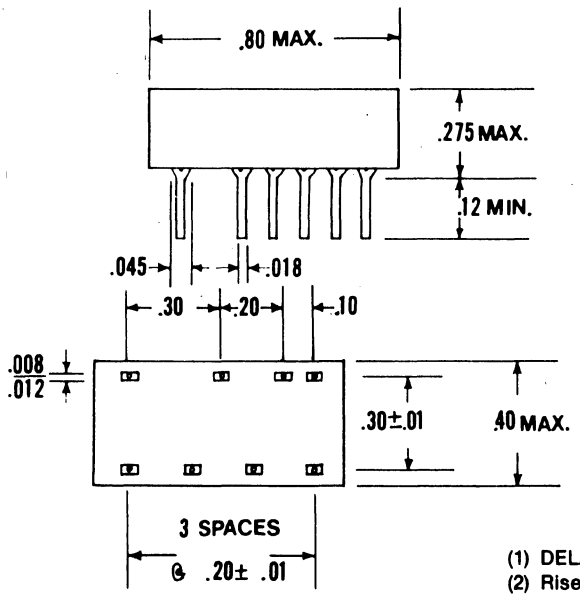
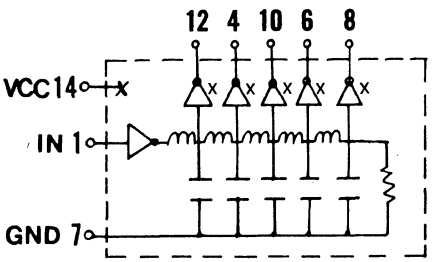
DIGITAL DELAY LINE SERIES 0447

DYNAMIC RAM TIMING DEVICE





(1) DELAYS MEASURED AT 1.5 Volt level on leading edge.
(2) Rise times measured from .75 Volts to 2.4 Volts.
(3) Measured with no loads on taps.

Part Number	Nom. Delay at ea. tap in Nsec (1), (3)					Rise Time
	P 12	P 4	P 10	P 6	P 8	(2) (3)
0447-0339-99	25 ± 5	45 ± 5	160 ± 8	185 ± 9	340 ± 17	4
0447-0399-99	30 ± 5	80 ± 5	220 ± 11	250 ± 12	400 ± 20	4
0447-0439-99	40 ± 5	100 ± 5	265 ± 13	290 ± 14	440 ± 22	4
0477-0499-99	85 ± 5	140 ± 7	320 ± 16	345 ± 17	515 ± 25	5

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3.0 Nsec.
Supply Current	60 ma TYP
Pulse Width	Min. of 20% Delay

ELECTRICAL CHARACTERISTICS

Supply Voltage Vcc	4.75 to 5.25 Volts
Logic 1 Input Current	50 Microamps Max.
Logic 0 Input Current	−2 Milliamps Max.
Logic 1 Output Voltage	2.6 Volts Min.
Logic 0 Output Voltage	.5 Volts Max.
All Measurements Made at VCC = 5.0 Volts @ 25°C	

DRIVE CAPABILITIES

Logic 0 Output	10 TTL Loads/Tap Max. (20 TTL loads/Unit Max.)
Logic 1 Output	10 TTL Loads/Unit Max.

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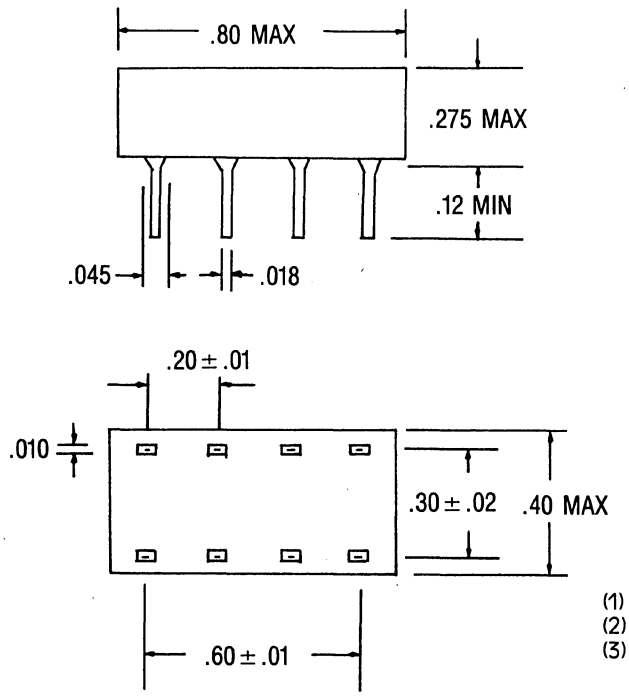
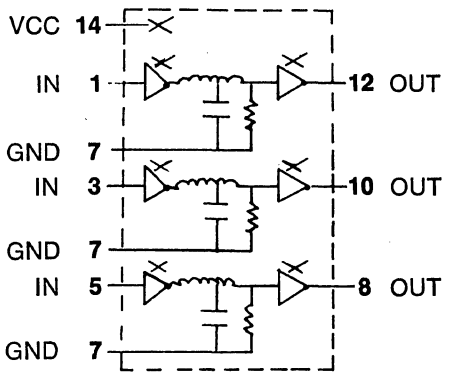
DIGITAL DELAY LINE SERIES 0447

TRIPLE OUTPUT MODULE





(1) DELAYS MEASURED AT 1.5 VOLT LEADING EDGE ONLY
(2) RISE TIME MEASURED FROM .75 VOLTS TO 2.4 VOLTS
(3) MEASURED WITH 1 TTL LOAD (15PF) ON EACH OUTPUT

Part Number	Delay Time	Rise Time
0447-0010-A3	10 NS ±1.5 NS	3 NS
0447-0020-A3	20 NS ±1.5 NS	3 NS
0447-0030-A3	30 NS ±2.0 NS	3 NS
0447-0040-A3	40 NS ±2.0 NS	3 NS
0447-0050-A3	50 NS ±2.5 NS	3 NS
0447-0060-A3	60 NS ±3.0 NS	4 NS
0447-0070-A3	70 NS ±3.5 NS	4 NS
0447-0080-A3	80 NS ±4.0 NS	4 NS
0447-0090-A3	90 NS ±4.0 NS	4 NS
0447-0100-A3	100 NS ±5.0 NS	4 NS
0447-0125-A3	125 NS ±6.0 NS	4 NS

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3 Nsec
Pulse Width	Min 100% of Total Delay

ELECTRICAL CHARACTERISTICS

Supply Voltage	5 Volts ±.25 Volts
Supply Current	Constant "0" in 115 ma max Constant "1" in 90 ma max
Logic 1 Input Current	50 μa max
Logic 0 Input Current	−2 ma max
Logic 1 Output Voltage	2.6 Volts min
Logic 0 Output Voltage	.5 Volts max
Temperature Range	0°C to +70°C
Temperature Coefficient	1.5 Nsec +100 ppm/°C max

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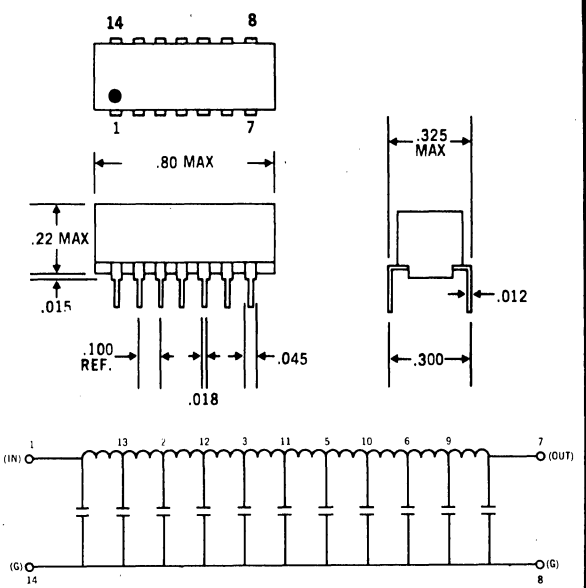
DELAY LINES

14 PIN DIP

- Built to conform to MIL-D-23859.
- Temperature Range −55°C to +125°C.
- Temperature Coefficient 100 ppm/°C or less.
- Will meet most stringent MIL requirements.
- Low attenuation.
- Excellent pulse fidelity.
- Compatible with TTL and other logic modes.
- Other delays available upon request.
- Contact Bel Engineering for special applications.
- Untapped Units Available Upon Request.
- 16 PIN DIP Also Available



Total Delay Nsec ±5%	Tap Delay	Distortion ±Max. %	Attenuation Max. %	Impedance ±10% 50Ω	100Ω	200Ω
5	.5±.3	10	5	0446-0005-50 Tr = 3	0446-0005-01 Tr = 3	0046-0005-02 Tr = 3.5
10	1±.35	10	5	0446-0010-50 Tr = 3.8	0446-0010-01 Tr = 3.8	0446-0010-02 Tr = 4
20	2±1	10	5	0446-0020-50 Tr = 5	0446-0020-01 Tr = 5	0446-0020-02 Tr = 5
30	3±1	10	5	0446-0030-50 Tr = 7	0446-0030-01 Tr = 7	0446-0030-02 Tr = 7
40	4±1	10	5	0446-0040-50 Tr = 8.5	0446-0040-01 Tr = 8.5	0446-0040-02 Tr = 8.5
50	5±2	10	5	0446-0050-50 Tr = 10	0446-0050-01 Tr = 10	0446-0050-02 Tr = 10
60	6±2	10	8	0446-0060-50 Tr = 12	0446-0060-01 Tr = 12	0446-0060-02 Tr = 12
70	7±2	10	8	0446-0070-50 Tr = 14	0446-0070-01 Tr = 14	0446-0070-02 Tr = 14
80	8±2	10	8	0446-0080-50 Tr = 16	0446-0080-01 Tr = 16	0446-0080-02 Tr = 16
90	9±2	10	8	0446-0090-50 Tr = 18	0446-0090-01 Tr = 18	0446-0090-02 Tr = 18
100	10±3	10	10	0446-0100-50 Tr = 20	0446-0100-01 Tr = 20	0446-0100-02 Tr = 20
150	15±3	10	10	0446-0150-50 Tr = 30	0446-0150-01 Tr = 28	0446-0150-02 Tr = 30
200	20±3	10	10	0446-0200-50 Tr = 40	0446-0200-01 Tr = 35	0446-0200-02 Tr = 40
250	25±3	10	10	0446-0250-50 Tr = 50	0446-0250-01 Tr = 45	0446-0250-02 Tr = 50
300	30±3	10	10	0446-0300-50 Tr = 60	0446-0300-01 Tr = 60	0446-0300-02 Tr = 60
400	40±3	10	10	0446-0400-50 Tr = 80	0446-0400-01 Tr = 80	0446-0400-02 Tr = 80
500	50±3	10	10	0446-0500-50 Tr = 100	0446-0500-01 Tr = 100	0446-0500-02 Tr = 100

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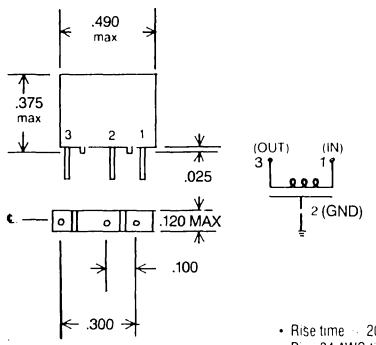
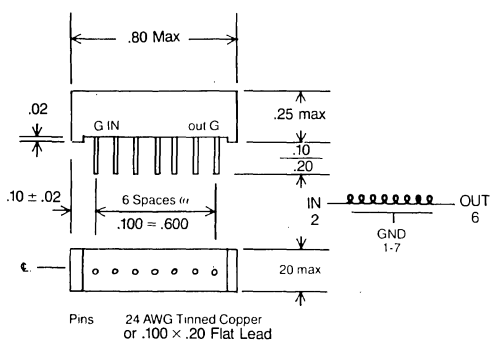
SINGLE-IN-LINE DELAY LINES

- compatible with ECL and TTL circuits
- temperature coefficient of delay = 100 PPM C max
- DIST. = 7.5% max
- Operating temp. range = −55 C to +125 C



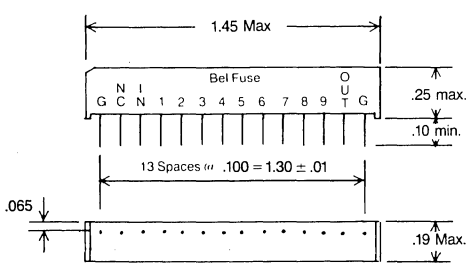
- Rise time = 20-80%
- Pins 24 AWG tinned copper
- DWV = 50 VDC

TIME DELAY IN NS	RISE TIME MAX IN NS	D.C.R. MAX IN OHMS	PART NUMBER	
			55 OHMS ± 10%	93 OHMS ± 10%
1 ± .2	1.6	.20	0402-0001-55	0402-0001-93
2 ± .2	1.6	.25	0402-0002-55	0402-0002-93
3 ± .2	1.7	.37	0402-0003-55	0402-0003-93
4 ± .2	1.7	.50	0402-0004-55	0402-0004-93
5 ± .25	1.8	.62	0402-0005-55	0402-0005-93
6 ± .3	2.0	.75	0402-0006-55	0402-0006-93
7 ± .3	2.2	.80	0402-0007-55	0402-0007-93
8 ± .3	2.4	.85	0402-0008-55	0402-0008-93
9 ± .3	2.6	.90	0402-0009-55	0402-0009-93
10 ± .3	2.8	.95	0402-0010-55	0402-0010-93



- Rise time = 10 to 90%
- DWV = 50 VDC
- DIST. = 10% max
- Taps available upon request
- Other delay increments available
- Other PIN OUTS Available

TIME DELAY IN NS	RISE TIME MAX IN NS	ATTEN. MAX IN %	PART NUMBERS		
			55 OHMS ± 10%	100 OHMS ± 10%	200 OHMS ± 10%
1 ± .3	2.6	3	0403-0001-55	0403-0001-01	0403-0001-02
2 ± .3	2.75	3	0403-0002-55	0403-0002-01	0403-0002-02
3 ± .3	2.9	3	0403-0003-55	0403-0003-01	0403-0003-02
4 ± .3	3.05	3	0403-0004-55	0403-0004-01	0403-0004-02
5 ± .3	3.2	5	0403-0005-55	0403-0005-01	0403-0005-02
10 ± .5	4	5	0403-0010-55	0403-0010-01	0403-0010-02
15 ± .7	5.25	5	0403-0015-55	0403-0015-01	0403-0015-02
20 ± 1	6.1	5	0403-0020-55	0403-0020-01	0403-0020-02
25 ± 1.2	7.5	5	0403-0025-55	0403-0025-01	0403-0025-02
30 ± 1.5	9.0	6	0403-0030-55	0403-0030-01	0403-0030-02
35 ± 1.7	10.5	6	0403-0035-55	0403-0035-01	0403-0035-02
40 ± 2	12.5	6	0403-0040-55	0403-0040-01	0403-0040-02
45 ± 2.7	13.5	6	0403-0045-55	0403-0045-01	0403-0045-02
50 ± 2.5	15.0	6	0403-0050-55	0403-0050-01	0403-0050-02



- Rise time = 10-90%
- DWV = 50 VDC
- Other delays available on request
- Pins .012 × .020 flat head

PART NUMBER	TIME DELAY IN NS	TAPS IN NS	TR IN NS	ZO 10%	D.C.R.
0438-0010-50	10	1 ± .25	2.5	50 Ohms	8 Ohms
0438-0020-50	20	2 ± .4	4	50 Ohms	1 Ohm
0438-0050-50	50	5 ± 1.5	9	50 Ohms	2 Ohms
0438-0100-50	100	10 ± 2	18	50 Ohms	3 Ohms
0438-0010-01	10	1 ± .25	2.5	100 Ohms	1.6 Ohms
0438-0020-01	20	2 ± .4	4	100 Ohms	2 Ohms
0438-0050-01	50	5 ± 1.5	9	100 Ohms	4 Ohms
0438-0100-01	100	10 ± 2	19	100 Ohms	9 Ohms
0438-0020-02	20	2 ± .4	4.5Ns	200 Ohms	5 Ohms
0438-0050-02	50	5 ± 1.5	10 Ns	200 Ohms	12 Ohms
0438-0100-02	100	10 ± 2	20 Ns	200 Ohms	17 Ohms

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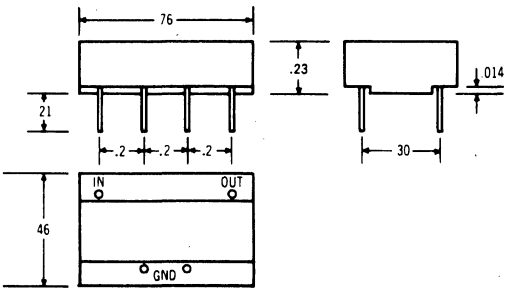
DUAL-IN-LINE

- Delays from 1-1000 nanoseconds.
- Band Width to 60 mhz.
- Impedance 50 to 1000 ohms.
- Resistive Terminations if desired.
- Tapped Delay Lines available.
- Several separate lines in one case.
- Contact Bel Engineering for special applications.



Time Delay nsec ±5%*	Impedance ±10%					
	50Ω	75Ω	100Ω	200Ω	500Ω	1000Ω
5	0440-0005-50 Tr = 5	0440-0005-75 Tr = 5	0440-0005-01 Tr = 5	0440-0005-02 Tr = 6	0440-0005-05 Tr = 6	0440-0005-10 Tr = 6
10	0440-0010-50 Tr = 5	0440-0010-75 Tr = 6	0440-0010-01 Tr = 6	0440-0010-02 Tr = 7	0440-0010-05 Tr = 7	0440-0010-10 Tr = 7
15	0440-0015-50 Tr = 8	0440-0015-75 Tr = 8	0440-0015-01 Tr = 8	0440-0015-02 Tr = 8	0440-0015-05 Tr = 8	0440-0015-10 Tr = 8
20	0444-0020-50 Tr = 10	0440-0020-75 Tr = 10	0440-0020-01 Tr = 10	0440-0020-02 Tr = 10	0440-0020-05 Tr = 10	0440-0020-10 Tr = 10
30	0444-0030-50 Tr = 12	0440-0030-75 Tr = 10	0440-0030-01 Tr = 10	0440-0030-02 Tr = 10	0440-0030-05 Tr = 10	0440-0030-10 Tr = 15
40	0444-0040-50 Tr = 17	0444-0040-75 Tr = 20	0440-0040-01 Tr = 13	0440-0040-02 Tr = 13	0440-0040-05 Tr = 15	0440-0040-10 Tr = 20
50	0444-0050-50 Tr = 18	0444-0050-75 Tr = 20	0440-0050-01 Tr = 15	0440-0050-02 Tr = 15	0440-0050-05 Tr = 18	0440-0050-10 Tr = 30
60	0444-0060-50 Tr = 23	0444-0060-75 Tr = 20	0444-0060-01 Tr = 18	0440-0060-02 Tr = 20	0440-0060-05 Tr = 22	0440-0060-10 Tr = 35
70	0444-0070-50 Tr = 23	0444-0070-75 Tr = 22	0444-0070-01 Tr = 19	0440-0070-02 Tr = 22	0440-0070-05 Tr = 25	0440-0070-10 Tr = 35
80	0444-0080-50 Tr = 28	0444-0080-75 Tr = 22	0444-0080-01 Tr = 19	0440-0080-02 Tr = 25	0440-0080-05 Tr = 30	0440-0080-10 Tr = 40
90	0444-0090-50 Tr = 30	0444-0090-75 Tr = 23	0444-0090-01 Tr = 20	0444-0090-02 Tr = 26	0440-0090-05 Tr = 33	0440-0090-10 Tr = 45
100	0444-0100-50 Tr = 35	0444-0100-75 Tr = 23	0444-0100-01 Tr = 20	0444-0100-02 Tr = 28	0440-0100-05 Tr = 35	0440-0100-10 Tr = 50
125	0444-0125-50 Tr = 45	0444-0125-75 Tr = 30	0444-0125-01 Tr = 22	0444-0125-02 Tr = 30	0440-0125-05 Tr = 37	0440-0125-10 Tr = 55
150	0444-0150-50 Tr = 50	0444-0150-75 Tr = 35	0444-0150-01 Tr = 27	0444-0150-02 Tr = 30	0440-0150-05 Tr = 40	0444-0150-10 Tr = 60
200	0444-0200-50 Tr = 55	0444-0200-75 Tr = 50	0444-0200-01 Tr = 37	0444-0200-02 Tr = 40	0444-0200-05 Tr = 40	0444-0200-10 Tr = 60
300			0444-0300-01 Tr = 57	0444-0300-02 Tr = 60	0444-0300-05 Tr = 55	0444-0300-10 Tr = 60
400				0444-0400-02 Tr = 60	0444-0400-05 Tr = 65	0444-0400-10 Tr = 70
500				0444-0500-02 Tr = 110	0444-0500-05 Tr = 95	0444-0500-10 Tr = 95
600				0444-0600-02 Tr = 110	0444-0600-05 Tr = 100	0444-0600-10 Tr = 125
700				0444-0700-02 Tr = 120	0444-0700-05 Tr = 110	0444-0700-10 Tr = 120
800					0444-0800-05 Tr = 120	0444-0800-10 Tr = 125
900					0444-0900-05 Tr = 135	0444-0900-10 Tr = 135
1000					0444-1000-05 Tr = 150	0444-1000-10 Tr = 150

*or 1 nsec (whichever is greater)

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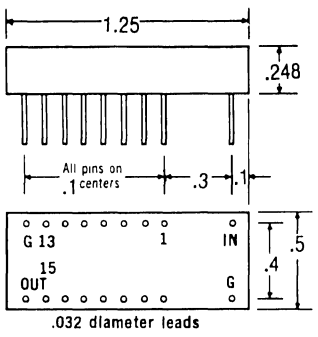
TAPPED DELAY LINES

A



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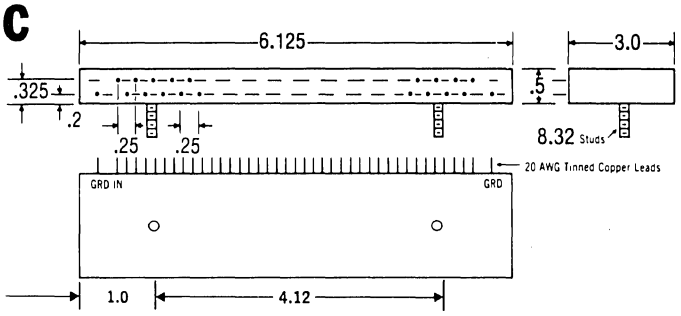

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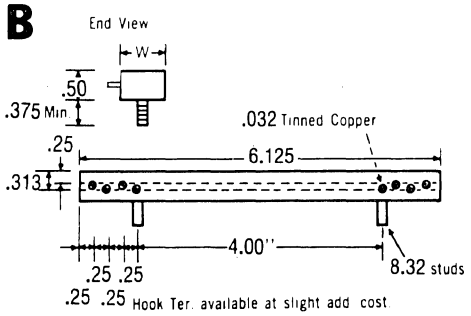

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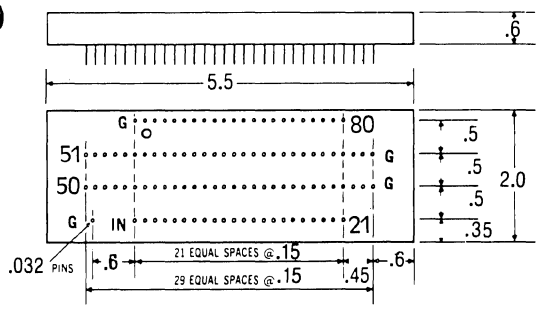

Part No.	Delay nsec	Tr nsec	No. of Taps	Delay/Tap nsec	Impedance	Width"	Style
0414-0155-01	15	5	15	1	100Ω	½	A
0414-0155-02	15	5	15	1	200Ω	½	A
0414-0155-03	15	5	15	1	500Ω	½	A
0414-0131-01	100	15	20	5	500Ω	.8	B
0414-0447-01	200	25	20	10	500Ω	.8	B
0414-0448-01	300	35	20	15	500Ω	.8	B
0414-0449-01	400	45	20	20	500Ω	.8	B
0414-0131-02	500	55	20	25	500Ω	.8	B
0414-0450-01	600	60	20	30	500Ω	.8	B
0414-0451-01	700	70	20	35	500Ω	.8	B
0414-0452-01	800	80	20	40	500Ω	.8	B
0414-0453-01	900	90	20	45	500Ω	.8	B
0414-0131-03	1000	100	20	50	500Ω	.8	B
0404-0454-01	1000	30	100	10	100Ω	2.0	D
0414-0455-01	2000	200	20	100	500Ω	.8	B
0404-0456-01	3000	300	20	150	500Ω	.8	B
0404-0457-01	4000	400	20	200	500Ω	.8	B
0404-0458-01	5000	500	20	250	500Ω	.8	B
0404-0459-01	7500	750	20	375	500Ω	1.2	B
0404-0460-01	10,000	1000	20	500	500Ω	1.2	B
0404-0461-01	12,500	750	25	500	500Ω	3	C
0404-0462-01	15,000	900	30	500	500Ω	3	C
0404-0463-01	17,500	1100	35	500	500Ω	3	C
0404-0464-01	20,000	1200	40	500	500Ω	3	C

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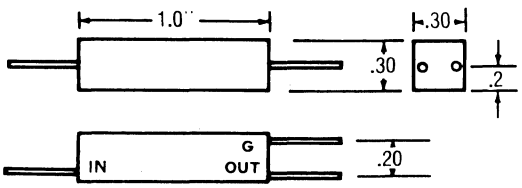
DISTRIBUTIVE

A



Lead Dia. = .032

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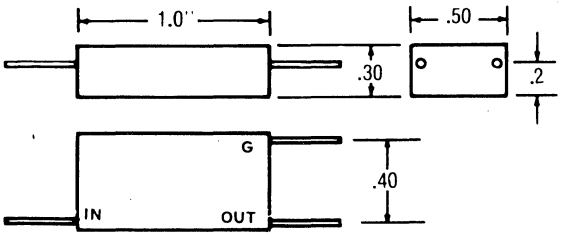

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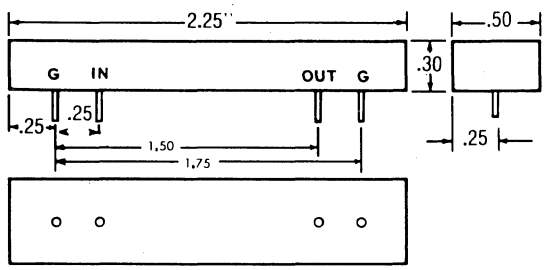

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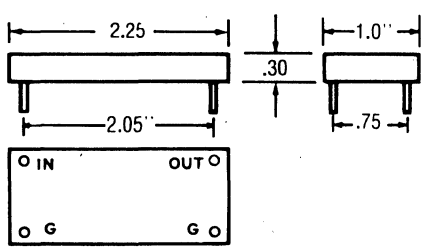

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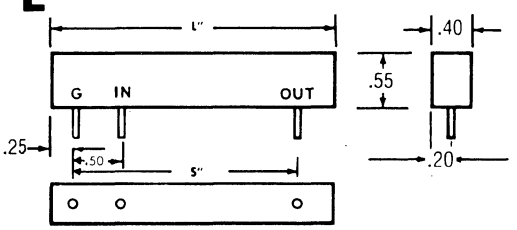

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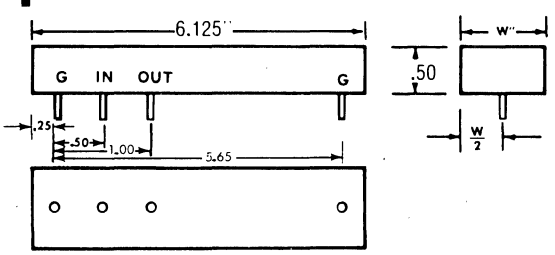

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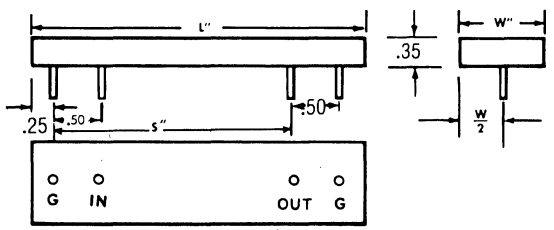

Lead Dia. = .032

The condensed version of our catalog items are listed here showing the most widely used sizes and types available for prompt shipment. Space prohibits the full listing of the many specials and the variations available.

CAUTION: Before finalizing your design, it is highly recommended you contact our Engineering Staff for their expert guidance, founded on our vast experience and up-to-date technology — a phone call can save you valuable time and money.

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DELAY LINES

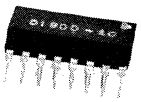
Part Number — Impedance ±10%				DELAY TIME ±5%	RISE TIME	CON-FIGU-RATION	LEAD SPACING "S"	LENGTH "L"	WIDTH "W"
93Ω	200Ω	500Ω	1000Ω	nsec	nsec 93Ω		INCHES	INCHES	INCHES
0420-0001-93	0420-0001-02	0420-0001-05	0420-0001-10	1	4.0	A	—	1.0	.3
0420-0002-93	0420-0002-02	0420-0002-05	0420-0002-10	2	4.0	A	—	1.0	.3
0420-0003-93	0420-0003-02	0420-0003-05	0420-0003-10	3	4.0	A	—	1.0	.3
0420-0004-93	0420-0004-02	0420-0004-05	0420-0004-10	4	4.0	A	—	1.0	.3
0420-0005-93	0420-0005-02	0420-0005-05	0420-0005-10	5	4.0	A	—	1.0	.3
0420-0010-93	0420-0010-02	0420-0010-05	0420-0010-10	10	4.0	A	—	1.0	.3
0420-0015-93	0420-0015-02	0420-0015-05	0420-0015-10	15	4.0	B	—	1.0	.5
0420-0020-93	0420-0020-02	0420-0020-05	0420-0020-10	20	4.0	B	—	1.0	.5
0420-0025-93	0420-0025-02	0420-0025-05	0420-0025-10	25	5.0	C	—	2.25	.5
0420-0030-93	0420-0030-02	0420-0030-05	0420-0030-10	30	6.0	C	—	2.25	.5
0420-0035-93	0420-0035-02	0420-0035-05	0420-0035-10	35	7.0	C	—	2.25	.5
0420-0040-93	0420-0040-02	0420-0040-05	0420-0040-10	40	8.0	C	—	2.25	.5
0420-0045-93	0420-0045-02	0420-0045-05	0420-0045-10	45	9.0	C	—	2.25	.5
0420-0050-93	0420-0050-02	0420-0050-05	0420-0050-10	50	9.0	C	—	2.25	.5
0420-0055-93	0420-0055-02	0420-0055-05	0420-0055-10	55	10.0	D	—	2.25	1.0
0420-0060-93	0420-0060-02	0420-0060-05	0420-0060-10	60	10.0	D	—	2.25	1.0
0420-0065-93	0420-0065-02	0420-0065-05	0420-0065-10	65	11.0	D	—	2.25	1.0
0420-0070-93	0420-0070-02	0420-0070-05	0420-0070-10	70	12.0	D	—	2.25	1.0
0420-0075-93	0420-0075-02	0420-0075-05	0420-0075-10	75	12.0	D	—	2.25	1.0
0420-0080-93	0420-0080-02	0420-0080-05	0420-0080-10	80	13.0	D	—	2.25	1.0
0420-0085-93	0420-0085-02	0420-0085-05	0420-0085-10	85	13.0	D	—	2.25	1.0
0420-0090-93	0420-0090-02	0420-0090-05	0420-0090-10	90	14.0	D	—	2.25	1.0
0420-0095-93	0420-0095-02	0420-0095-05	0420-0095-10	95	14.0	D	—	2.25	1.0
0420-0100-93	0420-0100-02	0420-0100-05	0420-0100-10	100	15.0	D	—	2.25	1.0
0420-0125-93	—	—	—	125	15.0	G	2	3.00	.75
—	0420-0125-02	—	—	125	18.0	G	2.8	3.8	.625
—	—	0420-0125-05	0420-0125-10	125	30.0	E	1.20	1.8	.4
0420-0150-93	—	—	—	150	15.0	G	2	3.0	1.0
—	0420-0150-02	—	—	150	20.0	G	2.8	3.8	.625
—	—	0420-0150-05	0420-0150-10	150	27.0	E	1.20	1.8	.4
0420-0175-93	—	—	—	175	20.0	G	2	3.0	1.0
—	0420-0175-02	—	—	175	20.0	G	2.8	3.8	.625
—	—	0420-0175-05	0420-0175-10	175	30.0	E	1.20	1.8	.4
0420-0200-93	—	—	—	200	20.0	G	2	3.0	1.0
—	0420-0200-02	—	—	200	20.0	G	2.8	3.8	.625
—	—	0420-0200-05	0420-0200-10	200	35.0	E	1.20	1.8	.4
0420-0250-93	—	—	—	250	32.0	G	2	3.0	1.000
—	0420-0250-02	—	—	250	35.0	G	2.8	3.8	.625
—	—	0420-0250-05	0420-0250-10	250	40.0	E	1.20	1.8	.4
0420-0300-93	—	—	—	300	40.0	G	5.125	6.125	1.5
—	0420-0300-02	—	—	300	40.0	G	2.8	3.8	.925
—	—	0420-0300-05	0420-0300-10	300	45.0	E	2.20	3.0	.4
0420-0400-93	—	—	—	400	45.0	G	5.125	6.125	1.5
—	0420-0400-02	—	—	400	45.0	G	2.8	3.8	.925
—	—	0420-0400-05	0420-0400-10	400	55.0	E	2.20	3.0	.4
0420-0500-93	—	—	—	500	65.0	G	5.125	6.125	1.5
—	0420-0500-02	—	—	500	65.0	G	2.8	3.8	.925
—	—	0420-0500-05	0420-0500-10	500	70.0	E	2.20	3.0	.4
—	0420-0600-02	—	—	600	75.0	G	2.8	3.8	1.5
—	—	0420-0600-05	0420-0600-10	600	75.0	E	2.20	3.9	.4
—	0420-0700-02	—	—	700	85.0	G	5.125	6.125	.8
—	—	0420-0700-05	0420-0700-10	700	85.0	E	2.20	3.9	.4
—	0420-0800-02	—	—	800	85.0	G	5.125	6.125	.8
—	—	0420-0800-05	0420-0800-10	800	95.0	E	3.40	4.25	.4
—	0420-0900-02	—	—	900	95.0	G	5.125	6.125	.8
—	—	0420-0900-05	0420-0900-10	900	100.0	E	4.40	5.25	.4
—	0420-1000-02	—	—	1000	110.0	G	5.125	6.125	.8
—	—	0420-1000-05	0420-1000-10	1000	110.0	E	4.40	5.25	.4
—	0420-1500-02	—	—	1500	150.0	F	—	6.125	2.0
—	—	0420-1500-05	0420-1500-10	1500	150.0	F	—	6.125	.8
—	0420-2000-02	—	—	2000	200.0	F	—	6.125	2.0
—	—	0420-2000-05	0420-2000-10	2000	200.0	F	—	6.125	.8
—	0420-2500-02	—	—	2500	250.0	F	—	6.125	2.0
—	—	0420-2500-05	0420-2500-10	2500	250.0	F	—	6.125	.8
—	0420-3000-02	—	—	3000	300.0	F	—	6.125	2.0
—	—	0420-3000-05	0420-3000-10	3000	300.0	F	—	6.125	1.2
—	0420-3500-02	—	—	3500	350.0	F	—	6.125	3.0
—	—	0420-3500-05	0420-3500-10	3500	350.0	F	—	6.125	1.2
—	0420-4000-02	—	—	4000	400.0	F	—	6.125	3.0
—	—	0420-4000-05	0420-4000-10	4000	400.0	F	—	6.125	2.0
—	0420-4500-02	—	—	4500	450.0	F	—	6.125	3.0
—	—	0420-4500-05	0420-4500-10	4500	450.0	F	—	5.125	2.0
—	0420-5000-02	—	—	5000	500.0	F	—	6.125	3.0
—	—	0420-5000-05	0420-5000-10	5000	500.0	F	—	6.125	2.0

bel BEL FUSE INC. 198 Van Vorst Street • Jersey City, N. J. 07302 • (201) 432-0463 • TWX 710-730-5301

FIXED AND TAPPED DELAY LINES

SUB-MINIATURE DUAL-IN-LINE TAPPED LUMPED CONSTANT LINES

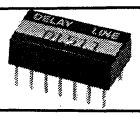
Each line has 10 tap delays spaced at equal intervals. Attenuation less than 1 dB. Temp. Coeff. less than 50 PPM/°C. DIP configuration compatible with automatic inserting equipment. Commercial and MIL Spec. models available.



MODEL	DELAY RANGE	RISE TIME OR FREQ. RESP.	IMPED-ANCE OHMS	SIZE INCHES
D1900-10	10 Nsec	2 Nsec	100	.21 x .30 x .78
D1900-20	20	3	100	.21 x .30 x .78
D1900-40	40	6	100	.21 x .30 x .78
D1900-60	60	9	100	.21 x .30 x .78
D1900-80	80	10	100	.21 x .30 x .78
D1900-100	100	20	100	.21 x .30 x .78
D8001	5	1	50	.21 x .30 x .78
D8004	10	2	100	.21 x .30 x .78
D8005	25	5	100	.21 x .30 x .78
D8007	30	6	100	.21 x .30 x .78

TAPPED DELAYS

Each line provides 10 tap delays spaced at equal intervals.



D1511-1	10 Nsec	3 Nsec		
D1511-2	20	6		
D1511-4	40	13		Dual-In-Line
D1511-6	60	20	100	Pin Spacing
D1511-8	80	26		.21 x .39 x .7
D1511-10	100	33		

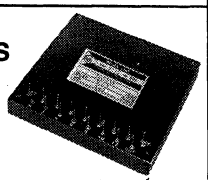
MINIATURE LUMPED CONSTANT

Hermetically sealed in a metal container. Delay tolerance ±5%. Temperature stability less than 50 PPM/°C, P.C. Mounting.

D647-110	50 Nsec	12 Nsec	50	.30 x 1.0 x 1.25
D647-211	100	12.5	50	.30 x 1.0 x 2.45
D647-312	250	21	50	.30 x 1.0 x 3.45
D647-323	500	42	150	.30 x 1.0 x 3.45
D647-334	750	63	500	.30 x 1.0 x 3.45
D647-115	1,000	250	50	.30 x 1.0 x 1.25
D647-236	1,450	180	500	.30 x 1.0 x 2.45
D647-327	2,900	240	150	.30 x 1.0 x 3.45
D647-338	4,350	360	500	.30 x 1.0 x 3.45

ATC TRANSPONDER AND BEACON CODING DELAY LINES

Standard 1.45 μsec tap spacings plus other special delay points are provided. Hermetically sealed steel cased, plastic encapsulated and P.C. mounted units are offered.

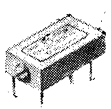


D1560	10.15 μsec	.33 μsec	400	.55 x 2.25 x 3.62
D1365	20.3	.5	180	.87 x 3.5 x 3.5
D1000	20.3	.5	330	.35 x 2 x 4
D120	25.0	.55	180	.75 x 5 x 4.37
D298A	25.3	.6	500	1.62 x 2.87 x 4.25
D637	20.3	.3	180	2.37 x 2.75 x 3.18
D1190	20.3	.4	400	.63 x 4 x 5
D1191	24.65	.5	500	.63 x 4 x 5
D1210	8.0	.5	500	5 x 1 x 4

VARIABLE DELAY LINES

DUAL-IN-LINE COMPATIBLE VARIABLE DELAY LINES

Sealed in plastic case. Temp. coeff. less than 50 PPM/°C. .020″ P.C. mounting pins.



V1570-1	0 - 10 Nsec	2 Nsec	100	.25 x .75 x 1.5
V1570-2	0 - 20	4	100	.25 x .75 x 1.5
V1570-3	0 - 40	8	100	.25 x .75 x 1.5
V1570-4	0 - 80	16	100	.25 x .75 x 1.5
V1570-5	0 - 160	32	200	.25 x .75 x 1.5
V1570-6	0 - 320	64	200	.25 x .75 x 1.5

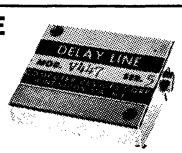
MIL VERSION

Hermetically sealed in a metal case.

V1768-1	0 - 10 Nsec	2 Nsec	100	.25 x .87 x 1.6
V1768-2	0 - 20	4	100	.25 x .87 x 1.6
V1768-3	0 - 40	8	100	.25 x .87 x 1.6

MINIATURE LUMPED VARIABLE Nanosecond Range

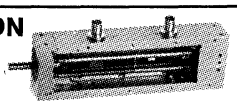
Hermetically sealed in a metal case. Lumped constant parameter. Temperature coefficient less than 50 PPM/°C. .030″ P.C. mounting pins.



V447-1	0 - 55 Nsec	15 Nsec	150	.31 x 1 x 1.25
V447-2	0 - 100	30	50	.31 x 1 x 1.25
V447-3	0 - 150	25	150	.31 x 1 x 2.45
V447-4	0 - 250	30	50	.31 x 1 x 2.45
V447-5	0 - 300	30	150	.31 x 1 x 3.45
V447-6	0 - 500	60	50	.31 x 1 x 3.45

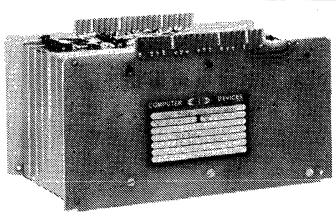
NOVEL INFINITE RESOLUTION

With input and output impedance of equal value. Voltage standing wave ratio less than ½ db to 45 MHz.



DV575-1	2 - 25 Nsec	70 MHz	200	1 x 1.25 x 5.37
DV575-2	2 - 50	70	100	1 x 1.25 x 5.37
DV575-3	2 - 50	70	200	1 x 1.25 x 5.37
DV575-4	2 - 50	70	93	1 x 1.25 x 5.37
DV575-5	2 - 25	70	50	1 x 1.25 x 5.37
DV575-6	2 - 50	70	93	1 x 1.25 x 5.37

DELAY LINE COMPUTER MEMORIES DELCOMS



THE DELAY LINE COMPUTER MEMORY (DELCOM) offers the **Lowest Price Per Bit** of any high speed memory device. Computer Devices Corp. offers convenient standard packages for all practical storage capacities from 10 bits to 20,000 bits in single delay line units as well as multi delay line units with massive storage capacities. All Delcoms are compatible with DTL and T^2L logic. Normal power requirements are +12 and −12 VDC and +5 VDC. However, Delcoms are tailored to your bit rate, delay, input-output logic and power requirements.

MANY OTHER MODELS AND SPECIALTY Delay Lines are available. If exactly what you want is not listed, please call.

COMPUTER DEVICES CORP.
63 AUSTIN BOULEVARD COMMACK, N.Y. 11725
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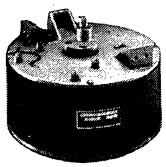
military & commercial

DELAY LINES

WITH OR WITHOUT CIRCUITRY

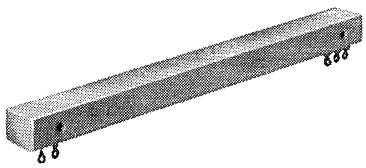
MAGNETOSTRICTIVE ★ LUMPED CONSTANT ★ ULTRASONIC ★ DISTRIBUTED CONSTANT ★ DISPERSIVE STRIP

MAGNETOSTRICTIVE DELAY LINES — Fixed and variable delays to 10,000 microseconds. Fixed — FMS Series; Variable — VM Series.



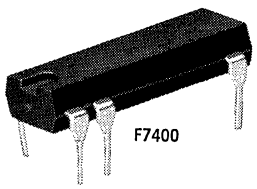
VARIABLE MAGLINE

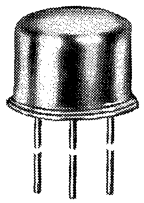
Delays up to 4000 μsec variable. Infinite resolution. Excellent temperature stability. Typical use — Radar range calibration.



ULTRASONIC DELAY LINES — Replaces most quartz or glass lines. Offers superior performance, lower attenuation and smaller size at less cost. Frequencies to 30 MHz. Delays to 200 usec and greater.

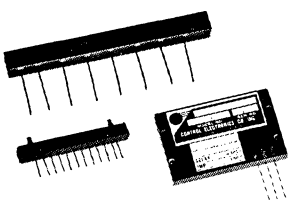
SUBMINIATURE DELAY LINES



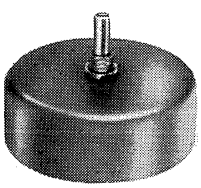


TO-5 and micrologic packaged delay lines from 0.01 to 0.64 and longer delays. Ideal for timing transistors and other circuit components.

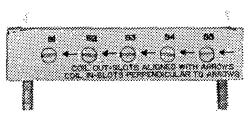
LUMPED CONSTANT DELAY LINES — Many shapes available including miniature types with pin connectors for PC Boards, connector fingers for plug-in units...multi-tapped units...terminal-ended units, etc. Delays from 0.05 usec to 500 usec for standard units. Delay to risetime ratios up to 100:1. Temperature stability to 50 ppm/C°.



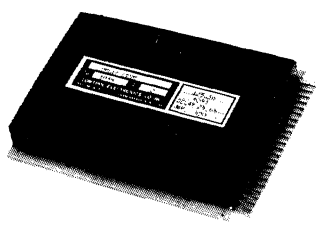
COMPACT FIXED DELAY LINES FOR PC BOARDS — Extremely high density packaging. Typical Unit: 25:1 delay-to-rise-time ratio in a volume of 2 cubic inches.



VARIABLE DELAY LINE Resolution of 1 part in 120. Delay up to 10 usec. 1″ x 3″.

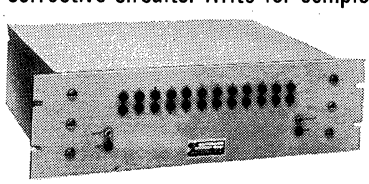


UNIQUE BINARY CODED SECTIONAL DELAY LINE — Uses miniature transfer switches. Also available with terminals for remote switching.



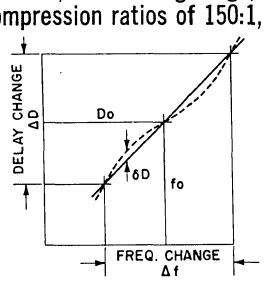
IFF MULTI-TAP DELAY LINES Standard IFF delay lines with taps every 1.45 usec. High density packaging available for airborne transponder use.

AUDIO, HIGH FREQUENCY & DISTRIBUTED CONSTANT DELAY LINES — With unusual circuits, extreme delays, high frequency application, rapid rise times, conforming waveform circuits and corrective circuits. Write for complete details.



AUDIO DELAY CABINET — Relay rack mounted cabinet houses 25 millisecond delay with taps at every ms. Units can be cascaded for longer delays.

DISPERSIVE STRIP DELAY LINES — Delay varies with frequency. A prime application is in Pulse Compression Radar Systems, eliminating large, expensive filter components. Compression ratios of 150:1, typical.



$\Delta D \cdot \Delta f$ = COMPRESSION RATIO OR DISPERSION FACTOR

$\frac{\Delta f}{fo}$ = BANDWIDTH %

fo = MIDBAND FREQUENCY

Do = MIDBAND DELAY

For all your Delay Line requirements, contact:

CONTROL ELECTRONICS COMPANY, INC.

107-B Allen Blvd. Farmingdale, NY 11735 Tel: (516) 694-0125

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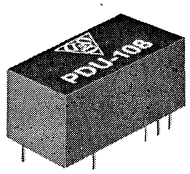
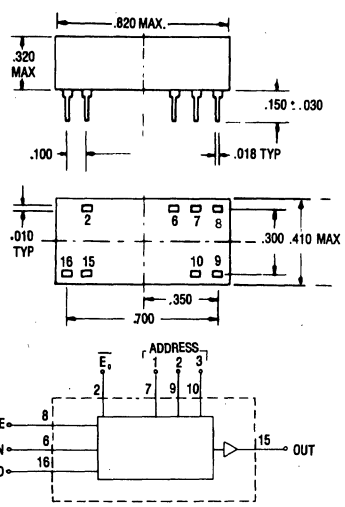
DIGITALLY PROGRAMMABLE DELAY LINES

SERIES PDU-108 (ECL Interfaced) 3 BIT



Specifications

- Operating temperature: −0°C to 70°C.
- Storage temperature; −55° to +125°C.
- Power dissipation: −290 MW typ. (no load).
- 16 pin DIP.
- Delay variation: Monotonic in one direction.
- Inherent delay: 5NS typ.
- Tolerance: 5% or ½ NS, whichever is greater.



TRUTH TABLE

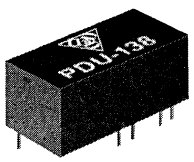
Enable	Address (Bit No.) 3	2	1	Delay Out
0	0	0	0	T_0
0	0	0	1	T_1
0	0	1	0	T_2
0	0	1	1	T_3
0	1	0	0	T_4
0	1	0	1	T_5
0	1	1	0	T_6
0	1	1	1	T_7
1	Ø	Ø	Ø	0

1 = High
0 = Low
Ø = Don't care
T_0 = Reference or inherent delay of circuit.
T_1 to T_7 = Multiplier of incremental delay.

Part No.**	Min. Delay Increment	Total Delay* Change	Part No.**	Min. Delay Increment	Total Delay* Change
PDU-108-1	1 NS ± .4 NS	7 NS	PDU-108-10	10 NS ± 1.0 NS	70 NS
PDU-108-2	2 NS ± .4 NS	14 NS	PDU-108-20	20 NS ± 1.5 NS	140 NS
PDU-108-3	3 NS ± .5 NS	21 NS	PDU-108-40	40 NS ± 2.0 NS	280 NS
PDU-108-5	5 NS ± .6 NS	35 NS	PDU-108-50	50 NS ± 2.5 NS	350 NS

*This delay value does not include the T_0 delay.
**Other delay increments available on request.

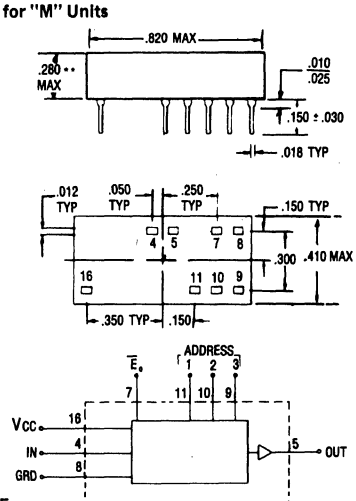
SERIES PDU-138 (TTL Interfaced) 3 BIT



Specifications

- Inherent delay: 7 NS ±1 NS.
- Temperature coefficient: 100 PPM/°C.
- 16 pin DIP.
- Delay variation: Monotonic in one direction.
- Tolerance: 5% or ½ NS.
- Operating temperature: 0-70°C. (−55 to +125°C on request) *

*Add "M" after PART NO. Example PDU-138-2M
**.320 Max. for "M" Units



TRUTH TABLE

Enable	Address (Bit No.) 3	2	1	Delay Out
0	0	0	0	T_0
0	0	0	1	T_1
0	0	1	0	T_2
0	0	1	1	T_3
0	1	0	0	T_4
0	1	0	1	T_5
0	1	1	0	T_6
0	1	1	1	T_7
1	Ø	Ø	Ø	0

1 = High
0 = Low
Ø = Don't care
T_0 = Reference or inherent delay of circuit.
T_1 to T_7 = Multiplier of incremental delay.

Part ** Number	Incremental Delay Per Step	Total Delay* Change	Part ** Number	Incremental Delay Per Step	Total Delay* Change
PDU-138-1	1 NS ± .4 NS	7 NS	PDU-138-15	15 NS ± 1.3 NS	105 NS
PDU-138-2	2 NS ± .4 NS	14 NS	PDU-138-20	20 NS ± 1.5 NS	140 NS
PDU-138-3	3 NS ± .5 NS	21 NS	PDU-138-40	40 NS ± 2.0 NS	280 NS
PDU-138-5	5 NS ± .6 NS	35 NS	PDU-138-50	50 NS ± 2.5 NS	350 NS
PDU-138-10	10 NS ± 1.0 NS	70 NS			

*This delay value does not include the T_0 delay.
** Other delay increments available on request.

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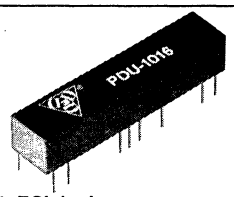
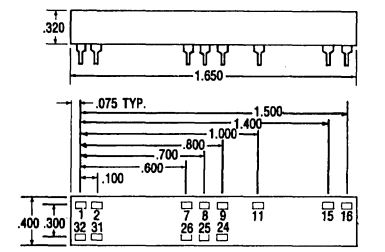
DIGITALLY PROGRAMMABLE DELAY LINES

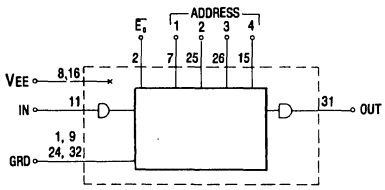
SERIES PDU-1016 (ECL Interfaced) 4-BIT



Specifications

- Input signal requirement: ECL logic.
- Output fan-out: ECL loads.
- Delay variation: Monotonic in one direction.
- Delay tolerance: ±5% or INS whichever is greater.
- Inherent delay: 11 NS ±1 NS for PDU-1016 −1 thru −5. Greater for rest of Part Numbers.
- Temperature range: 0-70°C.
- Temperature coefficient: 100 PPM/°C.
- Supply voltage: −5 Vdc.
- Power dissipation: 615 MW typ.





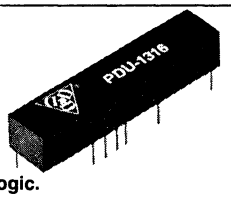
TRUTH TABLE

Enable (Eo)	Address (Bit No.) 4	3	2	1	Delay Out
0	0	0	0	0	T_o
0	0	0	0	1	T_1
0	0	0	1	0	T_2
0	0	0	1	1	T_3
0	0	1	0	0	T_4
0	0	1	0	1	T_5
0	0	1	1	0	T_6
0	0	1	1	1	T_7
0	1	0	0	0	T_8
0	1	0	0	1	T_9
0	1	0	1	0	T_{10}
0	1	0	1	1	T_{11}
0	1	1	0	0	T_{12}
0	1	1	0	1	T_{13}
0	1	1	1	0	T_{14}
0	1	1	1	1	T_{15}
1	0	0	0	0	0

0 = Logic 0
1 = Logic 1
0 = Don't care
T_o = Reference or inherent delay of circuit.
T_1 to T_{15} = Multiplier of incremental delay.

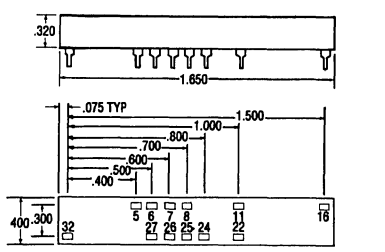
Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS	Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS
PDU-1016-1	1	15	PDU-1016-20	20	300
PDU-1016-2	2	30	PDU-1016-25	25	375
PDU-1016-3	3	45	PDU-1016-30	30	450
PDU-1016-4	4	60	PDU-1016-35	35	525
PDU-1016-5	5	75	PDU-1016-40	40	600
PDU-1016-6	6	90	PDU-1016-45	45	675
PDU-1016-8	8	120	PDU-1016-50	50	750
PDU-1016-10	10	150	PDU-1016-60	60	900
PDU-1016-12	12	180	PDU-1016-80	80	1,200
PDU-1016-15	15	225	PDU-1016-100	100	1,500

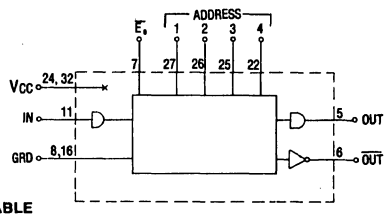
SERIES PDU-1316 (TTL Interfaced) 4 BIT



Specifications

- Input signal requirements: TTL logic.
- Output fan-out: TTL Schottky load.
- Delay variation: Monotonic in one direction.
- Delay tolerance: ±5% or 1 NS whichever is greater.
- Inherent delay: 19 NS ± 1 NS on pin 5 / 15 NS ± 1 NS on pin 6 } for PDU-1316 -1 thru -10
  Greater for rest of Part Numbers
- Temperature range: 0-70°C.
- Temperature coefficient: 100 PPM/°C.
- Supply voltage: 4.75 to 5.25 Vdc.
- Power dissipation: 740 MW Max.





TRUTH TABLE

Enable (Eo)	Address (Bit No.) 4	3	2	1	Delay Out
0	0	0	0	0	T_o
0	0	0	0	1	T_1
0	0	0	1	0	T_2
0	0	0	1	1	T_3
0	0	1	0	0	T_4
0	0	1	0	1	T_5
0	0	1	1	0	T_6
0	0	1	1	1	T_7
0	1	0	0	0	T_8
0	1	0	0	1	T_9
0	1	0	1	0	T_{10}
0	1	0	1	1	T_{11}
0	1	1	0	0	T_{12}
0	1	1	0	1	T_{13}
0	1	1	1	0	T_{14}
0	1	1	1	1	T_{15}
1	0	0	0	0	0

0 = Logic 0
1 = Logic 1
0 = Don't care
T_o = Reference or inherent delay of circuit.
T_1 to T_{15} = Multiplier of incremental delay.

Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS	Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS
PDU-1316-1	1	15	PDU-1316-20	20	300
PDU-1316-2	2	30	PDU-1316-25	25	375
PDU-1316-3	3	45	PDU-1316-30	30	450
PDU-1316-4	4	60	PDU-1316-35	35	525
PDU-1316-5	5	75	PDU-1316-40	40	600
PDU-1316-6	6	90	PDU-1316-45	45	675
PDU-1316-8	8	120	PDU-1316-50	50	750
PDU-1316-10	10	150	PDU-1316-60	60	900
PDU-1316-12	12	180	PDU-1316-80	80	1,200
PDU-1316-15	15	225	PDU-1316-100	100	1,500

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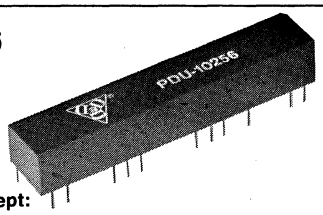
DIGITALLY PROGRAMMABLE DELAY LINES

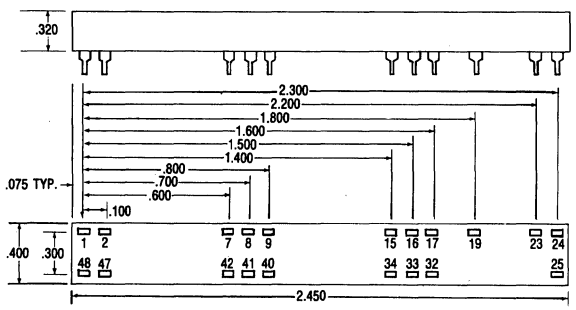
SERIES PDU-10256 (ECL Interfaced) 8-BIT

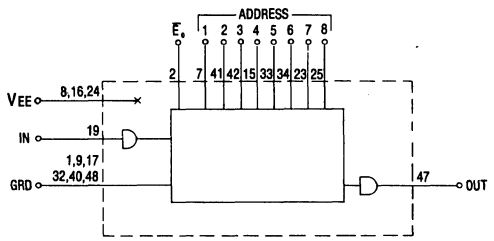


Specifications

Same as PDU-1016 except:

- **Inherent delay: 16 NS typ.**
- **Power dissipation: 925 MW typ.**





TRUTH TABLE

Address (Bit No.)								Enable	Delay Out
8	7	6	5	4	3	2	1	(Eo)	
0	0	0	0	0	0	0	0	0	T_0
0	0	0	0	0	0	0	1	0	T_1
0	0	0	0	0	0	1	0	0	T_2
0	0	0	0	0	0	1	1	0	T_3
0	0	0	0	0	1	0	0	0	T_4
0	0	0	0	0	1	0	1	0	T_5
0	0	0	0	0	1	1	0	0	T_6
0	0	0	0	0	1	1	1	0	T_7
0	0	0	0	1	0	0	0	0	T_8
0	0	0	0	1	0	0	1	0	T_9
0	0	0	0	1	0	1	0	0	T_{10}
0	0	0	0	1	0	1	1	0	T_{11}
0	0	0	0	1	1	0	0	0	T_{12}
0	0	0	0	1	1	0	1	0	T_{13}
0	0	0	0	1	1	1	0	0	T_{14}
0	0	0	0	1	1	1	1	0	T_{15}
0	0	0	1	0	0	0	0	0	T_{16}
0	0	0	1	0	0	0	1	0	T_{17}
0	0	0	1	0	0	1	0	0	T_{18}
0	0	0	1	0	0	1	1	0	T_{19}
0	0	0	1	0	1	0	0	0	T_{20}
0	0	0	1	0	1	0	1	0	T_{21}
0	0	0	1	0	1	1	0	0	T_{22}
0	0	0	1	0	1	1	1	0	T_{23}
0	0	0	1	1	0	0	0	0	T_{24}
0	0	0	1	1	0	0	1	0	T_{25}
0	0	0	1	1	0	1	0	0	T_{26}
0	0	0	1	1	0	1	1	0	T_{27}
0	0	0	1	1	1	0	0	0	T_{28}
0	0	0	1	1	1	0	1	0	T_{29}
0	0	0	1	1	1	1	0	0	T_{30}
0	0	0	1	1	1	1	1	0	T_{31}
0	0	1	0	0	0	0	0	0	T_{32}
0	0	1	0	0	0	0	1	0	T_{33}
0	0	1	0	0	0	1	0	0	T_{34}
0	0	1	0	0	0	1	1	0	T_{35}
0	0	1	0	0	1	0	0	0	T_{36}
0	0	1	0	0	1	0	1	0	T_{37}
0	0	1	0	0	1	1	0	0	T_{38}
0	0	1	0	0	1	1	1	0	T_{39}
0	0	1	0	1	0	0	0	0	T_{40}
0	0	1	0	1	0	0	1	0	T_{41}
0	0	1	0	1	0	1	0	0	T_{42}
0	0	1	0	1	0	1	1	0	T_{43}
0	0	1	0	1	1	0	0	0	T_{44}
0	0	1	0	1	1	0	1	0	T_{45}
0	0	1	0	1	1	1	0	0	T_{46}
0	0	1	0	1	1	1	1	0	T_{47}
0	0	1	1	0	0	0	0	0	T_{48}
0	0	1	1	0	0	0	1	0	T_{49}
0	0	1	1	0	0	1	0	0	T_{50}
0	0	1	1	0	0	1	1	0	T_{51}
0	0	1	1	0	1	0	0	0	T_{52}
0	0	1	1	0	1	0	1	0	T_{53}
0	0	1	1	0	1	1	0	0	T_{54}
0	0	1	1	0	1	1	1	0	T_{55}
0	0	1	1	1	0	0	0	0	T_{56}
0	0	1	1	1	0	0	1	0	T_{57}
0	0	1	1	1	0	1	0	0	T_{58}
0	0	1	1	1	0	1	1	0	T_{59}
0	0	1	1	1	1	0	0	0	T_{60}
0	0	1	1	1	1	0	1	0	T_{61}
0	0	1	1	1	1	1	0	0	T_{62}
0	0	1	1	1	1	1	1	0	T_{63}
0	1	0	0	0	0	0	0	0	T_{64}
0	1	0	0	0	0	0	1	0	T_{65}
0	1	0	0	0	0	1	0	0	T_{66}
0	1	0	0	0	0	1	1	0	T_{67}
0	1	0	0	0	1	0	0	0	T_{68}
0	1	0	0	0	1	0	1	0	T_{69}
0	1	0	0	0	1	1	0	0	T_{70}
0	1	0	0	0	1	1	1	0	T_{71}
0	1	0	0	1	0	0	0	0	T_{72}
0	1	0	0	1	0	0	1	0	T_{73}
0	1	0	0	1	0	1	0	0	T_{74}
0	1	0	0	1	0	1	1	0	T_{75}
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0	1	0	0	1	1	1	0	0	T_{78}
0	1	0	0	1	1	1	1	0	T_{79}
0	1	0	1	0	0	0	0	0	T_{80}
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0	1	0	1	0	1	0	1	0	T_{85}
0	1	0	1	0	1	1	0	0	T_{86}
0	1	0	1	0	1	1	1	0	T_{87}
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0	1	1	0	1	1	0	0	0	T_{108}
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0	1	1	0	1	1	1	1	0	T_{111}
0	1	1	1	0	0	0	0	0	T_{112}
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0	1	1	1	0	1	1	1	0	T_{119}
0	1	1	1	1	0	0	0	0	T_{120}
0	1	1	1	1	0	0	1	0	T_{121}
0	1	1	1	1	0	1	0	0	T_{122}
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1	0	1	0	0	0	1	0	0	T_{162}
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1	0	1	0	0	1	1	1	0	T_{167}
1	0	1	0	1	0	0	0	0	T_{168}
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1	0	1	0	1	0	1	0	0	T_{170}
1	0	1	0	1	0	1	1	0	T_{171}
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1	0	1	0	1	1	0	1	0	T_{173}
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1	0	1	1	0	0	0	0	0	T_{176}
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1	0	1	1	0	1	0	1	0	T_{181}
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1	0	1	1	0	1	1	1	0	T_{183}
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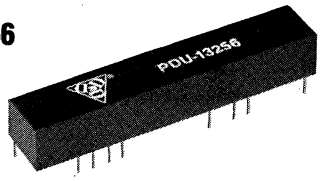
1	1	0	0	1	0	0	1	0	T_{201}
1	1	0	0	1	0	1	0	0	T_{202}
1	1	0	0	1	0	1	1	0	T_{203}
1	1	0	0	1	1	0	0	0	T_{204}
1	1	0	0	1	1	0	1	0	T_{205}
1	1	0	0	1	1	1	0	0	T_{206}
1	1	0	0	1	1	1	1	0	T_{207}
1	1	0	1	0	0	0	0	0	T_{208}
1	1	0	1	0	0	0	1	0	T_{209}
1	1	0	1	0	0	1	0	0	T_{210}
1	1	0	1	0	0	1	1	0	T_{211}
1	1	0	1	0	1	0	0	0	T_{212}
1	1	0	1	0	1	0	1	0	T_{213}
1	1	0	1	0	1	1	0	0	T_{214}
1	1	0	1	0	1	1	1	0	T_{215}
1	1	0	1	1	0	0	0	0	T_{216}
1	1	0	1	1	0	0	1	0	T_{217}
1	1	0	1	1	0	1	0	0	T_{218}
1	1	0	1	1	0	1	1	0	T_{219}
1	1	0	1	1	1	0	0	0	T_{220}
1	1	0	1	1	1	0	1	0	T_{221}
1	1	0	1	1	1	1	0	0	T_{222}
1	1	0	1	1	1	1	1	0	T_{223}
1	1	1	0	0	0	0	0	0	T_{224}
1	1	1	0	0	0	0	1	0	T_{225}
1	1	1	0	0	0	1	0	0	T_{226}
1	1	1	0	0	0	1	1	0	T_{227}
1	1	1	0	0	1	0	0	0	T_{228}
1	1	1	0	0	1	0	1	0	T_{229}
1	1	1	0	0	1	1	0	0	T_{230}
1	1	1	0	0	1	1	1	0	T_{231}
1	1	1	0	1	0	0	0	0	T_{232}
1	1	1	0	1	0	0	1	0	T_{233}
1	1	1	0	1	0	1	0	0	T_{234}
1	1	1	0	1	0	1	1	0	T_{235}
1	1	1	0	1	1	0	0	0	T_{236}
1	1	1	0	1	1	0	1	0	T_{237}
1	1	1	0	1	1	1	0	0	T_{238}
1	1	1	0	1	1	1	1	0	T_{239}
1	1	1	1	0	0	0	0	0	T_{240}
1	1	1	1	0	0	0	1	0	T_{241}
1	1	1	1	0	0	1	0	0	T_{242}
1	1	1	1	0	0	1	1	0	T_{243}
1	1	1	1	0	1	0	0	0	T_{244}
1	1	1	1	0	1	0	1	0	T_{245}
1	1	1	1	0	1	1	0	0	T_{246}
1	1	1	1	0	1	1	1	0	T_{247}
1	1	1	1	1	0	0	0	0	T_{248}
1	1	1	1	1	0	0	1	0	T_{249}
1	1	1	1	1	0	1	0	0	T_{250}
1	1	1	1	1	0	1	1	0	T_{251}
1	1	1	1	1	1	0	0	0	T_{252}
1	1	1	1	1	1	0	1	0	T_{253}
1	1	1	1	1	1	1	0	0	T_{254}
1	1	1	1	1	1	1	1	0	T_{255}
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	1	0

0 = Logic 0 1 = Logic 1 ϕ = Don't care
T_0 = Reference or inherent delay of circuit.
T_1 to T_{255} = Multiplier of incremental delay.

Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS	Part No.	Incremental Delay Per Step NS	Total Programmed Delay NS
PDU-10256-1	1	255	PDU-10256-6	6	1,530
PDU-10256-2	2	510	PDU-10256-7	7	1,785
PDU-10256-3	3	765	PDU-10256-8	8	2,040
PDU-10256-4	4	1,020	PDU-10256-9	9	2,295
PDU-10256-5	5	1,275	PDU-10256-10	10	2,550

NOTE: For the sake of simplicity all 256 programmable steps are not shown in this truth table.

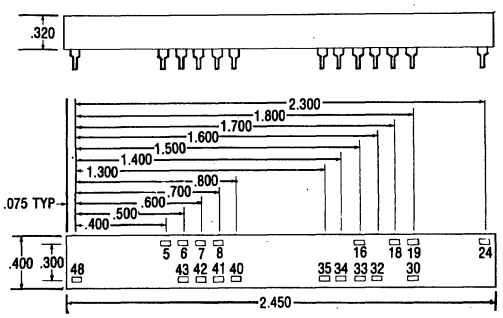
SERIES PDU-13256 (TTL Interfaced) 8-BIT

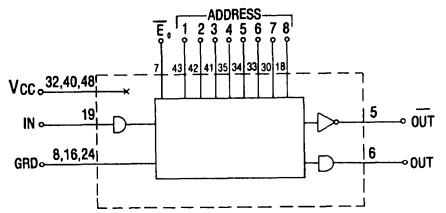


Specifications

Same as PDU-1316 except:

- **Inherent delay: 44 NS on pin 6, 45 NS on pin 5** } typ
- **Power dissipation: 1.1 W Max.**



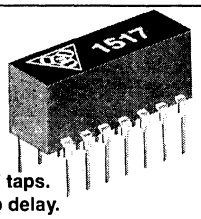


TRUTH TABLE

Address (Bit No.)								Enable	Delay Out
8	7	6	5	4	3	2	1	(Eo)	
0	0	0	0	0	0	0	0	0	T_0
0	0	0	0	0	0	0	1	0	T_1
0	0	0	0	0	0	1	0	0	T_2
0	0	0	0	0	0	1	1	0	T_3
0	0	0	0	0	1	0	0	0	T_4
0	0	0	0	0	1	0	1	0	T_5
0	0	0	0	0	1	1	0	0	T_6
0	0	0	0	0	1	1	1	0	T_7
0	0	0	0	1	0	0	0	0	T_8
0	0	0	0	1	0	0	1	0	T_9
0	0	0	0	1	0	1	0	0	T_{10}
0	0	0	0	1	0	1	1	0	T_{11}
0	0	0	0	1	1	0	0	0	T_{12}
0	0	0	0	1	1	0	1	0	T_{13}
0	0	0	0	1	1	1	0	0	T_{14}
0	0	0	0	1	1	1	1	0	T_{15}
0	0	0	1	0	0	0	0	0	T_{16}
0	0	0	1	0	0	0	1	0	T_{17}
0	0	0	1	0	0	1	0	0	T_{18}
0	0	0	1	0	0	1	1	0	T_{19}
0	0	0	1	0	1	0	0	0	T_{20}
0	0	0	1	0	1	0	1	0	T_{21}
0	0	0	1	0	1	1	0	0	T_{22}
0	0	0	1	0	1	1	1	0	T_{23}
0	0	0	1	1	0	0	0	0	T_{24}
0	0	0	1	1	0	0	1	0	T_{25}
0	0	0	1	1	0	1	0	0	T_{26}
0	0	0	1	1	0	1	1	0	T_{27}
0	0	0	1	1	1	0	0	0	T_{28}
0	0	0	1	1	1	0	1	0	T_{29}
0	0	0	1	1	1	1	0	0	T_{30}
0	0	0	1	1	1	1	1	0	T_{31}
0	0	1	0	0	0	0	0	0	T_{32}
0	0	1	0	0	0	0	1	0	T_{33}
0	0	1	0	0	0	1	0	0	T_{34}
0	0	1	0	0	0	1	1	0	T_{35}
0	0	1	0	0	1	0	0	0	T_{36}
0	0	1	0	0	1	0	1	0	T_{37}
0	0	1	0	0	1	1	0	0	T_{38}
0	0	1	0	0	1	1	1	0	T_{39}
0	0	1	0	1	0	0	0	0	T_{40}
0	0	1	0	1	0	0	1	0	T_{41}
0	0	1	0	1	0	1	0	0	T_{42}
0	0	1	0	1	0	1	1	0	T_{43}
0	0	1	0	1	1	0	0	0	T_{44}
0	0	1	0	1	1	0	1	0	T_{45}
0	0	1	0	1	1	1	0	0	T_{46}
0	0	1	0	1	1	1	1	0	T_{47}
0	0	1	1	0	0	0	0	0	T_{48}
0	0	1	1	0	0	0	1	0	T_{49}
0	0	1	1	0	0	1	0	0	T_{50}
0

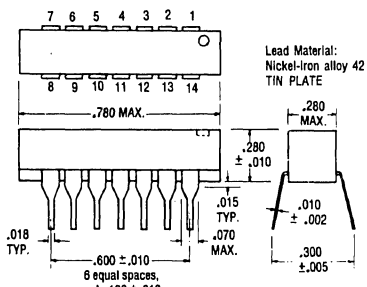
DIP-TAPPED DELAY LINES

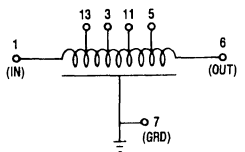
SERIES 1517
5 Taps



Specifications

- Delay accuracy: ±5% (others on request).
- No. taps: 5 Equally spaced taps.
- Taps accuracy: ±5% of tap delay.
- Impedance tolerance: ±10% (others on request).
- Rise-Time: 30% of time delay.
- Withstanding voltage: 50 Vdc. Min.
- Temperature coefficient: 100 PPM/°C.
- Environment: Meets or exceeds MIL-D-23859C.

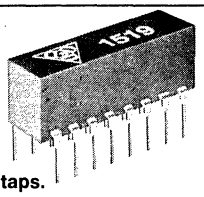




TAPS - CONNECTION

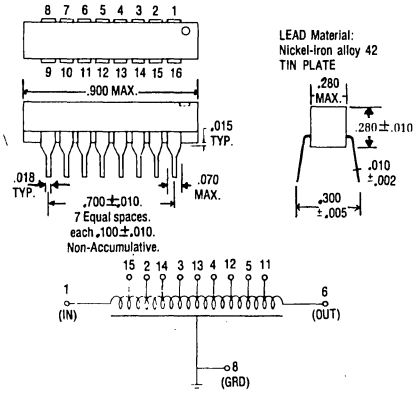
Part No.	Total Delay (NS)	Imp. (Ω)	Rdc. (Ω)	Part No.	Total Delay (NS)	Imp. (Ω)	Rdc. (Ω)
1517-10A	10	50	0.6	1517-150D	150	250	8.5
1517-15A	15	50	0.6	1517-15E	15	300	2.5
1517-20A	20	50	0.7	1517-30E	30	300	3.0
1517-30A	30	50	0.7	1517-50E	50	300	4.0
1517-40A	40	50	0.9	1517-60E	60	300	4.0
1517-5B	5	100	0.5	1517-75E	75	300	4.5
1517-10B	10	100	0.7	1517-90E	90	300	5.5
1517-15B	15	100	0.7	1517-120E	120	300	8.0
1517-20B	20	100	0.9	1517-130E	130	300	9.0
1517-25B	25	100	1.0	1517-180E	180	300	11.0
1517-30B	30	100	1.5	1517-220E	220	300	13.0
1517-40B	40	100	1.8	1517-20F	20	400	4.5
1517-50B	50	100	2.0	1517-40F	40	400	5.0
1517-60B	60	100	2.0	1517-60F	60	400	5.0
1517-75B	75	100	2.5	1517-80F	80	400	8.0
1517-10C	10	200	1.5	1517-100F	100	400	9.0
1517-20C	20	200	2.0	1517-120F	120	400	10.0
1517-30C	30	200	2.5	1517-160F	160	400	13.0
1517-40C	40	200	3.0	1517-180F	180	400	14.0
1517-50C	50	200	3.0	1517-240F	240	400	19.0
1517-60C	60	200	3.5	1517-300F	300	400	23.0
1517-80C	80	200	3.5	1517-25G	25	500	3.0
1517-90C	90	200	5.0	1517-50G	50	500	5.0
1517-120C	120	200	5.0	1517-75G	75	500	8.0
1517-150C	150	200	8.0	1517-100G	100	500	15.0
1517-25D	25	250	2.5	1517-125G	125	500	9.0
1517-37D	37	250	3.0	1517-150G	150	500	13.0
1517-50D	50	250	3.5	1517-200G	200	500	21.0
1517-60D	60	250	4.0	1517-225G	225	500	23.0
1517-75D	75	250	4.0	1517-300G	300	500	29.0
1517-100D	100	250	5.0				

SERIES 1519
10 Taps



Specifications

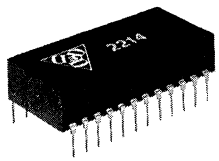
- Delay accuracy: ±5% (others on request).
- No. taps: 10 Equally spaced taps.
- Taps accuracy: ±5% of tap delay.
- Impedance tolerance: ±10% (others on request).
- Rise-Time: 20% of time delay.
- Withstanding voltage: 50 Vdc. Min.
- Temperature coefficient: 100 PPM/°C.
- Environment: Meets or exceeds MIL-D-23859C.



Part No.	Total Delay (NS)	Imp. (Ω)	Rdc. (Ω)	Part No.	Total Delay (NS)	Imp. (Ω)	Rdc. (Ω)
1519-20A	20	50	1.0	1519-200D	200	250	10.0
1519-25A	25	50	1.0	1519-225D	225	250	11.0
1519-30A	30	50	1.2	1519-300D	300	250	17.0
1519-40A	40	50	1.5	1519-375D	375	250	20.0
1519-45A	45	50	1.5	1519-500D	500	250	24.0
1519-50A	50	50	1.5	1519-30E	30	300	5.0
1519-60A	60	50	1.5	1519-60E	60	300	6.0
1519-75A	75	50	1.8	1519-90E	90	300	7.0
1519-100A	100	50	2.0	1519-120E	120	300	8.0
1519-10B	10	100	1.0	1519-150E	150	300	9.0
1519-20B	20	100	1.5	1519-180E	180	300	11.0
1519-30B	30	100	1.5	1519-240E	240	300	16.0
1519-40B	40	100	1.8	1519-270E	270	300	18.0
1519-50B	50	100	2.0	1519-360E	360	300	21.0
1519-60B	60	100	3.0	1519-450E	450	300	25.0
1519-80B	80	100	3.5	1519-600E	600	300	40.0
1519-90B	90	100	3.5	1519-40F	40	400	8.5
1519-100B	100	100	4.0	1519-80F	80	400	9.0
1519-120B	120	100	4.0	1519-120F	120	400	9.0
1519-150B	150	100	5.0	1519-160F	160	400	16.0
1519-200B	200	100	6.0	1519-200F	200	400	18.0
1519-250B	250	100	7.0	1519-240F	240	400	20.0
1519-20C	20	200	3.0	1519-320F	320	400	26.0
1519-40C	40	200	4.0	1519-360F	360	400	28.0
1519-60C	60	200	4.5	1519-480F	480	400	38.0
1519-80C	80	200	5.5	1519-600F	600	400	45.0
1519-100C	100	200	6.0	1519-800F	800	400	40.0
1519-120C	120	200	6.5	1519-50G	50	500	6.0
1519-160C	160	200	7.0	1519-100G	100	500	10.0
1519-180C	180	200	8.5	1519-150G	150	500	16.0
1519-200C	200	200	9.0	1519-200G	200	500	30.0
1519-240C	240	200	9.5	1519-250G	250	500	18.0
1519-300C	300	200	16.0	1519-300G	300	500	26.0
1519-400C	400	200	16.0	1519-400G	400	500	42.0
1519-50D	50	250	5.5	1519-450G	450	500	45.0
1519-75D	75	250	6.0	1519-500G	500	500	55.0
1519-100D	100	250	7.0	1519-600G	600	500	58.0
1519-125D	125	250	8.0	1519-750G	750	500	50.0
1519-150D	150	250	8.5	1519-1000G	1000	500	65.0

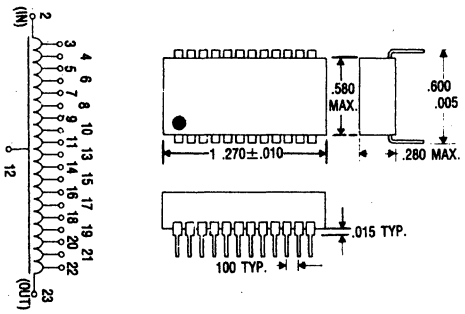
DIP-TAPPED DELAY LINES

SERIES 2214
20 Taps



Specifications

- 20 Equally spaced taps.
- Td/Tr = 10/1.
- Delay tolerance: ±5% or INS whichever is greater.
- Tap tolerance: ±5% or INS whichever is greater.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −55°C to +125°C.
- Dielectric breakdown: 50 Vdc.
- Meets or exceeds MIL-D-23859C.
- Epoxy encapsulated.

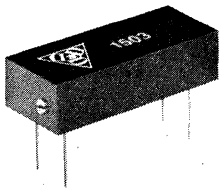


Part No.	Imp. (Ω)	Total Delay (NS)	Tap Increment (NS)	Rdc (Ω)
2214-50A	50	50	2.5	3.2
2214-60A	50	60	3.0	3.6
2214-80A	50	80	4.0	5.0
2214-100A	50	100	5.0	6.0
2214-150A	50	150	7.5	6.0
2214-200A	50	200	10.0	7.0
2214-50B	100	50	2.5	6.0
2214-60B	100	60	3.0	6.0
2214-80B	100	80	4.0	6.5
2214-100B	100	100	5.0	7.0
2214-150B	100	150	7.5	8.0
2214-200B	100	200	10.0	8.5
2214-300B	100	300	15.0	11.0
2214-400B	100	400	20.0	12.0
2214-40C	200	40	2.0	7.0
2214-80C	200	80	4.0	8.0
2214-120C	200	120	6.0	10.0
2214-200C	200	200	10.0	13.0
2214-300C	200	300	15.0	12.0
2214-400C	200	400	20.0	15.0
2214-500C	200	500	25.0	17.0
2214-600C	200	600	30.0	23.0
2214-800C	200	800	40.0	38.0
2214-50D	250	50	2.5	7.0
2214-100D	250	100	5.0	10.0
2214-150D	250	150	7.5	12.0
2214-200D	250	200	10.0	22.0
2214-250D	250	250	12.5	21.0
2214-300D	250	300	15.0	23.0
2214-400D	250	400	20.0	26.0
2214-500D	250	500	25.0	30.0
2214-600D	250	600	30.0	37.0
2214-800D	250	800	40.0	41.0
2214-1000D	250	1000	50.0	47.0
2214-200G	500	200	10.0	20.0
2214-300G	500	300	15.0	37.0
2214-400G	500	400	20.0	40.0
2214-500G	500	500	25.0	45.0
2214-600G	500	600	30.0	52.0
2214-800G	500	800	40.0	80.0
2214-1000G	500	1000	50.0	100.0
2214-1200G	500	1200	60.0	110.0
2214-1500G	500	1500	75.0	130.0
2214-2000G	500	2000	100.0	156.0

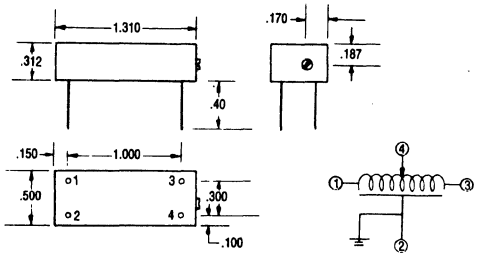
CONTINUOUSLY VARIABLE DELAY LINES

SERIES 1503

Specifications



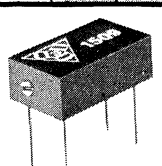
- Continuously variable delay.
- Multi-turn adjusting screw (40 turns approx.).
- Temperature coefficient — 100 PPM/°C.
- Rise-time −20% of time delay
- Flat leads (.020 x .010).
- Withstanding voltage — 50 Vdc.
- Resolution — .12NS approx.



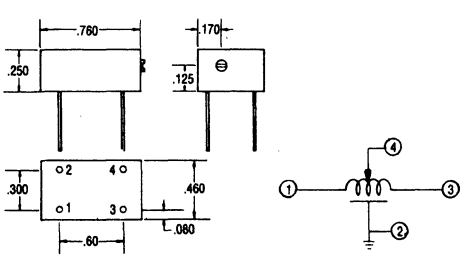
Part No.	Td (NS)	Imp. (Ω)	Rdc (Ω)	Part No.	Td (NS)	Imp. (Ω)	Rdc (Ω)
1503-15A	15	50	.7	1503-100B	100	100	6.0
1503-25A	25	50	.8	1503-120B	120	100	8.0
1503-30A	30	50	1.0	1503-160B	160	100	10.0
1503-40A	40	50	1.5	1503-200B	200	100	14.0
1503-50A	50	50	1.7	1503-30C	30	200	4.0
1503-60A	60	50	2.0	1503-60C	60	200	8.0
1503-80A	80	50	3.0	1503-100C	100	200	14.0
1503-100A	100	50	3.5	1503-20D	20	250	5.0
1503-15B	15	100	1.0	1503-20E	20	300	5.0
1503-30B	30	100	2.0	1503-30F	30	350	8.0
1503-50B	50	100	3.0	1503-25G	25	400	8.0
1503-60B	60	100	4.0	1503-40H	40	500	12.0
1503-80B	80	100	5.0				

SERIES 1509

Specifications



- Low cost unit.
- Fits standard DIP sockets.
- Continuously variable.
- 20 Turns approx.
- Resolution — .15 NS.
- Withstanding voltage — 100 Vdc.
- Temperature coefficient — 200 PPM/°C.
- Flat leads (.020 x .010).

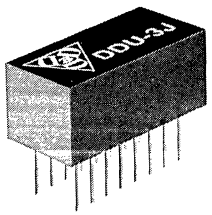


Part No.	Td (NS)	Impedence (Ω)	TR (NS)	Rdc (Ω)
1509-05B	5	100	3	.4
1509-20C	20	200	8	1.0
1509-30F	30	400	10	7.0
1509-40H	40	500	15	13.0

DATA DELAY DEVICES Inc. ■ 385 Lakeview Avenue, Clifton, New Jersey 07011 ■ (201) 772-1106 ■ TWX 710-989-7008

DIGITAL DELAY LINES

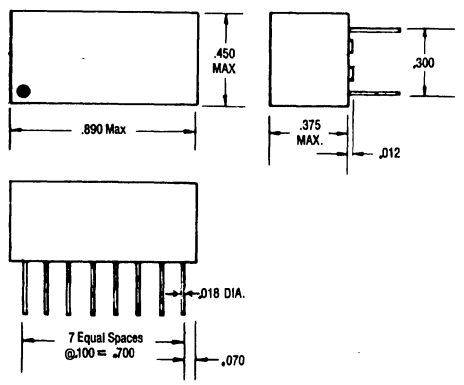
SERIES: DDU-3J (TTL Interfaced) 1 to 5 Taps, 16 pins DIP

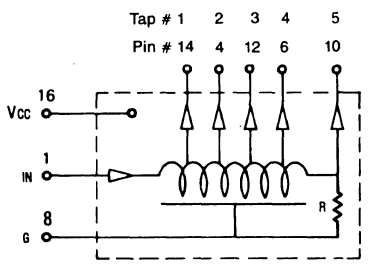


Specifications

- Delay tolerance: ±5% or better; or 2 NS whichever is greater.
- Rise-time: 4 NS typically.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −0°C to 70°C standard (−55°C to + 125°C on request).*

*Add "M" to PART NO. Example DDU-3J-5100M

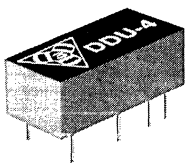




SCHEMATIC DIAGRAM FOR 5 DELAYS OUTPUT

Part No.	5 Delays Output (NS) Delay @ Pin #14	Delay @ Pin #4	Delay @ Pin #12	Delay @ Pin #6	Delay @ Pin #10
DDU-3J-5025	5	10	15	20	25
DDU-3J-5050	10	20	30	40	50
DDU-3J-5075	15	30	45	60	75
DDU-3J-5100	20	40	60	80	100
DDU-3J-5125	25	50	75	100	125
DDU-3J-5150	30	60	90	120	150
DDU-3J-5200	40	80	120	160	200
DDU-3J-5250	50	100	150	200	250
DDU-3J-5300	60	120	180	240	300
DDU-3J-5400	80	160	240	320	400
DDU-3J-5500	100	200	300	400	500

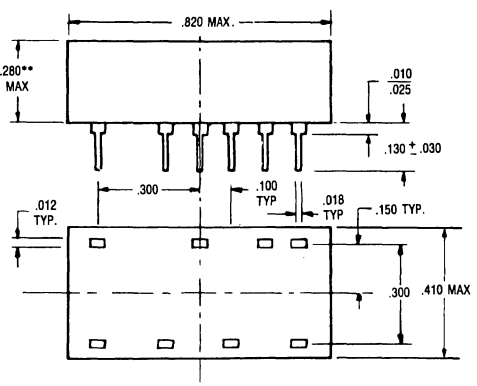
SERIES DDU-4 (TTL Interfaced) 1 to 5 Taps, 14 pins DIP

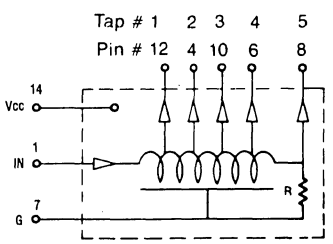


Specifications

- Delay tolerance: ±5% or better; or 2NS whichever is greater.
- Rise-time: 4 NS typically.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −0°C to 70°C standard (−55°C to +125°C on request).*

*Add "M" after PART NO. Example DDU-4-5100M
**.320 Max. for "M" units.





SCHEMATIC DIAGRAM FOR 5 DELAYS OUTPUT

Part No.	5 Delays Output (NS) Delay @ Pin #12	Delay @ Pin #4	Delay @ Pin #10	Delay @ Pin #6	Delay @ Pin #8
DDU-4-5025	5	10	15	20	25
DDU-4-5050	10	20	30	40	50
DDU-4-5075	15	30	45	60	75
DDU-4-5100	20	40	60	80	100
DDU-4-5125	25	50	75	100	125
DDU-4-5150	30	60	90	120	150
DDU-4-5200	40	80	120	160	200
DDU-4-5250	50	100	150	200	250
DDU-4-5300	60	120	180	240	300
DDU-4-5400	80	160	240	320	400
DDU-4-5500	100	200	300	400	500

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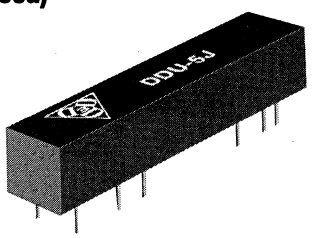
DIGITAL DELAY LINES

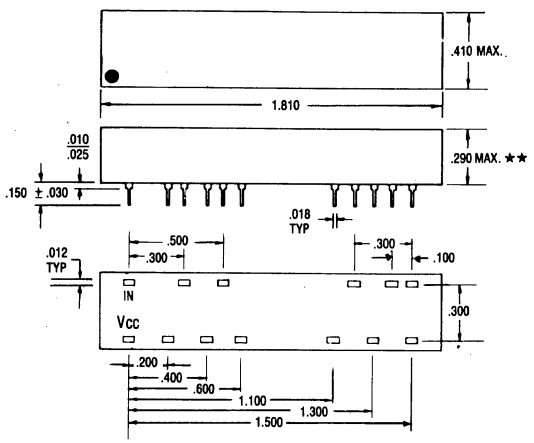
SERIES DDU-5J
(TTL Interfaced)
10 Taps,
32 pins DIP

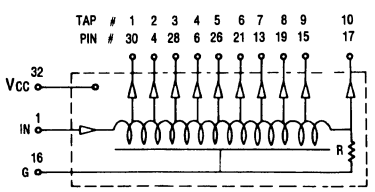


Specifications

- Delay tolerance: ±5% or better; or 2NS whichever is greater.
- Rise-time: 4 NS typically.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −0°C to 70°C standard (−55°C to +125°C on request).*

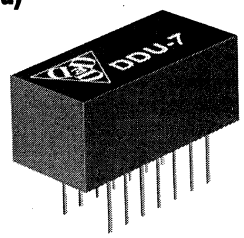
*Add "M" after PART NO. Example DDU-5J-10100M
**.320 Max. for "M" units.





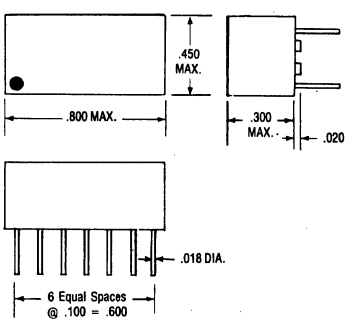
Part No.	Total Delay (NS)	Delay Per Tap (NS)	Part No.	Total Delay (NS)	Delay Per Tap (NS)
DDU-5J-10050	50	5	DDU-5J-10400	400	40
DDU-5J-10100	100	10	DDU-5J-10500	500	50
DDU-5J-10150	150	15	DDU-5J-101000	1000	100
DDU-5J-10200	200	20	DDU-5J-101500	1500	150
DDU-5J-10250	250	25	DDU-5J-102000	2000	200
DDU-5J-10300	300	30			

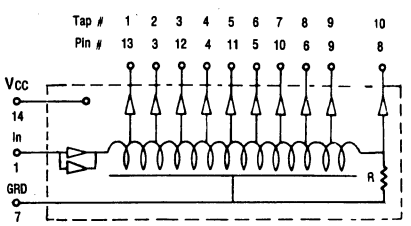
SERIES DDU-7
(TTL Interfaced)
10 Taps,
14 pins DIP



Specifications

- Input & output completely buffered.
- Delay tolerance: ±5%, or 2 NS whichever is greater.
- Rise-time: 4 NS typ.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −55°C to 125°C.
- Supply voltage: 4.5 to 5.5. Vdc.
- Power dissipation: 240 MW.





Part No.	Total Delay (NS)	Delay Per Tap (NS)	Part No.	Total Delay (NS)	Delay Per Tap (NS)
*DDU-7-10	10	1	DDU-7-200	200	20.0
*DDU-7-20	20	2	DDU-7-250	250	25.0
*DDU-7-25	25	2.5	DDU-7-300	300	30.0
*DDU-7-50	50	5.0	DDU-7-400	400	40.0
DDU-7-100	100	10.0	DDU-7-500	500	50.0
DDU-7-150	150	15.0			

* Time delay measurements referenced to 1st tap

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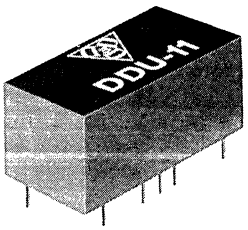
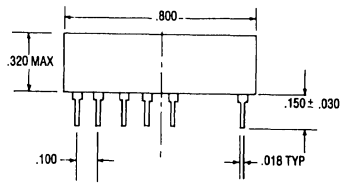
DIGITAL DELAY LINES

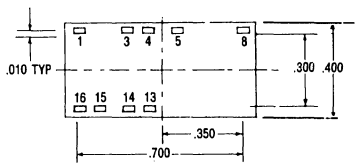
SERIES DDU-11 (ECL Interfaced) 5 Taps, 16 pins DIP

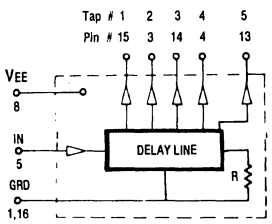


Specifications

- Input & output completely buffered.
- Delay tolerance: ±5% or 2 NS whichever is greater.
- Rise-time: 2 NS typ.
- Temperature coefficient: 100 PPM/°C.
- Temperature range: −30°C to 85°C.
- Supply voltage: −5.2 Vdc.
- Power dissipation: 200 MW typ. (no load).





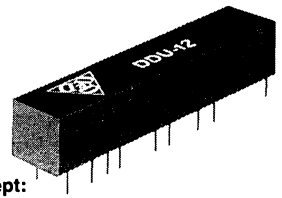


Pull-down resistor on output taps not provided inside unit.

Part No.	Total Delay (NS)	Delay Per Tap (NS)	Part No.	Total Delay (NS)	Delay Per Tap (NS)
*DDU-11-5	5	1	DDU-11-150	150	30
*DDU-11-10	10	2	DDU-11-200	200	40
*DDU-11-20	20	4	DDU-11-250	250	50
*DDU-11-25	25	5	DDU-11-300	300	60
DDU-11-50	50	10	DDU-11-400	400	80
DDU-11-75	75	15	DDU-11-500	500	100
DDU-11-100	100	20			

* Time delay measurements referenced to 1st tap

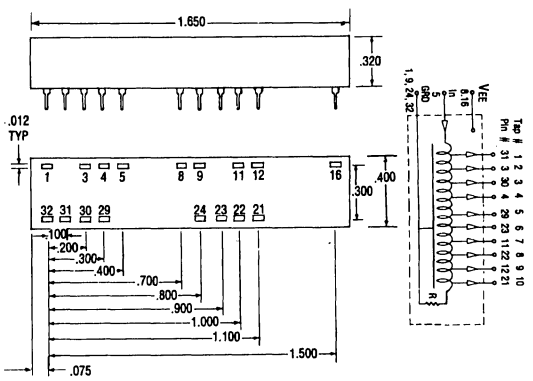
SERIES DDU-12 (ECL Interfaced) 10 Taps, 32 pins DIP



Specifications

Same as DDU-11 except:

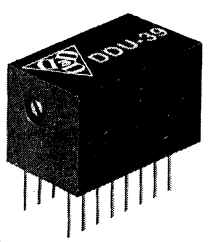
- Power dissipation: 400 MW typ (no load)



Part No.	Total Delay (NS)	Delay Per Tap (NS)	Part No.	Total Delay (NS)	Delay Per Tap (NS)
*DDU-12-10	10	1	DDU-12-200	200	20
*DDU-12-20	20	2	DDU-12-250	250	25
*DDU-12-25	25	2.5	DDU-12-300	300	30
*DDU-12-40	40	4	DDU-12-400	400	40
*DDU-12-50	50	5	DDU-12-500	500	50
DDU-12-75	75	7.5	DDU-12-750	750	75
DDU-12-100	100	10	DDU-12-1000	1000	100
DDU-12-150	150	15	DDU-12-1500	1500	150

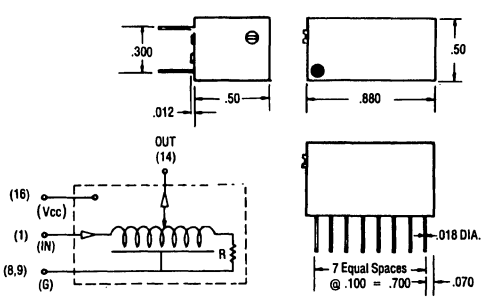
*Time delay measurements referenced to 1st tap.

SERIES DDU-39 (TTL Interfaced) 16 pin DIP.



Specifications

- Temperature coefficient −200PPM/°C.
- Rise-time — 4 NS typically.
- Temperature range −0°C to 70°C standard (−55°C to +125°C on request).



Continuously adjustable from 10NS to 30NS

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EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

Engineered Components Company is pleased to introduce several new product lines and expanded capability in active digital modules. The succeeding 15 pages contain abbreviated data sheets covering 29 product lines of both passive-analog and active-digital delay lines

In addition to the delay lines shown, pages 1•1434 through 1•1441 in this section provide data on the following additional active digital products utilizing LC delay line technology:

Noise Filter Modules
Pulse Generator Modules
Square Wave Generator Modules
Digital Clock Modules
Digital Frequency Multiplier Modules

These modules are designed specifically for mounting on printed circuit boards in system applications where critical timing functions are required. These products find wide industrial applications in microcomputer, computer interface, radar timing, communication, instrumentation, dynamic and static memory timing and high speed RAM, PROM and IC test equipment.

The following active delay line modules are covered in this listing:

Five (5) output Logic Delay Modules
Ten (10) output Logic Delay Modules
Fixed Logic Delay Lines
Multiple Logic Delay Lines
Programmable Logic Delay Lines

These products are offered in modules compatible with T^2L Schottky, T^2L low power Schottky, ECL 10,000 and ECL 100K logic families.

CONSTRUCTION: The active digital modules shown in the following pages are of hybrid construction utilizing the proven technologies of active integrated circuitry and of passive networks utilizing capacitive, inductive and resistive elements. All integrated circuits used in these modules are pre-packaged by the manufacturer and burned-in to Level B of MIL-STD-883 to ensure a high MTBF. The passive elements utilized in the construction have been selected to provide adequate derating to preclude premature failures, thus contributing additionally to a high MTBF. On the detailed product pages, you will find MTBFs that are obtained by calculations per MIL-HDBK-217B for a 50°C ground fixed environment. In the case of the T^2L modules, the operating temperature is 0° to +70°C, for ECL 10,000 it is −30° to +85°C and for ECL 100K it is 0° to +85°C.

PACKAGING: The modules shown in the following pages are packaged in dual-in-line configuration. All modules are epoxy encapsulated in housings molded of flame-proof Diallyl Phthalate. Leads meet the solderability requirements of MIL-STD-202, Method 208. Standoffs are provided, either on the leads or on the housing, to provide positive standoff of the modules from the printed circuit boards to permit solder-fillet formation and flush cleaning of solder-flux residues for improved reliability.

MARKING: Marking of all modules consists of manufacturer's name, logo (EC^2), part number, terminal identification and date code of manufacture. All marking is applied by silk screen process using white epoxy paint in accordance with MIL-STD-130, to meet the permanency of identification required by MIL-STD-202, Method 215.

EXTENDED TEMPERATURE RANGE: Many of the products shown in the following pages are also available as standard products in an extended temperature range of −55° to +125°C. These standard product lines are the TTLDL, TTLDM and the MTTLDL. Most products, however, can be supplied in the extended temperature range, based upon specific customer requirements, even though no standard product line exists.

SPECIALS: In addition to the items offered as standard products, we continually develop "made to order" parts where differences in tolerances, delays, silhouette, etc., are required. Engineered Components Company has the technical staff and capability, the modern equipment and extensive component inventory to support development and production of special variations of our standard product lines. Because of our experience and expertise in the unique products which we presently produce, in many instances we are able to develop entirely new special modules. Lead time for special versions is often only a matter of a few weeks and, in some cases, even days. We invite your inquiries.

Engineered Components Company is dedicated to customer service which includes on-time delivery, development of special products required to satisfy a particular need, customer satisfaction and a response to advanced state-of-the-art developments in active module products required by industry applications. We shall always strive to be progressive, innovative and responsible. Because of the extensive standard products available from our company, it is impossible to have all items in inventory at all times. We will make the commitment, however, to satisfy the customer's requirement for delivery and continually strive to "put out the fires" and to provide the product in sufficient numbers to prevent customer production problems whenever possible.

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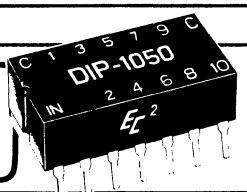
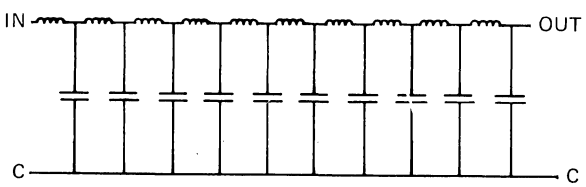


DIP LUMPED CONSTANT Low Profile
PASSIVE DELAY LINE

- Analog input and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 10 to 150ns
- Available in impedances of 50,100 and 200 ohms
- Dimensions: .290 wide X .725 long X .225 high
- MTBF in excess of 2 million hours

BLOCK DIAGRAM IS SHOWN BELOW

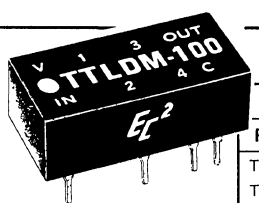


Part Number	Delay Time (ns)	Rise Time (ns)	ϕ-Tap Delay (ns)	Impedance (ohms)	DCR (ohms)
DIP-510	10	3.0	1.0	50	1.0
DIP-515	15	4.0	1.5		1.0
DIP-520	20	5.0	2.0		1.0
DIP-525	25	5.5	2.5		1.5
DIP-530	30	7.0	3.0		1.5
DIP-540	40	8.5	4.0		1.8
DIP-550	50	10	5.0		2.0
DIP-560	60	11.5	6.0		2.5
DIP-570	70	13.0	7.0		2.8
DIP-580	80	14.5	8.0		3.0
DIP-590	90	16	9.0		3.3
DIP-5100	100	18.0	10.0		3.5
DIP-5150	150	25.0	15.0	50	4.2
DIP-1010	10	3.0	1.0	100	1.3
DIP-1015	15	4.0	1.5		1.5
DIP-1020	20	4.5	2.0		2.0
DIP-1025	25	5.0	2.5		2.2
DIP-1030	30	6.0	3.0		2.5
DIP-1040	40	7.5	4.0		2.8
DIP-1050	50	9.5	5.0		3.0
DIP-1060	60	11	6.0		3.2
DIP-1070	70	12.5	7.0		3.5
DIP-1080	80	14	8.0		3.7
DIP-1090	90	15	9.0		4.0
DIP-10100	100	16.0	10.0	100	4.2
DIP-2010	10	3.7	1.0	200	2.0
DIP-2015	15	4.5	1.5		2.5
DIP-2020	20	5.5	2.0		2.8
DIP-2025	25	6.2	2.5		3.0
DIP-2030	30	7.8	3.0		3.5
DIP-2040	40	8.8	4.0		4.0
DIP-2050	50	10.6	5.0	200	4.5

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

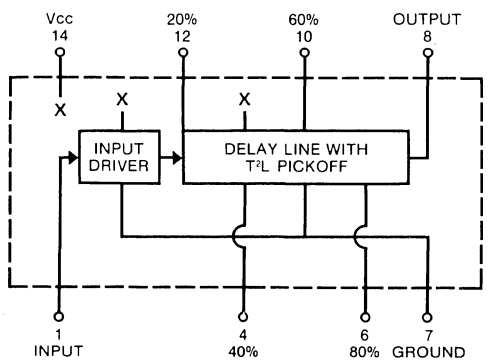
ABOVE DATA FROM CATALOG NO. C/112880

T²L COMPATIBLE Low Profile
LOGIC DELAY MODULE (Schottky)



- T²L input and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 25 to 1000ns
- 20% taps — each isolated and with 10 T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

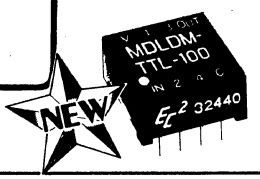


ϕ DELAYS AND TOLERANCES (in ns)					
PART NO.	Tap 1	Tap 2	Tap 3	Tap 4	OUTPUT
TTLDM-25	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1
TTLDM-30	6 ±1	12 ±1	18 ±1	24 ±1	30 ±1
TTLDM-35	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5
TTLDM-40	8 ±1	16 ±1	24 ±1.5	32 ±1.5	40 ±1.5
TTLDM-45	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2
TTLDM-50	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2
TTLDM-75	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5
TTLDM-100	20 ±1	40 ±1.5	60 ±2	80 ±3	100 ±3
TTLDM-125	25 ±1	50 ±2	75 ±2.5	100 ±3	125 ±4
TTLDM-150	30 ±1.5	60 ±2	90 ±3	120 ±4	150 ±5
TTLDM-175	35 ±1.5	70 ±2.5	105 ±4	140 ±5	175 ±5
TTLDM-200	40 ±1.5	80 ±2.5	120 ±4	160 ±5	200 ±6
TTLDM-225	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7
TTLDM-250	50 ±2	100 ±3	150 ±4.5	200 ±6	250 ±8
TTLDM-300	60 ±2	120 ±4	180 ±5	240 ±7	300 ±9
TTLDM-350	70 ±2	140 ±4.5	210 ±7	280 ±9	350 ±11
TTLDM-400	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12
TTLDM-450	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14
TTLDM-500	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15
TTLDM-600	120 ±4	240 ±7	360 ±11	480 ±15	600 ±18
TTLDM-700	140 ±4	280 ±9	420 ±13	560 ±17	700 ±20
TTLDM-800	160 ±5	320 ±10	480 ±15	640 ±19	800 ±20
TTLDM-900	180 ±6	360 ±11	520 ±16	720 ±20	900 ±22
TTLDM-1000	200 ±6	400 ±12	600 ±18	800 ±20	1000 ±22

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/91579

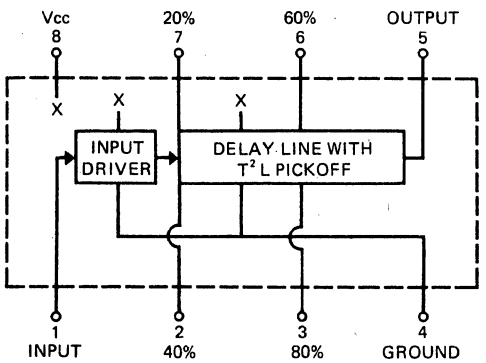
EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*



T²L COMPATIBLE "Mini DIP" Low Profile
LOGIC DELAY MODULE (Schottky)

- T²L input and outputs
- Delays stable and precise
- 8-pin DIP package
- Available in delays from 25 to 500ns
- 20% taps – each isolated and with 10 Schottky T²L fan-out capacity
- Fast rise time on all outputs
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours.
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

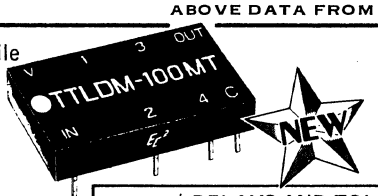


ϕDELAYS AND TOLERANCES (in ns)					
Part Number	Tap 1	Tap 2	Tap 3	Tap 4	Output
MDLDM-TTL-25	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1
MDLDM-TTL-30	6 ±1	12 ±1	18 ±1	24 ±1	30 ±1
MDLDM-TTL-35	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5
MDLDM-TTL-40	8 ±1	16 ±1	24 ±1.5	32 ±1.5	40 ±1.5
MDLDM-TTL-45	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2
MDLDM-TTL-50	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2
MDLDM-TTL-75	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5
MDLDM-TTL-100	20 ±1	40 ±1.5	60 ±2	80 ±3	100 ±3
MDLDM-TTL-125	25 ±1	50 ±2	75 ±2.5	100 ±3	125 ±4
MDLDM-TTL-150	30 ±1.5	60 ±2	90 ±3	120 ±4	150 ±5
MDLDM-TTL-175	35 ±1.5	70 ±2.5	105 ±4	140 ±5	175 ±5
MDLDM-TTL-200	40 ±1.5	80 ±2.5	120 ±4	160 ±5	200 ±6
MDLDM-TTL-225	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7
MDLDM-TTL-250	50 ±2	100 ±3	150 ±4.5	200 ±6	250 ±8
MDLDM-TTL-300	60 ±2	120 ±4	180 ±5	240 ±7	300 ±9
MDLDM-TTL-350	70 ±2	140 ±4.5	210 ±7	280 ±9	350 ±11
MDLDM-TTL-400	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12
MDLDM-TTL-450	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14
MDLDM-TTL-500	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

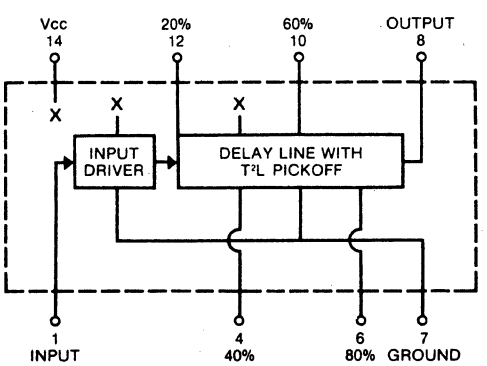
ABOVE DATA FROM CATALOG NO. C/012982

T²L COMPATIBLE "Thinny DIP" Super Low Profile
LOGIC DELAY MODULE (Schottky)



- Full military temperature range
- T²L input and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 25 to 500ns
- 20% taps – each isolated and with 10 T²L fan-out capacity
- Fast rise time on all outputs
- Dimensions: .500 wide X .800 long X .165 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of −55° to +125°C

BLOCK DIAGRAM IS SHOWN BELOW

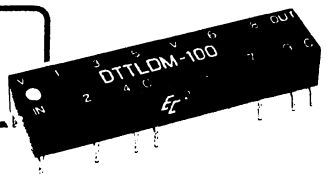


ϕ DELAYS AND TOLERANCES (in ns)					
Part Number	Tap 1	Tap 2	Tap 3	Tap 4	Output
TTLDM-25MT	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1
TTLDM-30MT	6 ±1	12 ±1	18 ±1	24 ±1	30 ±1
TTLDM-35MT	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5
TTLDM-40MT	8 ±1	16 ±1	24 ±1.5	32 ±1.5	40 ±1.5
TTLDM-45MT	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2
TTLDM-50MT	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2
TTLDM-75MT	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5
TTLDM-100MT	20 ±1	40 ±1.5	60 ±2	80 ±3	100 ±3
TTLDM-125MT	25 ±1	50 ±2	75 ±2.5	100 ±3	125 ±4
TTLDM-150MT	30 ±1.5	60 ±2	90 ±3	120 ±4	150 ±5
TTLDM-175MT	35 ±1.5	70 ±2.5	105 ±4	140 ±5	175 ±5
TTLDM-200MT	40 ±1.5	80 ±2.5	120 ±4	160 ±5	200 ±6
TTLDM-225MT	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7
TTLDM-250MT	50 ±2	100 ±3	150 ±4.5	200 ±6	250 ±8
TTLDM-300MT	60 ±2	120 ±4	180 ±5	240 ±7	300 ±9
TTLDM-350MT	70 ±2	140 ±4.5	210 ±7	280 ±9	350 ±11
TTLDM-400MT	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12
TTLDM-450MT	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14
TTLDM-500MT	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/060280R

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

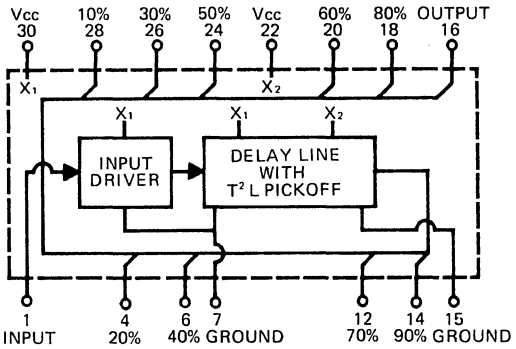


T²L COMPATIBLE Low Profile

DOUBLE LOGIC DELAY MODULE (Schottky)

- T²L input and outputs
- Delays stable and precise
- 30-pin DIP package
- Available in delays from 50ns to 1000ns
- 10% taps – each isolated and with 10 T²L fan-out capacity
- Fast rise time on all outputs
- Dimensions: .400 wide X 1.600 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



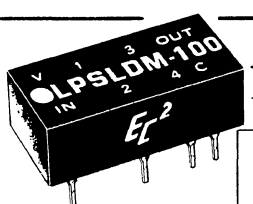
ϕDELAYS AND TOLERANCES (in ns)										
Part Number	Tap 1	Tap 2	Tap 3	Tap 4	Tap 5	Tap 6	Tap 7	Tap 8	Tap 9	Output
DTTLDM-50	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1.5	30 ±1.5	35 ±1.5	40 ±2	45 ±2	50 ±2
DTTLDM-60	6 ±1	12 ±1	18 ±1	24 ±1.5	30 ±1.5	36 ±1.5	42 ±2	48 ±2	54 ±2	60 ±2.5
DTTLDM-70	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5	42 ±2	49 ±2	56 ±2	63 ±2.5	70 ±2.5
DTTLDM-80	8 ±1	16 ±1	24 ±1.5	32 ±1.5	40 ±2	48 ±2	56 ±2	64 ±2.5	72 ±2.5	80 ±3
DTTLDM-90	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2	54 ±2	63 ±2.5	72 ±2.5	81 ±3	90 ±3
DTTLDM-100	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2	60 ±2.5	70 ±2.5	80 ±3	90 ±3	100 ±3
DTTLDM-150	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5	90 ±3	105 ±4	120 ±4	135 ±4	150 ±5
DTTLDM-200	20 ±1	40 ±2	60 ±2.5	80 ±3	100 ±3	120 ±4	140 ±5	160 ±5	180 ±6	200 ±6
DTTLDM-250	25 ±1.5	50 ±2	75 ±2.5	100 ±3	125 ±4	150 ±5	175 ±5	200 ±6	225 ±7	250 ±8
DTTLDM-300	30 ±1.5	60 ±2.5	90 ±3	120 ±4	150 ±5	180 ±6	210 ±7	240 ±7	270 ±8	300 ±9
DTTLDM-350	35 ±1.5	75 ±2.5	105 ±4	140 ±5	175 ±5	210 ±7	245 ±8	280 ±9	315 ±10	350 ±11
DTTLDM-400	40 ±2	80 ±3	120 ±4	160 ±5	200 ±6	240 ±7	280 ±9	320 ±10	360 ±11	400 ±12
DTTLDM-450	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7	270 ±8	315 ±10	360 ±11	405 ±12	450 ±14
DTTLDM-500	50 ±2	100 ±3	150 ±5	200 ±6	250 ±8	300 ±9	350 ±11	400 ±12	450 ±14	500 ±15
DTTLDM-600	60 ±2.5	120 ±4	180 ±5	240 ±7	300 ±9	360 ±11	420 ±13	480 ±15	540 ±16	600 ±18
DTTLDM-700	70 ±2.5	140 ±5	210 ±7	280 ±9	350 ±11	420 ±13	490 ±15	560 ±17	630 ±19	700 ±20
DTTLDM-800	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12	480 ±15	560 ±17	640 ±19	720 ±20	800 ±20
DTTLDM-900	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14	540 ±16	630 ±19	720 ±20	810 ±20	900 ±22
DTTLDM-1000	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15	600 ±18	700 ±20	800 ±20	900 ±22	1000 ±22

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/010380

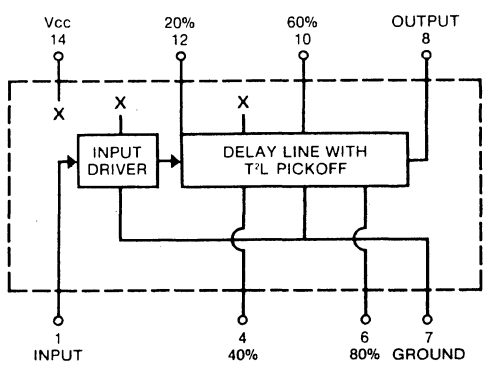
T²L COMPATIBLE Low Profile

LOGIC DELAY MODULE (Low Power Schottky)



- T²L input and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 50 to 500ns
- 20% taps – each isolated and 20 low power Schottky T²L fan-out capacity
- Rise time 8ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to 70°C

BLOCK DIAGRAM IS SHOWN BELOW

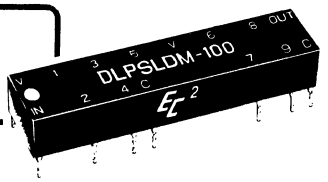


ϕDELAYS AND TOLERANCES (in ns)					
PART NO.	Tap 1	Tap 2	Tap 3	Tap 4	OUTPUT
LPSLDM-50	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2
LPSLDM-55	11 ±1	22 ±1	33 ±1.5	44 ±2	55 ±2
LPSLDM-60	12 ±1	24 ±1.5	36 ±1.5	48 ±2	60 ±2
LPSLDM-65	13 ±1	26 ±1.5	39 ±1.5	52 ±2	65 ±2
LPSLDM-70	14 ±1	28 ±1.5	42 ±2	56 ±2	70 ±2.5
LPSLDM-75	15 ±1	30 ±1.5	45 ±2	60 ±2	75 ±2.5
LPSLDM-80	16 ±1	32 ±1.5	48 ±2	64 ±2	80 ±2.5
LPSLDM-85	17 ±1	34 ±1.5	51 ±2	68 ±2	85 ±2.5
LPSLDM-90	18 ±1	36 ±1.5	54 ±2	72 ±2.5	90 ±3
LPSLDM-95	19 ±1	38 ±1.5	57 ±2	76 ±2.5	95 ±3
LPSLDM-100	20 ±1	40 ±1.5	60 ±2	80 ±3	100 ±3
LPSLDM-125	25 ±1	50 ±2	75 ±2.5	100 ±3	125 ±4
LPSLDM-150	30 ±1.5	60 ±2	90 ±3	120 ±4	150 ±5
LPSLDM-175	35 ±1.5	70 ±2.5	105 ±4	140 ±5	175 ±5
LPSLDM-200	40 ±1.5	80 ±2.5	120 ±4	160 ±5	200 ±6
LPSLDM-225	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7
LPSLDM-250	50 ±2	100 ±3	150 ±4.5	200 ±6	250 ±8
LPSLDM-300	60 ±2	120 ±4	180 ±5	240 ±7	300 ±9
LPSLDM-350	70 ±2	140 ±4.5	210 ±7	280 ±9	350 ±11
LPSLDM-400	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12
LPSLDM-450	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14
LPSLDM-500	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/111579

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

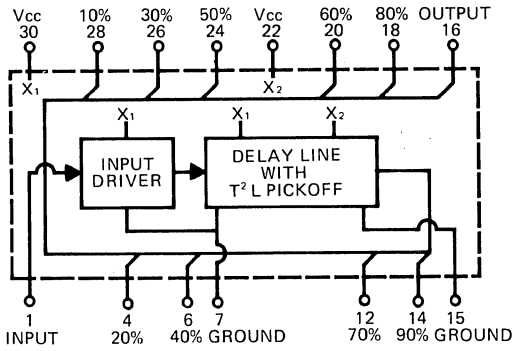


T²L COMPATIBLE Low Profile

DOUBLE LOGIC DELAY MODULE (Low Power Schottky)

- T²L inputs and outputs
- Delays stable and precise
- 30-pin DIP package
- Available in delays from 100ns to 1000ns
- 10% taps – each isolated and with 20 low power Schottky T²L fan-out capacity
- Rise time 8ns maximum
- Dimensions: .400 wide X 1.600 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of 0° to +70°C

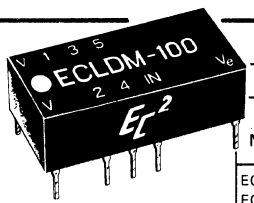
BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Tap 1	Tap 2	Tap 3	Tap 4	Tap 5	Tap 6	Tap 7	Tap 8	Tap 9	Output
	◊DELAYS AND TOLERANCES (in ns)									
DLPSLDM-100	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2	60 ±2.5	70 ±2.5	80 ±3	90 ±3	100 ±3
DLPSLDM-150	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5	90 ±3	105 ±4	120 ±4	135 ±4	150 ±5
DLPSLDM-200	20 ±1	40 ±2	60 ±2.5	80 ±3	100 ±3	120 ±4	140 ±5	160 ±5	180 ±6	200 ±6
DLPSLDM-250	25 ±1.5	50 ±2	75 ±2.5	100 ±3	125 ±4	150 ±5	175 ±5	200 ±6	225 ±7	250 ±8
DLPSLDM-300	30 ±1.5	60 ±2.5	90 ±3	120 ±4	150 ±5	180 ±6	210 ±7	240 ±7	270 ±8	300 ±9
DLPSLDM-350	35 ±1.5	75 ±2.5	105 ±4	140 ±5	175 ±5	210 ±7	245 ±8	280 ±9	315 ±10	350 ±11
DLPSLDM-400	40 ±2	80 ±3	120 ±4	160 ±5	200 ±6	240 ±7	280 ±9	320 ±10	360 ±11	400 ±12
DLPSLDM-450	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7	270 ±8	315 ±10	360 ±11	405 ±12	450 ±14
DLPSLDM-500	50 ±2	100 ±3	150 ±5	200 ±6	250 ±8	300 ±9	350 ±11	400 ±12	450 ±14	500 ±15
DLPSLDM-600	60 ±2.5	120 ±4	180 ±5	240 ±7	300 ±9	360 ±11	420 ±13	480 ±15	540 ±16	600 ±18
DLPSLDM-700	70 ±2.5	140 ±5	210 ±7	280 ±9	350 ±11	420 ±13	490 ±15	560 ±17	630 ±19	700 ±20
DLPSLDM-800	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12	480 ±15	560 ±17	640 ±19	720 ±20	800 ±20
DLPSLDM-900	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14	540 ±16	630 ±19	720 ±20	810 ±20	900 ±22
DLPSLDM-1000	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15	600 ±18	700 ±20	800 ±20	900 ±22	1000 ±22

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/021280

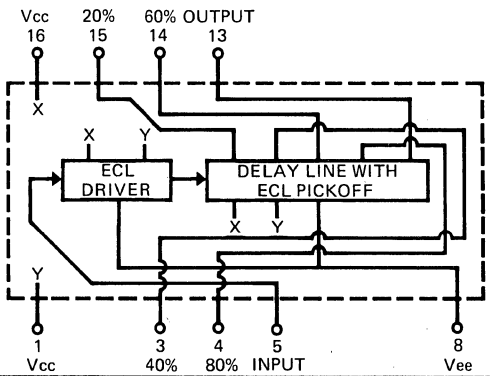


ECL 10K COMPATIBLE Low Profile

LOGIC DELAY MODULE

- ECL input and outputs
- Delays stable and precise
- 16-pin DIP package
- Available in delays from 25ns to 1000ns
- 20% taps – each isolated and with 70 ECL DC fan-out capacity
- Fast rise times on all outputs
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of –30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW

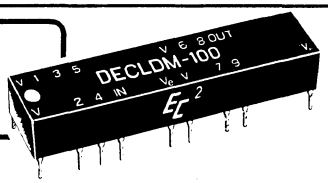


PART NUMBER	RISE TIME MAX.	Tap 1	Tap 2	Tap 3	Tap 4	OUTPUT
	◊RISE TIME, DELAYS AND TOLERANCES (in ns)					
ECLDM-6	4	2 ±.2	3 ±.2	4 ±.2	5 ±.2	6 ±.2
ECLDM-10	4	2 ±.5	4 ±.5	6 ±.5	8 ±.5	10 ±.5
ECLDM-15	4	3 ±.5	6 ±.5	9 ±.5	12 ±.5	15 ±.5
ECLDM-20	4	4 ±.5	8 ±.5	12 ±.5	16 ±.5	20 ±.5
ECLDM-25	4	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1
ECLDM-30	4	6 ±1	12 ±1	18 ±1	24 ±1	30 ±1
ECLDM-35	4	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5
ECLDM-40	4	8 ±1	16 ±1	25 ±1.5	32 ±1.5	40 ±1.5
ECLDM-45	5	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2
ECLDM-50	5	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2
ECLDM-75	8	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5
ECLDM-100	10	20 ±1	40 ±1.5	60 ±2	80 ±3	100 ±3
ECLDM-125	15	25 ±1	50 ±2	75 ±2.5	100 ±3	125 ±4
ECLDM-150	15	30 ±1.5	60 ±2	90 ±3	120 ±4	150 ±5
ECLDM-175	20	35 ±1.5	70 ±2.5	105 ±4	140 ±5	175 ±5
ECLDM-200	20	40 ±1.5	80 ±2.5	120 ±4	160 ±5	200 ±6
ECLDM-225	25	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7
ECLDM-250	25	50 ±2	100 ±3	150 ±4.5	200 ±6	250 ±8
ECLDM-300	30	60 ±2	120 ±4	180 ±5	240 ±7	300 ±9
ECLDM-350	35	70 ±2	140 ±4.5	210 ±7	280 ±9	350 ±11
ECLDM-400	40	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12
ECLDM-450	45	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14
ECLDM-500	50	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15
ECLDM-600	30	120 ±4	240 ±7	360 ±11	480 ±15	600 ±18
ECLDM-700	35	140 ±4	280 ±9	420 ±13	560 ±17	700 ±20
ECLDM-800	40	160 ±5	320 ±10	480 ±15	640 ±19	800 ±20
ECLDM-900	45	180 ±6	360 ±11	520 ±16	720 ±20	900 ±22
ECLDM-1000	50	200 ±6	400 ±12	600 ±18	800 ±20	1000 ±22

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/021580

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

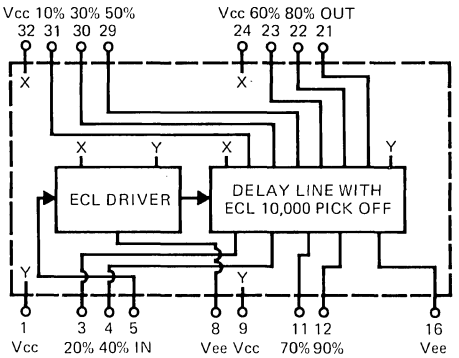


ECL 10K COMPATIBLE Low Profile

DOUBLE LOGIC DELAY MODULE

- ECL input and outputs
- Delays stable and precise
- 32-pin DIP package
- Available in delays from 11ns to 1000ns
- 10% taps – each isolated and with 70 ECL DC fan-out capacity
- Fast rise time on all outputs
- Dimensions: .400 wide X 1.600 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



ϕ DELAYS AND TOLERANCES (in ns)										
Part Number	Tap 1	Tap 2	Tap 3	Tap 4	Tap 5	Tap 6	Tap 7	Tap 8	Tap 9	Output
DECLDM-11	2 ±.5	3 ±.5	4 ±.5	5 ±1	6 ±1	7 ±1	8 ±1	9 ±1	10 ±1	11 ±1
DECLDM-20	2 ±.5	4 ±.5	6 ±1	8 ±1	10 ±1	12 ±1	14 ±1	16 ±1	18 ±1	20 ±1
DECLDM-30	3 ±.5	6 ±1	9 ±1	12 ±1	15 ±1	18 ±1	21 ±1	24 ±1.5	27 ±1.5	30 ±1.5
DECLDM-40	4 ±.5	8 ±1	12 ±1	16 ±1	20 ±1	24 ±1.5	28 ±1.5	32 ±1.5	36 ±1.5	40 ±2
DECLDM-50	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1.5	30 ±1.5	35 ±1.5	40 ±2	45 ±2	50 ±2
DECLDM-60	6 ±1	12 ±1	18 ±1	24 ±1.5	30 ±1.5	36 ±1.5	42 ±2	48 ±2	54 ±2	60 ±2.5
DECLDM-70	7 ±1	14 ±1	21 ±1	28 ±1.5	35 ±1.5	42 ±2	49 ±2	56 ±2	63 ±2	70 ±2.5
DECLDM-80	8 ±1	16 ±1	24 ±1.5	32 ±1.5	40 ±2	48 ±2	56 ±2	64 ±2.5	72 ±2.5	80 ±3
DECLDM-90	9 ±1	18 ±1	27 ±1.5	36 ±1.5	45 ±2	54 ±2	63 ±2	72 ±2.5	81 ±3	90 ±3
DECLDM-100	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2	60 ±2.5	70 ±2.5	80 ±3	90 ±3	100 ±3
DECLDM-150	15 ±1	30 ±1.5	45 ±2	60 ±2.5	75 ±2.5	90 ±3	105 ±4	120 ±4	135 ±4	150 ±5
DECLDM-200	20 ±1	40 ±2	60 ±2.5	80 ±3	100 ±3	120 ±4	140 ±5	160 ±5	180 ±6	200 ±6
DECLDM-250	25 ±1.5	50 ±2	75 ±2.5	100 ±3	125 ±4	150 ±5	175 ±5	200 ±6	225 ±7	250 ±8
DECLDM-300	30 ±1.5	60 ±2.5	90 ±3	120 ±4	150 ±5	180 ±6	210 ±7	240 ±7	270 ±8	300 ±9
DECLDM-350	35 ±1.5	75 ±2.5	105 ±4	140 ±5	175 ±5	210 ±7	245 ±8	280 ±9	315 ±10	350 ±11
DECLDM-400	40 ±2	80 ±3	120 ±4	160 ±5	200 ±6	240 ±7	280 ±9	320 ±10	360 ±11	400 ±12
DECLDM-450	45 ±2	90 ±3	135 ±4	180 ±6	225 ±7	270 ±8	315 ±10	360 ±11	405 ±12	450 ±14
DECLDM-500	50 ±2	100 ±3	150 ±5	200 ±6	250 ±8	300 ±9	350 ±11	400 ±12	450 ±14	500 ±15
DECLDM-600	60 ±2.5	120 ±4	180 ±6	240 ±7	300 ±9	360 ±11	420 ±13	480 ±15	540 ±16	600 ±18
DECLDM-700	70 ±2.5	140 ±5	210 ±7	280 ±9	350 ±11	420 ±13	490 ±15	560 ±17	630 ±19	700 ±20
DECLDM-800	80 ±3	160 ±5	240 ±7	320 ±10	400 ±12	480 ±15	560 ±17	640 ±19	720 ±20	800 ±20
DECLDM-900	90 ±3	180 ±6	270 ±8	360 ±11	450 ±14	540 ±16	630 ±19	720 ±20	810 ±20	900 ±22
DECLDM-1000	100 ±3	200 ±6	300 ±9	400 ±12	500 ±15	600 ±18	700 ±20	800 ±20	900 ±22	1000 ±22

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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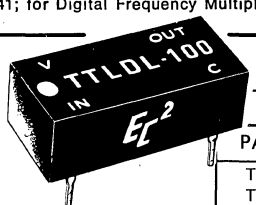
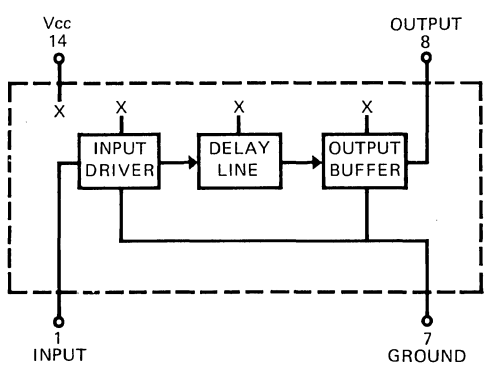


T²L COMPATIBLE Low Profile

LOGIC DELAY LINE (Schottky)

- T²L input and output
- Delay stable and precise
- 14-pin DIP package
- Available in delays from 5ns to 1000ns
- Output isolated and with 10 T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



ϕ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
TTLDL-5	5 ±1	TTLDL-60	60 ±2
TTLDL-6	6 ±1	TTLDL-65	65 ±2.5
TTLDL-7	7 ±1	TTLDL-70	70 ±2.5
TTLDL-8	8 ±1	TTLDL-75	75 ±2.5
TTLDL-9	9 ±1	TTLDL-80	80 ±2.5
TTLDL-10	10 ±1	TTLDL-85	85 ±3
TTLDL-11	11 ±1	TTLDL-90	90 ±3
TTLDL-12	12 ±1	TTLDL-95	95 ±3
TTLDL-13	13 ±1	TTLDL-100	100 ±3
TTLDL-14	14 ±1	TTLDL-125	125 ±4
TTLDL-15	15 ±1	TTLDL-150	150 ±4.5
TTLDL-16	16 ±1	TTLDL-175	175 ±5
TTLDL-17	17 ±1	TTLDL-200	200 ±6
TTLDL-18	18 ±1	TTLDL-225	225 ±7
TTLDL-19	19 ±1	TTLDL-250	250 ±8
TTLDL-20	20 ±1	TTLDL-275	275 ±9
TTLDL-21	21 ±1	TTLDL-300	300 ±10
TTLDL-22	22 ±1	TTLDL-350	350 ±11
TTLDL-23	23 ±1	TTLDL-400	400 ±12
TTLDL-24	24 ±1	TTLDL-450	450 ±14
TTLDL-25	25 ±1	TTLDL-500	500 ±15
TTLDL-30	30 ±1.5	TTLDL-600	600 ±18
TTLDL-35	35 ±1.5	TTLDL-700	700 ±20
TTLDL-40	40 ±1.5	TTLDL-800	800 ±22
TTLDL-45	45 ±2	TTLDL-900	900 ±24
TTLDL-50	50 ±2	TTLDL-1000	1000 ±26
TTLDL-55	55 ±2		

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/112279

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
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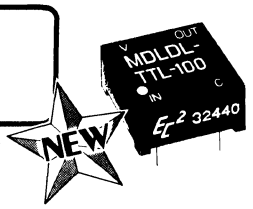
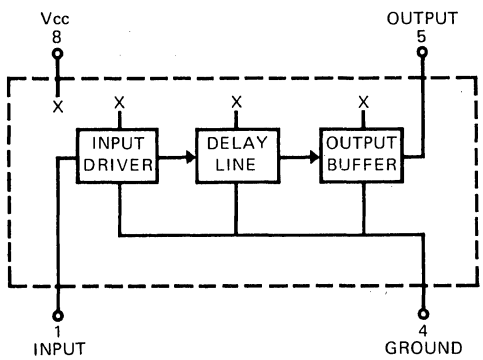


T²L COMPATIBLE "Mini DIP" Low Profile
LOGIC DELAY LINE (Schottky)

- T²L input and output
- Delay stable and precise
- 8-pin DIP package
- Available in delays from 5 to 500ns
- Output isolated and with 10 Schottky T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

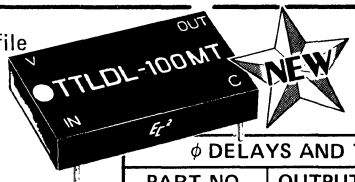


ϕDELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
MDLDL-TTL-5	5 ±1	MDLDL-TTL-45	45 ±2
MDLDL-TTL-6	6 ±1	MDLDL-TTL-50	50 ±2
MDLDL-TTL-7	7 ±1	MDLDL-TTL-55	55 ±2
MDLDL-TTL-8	8 ±1	MDLDL-TTL-60	60 ±2
MDLDL-TTL-9	9 ±1	MDLDL-TTL-65	65 ±2.5
MDLDL-TTL-10	10 ±1	MDLDL-TTL-70	70 ±2.5
MDLDL-TTL-11	11 ±1	MDLDL-TTL-75	75 ±2.5
MDLDL-TTL-12	12 ±1	MDLDL-TTL-80	80 ±2.5
MDLDL-TTL-13	13 ±1	MDLDL-TTL-85	85 ±3
MDLDL-TTL-14	14 ±1	MDLDL-TTL-90	90 ±3
MDLDL-TTL-15	15 ±1	MDLDL-TTL-95	95 ±3
MDLDL-TTL-16	16 ±1	MDLDL-TTL-100	100 ±3
MDLDL-TTL-17	17 ±1	MDLDL-TTL-125	125 ±4
MDLDL-TTL-18	18 ±1	MDLDL-TTL-150	150 ±4.5
MDLDL-TTL-19	19 ±1	MDLDL-TTL-175	175 ±5
MDLDL-TTL-20	20 ±1	MDLDL-TTL-200	200 ±6
MDLDL-TTL-21	21 ±1	MDLDL-TTL-225	225 ±7
MDLDL-TTL-22	22 ±1	MDLDL-TTL-250	250 ±8
MDLDL-TTL-23	23 ±1	MDLDL-TTL-275	275 ±9
MDLDL-TTL-24	24 ±1	MDLDL-TTL-300	300 ±10
MDLDL-TTL-25	25 ±1	MDLDL-TTL-350	350 ±11
MDLDL-TTL-30	30 ±1.5	MDLDL-TTL-400	400 ±12
MDLDL-TTL-35	35 ±1.5	MDLDL-TTL-450	450 ±14
MDLDL-TTL-40	40 ±1.5	MDLDL-TTL-500	500 ±15

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

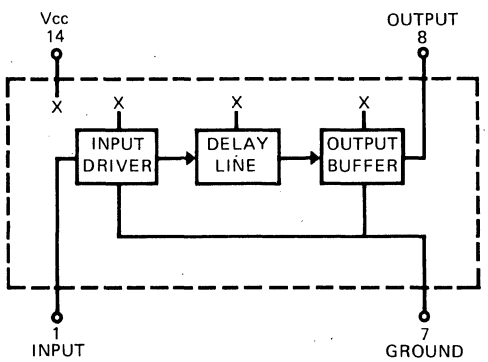
ABOVE DATA FROM CATALOG NO. C/123081

T²L COMPATIBLE "Thinny DIP" Super Low Profile
LOGIC DELAY LINE (Schottky)



- Full military temperature range
- T²L input and output
- Delay stable and precise
- 14-pin DIP package
- Available in delays from 5 to 500ns
- Output isolated and with 10 T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .500 wide X .800 long X .165 high
- ICs burned in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of −55° to +125°C

BLOCK DIAGRAM IS SHOWN BELOW

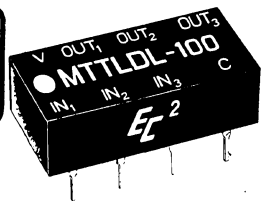


ϕ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
TTLDL-5MT	5 ±1	TTLDL-45MT	45 ±2
TTLDL-6MT	6 ±1	TTLDL-50MT	50 ±2
TTLDL-7MT	7 ±1	TTLDL-55MT	55 ±2
TTLDL-8MT	8 ±1	TTLDL-60MT	60 ±2
TTLDL-9MT	9 ±1	TTLDL-65MT	65 ±2.5
TTLDL-10MT	10 ±1	TTLDL-70MT	70 ±2.5
TTLDL-11MT	11 ±1	TTLDL-75MT	75 ±2.5
TTLDL-12MT	12 ±1	TTLDL-80MT	80 ±2.5
TTLDL-13MT	13 ±1	TTLDL-85MT	85 ±3
TTLDL-14MT	14 ±1	TTLDL-90MT	90 ±3
TTLDL-15MT	15 ±1	TTLDL-95MT	95 ±3
TTLDL-16MT	16 ±1	TTLDL-100MT	100 ±3
TTLDL-17MT	17 ±1	TTLDL-125MT	125 ±4
TTLDL-18MT	18 ±1	TTLDL-150MT	150 ±4.5
TTLDL-19MT	19 ±1	TTLDL-175MT	175 ±5
TTLDL-20MT	20 ±1	TTLDL-200MT	200 ±6
TTLDL-21MT	21 ±1	TTLDL-225MT	225 ±7
TTLDL-22MT	22 ±1	TTLDL-250MT	250 ±8
TTLDL-23MT	23 ±1	TTLDL-275MT	275 ±9
TTLDL-24MT	24 ±1	TTLDL-300MT	300 ±10
TTLDL-25MT	25 ±1	TTLDL-350MT	350 ±11
TTLDL-30MT	30 ±1.5	TTLDL-400MT	400 ±12
TTLDL-35MT	35 ±1.5	TTLDL-450MT	450 ±14
TTLDL-40MT	40 ±1.5	TTLDL-500MT	500 ±15

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/092280

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

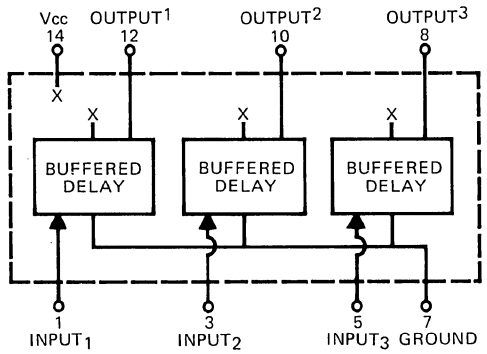


T²L COMPATIBLE Low Profile

MULTI-LOGIC DELAY LINE (Schottky)

- T²L inputs and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 5ns to 250ns each isolated and with 10 T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of 0° to +70°C.

BLOCK DIAGRAM IS SHOWN BELOW



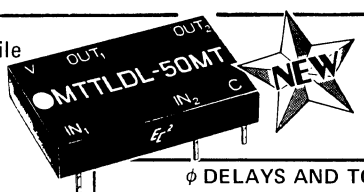
φ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
MTTLDL-5	5 ±1	MTTLDL-30	30 ±1.5
MTTLDL-6	6 ±1	MTTLDL-35	35 ±1.5
MTTLDL-7	7 ±1	MTTLDL-40	40 ±1.5
MTTLDL-8	8 ±1	MTTLDL-45	45 ±2
MTTLDL-9	9 ±1	MTTLDL-50	50 ±2
MTTLDL-10	10 ±1	MTTLDL-55	55 ±2
MTTLDL-11	11 ±1	MTTLDL-60	60 ±2
MTTLDL-12	12 ±1	MTTLDL-65	65 ±2.5
MTTLDL-13	13 ±1	MTTLDL-70	70 ±2.5
MTTLDL-14	14 ±1	MTTLDL-75	75 ±2.5
MTTLDL-15	15 ±1	MTTLDL-80	80 ±2.5
MTTLDL-16	16 ±1	MTTLDL-85	85 ±3
MTTLDL-17	17 ±1	MTTLDL-90	90 ±3
MTTLDL-18	18 ±1	MTTLDL-95	95 ±3
MTTLDL-19	19 ±1	MTTLDL-100	100 ±3
MTTLDL-20	20 ±1	MTTLDL-125	125 ±4
MTTLDL-21	21 ±1	MTTLDL-150	150 ±4.5
MTTLDL-22	22 ±1	MTTLDL-175	175 ±5
MTTLDL-23	23 ±1	MTTLDL-200	200 ±6
MTTLDL-24	24 ±1	MTTLDL-225	225 ±7
MTTLDL-25	25 ±1	MTTLDL-250	250 ±8

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/011080

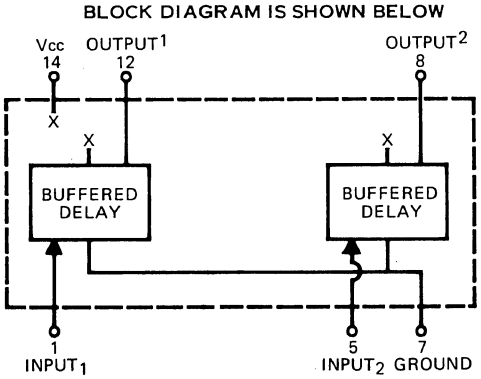
T²L COMPATIBLE "Thinny DIP" Super Low Profile

MULTI-LOGIC DELAY LINE (Schottky)



- Full military temperature range
- T²L inputs and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 5 to 250ns – each isolated and with 10 T²L fan-out capacity
- Rise time 4ns maximum
- Dimensions: .500 wide X .800 long X .165 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of −55° to +125°C

BLOCK DIAGRAM IS SHOWN BELOW

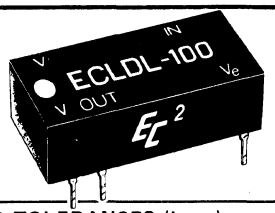


φ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
MTTLDL-5MT	5 ±1	MTTLDL-30MT	30 ±1.5
MTTLDL-6MT	6 ±1	MTTLDL-35MT	35 ±1.5
MTTLDL-7MT	7 ±1	MTTLDL-40MT	40 ±1.5
MTTLDL-8MT	8 ±1	MTTLDL-45MT	45 ±2
MTTLDL-9MT	9 ±1	MTTLDL-50MT	50 ±2
MTTLDL-10MT	10 ±1	MTTLDL-55MT	55 ±2
MTTLDL-11MT	11 ±1	MTTLDL-60MT	60 ±2
MTTLDL-12MT	12 ±1	MTTLDL-65MT	65 ±2.5
MTTLDL-13MT	13 ±1	MTTLDL-70MT	70 ±2.5
MTTLDL-14MT	14 ±1	MTTLDL-75MT	75 ±2.5
MTTLDL-15MT	15 ±1	MTTLDL-80MT	80 ±2.5
MTTLDL-16MT	16 ±1	MTTLDL-85MT	85 ±3
MTTLDL-17MT	17 ±1	MTTLDL-90MT	90 ±3
MTTLDL-18MT	18 ±1	MTTLDL-95MT	95 ±3
MTTLDL-19MT	19 ±1	MTTLDL-100MT	100 ±3
MTTLDL-20MT	20 ±1	MTTLDL-125MT	125 ±4
MTTLDL-21MT	21 ±1	MTTLDL-150MT	150 ±4.5
MTTLDL-22MT	22 ±1	MTTLDL-175MT	175 ±5
MTTLDL-23MT	23 ±1	MTTLDL-200MT	200 ±6
MTTLDL-24MT	24 ±1	MTTLDL-225MT	225 ±7
MTTLDL-25MT	25 ±1	MTTLDL-250MT	250 ±8

Note: For other active digital modules, i.e., Noice Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/100680

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

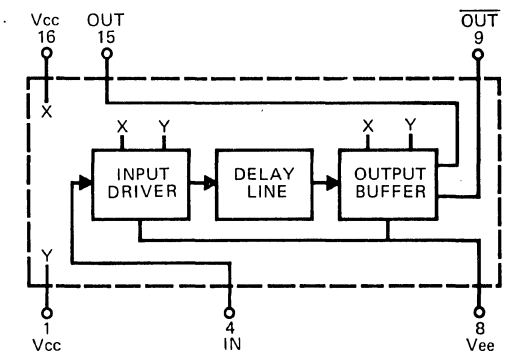


ECL 10K COMPATIBLE Low Profile

LOGIC DELAY LINE

- ECL input and output
- Delays stable and precise
- 16-pin DIP package
- Available in delays from 2ns to 1000ns
- Output isolated and with 70 ECL DC fan-out capacity
- Fast rise times on all outputs
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of – 30°C to +85°C

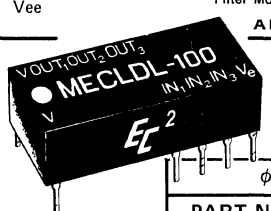
BLOCK DIAGRAM IS SHOWN BELOW



ϕ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
ECLDL-2	±.3	ECLDL-50	50 ±2
ECLDL-3	±.4	ECLDL-55	55 ±2
ECLDL-4	±.5	ECLDL-60	60 ±2
ECLDL-5	5 ±1	ECLDL-65	65 ±2.5
ECLDL-6	6 ±1	ECLDL-70	70 ±2.5
ECLDL-7	7 ±1	ECLDL-75	75 ±2.5
ECLDL-8	8 ±1	ECLDL-80	80 ±2.5
ECLDL-9	9 ±1	ECLDL-85	85 ±3
ECLDL-10	10 ±1	ECLDL-90	90 ±3
ECLDL-11	11 ±1	ECLDL-95	95 ±3
ECLDL-12	12 ±1	ECLDL-100	100 ±3
ECLDL-13	13 ±1	ECLDL-125	125 ±4
ECLDL-14	14 ±1	ECLDL-150	150 ±4.5
ECLDL-15	15 ±1	ECLDL-175	175 ±5
ECLDL-16	16 ±1	ECLDL-200	200 ±6
ECLDL-17	17 ±1	ECLDL-225	225 ±7
ECLDL-18	18 ±1	ECLDL-250	250 ±8
ECLDL-19	19 ±1	ECLDL-275	275 ±9
ECLDL-20	20 ±1	ECLDL-300	300 ±10
ECLDL-21	21 ±1	ECLDL-350	350 ±11
ECLDL-22	22 ±1	ECLDL-400	400 ±12
ECLDL-23	23 ±1	ECLDL-450	450 ±14
ECLDL-24	24 ±1	ECLDL-500	500 ±15
ECLDL-25	25 ±1	ECLDL-600	600 ±18
ECLDL-30	30 ±1.5	ECLDL-700	700 ±20
ECLDL-35	35 ±1.5	ECLDL-800	800 ±22
ECLDL-40	40 ±1.5	ECLDL-900	900 ±24
ECLDL-45	45 ±2	ECLDL-1000	1000 ±26

Note: For other active digital modules, i.e., Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442 and for Noise Filter Modules, see page 1•1434.

ABOVE DATA FROM CATALOG NO. C/011180

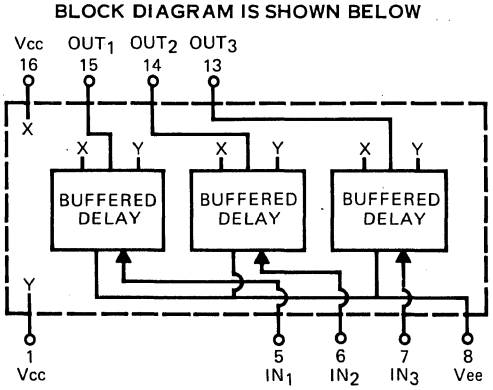


ECL 10K COMPATIBLE Low Profile

MULTI-LOGIC DELAY LINE

- ECL inputs and outputs
- Delays stable and precise
- 16-pin DIP package
- Available in delays from 5ns to 100ns
- Each output isolated and with 70 ECL DC fan-out capacity
- Fast rise times on all outputs
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of – 30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW

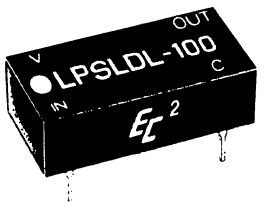


ϕ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
MECLDL-5	5 ±1	MECLDL-23	23 ±1
MECLDL-6	6 ±1	MECLDL-24	24 ±1
MECLDL-7	7 ±1	MECLDL-25	25 ±1
MECLDL-8	8 ±1	MECLDL-30	30 ±1.5
MECLDL-9	9 ±1	MECLDL-35	35 ±1.5
MECLDL-10	10 ±1	MECLDL-40	40 ±1.5
MECLDL-11	11 ±1	MECLDL-45	45 ±2
MECLDL-12	12 ±1	MECLDL-50	50 ±2
MECLDL-13	13 ±1	MECLDL-55	55 ±2
MECLDL-14	14 ±1	MECLDL-60	60 ±2
MECLDL-15	15 ±1	MECLDL-65	65 ±2.5
MECLDL-16	16 ±1	MECLDL-70	70 ±2.5
MECLDL-17	17 ±1	MECLDL-75	75 ±2.5
MECLDL-18	18 ±1	MECLDL-80	80 ±2.5
MECLDL-19	19 ±1	MECLDL-85	85 ±3
MECLDL-20	20 ±1	MECLDL-90	90 ±3
MECLDL-21	21 ±1	MECLDL-95	95 ±3
MECLDL-22	22 ±1	MECLDL-100	100 ±3

Note: For other active digital modules, i.e., Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442 and for Noise Filter Modules, see page 1•1434.

ABOVE DATA FROM CATALOG NO. C/011880

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

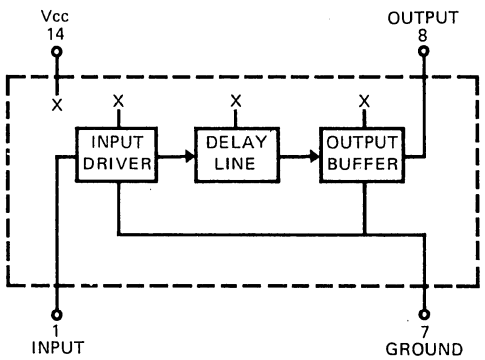


T²L COMPATIBLE Low Profile

LOGIC DELAY LINE
(Low Power Schottky)

- T²L input and output
- Delay stable and precise
- 14-pin DIP package
- Available in delays from 10ns to 500ns
- Output isolated and with 20 T²L fan-out capacity
- Rise time 8ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

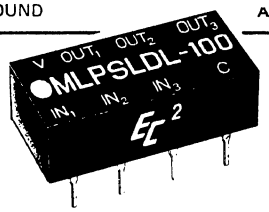
BLOCK DIAGRAM IS SHOWN BELOW



φ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
LPSLDL-10	10 ±1	LPSLDL-60	60 ±2
LPSLDL-11	11 ±1	LPSLDL-65	65 ±2.5
LPSLDL-12	12 ±1	LPSLDL-70	70 ±2.5
LPSLDL-13	13 ±1	LPSLDL-75	75 ±2.5
LPSLDL-14	14 ±1	LPSLDL-80	80 ±2.5
LPSLDL-15	15 ±1	LPSLDL-85	85 ±3
LPSLDL-16	16 ±1	LPSLDL-90	90 ±3
LPSLDL-17	17 ±1	LPSLDL-95	95 ±3
LPSLDL-18	18 ±1	LPSLDL-100	100 ±3
LPSLDL-19	19 ±1	LPSLDL-125	125 ±4
LPSLDL-20	20 ±1	LPSLDL-150	150 ±4.5
LPSLDL-21	21 ±1	LPSLDL-175	175 ±5
LPSLDL-22	22 ±1	LPSLDL-200	200 ±6
LPSLDL-23	23 ±1	LPSLDL-225	225 ±7
LPSLDL-24	24 ±1	LPSLDL-250	250 ±8
LPSLDL-25	25 ±1	LPSLDL-275	275 ±9
LPSLDL-30	30 ±1.5	LPSLDL-300	300 ±10
LPSLDL-35	35 ±1.5	LPSLDL-350	350 ±11
LPSLDL-40	40 ±1.5	LPSLDL-400	400 ±12
LPSLDL-45	45 ±2	LPSLDL-450	450 ±14
LPSLDL-50	50 ±2	LPSLDL-500	500 ±15
LPSLDL-55	55 ±2		

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/021980

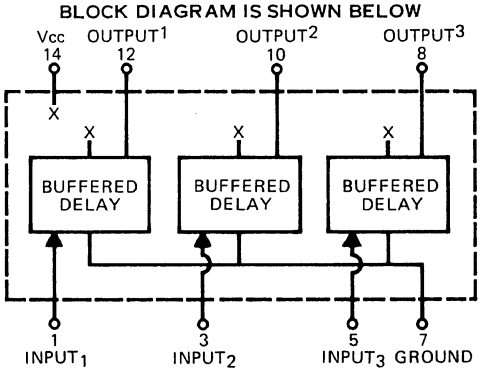


T²L COMPATIBLE Low Profile

MULTI-LOGIC DELAY LINE
(Low Power Schottky)

- T²L inputs and outputs
- Delays stable and precise
- 14-pin DIP package
- Available in delays from 10ns to 100ns – each isolated and with 20 low power Schottky T²L fan-out capacity
- Rise time 8ns maximum
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

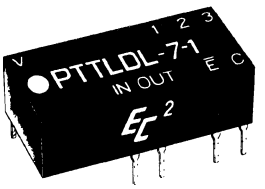


φ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
MLPSLDL-10	10 ±1	MLPSLDL-30	30 ±1.5
MLPSLDL-11	11 ±1	MLPSLDL-35	35 ±1.5
MLPSLDL-12	12 ±1	MLPSLDL-40	40 ±1.5
MLPSLDL-13	13 ±1	MLPSLDL-45	45 ±2
MLPSLDL-14	14 ±1	MLPSLDL-50	50 ±2
MLPSLDL-15	15 ±1	MLPSLDL-55	55 ±2
MLPSLDL-16	16 ±1	MLPSLDL-60	60 ±2
MLPSLDL-17	17 ±1	MLPSLDL-65	65 ±2.5
MLPSLDL-18	18 ±1	MLPSLDL-70	70 ±2.5
MLPSLDL-19	19 ±1	MLPSLDL-75	75 ±2.5
MLPSLDL-20	20 ±1	MLPSLDL-80	80 ±2.5
MLPSLDL-21	21 ±1	MLPSLDL-85	85 ±3
MLPSLDL-22	22 ±1	MLPSLDL-90	90 ±3
MLPSLDL-23	23 ±1	MLPSLDL-95	95 ±3
MLPSLDL-24	24 ±1	MLPSLDL-100	100 ±3
MLPSLDL-25	25 ±1		

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/022680

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

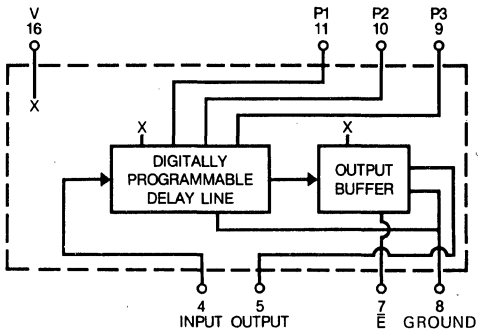


T²L COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (3-Bit) (Schottky)

- T²L input and output
- Delays stable and precise
- 16-pin DIP package
- Available in delays up to 77ns
- Available in 10 delay steps with resolution from 1ns to 10ns
- Propagation delays fully compensated
- All delays digitally programmable
- 10 T²L fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 2 million hours.
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



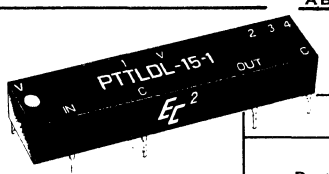
ϕ DELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step	**Maximum Deviation From Programmed Delay
PTTLDL-7-1	7 ±.3	14	1 ±.3	±.4
PTTLDL-7-2	7 ±.3	21	2 ±.4	±.6
PTTLDL-7-3	7 ±.3	28	3 ±.5	±.8
PTTLDL-7-4	7 ±.3	35	4 ±.5	±.9
PTTLDL-7-5	7 ±.3	42	5 ±.5	±1
PTTLDL-7-6	7 ±.3	49	6 ±.6	±1.2
PTTLDL-7-7	7 ±.3	56	7 ±.7	±1.4
PTTLDL-7-8	7 ±.3	63	8 ±.8	±1.6
PTTLDL-7-9	7 ±.3	70	9 ±.9	±1.8
PTTLDL-7-10	7 ±.3	77	10 ±1	±2

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/011780

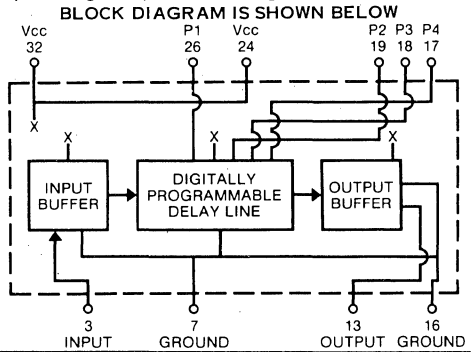
T²L COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (4-Bit) (Schottky)



- T²L input and output
- Delays stable and precise
- 32-pin DIP package
- Available in delays up to 765ns
- Available in 18 delay steps with resolution from 1ns to 50ns
- Propagation delays fully compensated
- All delays digitally programmable
- 10 T²L fan-out capacity
- Dimensions: .400 wide X 1.650 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

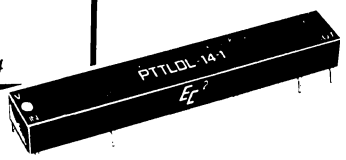


ϕDELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step	**Maximum Deviation From Programmed Delay
PTTLDL-15-1	15 ±.6	30	1 ±.4	±.8
PTTLDL-15-2	15 ±.6	45	2 ±.5	±1.2
PTTLDL-15-3	15 ±.6	60	3 ±.5	±1.6
PTTLDL-15-4	15 ±.6	75	4 ±.6	±1.8
PTTLDL-15-5	15 ±.6	90	5 ±.6	±2.0
PTTLDL-15-6	15 ±.6	105	6 ±.8	±2.4
PTTLDL-15-7	15 ±.6	120	7 ±.8	±2.8
PTTLDL-15-8	15 ±.6	135	8 ±1	±3.2
PTTLDL-15-9	15 ±.6	150	9 ±1	±3.6
PTTLDL-15-10	15 ±.6	165	10 ±1	±4
PTTLDL-15-15	15 ±.6	240	15 ±1.5	±6
PTTLDL-15-20	15 ±.6	315	20 ±2	±8
PTTLDL-15-25	15 ±.6	390	25 ±2	±10
PTTLDL-15-30	15 ±.6	465	30 ±2.5	±12
PTTLDL-15-35	15 ±.6	540	35 ±2.5	±14
PTTLDL-15-40	15 ±.6	615	40 ±3	±16
PTTLDL-15-45	15 ±.6	690	45 ±3	±18
PTTLDL-15-50	15 ±.6	765	50 ±3	±20

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/012480

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

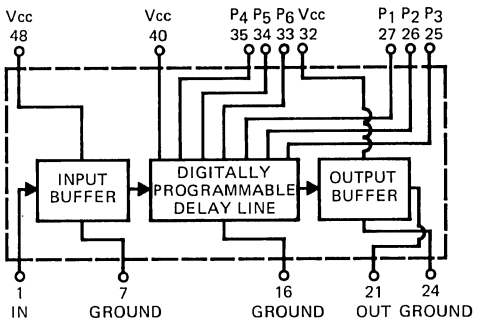


T²L COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (6-Bit) (Schottky)

- T²L input and output
- Delays stable and precise
- 48-pin DIP package
- Available in delays up to 329ns
- 5 delay steps available with resolution from 1ns to 5ns
- Propagation delays fully compensated
- All delays digitally programmable
- 10 T²L fan-out capacity
- Dimensions: .400 wide X 2.450 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 500,000 hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



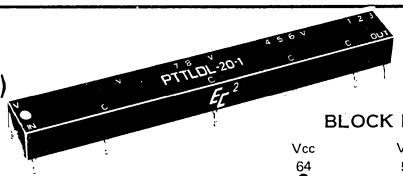
ϕ DELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step (Nom)	* *Maximum Deviation From Programmed Delay
PTTLDL-14-1	14 ±.3	77	1	±1.5
PTTLDL-14-2	14 ±.3	140	2	±2
PTTLDL-14-3	14 ±.3	203	3	±3
PTTLDL-14-4	14 ±.3	266	4	±4
PTTLDL-14-5	14 ±.3	329	5	±5

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/013180

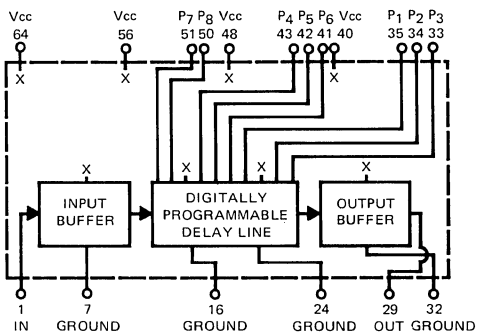
T²L COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (8-Bit) (Schottky)



- T²L input and output levels
- Delays stable and precise
- 64-pin DIP package
- Available in delays up to 1295ns
- 5 delay steps available with resolution from 1ns to 5ns
- Propagation delays fully compensated
- All delays digitally programmable
- 10 T²L fan-out capacity
- Dimensions: .400 wide X 3.250 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 300,000 hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

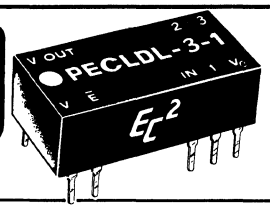


ϕ DELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step (Nom)	* *Maximum Deviation From Programmed Delay
PTTLDL-20-1	20 ±.5	275	1	±6
PTTLDL-20-2	20 ±.5	530	2	±8
PTTLDL-20-3	20 ±.5	785	3	±12
PTTLDL-20-4	20 ±.5	1040	4	±16
PTTLDL-20-5	20 ±.5	1295	5	±20

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/020580

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

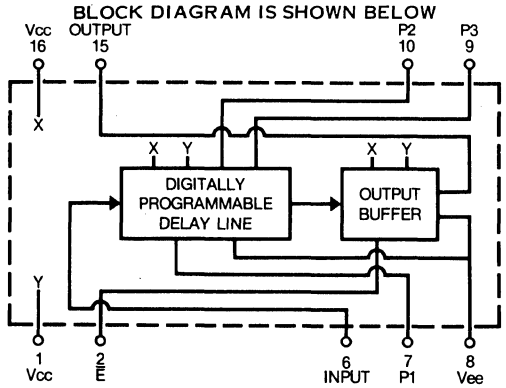


ECL 10K COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (3-Bit)

- ECL input and output levels
- Delays stable and precise
- 16-pin DIP package
- Available in delays up to 353ns
- Available in 18 delay steps with resolution from 1ns to 50ns
- Propagation delays fully compensated
- All delays digitally programmable
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW

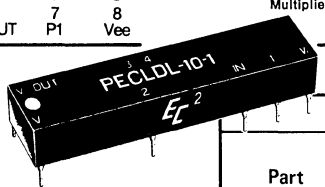


φ DELAYS AND TOLERANCES (in ns)

Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step	**Maximum Deviation From Programmed Delay
PECLDL-3-1	2.8 ±.3	10	1 ±.3	±.4
PECLDL-3-2	2.8 ±.3	17	2 ±.4	±.6
PECLDL-3-3	2.8 ±.3	24	3 ±.5	±.8
PECLDL-3-4	2.8 ±.3	31	4 ±.5	±.9
PECLDL-3-5	2.8 ±.3	38	5 ±.5	±1
PECLDL-3-6	2.8 ±.3	45	6 ±.6	±1.2
PECLDL-3-7	2.8 ±.3	52	7 ±.7	±1.4
PECLDL-3-8	2.8 ±.3	59	8 ±.8	±1.6
PECLDL-3-9	2.8 ±.3	66	9 ±.9	±1.8
PECLDL-3-10	2.8 ±.3	73	10 ±1	±2
PECLDL-3-15	2.8 ±.3	108	15 ±1	±3
PECLDL-3-20	2.8 ±.3	143	20 ±1.5	±4
PECLDL-3-25	2.8 ±.3	178	25 ±1.5	±5
PECLDL-3-30	2.8 ±.3	213	30 ±2	±6
PECLDL-3-35	2.8 ±.3	248	35 ±2	±7
PECLDL-3-40	2.8 ±.3	283	40 ±2.5	±8
PECLDL-3-45	2.8 ±.3	318	45 ±2.5	±9
PECLDL-3-50	2.8 ±.3	353	50 ±2.5	±10

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/123079

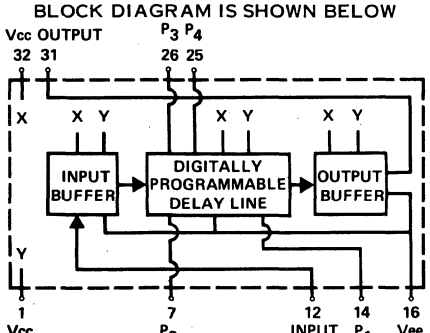


ECL 10K COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (4-Bit)

- ECL input and output levels
- Delays stable and precise
- 32-pin DIP package
- Available in delays up to 760ns
- Available in 18 delay steps with resolution from 1ns to 50ns
- Propagation delays fully compensated
- All delays digitally programmable
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X 1.600 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 800,000 hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



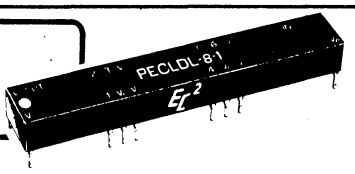
φ DELAYS AND TOLERANCES (in ns)

Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step	**Maximum Deviation From Programmed Delay
PECLDL-10-1	10 ±.6	25	1 ±.4	±.8
PECLDL-10-2	10 ±.6	40	2 ±.5	±1.2
PECLDL-10-3	10 ±.6	55	3 ±.5	±1.6
PECLDL-10-4	10 ±.6	70	4 ±.6	±1.8
PECLDL-10-5	10 ±.6	85	5 ±.6	±2.0
PECLDL-10-6	10 ±.6	100	6 ±.8	±2.4
PECLDL-10-7	10 ±.6	115	7 ±.8	±2.8
PECLDL-10-8	10 ±.6	130	8 ±1	±3.2
PECLDL-10-9	10 ±.6	145	9 ±1	±3.6
PECLDL-10-10	10 ±.6	160	10 ±1	±4
PECLDL-10-15	10 ±.6	235	15 ±1.5	±6
PECLDL-10-20	10 ±.6	310	20 ±2	±8
PECLDL-10-25	10 ±.6	385	25 ±2	±10
PECLDL-10-30	10 ±.6	460	30 ±2.5	±12
PECLDL-10-35	10 ±.6	535	35 ±2.5	±14
PECLDL-10-40	10 ±.6	610	40 ±3	±16
PECLDL-10-45	10 ±.6	685	45 ±3	±18
PECLDL-10-50	10 ±.6	760	50 ±3	±20

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/030180

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

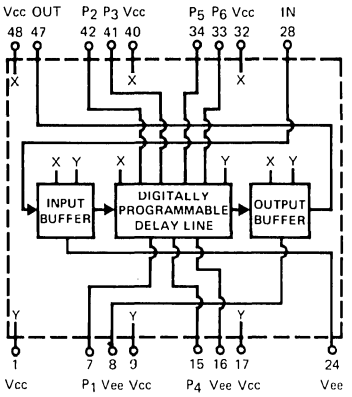


ECL 10K COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (6-Bit)

- ECL input and output levels
- Delays stable and precise
- 48-pin DIP package
- Available in delays up to 323ns
- Available in 5 delay steps with resolution from 1ns to 5ns
- Propagation delays fully compensated
- All delays digitally programmable
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X 2.400 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 500,000 hours
- Operating temperature range of – 30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



ϕ DELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step (Nom)	* *Maximum Deviation From Programmed Delay
PECLDL-8-1	8 ±.3	71	1	±1.5
PECLDL-8-2	8 ±.3	134	2	±2
PECLDL-8-3	8 ±.3	197	3	±3
PECLDL-8-4	8 ±.3	260	4	±4
PECLDL-8-5	8 ±.3	323	5	±5

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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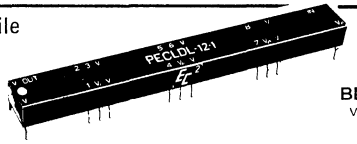
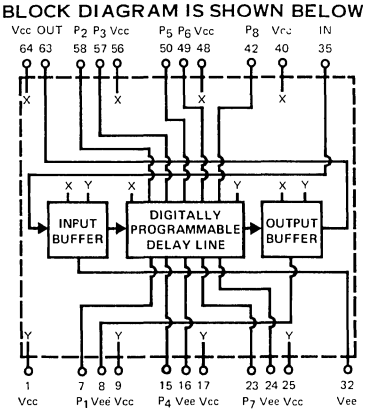
ECL 10K COMPATIBLE Low Profile

PROGRAMMABLE LOGIC DELAY LINE (8-Bit)



- ECL input and output levels
- Delays stable and precise
- 64-pin DIP package
- Available in delays up to 1287ns
- Available in 5 delay steps with resolution from 1ns to 5ns
- Propagation delays fully compensated
- All delays digitally programmable
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X 3.200 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 300,000 hours
- Operating temperature range of – 30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW

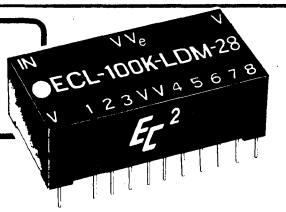


ϕ DELAYS AND TOLERANCES (in ns)				
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	Delay Change Per Step (Nom)	* *Maximum Deviation From Programmed Delay
PECLDL-12-1	12 ±.5	267	1	±6
PECLDL-12-2	12 ±.5	522	2	±8
PECLDL-12-3	12 ±.5	777	3	±12
PECLDL-12-4	12 ±.5	1032	4	±16
PECLDL-12-5	12 ±.5	1287	5	±20

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/033180

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

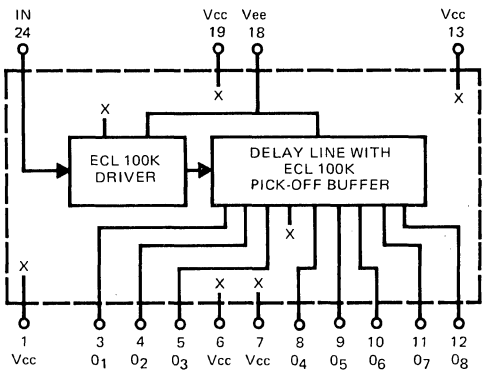


ECL 100K COMPATIBLE

LOGIC DELAY MODULE

- ECL 100K input and outputs
- Delays stable and precise
- 24-pin DIP package
- Available in delays from 16ns to 80ns
- 12.5% taps – each isolated and with 70 ECL DC fan-out capacity
- Dimensions: .500 wide X 1.300 long X .375 high
- Rise time 1ns nominal on all outputs
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1 million hours
- Operating temperature range of 0° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



ϕRISE TIME, DELAYS AND TOLERANCES (in ns)									
Part Number	Rise Time Max.	Tap 1	Tap 2	Tap 3	Tap 4	Tap 5	Tap 6	Tap 7	Output
ECL-100K-LDM-16	2.0	2 ±.2	4 ±.4	6 ±.6	8 ±.8	10 ±1	12 ±1	14 ±1	16 ±1
ECL-100K-LDM-20	2.0	2.5 ±.25	5 ±.5	7.5 ±.75	10 ±1	12.5 ±1	15 ±1	17.5 ±1	20 ±1
ECL-100K-LDM-24	2.0	3 ±.3	6 ±.6	9 ±.9	12 ±1	15 ±1	18 ±1	21 ±1	24 ±1
ECL-100K-LDM-28	2.0	3.5 ±.35	7 ±.7	10.5 ±1	14 ±1	17.5 ±1	21 ±1	24.5 ±1	28 ±1
ECL-100K-LDM-32	2.5	4 ±.4	8 ±.8	12 ±1	16 ±1	20 ±1	24 ±1	28 ±1	32 ±1
ECL-100K-LDM-36	2.5	4.5 ±.45	9 ±.9	13.5 ±1	18 ±1	22.5 ±1	27 ±1	31.5 ±1	36 ±1
ECL-100K-LDM-40	2.5	5 ±.5	10 ±1	15 ±1	20 ±1	25 ±1	30 ±1	35 ±1	40 ±1.5
ECL-100K-LDM-44	3.0	5.5 ±.55	11 ±1	16.5 ±1	22 ±1	27.5 ±1	33 ±1	38.5 ±1	44 ±1.5
ECL-100K-LDM-48	3.0	6 ±.6	12 ±1	18 ±1	24 ±1	30 ±1	36 ±1	42 ±1.5	48 ±2
ECL-100K-LDM-52	3.0	6.5 ±.65	13 ±1	19.5 ±1	26 ±1	32.5 ±1	39 ±1.5	45.5 ±2	52 ±2
ECL-100K-LDM-56	3.0	7 ±.7	14 ±1	21 ±1	28 ±1	35 ±1	42 ±1.5	49 ±2	56 ±2
ECL-100K-LDM-60	4.0	7.5 ±.75	15 ±1	22.5 ±1	30 ±1	37.5 ±1	45 ±1.5	52.5 ±2	60 ±2
ECL-100K-LDM-64	4.0	8 ±.8	16 ±1	24 ±1	32 ±1	40 ±1.5	48 ±2	56 ±2	64 ±2
ECL-100K-LDM-68	4.0	8.5 ±.85	17 ±1	25.5 ±1	34 ±1	42.5 ±1.5	51 ±2	59.5 ±2	68 ±2
ECL-100K-LDM-72	4.5	9 ±.9	18 ±1	27 ±1	36 ±1	45 ±1.5	54 ±2	63 ±2	72 ±2.5
ECL-100K-LDM-76	4.5	9.5 ±.95	19 ±1	28.5 ±1	38 ±1	47.5 ±2	57 ±2	66.5 ±2	76 ±2.5
ECL-100K-LDM-80	4.5	10 ±1	20 ±1	30 ±1	40 ±1.5	50 ±2	60 ±2	70 ±2	80 ±2.5

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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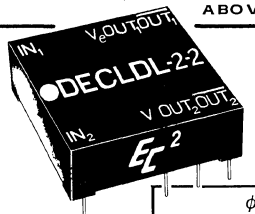
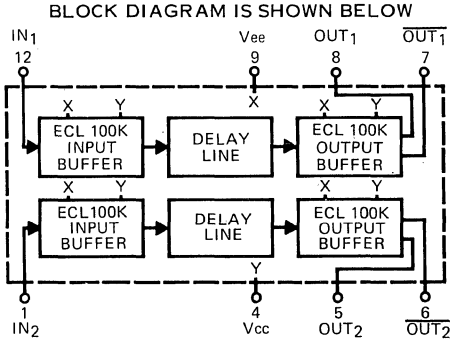


ECL 100K COMPATIBLE

DUAL LOGIC DELAY LINE

- ECL 100K input and output levels
- Delays stable and precise
- 12-pin DIP package
- Available in delays from 2ns to 20ns
- Outputs isolated and with 70 ECL DC fan-out capacity
- Rise time 1ns nominal
- Dimensions: .700 wide X .875 long X .325 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1 million hours
- Operating temperature range of 0° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW

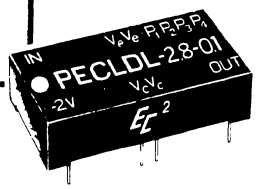


ϕ DELAYS AND TOLERANCES (in ns)			
PART NO.	OUTPUT	PART NO.	OUTPUT
DECLDL-2-2	2±.2	DECLDL-2-10	10±1
DECLDL-2-2.5	2.5±.2	DECLDL-2-10.5	10.5±1
DECLDL-2-3	3±.3	DECLDL-2-11	11±1
DECLDL-2-3.5	3.5±.3	DECLDL-2-11.5	11.5±1
DECLDL-2-4	4±.4	DECLDL-2-12	12±1
DECLDL-2-4.5	4.5±.4	DECLDL-2-12.5	12.5±1
DECLDL-2-5	5±.5	DECLDL-2-13	13±1
DECLDL-2-5.5	5.5±.5	DECLDL-2-13.5	13.5±1
DECLDL-2-6	6±.6	DECLDL-2-14	14±1
DECLDL-2-6.5	6.5±.6	DECLDL-2-14.5	14.5±1
DECLDL-2-7	7±.7	DECLDL-2-15	15±1
DECLDL-2-7.5	7.5±.7	DECLDL-2-16	16±1
DECLDL-2-8	8±.8	DECLDL-2-17	17±1
DECLDL-2-8.5	8.5±.8	DECLDL-2-18	18±1
DECLDL-2-9	9±.9	DECLDL-2-19	19±1
DECLDL-2-9.5	9.5±.9	DECLDL-2-20	20±1

Note: For other active digital modules, i.e., Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1442; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/012580

EC² engineered components company
3580 Sacramento Drive, P. O. Box Y, San Luis Obispo, California 93406
Phone (805) 544-3800 — *For Calls Outside California, Toll Free (800) 235-4144*

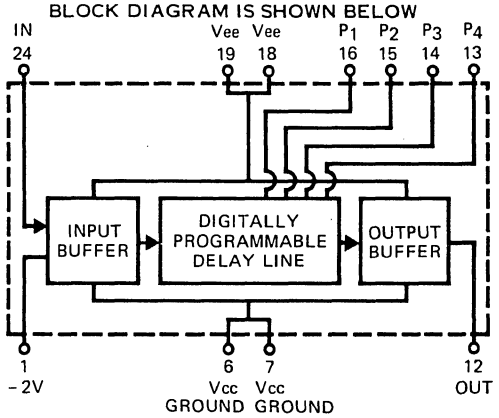


ECL 100K COMPATIBLE

PROGRAMMABLE LOGIC DELAY LINE (4-Bit)

- ECL 100K input and output levels
- Delays stable and precise
- 24-pin DIP package
- Available in delays up to 77.8ns
- Available in 18 delay steps with resolution from 0.1ns to 5.0ns
- Propagation delays fully compensated
- All delays digitally programmable
- 70 ECL DC fan-out capacity
- Dimensions: .650 wide X 1.350 long X .375 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 750,000 hours
- Operating temperature range of 0° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



ϕ DELAYS AND TOLERANCES (in ns)			
Part Number	*Step Zero Delay Time	Maximum Delay Time (Nom)	* *Maximum Deviation From Programmed Delay
PECLDL-2.8-0.1	2.8 ±.2	4.3	±.1
PECLDL-2.8-0.2	2.8 ±.2	5.8	±.2
PECLDL-2.8-0.3	2.8 ±.2	7.3	±.25
PECLDL-2.8-0.4	2.8 ±.2	8.8	±.3
PECLDL-2.8-0.5	2.8 ±.2	10.3	±.35
PECLDL-2.8-0.6	2.8 ±.2	11.8	±.4
PECLDL-2.8-0.7	2.8 ±.2	13.3	±.45
PECLDL-2.8-0.8	2.8 ±.2	14.8	±.5
PECLDL-2.8-0.9	2.8 ±.2	16.3	±.5
PECLDL-2.8-1.0	2.8 ±.2	17.8	±.5
PECLDL-2.8-1.5	2.8 ±.2	25.3	±.8
PECLDL-2.8-2.0	2.8 ±.2	32.8	±1.0
PECLDL-2.8-2.5	2.8 ±.2	40.3	±1.3
PECLDL-2.8-3.0	2.8 ±.2	47.8	±1.5
PECLDL-2.8-3.5	2.8 ±.2	55.3	±1.8
PECLDL-2.8-4.0	2.8 ±.2	62.8	±2.0
PECLDL-2.8-4.5	2.8 ±.2	70.3	±2.3
PECLDL-2.8-5.0	2.8 ±.2	77.8	±2.5

Note: For other active digital modules, i.e., Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442 and for Noise Filter Modules, see page 1•1434.

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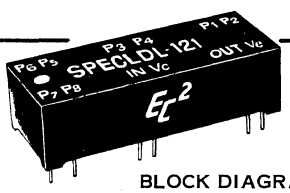
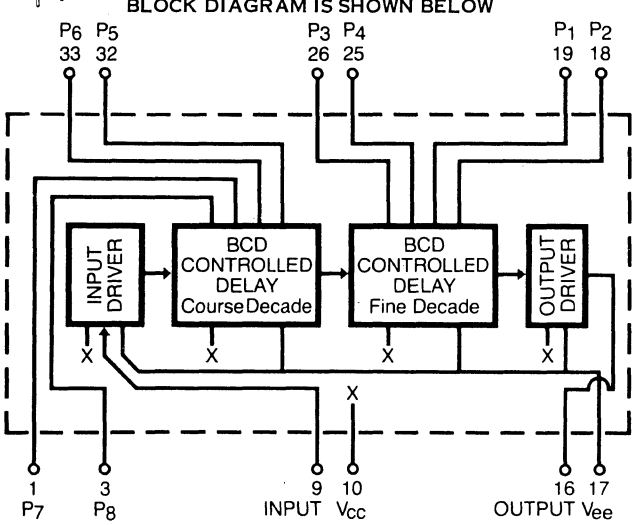


ECL 100K COMPATIBLE

SPECIAL PROGRAMMABLE LOGIC DELAY LINE

- ECL 100K Input and output levels
- Delays stable and precise
- 34-pin DIP package
- 100 steps of BCD programming
- 100ps per step resolution
- Propagation delays fully compensated
- 70 ECL DC fan-out capacity
- Dimensions: .700 wide X 1.750 long X .500 high
- Rise time 1ns nominal
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 500,000 hours
- Operating temperature range of 0° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



Note: For other active digital modules, i.e., Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442 and for Noise Filter Modules, see page 1•1434.

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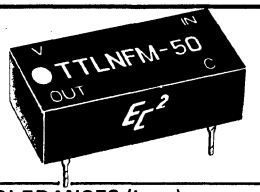
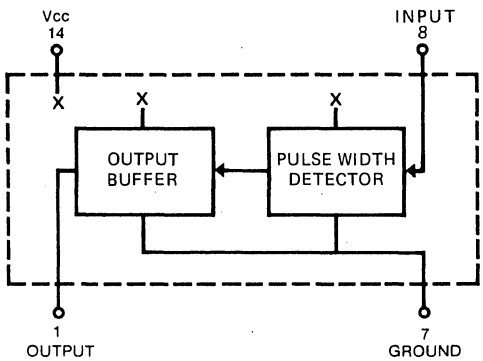


T²L COMPATIBLE Low Profile

LOGIC NOISE FILTER MODULE (Schottky)

- T²L input and output
- Pulse width detection stable and precise
- 14-pin DIP package
- Available in pulse widths from 5ns to 500ns
- 8 T²L fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3.5 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



TIMES AND TOLERANCES (in ns)			
PART NO.	ϕ Pulse Widths		
	Nominal	Suppress	Pass
TTLNFM-5	5	≤4	≥6
TTLNFM-10	10	≤9	≥11
TTLNFM-15	15	≤14	≥16
TTLNFM-20	20	≤19	≥21
TTLNFM-25	25	≤24	≥26
TTLNFM-30	30	≤29	≥31
TTLNFM-35	35	≤34	≥36
TTLNFM-40	40	≤39	≥41
TTLNFM-45	45	≤43.5	≥46.5
TTLNFM-50	50	≤48.5	≥51.5
TTLNFM-60	60	≤58	≥62
TTLNFM-70	70	≤68	≥72
TTLNFM-75	75	≤73	≥77
TTLNFM-80	80	≤78	≥82
TTLNFM-90	90	≤88	≥92
TTLNFM-100	100	≤98	≥102
TTLNFM-125	125	≤123	≥127
TTLNFM-150	150	≤147	≥153
TTLNFM-175	175	≤172	≥178
TTLNFM-200	200	≤196	≥204
TTLNFM-250	250	≤245	≥255
TTLNFM-300	300	≤294	≥306
TTLNFM-400	400	≤392	≥408
TTLNFM-500	500	≤490	≥510

The output of the module will remain at state "0" for any transient input pulses shorter than suppress times and will change to state "1" for pulses longer than pass times. Input pulse width is measured at the +1.5 level.

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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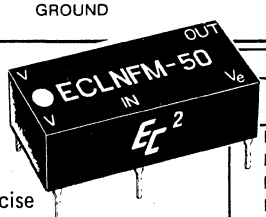
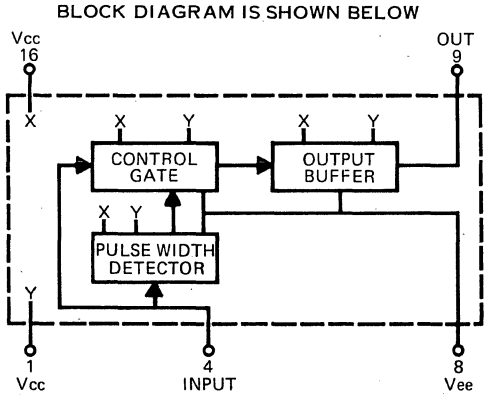


ECL 10K COMPATIBLE Low Profile

LOGIC NOISE FILTER MODULE

- ECL input and output
- Pulse width detection stable and precise
- 16-pin DIP package
- Available in pulse widths from 5ns to 500ns
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3.5 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



TIMES AND TOLERANCES (in ns)			
PART NO.	ϕ Pulse Widths		
	Nominal	Suppress	Pass
ECLNFM-5	5	≤4	≥6
ECLNFM-10	10	≤9	≥11
ECLNFM-15	15	≤14	≥16
ECLNFM-20	20	≤19	≥21
ECLNFM-25	25	≤24	≥26
ECLNFM-30	30	≤29	≥31
ECLNFM-35	35	≤34	≥36
ECLNFM-40	40	≤39	≥41
ECLNFM-45	45	≤43.5	≥46.5
ECLNFM-50	50	≤48.5	≥51.5
ECLNFM-60	60	≤58	≥62
ECLNFM-70	70	≤68	≥72
ECLNFM-75	75	≤73	≥77
ECLNFM-80	80	≤78	≥82
ECLNFM-90	90	≤88	≥92
ECLNFM-100	100	≤98	≥102
ECLNFM-125	125	≤123	≥127
ECLNFM-150	150	≤147	≥153
ECLNFM-175	175	≤172	≥178
ECLNFM-200	200	≤196	≥204
ECLNFM-250	250	≤245	≥255
ECLNFM-300	300	≤294	≥306
ECLNFM-400	400	≤392	≥408
ECLNFM-500	500	≤490	≥510

The output of the module will remain at state "0" for any transient input pulses shorter than suppress times and will change to state "1" for pulses longer than pass times. Input pulse width is measured at the −1.3V level.

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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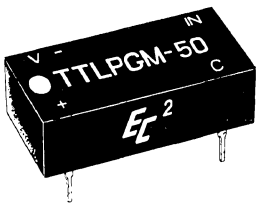
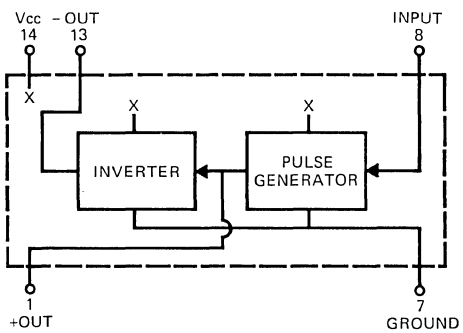


T²L COMPATIBLE Low Profile
PULSE GENERATOR MODULE (Schottky)

- T²L inputs and outputs
- Pulse widths stable and precise
- 14-pin DIP package
- Available in pulse widths from 5ns to 100ns
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 4 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)	Maximum Pulse Rate (in Mhz)
TTLPGM-5	5 ±1	98
TTLPGM-6	6 ±1	80
TTLPGM-7	7 ±1	70
TTLPGM-8	8 ±1	60
TTLPGM-9	9 ±1	54
TTLPGM-10	10 ±1	49
TTLPGM-15	15 ±1	32
TTLPGM-20	20 ±1	24
TTLPGM-25	25 ±1	19
TTLPGM-30	30 ±1	15
TTLPGM-35	35 ±1.5	13
TTLPGM-40	40 ±1.5	11
TTLPGM-45	45 ±1.5	10
TTLPGM-50	50 ±1.5	9
TTLPGM-60	60 ±1.5	8
TTLPGM-70	70 ±2	7
TTLPGM-75	75 ±2	6
TTLPGM-80	80 ±2	6
TTLPGM-90	90 ±3	5
TTLPGM-100	100 ±3	4

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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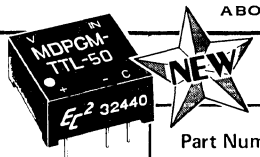
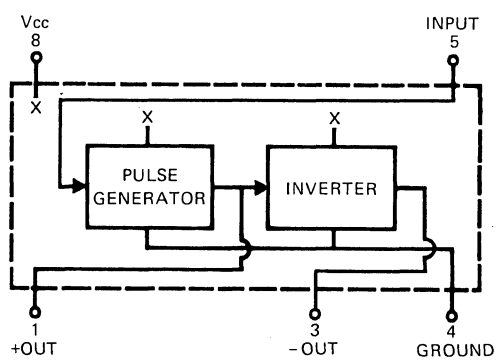


T²L COMPATIBLE "Mini DIP" Low Profile
PULSE GENERATOR MODULE (Schottky)

- T²L input and output
- Pulse widths stable and precise
- 8-pin DIP package
- Available in pulse widths from 5 to 500ns
- 8 Schottky T²L fan-out capacity
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 4 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)	Maximum Pulse Rate (in Mhz)
MDPGM-TTL-5	5 ±1	98
MDPGM-TTL-6	6 ±1	80
MDPGM-TTL-7	7 ±1	70
MDPGM-TTL-8	8 ±1	55
MDPGM-TTL-9	9 ±1	50
MDPGM-TTL-10	10 ±1	45
MDPGM-TTL-15	15 ±1	30
MDPGM-TTL-20	20 ±1	20
MDPGM-TTL-25	25 ±1	17
MDPGM-TTL-30	30 ±1	15
MDPGM-TTL-35	35 ±1.5	13
MDPGM-TTL-40	40 ±1.5	11
MDPGM-TTL-45	45 ±1.5	10
MDPGM-TTL-50	50 ±1.5	9
MDPGM-TTL-60	60 ±1.5	8
MDPGM-TTL-70	70 ±2	7
MDPGM-TTL-75	75 ±2	6
MDPGM-TTL-80	80 ±2	6
MDPGM-TTL-90	90 ±3	5
MDPGM-TTL-100	100 ±3	4
MDPGM-TTL-150	150 ±4	3
MDPGM-TTL-200	200 ±6	2
MDPGM-TTL-250	250 ±7	2
MDPGM-TTL-300	300 ±9	1.5
MDPGM-TTL-400	400 ±10	1.0
MDPGM-TTL-500	500 ±10	0.9

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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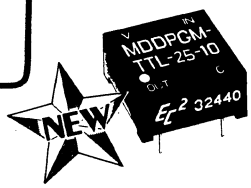
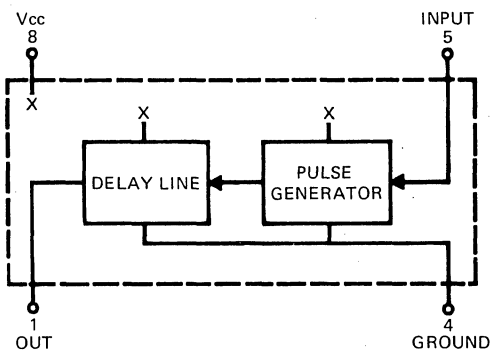


T²L COMPATIBLE "Mini DIP" Low Profile
DELAYED PULSE GENERATOR MODULE (Schottky)

- T²L input and output
- Pulse widths stable and precise
- 8-pin DIP package
- Available in pulse widths from 5 to 100ns
- 10 Schottky T²L fan-out capacity
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 4 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)
MDDPGM-TTL-___-5	5 ±1
MDDPGM-TTL-___-6	6 ±1
MDDPGM-TTL-___-7	7 ±1
MDDPGM-TTL-___-8	8 ±1
MDDPGM-TTL-___-9	9 ±1
MDDPGM-TTL-___-10	10 ±1
MDDPGM-TTL-___-15	15 ±1
MDDPGM-TTL-___-20	20 ±1
MDDPGM-TTL-___-25	25 ±1
MDDPGM-TTL-___-30	30 ±1
MDDPGM-TTL-___-35	35 ±1.5
MDDPGM-TTL-___-40	40 ±1.5
MDDPGM-TTL-___-45	45 ±1.5
MDDPGM-TTL-___-50	50 ±1.5
MDDPGM-TTL-___-60	60 ±1.5
MDDPGM-TTL-___-70	70 ±2
MDDPGM-TTL-___-75	75 ±2
MDDPGM-TTL-___-80	80 ±2
MDDPGM-TTL-___-90	90 ±3
MDDPGM-TTL-___-100	100 ±3

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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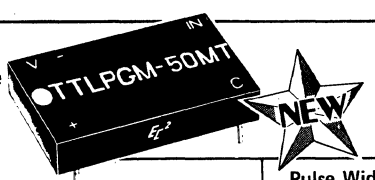
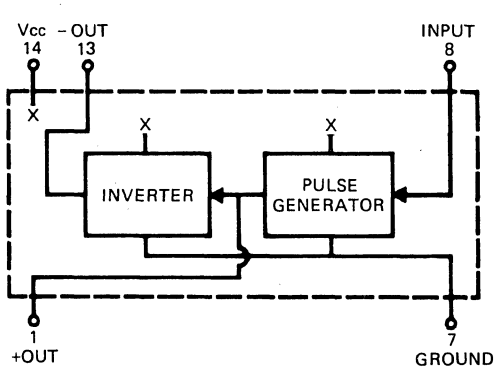


T²L COMPATIBLE "Thinny DIP" Super Low Profile
PULSE GENERATOR MODULE (Schottky)

- Full military temperature range
- T²L input and output
- Pulse widths stable and precise
- 14-pin DIP package
- Available in pulse widths from 5 to 100ns
- Dimensions: .500 wide X .800 long X .165 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 4 million hours
- Operating temperature range of −55° to +125°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)	Maximum Pulse Rate (in Mhz)
TTLPGM-5MT	5 ±1	98
TTLPGM-6MT	6 ±1	80
TTLPGM-7MT	7 ±1	70
TTLPGM-8MT	8 ±1	60
TTLPGM-9MT	9 ±1	54
TTLPGM-10MT	10 ±1	49
TTLPGM-15MT	15 ±1	32
TTLPGM-20MT	20 ±1	24
TTLPGM-25MT	25 ±1	19
TTLPGM-30MT	30 ±1	15
TTLPGM-35MT	35 ±1.5	13
TTLPGM-40MT	40 ±1.5	11
TTLPGM-45MT	45 ±1.5	10
TTLPGM-50MT	50 ±1.5	9
TTLPGM-60MT	60 ±1.5	8
TTLPGM-70MT	70 ±2	7
TTLPGM-75MT	75 ±2	6
TTLPGM-80MT	80 ±2	6
TTLPGM-90MT	90 ±3	5
TTLPGM-100MT	100 ±3	4

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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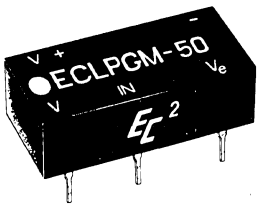
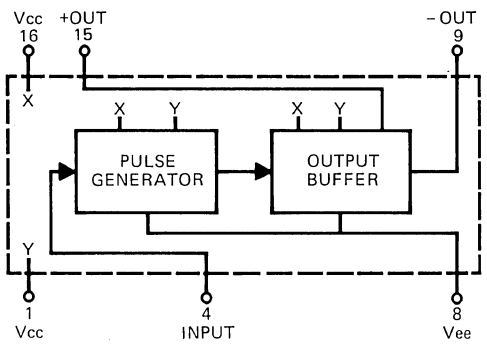


ECL 10K COMPATIBLE Low Profile

PULSE GENERATOR MODULE

- ECL input and outputs
- Pulse widths stable and precise
- 16-pin DIP package
- Available in pulse widths from 5ns to 100ns
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)	Maximum Pulse Rate (in Mhz)
ECLPGM-5	5 ±1	98
ECLPGM-6	6 ±1	80
ECLPGM-7	7 ±1	70
ECLPGM-8	8 ±1	60
ECLPGM-9	9 ±1	54
ECLPGM-10	10 ±1	49
ECLPGM-15	15 ±1	32
ECLPGM-20	20 ±1	24
ECLPGM-25	25 ±1	19
ECLPGM-30	30 ±1	15
ECLPGM-35	35 ±1.5	13
ECLPGM-40	40 ±1.5	11
ECLPGM-45	45 ±1.5	10
ECLPGM-50	50 ±1.5	9
ECLPGM-60	60 ±1.5	8
ECLPGM-70	70 ±2	7
ECLPGM-75	75 ±2	6
ECLPGM-80	80 ±2	6
ECLPGM-90	90 ±3	5
ECLPGM-100	100 ±3	4

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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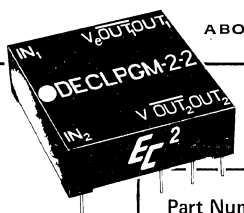
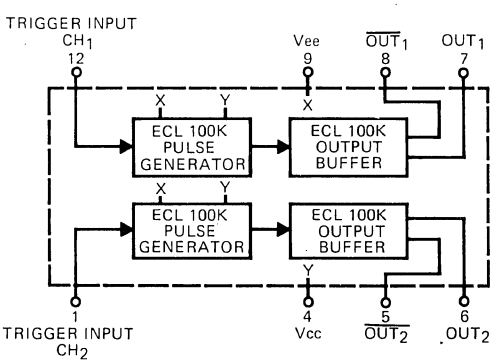


ECL 100K COMPATIBLE

DUAL PULSE GENERATOR MODULE

- ECL 100K input and output levels
- Dual units with separate trigger inputs and outputs
- Pulse widths stable and precise
- 12-pin DIP package
- Available in pulse widths from 2ns to 50ns
- 70 ECL DC fan-out capacity
- Dimensions: .700 wide X .875 long X .325 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1 million hours
- Operating temperature range of 0° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Pulse Width (in ns)	Maximum Pulse Rate (in Mhz)
DECLPGM-2-2	2 ±.2	200
DECLPGM-2-3	3 ±.3	133
DECLPGM-2-4	4 ±.4	100
DECLPGM-2-5	5 ±.5	80
DECLPGM-2-6	6 ±.6	66
DECLPGM-2-7	7 ±.7	57
DECLPGM-2-8	8 ±.8	50
DECLPGM-2-9	9 ±.9	44
DECLPGM-2-10	10 ±1	40
DECLPGM-2-12	12 ±1	33
DECLPGM-2-14	14 ±1	28
DECLPGM-2-16	16 ±1	25
DECLPGM-2-18	18 ±1	22
DECLPGM-2-20	20 ±1	20
DECLPGM-2-25	25 ±1	16
DECLPGM-2-30	30 ±1	13
DECLPGM-2-35	35 ±1	11
DECLPGM-2-40	40 ±1	10
DECLPGM-2-45	45 ±1	9
DECLPGM-2-50	50 ±1	8

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see pages 1•1434; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441; for Digital Frequency Multiplier Modules, see page 1•1442.

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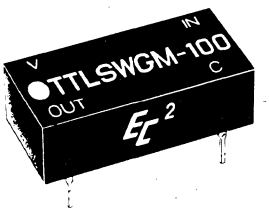
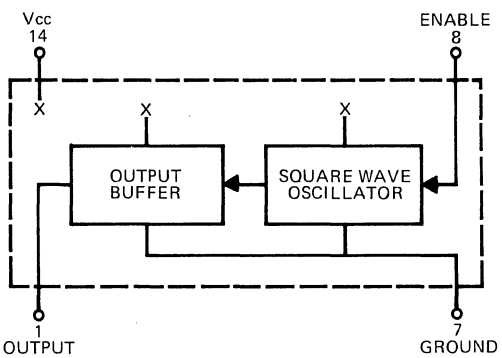


T²L COMPATIBLE Low Profile
SQUARE WAVE GENERATOR MODULE (Schottky)

- T²L input and output
- Output wavetrain can be started in sync with random events
- 14-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- Output frequencies controlled to within ±2%
- 10 T²L fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW

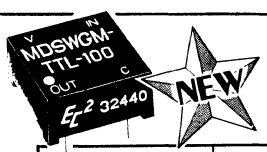


Part Number	Output Frequency	Part Number	Output Frequency
TTLSWGM-2	2 Mhz	TTLSWGM-35	35 Mhz
TTLSWGM-3	3 Mhz	TTLSWGM-40	40 Mhz
TTLSWGM-4	4 Mhz	TTLSWGM-45	45 Mhz
TTLSWGM-5	5 Mhz	TTLSWGM-50	50 Mhz
TTLSWGM-10	10 Mhz	TTLSWGM-60	60 Mhz
TTLSWGM-15	15 Mhz	TTLSWGM-70	70 Mhz
TTLSWGM-20	20 Mhz	TTLSWGM-80	80 Mhz
TTLSWGM-25	25 Mhz	TTLSWGM-90	90 Mhz
TTLSWGM-30	30 Mhz	TTLSWGM-100	100 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

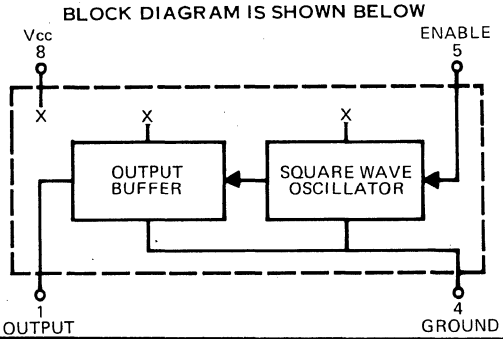
ABOVE DATA FROM CATALOG NO. C/030580

T²L COMPATIBLE "Mini DIP" Low Profile
SQUARE WAVE GENERATOR MODULE (Schottky)



- T²L input and output
- Output wavetrain can be started in sync with random events
- 8-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- Output frequencies controlled to within ±2%
- 10 Schottky T²L fan-out capacity
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Output Frequency	Part Number	Output Frequency
MDSWGM-TTL-2	2 Mhz	MDSWGM-TTL-13	13 Mhz
MDSWGM-TTL-2.5	2.5 Mhz	MDSWGM-TTL-14	14 Mhz
MDSWGM-TTL-3	3 Mhz	MDSWGM-TTL-15	15 Mhz
MDSWGM-TTL-3.5	3.5 Mhz	MDSWGM-TTL-20	20 Mhz
MDSWGM-TTL-4	4 Mhz	MDSWGM-TTL-25	25 Mhz
MDSWGM-TTL-4.5	4.5 Mhz	MDSWGM-TTL-30	30 Mhz
MDSWGM-TTL-5	5 Mhz	MDSWGM-TTL-35	35 Mhz
MDSWGM-TTL-5.5	5.5 Mhz	MDSWGM-TTL-40	40 Mhz
MDSWGM-TTL-6	6 Mhz	MDSWGM-TTL-45	45 Mhz
MDSWGM-TTL-7	7 Mhz	MDSWGM-TTL-50	50 Mhz
MDSWGM-TTL-8	8 Mhz	MDSWGM-TTL-60	60 Mhz
MDSWGM-TTL-9	9 Mhz	MDSWGM-TTL-70	70 Mhz
MDSWGM-TTL-10	10 Mhz	MDSWGM-TTL-80	80 Mhz
MDSWGM-TTL-11	11 Mhz	MDSWGM-TTL-90	90 Mhz
MDSWGM-TTL-12	12 Mhz	MDSWGM-TTL-100	100 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

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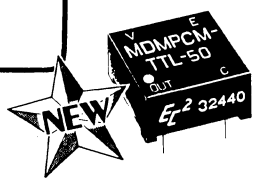
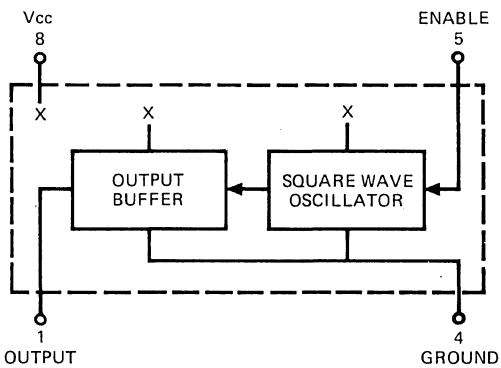


T²L COMPATIBLE "Mini DIP" Low Profile

MICRO PROCESSOR CLOCK MODULE (Schottky)

- T²L input and output (NMOS compatible)
- Output wavetrain can be delayed by enable (wait) line
- 8-pin DIP package
- Available in frequencies from 2 Mhz to 50 Mhz
- Output frequencies controlled to within ±2%
- 10 Schottky T²L fan-out capacity
- Dimensions: .400 wide X .500 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



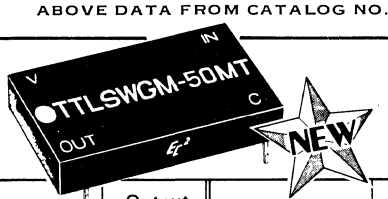
Part Number	Output Frequency	Part Number	Output Frequency
MDMPCM-TTL-2	2 Mhz	MDMPCM-TTL-11	11 Mhz
MDMPCM-TTL-2.5	2.5 Mhz	MDMPCM-TTL-12	12 Mhz
MDMPCM-TTL-3	3 Mhz	MDMPCM-TTL-13	13 Mhz
MDMPCM-TTL-3.5	3.5 Mhz	MDMPCM-TTL-14	14 Mhz
MDMPCM-TTL-4	4 Mhz	MDMPCM-TTL-15	15 Mhz
MDMPCM-TTL-4.5	4.5 Mhz	MDMPCM-TTL-20	20 Mhz
MDMPCM-TTL-5	5 Mhz	MDMPCM-TTL-25	25 Mhz
MDMPCM-TTL-5.5	5.5 Mhz	MDMPCM-TTL-30	30 Mhz
MDMPCM-TTL-6	6 Mhz	MDMPCM-TTL-35	35 Mhz
MDMPCM-TTL-7	7 Mhz	MDMPCM-TTL-40	40 Mhz
MDMPCM-TTL-8	8 Mhz	MDMPCM-TTL-45	45 Mhz
MDMPCM-TTL-9	9 Mhz	MDMPCM-TTL-50	50 Mhz
MDMPCM-TTL-10	10 Mhz		

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/021582

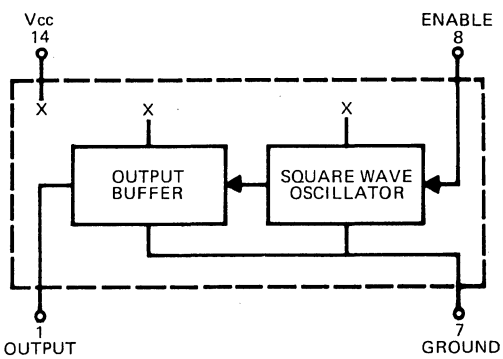
T²L COMPATIBLE "Thinny DIP" Super Low Profile

SQUARE WAVE GENERATOR MODULE (Schottky)



- Full military temperature range
- T²L input and output
- Output wavetrain can be started in sync with random events
- 14-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- Output frequencies controlled to within ±2%
- 10 T²L fan-out capacity
- Dimensions: .500 wide X .800 long X .165 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 3 million hours
- Operating temperature range of −55° to +125°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Output Frequency	Part Number	Output Frequency
TTLSWGM-2MT	2 Mhz	TTLSWGM-13MT	13 Mhz
TTLSWGM-2.5MT	2.5 Mhz	TTLSWGM-14MT	14 Mhz
TTLSWGM-3MT	3 Mhz	TTLSWGM-15MT	15 Mhz
TTLSWGM-3.5MT	3.5 Mhz	TTLSWGM-20MT	20 Mhz
TTLSWGM-4MT	4 Mhz	TTLSWGM-25MT	25 Mhz
TTLSWGM-4.5MT	4.5 Mhz	TTLSWGM-30MT	30 Mhz
TTLSWGM-5MT	5 Mhz	TTLSWGM-35MT	35 Mhz
TTLSWGM-5.5MT	5.5 Mhz	TTLSWGM-40MT	40 Mhz
TTLSWGM-6MT	6 Mhz	TTLSWGM-45MT	45 Mhz
TTLSWGM-7MT	7 Mhz	TTLSWGM-50MT	50 Mhz
TTLSWGM-8MT	8 Mhz	TTLSWGM-60MT	60 Mhz
TTLSWGM-9MT	9 Mhz	TTLSWGM-70MT	70 Mhz
TTLSWGM-10MT	10 Mhz	TTLSWGM-80MT	80 Mhz
TTLSWGM-11MT	11 Mhz	TTLSWGM-90MT	90 Mhz
TTLSWGM-12MT	12 Mhz	TTLSWGM-100MT	100Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

ABOVE DATA FROM CATALOG NO. C/101680

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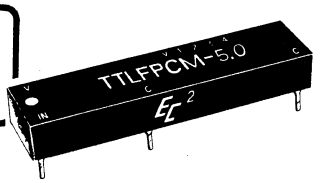
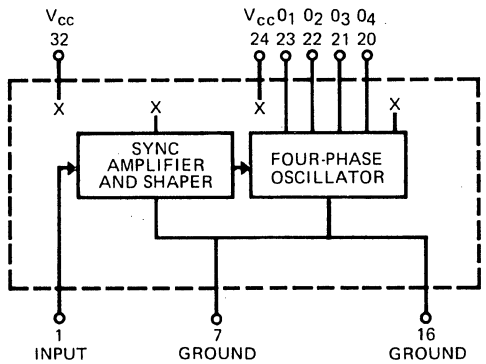


T²L COMPATIBLE Low Profile

FOUR-PHASE CLOCK MODULE (Schottky)

- T²L input and outputs
- Output wavetrain synchronized with input square wave
- 32-pin DIP package
- Available in frequencies from 200 Khz to 12 Mhz
- 10 T²L fan-out capacity per phase
- Dimensions: .400 wide X 1.650 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Operating Frequency	Part Number	Operating Frequency
TTLFPCM-0.2	200 Khz	TTLFPCM-3.0	3.0 Mhz
TTLFPCM-0.3	300 Khz	TTLFPCM-3.5	3.5 Mhz
TTLFPCM-0.4	400 Khz	TTLFPCM-4.0	4.0 Mhz
TTLFPCM-0.5	500 Khz	TTLFPCM-4.5	4.5 Mhz
TTLFPCM-0.6	600 Khz	TTLFPCM-5.0	5.0 Mhz
TTLFPCM-0.7	700 Khz	TTLFPCM-6.0	6.0 Mhz
TTLFPCM-0.8	800 Khz	TTLFPCM-7.0	7.0 Mhz
TTLFPCM-0.9	900 Khz	TTLFPCM-8.0	8.0 Mhz
TTLFPCM-1.0	1.0 Mhz	TTLFPCM-9.0	9.0 Mhz
TTLFPCM-1.5	1.5 Mhz	TTLFPCM-10.0	10.0 Mhz
TTLFPCM-2.0	2.0 Mhz	TTLFPCM-11.0	11.0 Mhz
TTLFPCM-2.5	2.5 Mhz	TTLFPCM-12.0	12.0 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

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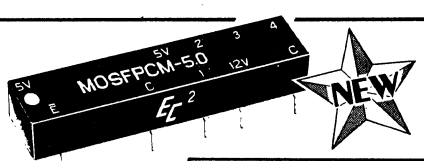
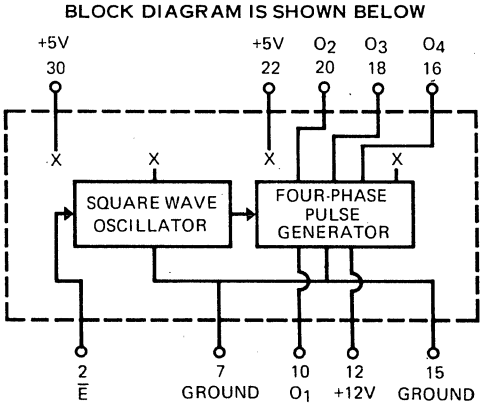
MOS COMPATIBLE Low Profile

FOUR-PHASE CLOCK MODULE



- T²L input and 12V MOS output
- 20% time slots result in non-overlapping phases
- 30-pin DIP package
- Available in frequencies from 500 Khz to 15 Mhz
- Dimensions: .400 wide X .1.600 long X .300 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 750,000 hours
- Operating temperature range of 0° to +70°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Operating Frequency	Part Number	Operating Frequency
MOSFPCM-0.5	500 Khz	MOSFPCM-4.5	4.5 Mhz
MOSFPCM-0.6	600 Khz	MOSFPCM-5.0	5.0 Mhz
MOSFPCM-0.7	700 Khz	MOSFPCM-6.0	6.0 Mhz
MOSFPCM-0.8	800 Khz	MOSFPCM-7.0	7.0 Mhz
MOSFPCM-0.9	900 Khz	MOSFPCM-8.0	8.0 Mhz
MOSFPCM-1.0	1.0 Mhz	MOSFPCM-9.0	9.0 Mhz
MOSFPCM-1.5	1.5 Mhz	MOSFPCM-10.0	10.0 Mhz
MOSFPCM-2.0	2.0 Mhz	MOSFPCM-11.0	11.0 Mhz
MOSFPCM-2.5	2.5 Mhz	MOSFPCM-12.0	12.0 Mhz
MOSFPCM-3.0	3.0 Mhz	MOSFPCM-13.0	13.0 Mhz
MOSFPCM-3.5	3.5 Mhz	MOSFPCM-14.0	14.0 Mhz
MOSFPCM-4.0	4.0 Mhz	MOSFPCM-15.0	15.0 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

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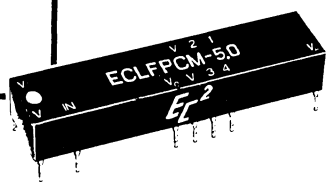

ECL 10K COMPATIBLE Low Profile

FOUR-PHASE CLOCK MODULE

- ECL input and outputs
- Output wavetrain synchronized with input square wave
- 32-pin DIP package
- Available in frequencies from 200 Khz to 20 Mhz
- 70 ECL DC fan-out capacity per phase
- Dimensions: .400 wide X 1.600 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of −30° to +85°C

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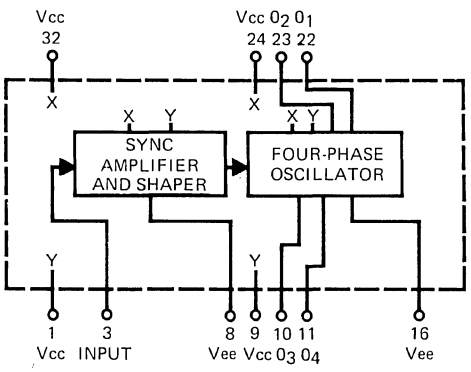

Part Number	Operating Frequency	Part Number	Operating Frequency
ECLFPCM-0.2	200 Khz	ECLFPCM-4.0	4.0 Mhz
ECLFPCM-0.3	300 Khz	ECLFPCM-4.5	4.5 Mhz
ECLFPCM-0.4	400 Khz	ECLFPCM-5.0	5.0 Mhz
ECLFPCM-0.5	500 Khz	ECLFPCM-6.0	6.0 Mhz
ECLFPCM-0.6	600 Khz	ECLFPCM-7.0	7.0 Mhz
ECLFPCM-0.7	700 Khz	ECLFPCM-8.0	8.0 Mhz
ECLFPCM-0.8	800 Khz	ECLFPCM-9.0	9.0 Mhz
ECLFPCM-0.9	900 Khz	ECLFPCM-10.0	10.0 Mhz
ECLFPCM-1.0	1.0 Mhz	ECLFPCM-12.0	12.0 Mhz
ECLFPCM-1.5	1.5 Mhz	ECLFPCM-14.0	14.0 Mhz
ECLFPCM-2.0	2.0 Mhz	ECLFPCM-16.0	16.0 Mhz
ECLFPCM-2.5	2.5 Mhz	ECLFPCM-18.0	18.0 Mhz
ECLFPCM-3.0	3.0 Mhz	ECLFPCM-20.0	20.0 Mhz
ECLFPCM-3.5	3.5 Mhz		

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

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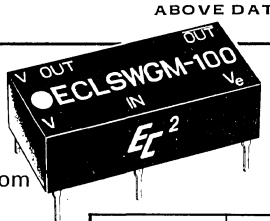
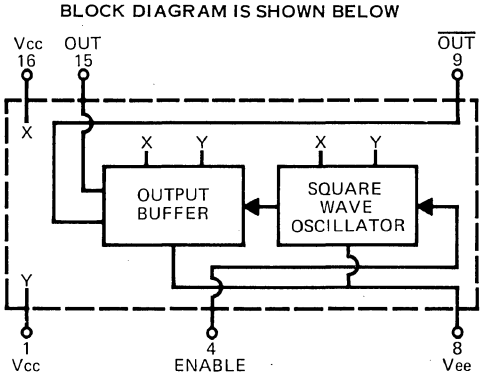


ECL 10K COMPATIBLE Low Profile

SQUARE WAVE GENERATOR MODULE

- ECL input and output
- Output wavetrain can be started in sync with random events
- 16-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- Output frequencies controlled to within ±2%
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1.5 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Output Frequency	Part Number	Output Frequency
ECLSWGM-2	2 Mhz	ECLSWGM-15	15 Mhz
ECLSWGM-3	3 Mhz	ECLSWGM-20	20 Mhz
ECLSWGM-4	4 Mhz	ECLSWGM-25	25 Mhz
ECLSWGM-5	5 Mhz	ECLSWGM-30	30 Mhz
ECLSWGM-6	6 Mhz	ECLSWGM-35	35 Mhz
ECLSWGM-7	7 Mhz	ECLSWGM-40	40 Mhz
ECLSWGM-8	8 Mhz	ECLSWGM-45	45 Mhz
ECLSWGM-9	9 Mhz	ECLSWGM-50	50 Mhz
ECLSWGM-10	10 Mhz	ECLSWGM-60	60 Mhz
ECLSWGM-11	11 Mhz	ECLSWGM-70	70 Mhz
ECLSWGM-12	12 Mhz	ECLSWGM-80	80 Mhz
ECLSWGM-13	13 Mhz	ECLSWGM-90	90 Mhz
ECLSWGM-14	14 Mhz	ECLSWGM-100	100 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Digital Frequency Multiplier Modules, see page 1•1442.

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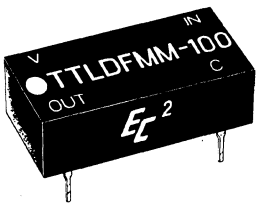
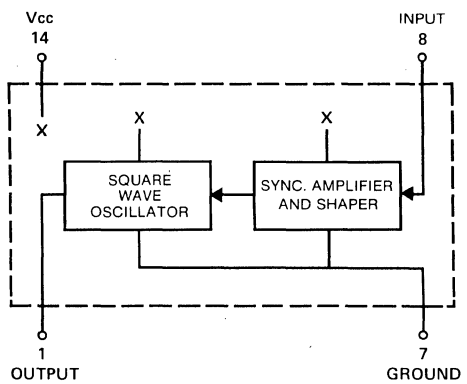


T²L COMPATIBLE Low Profile

DIGITAL FREQUENCY MULTIPLIER MODULE (Schottky)

- T²L input and output
- Output wavetrain synchronized with input square wave
- 14-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- 10 T²L fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned in to Level B of MIL-STD-883
- MTBF in excess of 2 million hours
- Operating temperature range of 0° to +70°C

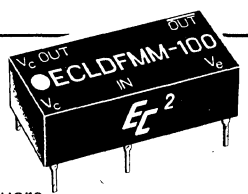
BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Output Frequency	Part Number	Output Frequency
TTLDFMM-2	2 Mhz	TTLDFMM-15	15 Mhz
TTLDFMM-3	3 Mhz	TTLDFMM-20	20 Mhz
TTLDFMM-4	4 Mhz	TTLDFMM-25	25 Mhz
TTLDFMM-5	5 Mhz	TTLDFMM-30	30 Mhz
TTLDFMM-6	6 Mhz	TTLDFMM-35	35 Mhz
TTLDFMM-7	7 Mhz	TTLDFMM-40	40 Mhz
TTLDFMM-8	8 Mhz	TTLDFMM-45	45 Mhz
TTLDFMM-9	9 Mhz	TTLDFMM-50	50 Mhz
TTLDFMM-10	10 Mhz	TTLDFMM-60	60 Mhz
TTLDFMM-11	11 Mhz	TTLDFMM-70	70 Mhz
TTLDFMM-12	12 Mhz	TTLDFMM-80	80 Mhz
TTLDFMM-13	13 Mhz	TTLDFMM-90	90 Mhz
TTLDFMM-14	14 Mhz	TTLDFMM-100	100 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441.

ABOVE DATA FROM CATALOG NO. C/031980

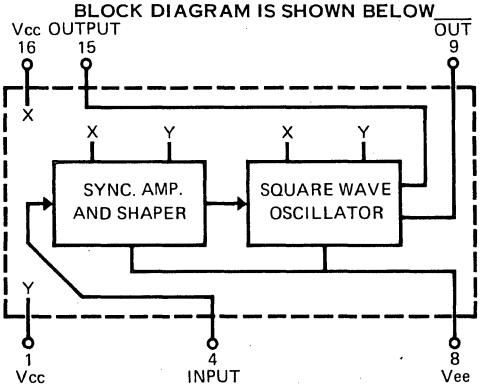


ECL 10K COMPATIBLE Low Profile

DIGITAL FREQUENCY MULTIPLIER MODULE

- ECL input and output
- Output wavetrain synchronized with input square wave
- 16-pin DIP package
- Available in frequencies from 2 Mhz to 100 Mhz
- 70 ECL DC fan-out capacity
- Dimensions: .400 wide X .800 long X .250 high
- ICs burned-in to Level B of MIL-STD-883
- MTBF in excess of 1 million hours
- Operating temperature range of −30° to +85°C

BLOCK DIAGRAM IS SHOWN BELOW



Part Number	Output Frequency	Part Number	Output Frequency
ECLDFMM-2	2 Mhz	ECLDFMM-15	15 Mhz
ECLDFMM-3	3 Mhz	ECLDFMM-20	20 Mhz
ECLDFMM-4	4 Mhz	ECLDFMM-25	25 Mhz
ECLDFMM-5	5 Mhz	ECLDFMM-30	30 Mhz
ECLDFMM-6	6 Mhz	ECLDFMM-35	35 Mhz
ECLDFMM-7	7 Mhz	ECLDFMM-40	40 Mhz
ECLDFMM-8	8 Mhz	ECLDFMM-45	45 Mhz
ECLDFMM-9	9 Mhz	ECLDFMM-50	50 Mhz
ECLDFMM-10	10 Mhz	ECLDFMM-60	60 Mhz
ECLDFMM-11	11 Mhz	ECLDFMM-70	70 Mhz
ECLDFMM-12	12 Mhz	ECLDFMM-80	80 Mhz
ECLDFMM-13	13 Mhz	ECLDFMM-90	90 Mhz
ECLDFMM-14	14 Mhz	ECLDFMM-100	100 Mhz

Note: For other active digital modules, i.e., Logic Delay Lines, see pages 1•1419 through 1•1433; for Noise Filter Modules, see page 1•1434; for Pulse Generator Modules, see pages 1•1435 through 1•1437; for Square Wave Generator Modules and Digital Clocks, see pages 1•1438 through 1•1441.

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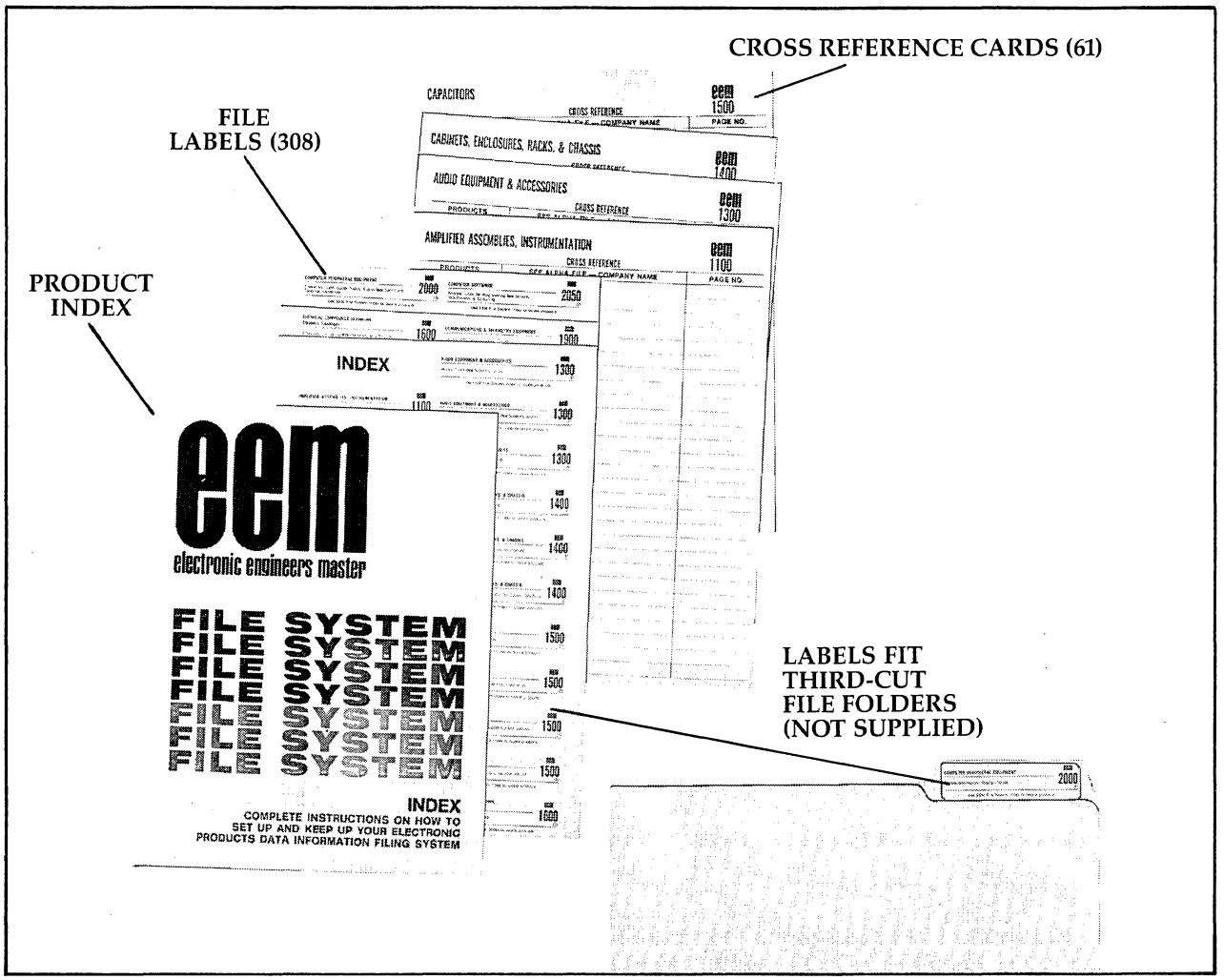

WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

ESC ELECTRONICS CORPORATION
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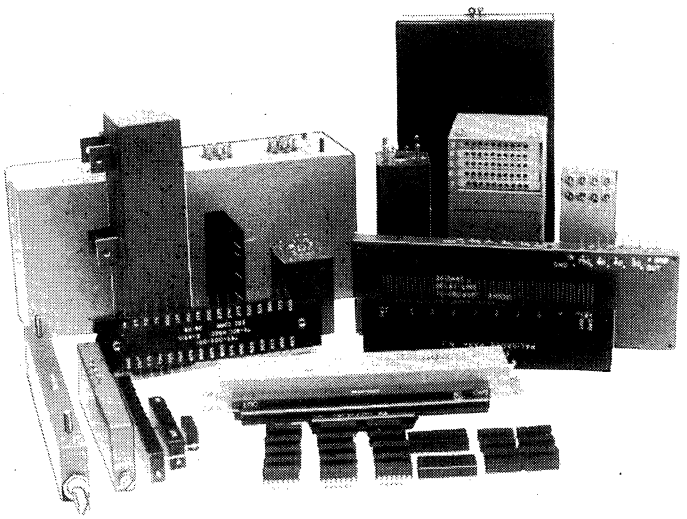
PHONE: (201) 947-0400 ● TWX 710-991-9780
TOLL FREE
800-631-0853
(except N.J.)

DELAY LINES

OVER 30 YEARS OF SUPERIOR QUALITY AND RELIABILITY!

30 years of experience and expertise in delay line design and manufacture. The following pages list a large sampling of the industry's current demand for short delay lines both analog and digital types, but ESC is still the most chosen source for delay lines ranging up to several hundred milliseconds and with delay-to-rise time ratios up to 250:1. In addition to lumped constant types, also manufactured are distributed constant, voltage variables and mechanically variable devices.



ESC ALSO DESIGNS AND MANUFACTURES TYPICALLY:

Equalized, Precision tapped, low distortion, beam forming delay lines for sonars, scanners, transponders, sorters, Tacan and DME, etc.

Programmable and mechanically variable Delay lines for the TV Broadcast industry, including video cable simulators and voltage variable Delay Lines.

Proven design, manufacturing capabilities, and facilities encompassing all quality levels dictated by MIL-I-45208 and MIL-Q-9858A.

HIGH RELIABILITY:

The proven design and manufacturing techniques are employed by ESC for all levels of reliability required for the military, satellite or space probes and encompass quality levels dictated by MIL-I-45208 & MIL-Q-9858A as applicable.

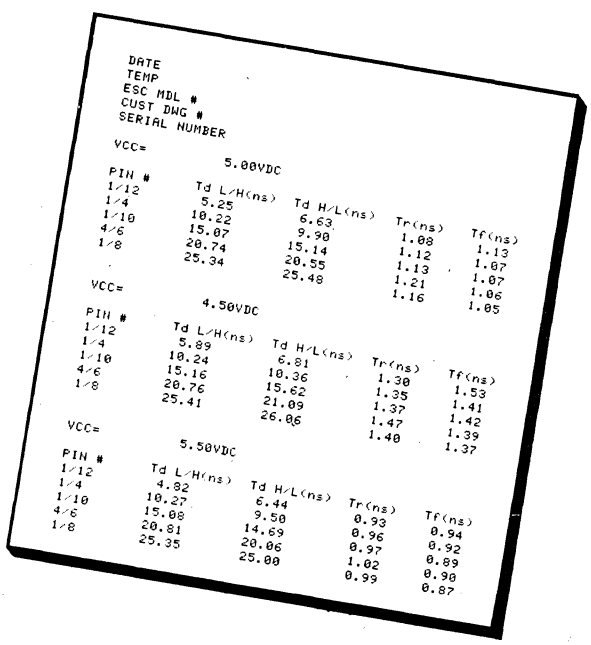
ESC has participated in many hi-rel programs over the years starting with Appolo, Minuteman and the Viking Probe and currently in such programs as Trident, F15,F16,B-1, Space Shuttle and Peacekeeper.

ESC maintains an extensive continuous program of life testing on the new generation of military TTL compatible hybrid delay lines. This program has accumulated in excess of 12.8 million unit hours of test,yielding a failure rate of .0234%/per 1000 hrs.

ESC has expanded its testing capabilities for the new generation of TTL,DTL & ECL Compatible hybrid delay lines. Testing is accomplished by computer controlled, state-of-the-art equipment, which is capable of recording leading and trailing edge delay time, rise and fall time, all within seconds. In addition and at comparable speeds, the hybrid delay line DC parameters such as Icc,Vi,Vol,Voh,Ii,Iil and Iin are swiftly measured and recorded if necessary.

The highly accurate and high speed testing system allows all parameters to be tested on a 100% basis guaranteeing the highest quality product to our customers.

At the side is a sample computer read-out exhibiting the leading and trailing delay and rise and fall times at three operating levels for a TTL hybrid delay line.



DATE
TEMP
ESC MDL #
CUST DWG #
SERIAL NUMBER

VCC= 5.00VDC

PIN #	Td L/H(ns)	Td H/L(ns)	Tr(ns)	Tf(ns)
1/12	5.25	6.63	1.08	1.13
1/4	10.22	9.90	1.12	1.07
1/10	15.07	15.14	1.13	1.07
4/6	20.74	20.55	1.21	1.06
1/8	25.34	25.48	1.16	1.05

VCC= 4.50VDC

PIN #	Td L/H(ns)	Td H/L(ns)	Tr(ns)	Tf(ns)
1/12	5.89	6.81	1.30	1.53
1/4	10.24	10.36	1.35	1.41
1/10	15.16	15.62	1.37	1.42
4/6	20.76	21.09	1.47	1.39
1/8	25.41	26.06	1.40	1.37

VCC= 5.50VDC

PIN #	Td L/H(ns)	Td H/L(ns)	Tr(ns)	Tf(ns)
1/12	4.82	6.44	0.93	0.94
1/4	10.27	9.50	0.96	0.92
1/10	15.08	14.69	0.97	0.89
4/6	20.81	20.06	1.02	0.90
1/8	25.35	25.00	0.99	0.87

Write or call for catalog!

DELAY LINES

DELAY LINES

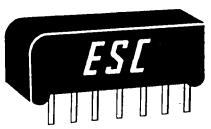
SERIES SIL-7
SINGLE-IN-LINE
5 TAPS

SPECIFICATIONS:

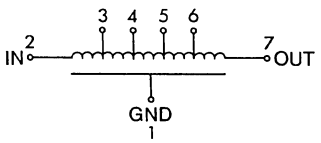
- Output Time Delay Tolerance:
  ± 5% for 20ns and above
  ± 10% for 10ns and below
- Distortion:
  ± 10% at output
- Attenuation:
  0.5 db max
- Temperature Coefficient:
  100 ppm/°C
- Operating Temperature Range:
  -55°C to + 125°C
- Dielectric Strength:
  50 VDC
- Conforms to applicable portions of MIL-D-23859
- Size: .800 lg X .200 w X .250 h

Time Delay (ns)	Rise Time max (ns)	No. of Taps	Delay/ Tap	MODEL NO.	
				50 ohms ± 10%	100 ohms ± 10%
1	1.5	none	—	SLA-1	SLB-1
2	1.5	none	—	SLA-2	SLB-2
3	1.5	none	—	SLA-3	SLB-3
4	2.0	none	—	SLA-4	SLB-4
5	2.0	5	1 ± .3	SLA-5	SLB-5
10	3.0	5	2 ± .4	SLA-10	SLB-10
20	6.0	5	4 ± .5	SLA-20	SLB-20
30	9.0	5	6 ± 1.0	SLA-30	SLB-30
40	12.0	5	8 ± 1.0	SLA-40	SLB-40
50	15.0	5	10 ± 1.0	SLA-50	SLB-50

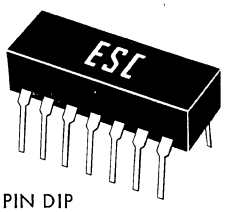
Consult Factory for Longer Delay Times



7 PIN



SERIES DIP-14
5 TAPS

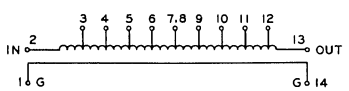


14 PIN DIP

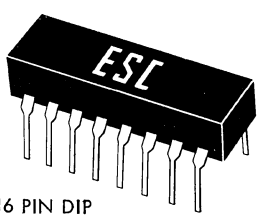
SPECIFICATIONS:

- Operating Temperature:
  - 55°C to + 125°C
- Temperature Coefficient:
  100ppm/°C max
- Attenuation: 1 db max
- Distortion: 10% max
- Dielectric Strength: 50 VDC
- Conforms to applicable portions of MIL-D-23859
- Size: .785 lg X .320 w X .300 h.

IMPEDANCE ± 10% →				50	75	100	200
Time Delay (nsec)± 5%	Rise Time (nsec)	No. of Taps	Delay per Tap (nsec) non-cumulative	MODEL NO.			
10 ± 1 ns	1.7	10	1.0 ± .5	5P10	7P10	1P10	—
20	3.3	10	2.0 ± .5	5P20	7P20	1P20	2P20
30	5.0	10	3.0 ± 1	5P30	7P30	1P30	2P30
40	6.5	10	4.0 ± 1	5P40	7P40	1P40	2P40
50	8.0	10	5.0 ± 1	5P50	7P50	1P50	2P50
100	16	10	10 ± 1.5	5P100	7P100	1P100	2P100
150	25	10	15 ± 1.5	—	—	1P150	2P150
200	35	10	20 ± 2	—	—	1P200	2P200



SERIES DIP-16
EXTENDED DELAY
10 TAPS

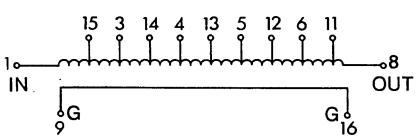


16 PIN DIP

Impedance ± 10% (ohms) →				100	200	300	500
Time Delay (ns) ± 5%	Rise Time (ns) max	No. of Taps	Delay per Tap (ns) ± 2 ns or 5% (whichever is greater)	MODEL NO.			
250	45	10	25	1N25	2N25	3N25	5N25
300	55	10	30	1N30	2N30	3N30	5N30
350	65	10	35	1N35	2N35	3N35	5N35
400	70	10	40	1N40	2N40	3N40	5N40
450	80	10	45	1N45	2N45	3N45	5N45
500	90	10	50	1N50	2N50	3N50	5N50
600	110	10	60	1N60	2N60	3N60	—
800	145	10	80	1N80	2N80	—	—
1000	180	10	100	1N100	2N100	—	—

SPECIFICATIONS:

- Operating Temperature Range: -55°C to + 125°C
- Temperature Coefficient: 100 ppm/°C
- Attenuation: 1 db max
- Distortion (at max. delay): ± 10% max
- Dielectric Strength: 25 VDC
- Size: .89 lg X .320 w X .280 h.
- Conforms to applicable portions of MIL-D-23859



Looking for LC Filters? See our page in Section 2700

ESC ELECTRONICS CORPORATION

ESC ELECTRONICS CORPORATION
534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE: (201) 947-0400 ● TWX 710-991-9780
TOLL FREE 800-631-0853 (except N.J.)

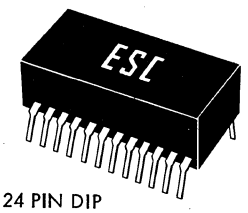
SERIES DIP-24

TO 2000 NSEC 20 TAPS

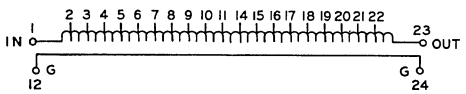
SPECIFICATIONS:

- Operating Temperature: -55°C to + 125°C
- Temperature Coefficient: 100ppm/°C
- Attenuation: 1 db max
- Distortion: 10% max
- Dielectric Strength: 50 VDC
- Size: 1.3 lg X .580 w X .300 h.

IMPEDANCE 10% (OHMS) →				100	200
Time Delay ±5%(ns)	Rise Time (ns)Max	No. of Taps	Delay per Tap	MODEL NO.	
500	42	20	25	124-5	224-5
600	50	20	30	124-6	224-6
800	67	20	40	124-8	224-8
1000	84	20	50	124-10	224-10
1200	110	20	60	124-12	224-12
1500	125	20	75	124-15	224-15
2000	170	20	100	—	224-20

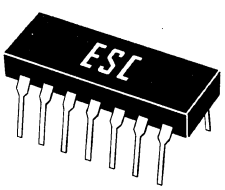


24 PIN DIP



SERIES MIL-23

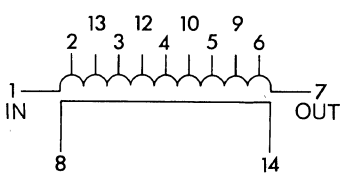
LOW PROFILE TO MIL-D-23859/23



14 PIN DIP

SPECIFICATIONS:

- Total Time Delay Tolerance: ± 2 ns Below 40 ns Delay; ± 5% Above 40 ns Delay
- No. of Taps: 10
- Temperature Coefficient: 100 ppm/°C max.
- Operating Temp. Range: - 55°C to + 125°C
- Distortion at max delay: ± 10% max.
- Attenuation: 10% max.
- Dielectric Strength: 50 VDC
- Environmental Conditions: per MIL-D-23859/23
- Size: 14 Pin, .750L X .300W X .187H



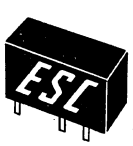
Total Td ns	Rise Time max(ns)	IMPEDANCE ± 10% 50Ω	100Ω	200Ω
10	3	A002	B102	-
15	4	A003	B103	-
20	5.5	A004	B104	-
25	6	A005	B105	-
30	6.5	A006	B106	-
35	7	A007	B107	-
40	8	A008	B108	C208
45	9	A009	B109	C209
50	10	A010	B110	C210
60	12	A012	B112	C212
80	16	A016	B116	C216
100	20	A020	B120	C220
120	24	A022	B122	C222
140	28	A024	B124	C224
150	30	A025	B125	C225
160	32	A026	B126	-
180	36	A028	B128	-
200	40	A030	B130	-
220	45	-	B132	-
240	50	-	B134	-
250	50	-	B135	-
260	55	-	B136	-
280	60	-	B138	-
300	60	-	B140	-
330	70	-	B143	-

SERIES ST

MINIATURE SINGLES

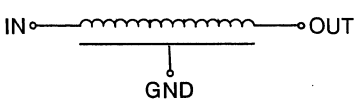
Miniature trimming delay lines in increments of 0.5 ns for your fine "tweeking."

Td (ns)	Impedance ± 10% 50 Ω	100 Ω
1.0	SAT-10	SBT-10
1.5	SAT-15	SBT-15
2.0	SAT-20	SBT-20
2.5	SAT-25	SBT-25
3.0	SAT-30	SBT-30
3.5	SAT-35	SBT-35
4.0	SAT-40	SBT-40
4.5	SAT-45	SBT-45
5.0	SAT-50	SBT-50



SPECIFICATIONS:

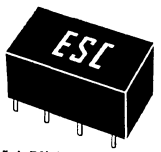
- Delay tolerance: ± .25 ns
- Operating Temp: -55°C to + 125°C
- Attenuation: 0.25db max
- Dielectric Strength: 50VDC
- Temp. coefficient: 100ppm/°C
- Conforms to applicable portion of MIL-D-23859
- Band width 200 Mhz (-3db)
- Size: .56L X .20W X .25H



DELAY LINES

DELAY LINES

DIGITAL DELAY LINES

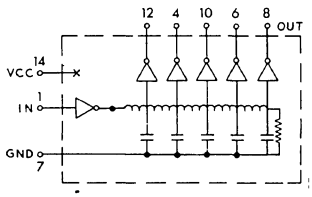


14 PIN

SERIES 14T
DIGITAL TTL/DTL 5 TAPS

TTL, DTL

Model No.	Delay (ns)	Delay/ Tap (ns)
14T25	25	5
14T30	30	6
14T35	35	7
14T40	40	8
14T45	45	9
14T50	50	10
14T75	75	15
14T100	100	20
14T150	150	30
14T200	200	40
14T250	250	50
14T300	300	60
14T500	500	100



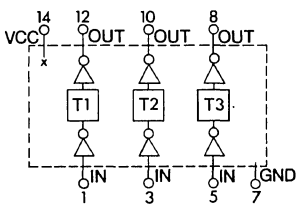
LOW POWER SCHOTTKY

Model No.	Delay (ns)	Delay Tap (ns)
14LT50	50	10
14LT75	75	15
14LT100	100	20
14LT150	150	30
14LT200	200	40
14LT250	250	50
14LT300	300	60
14LT500	500	100

SERIES 14LT
LOW POWER SCHOTTKY 5 TAPS

SERIES 14P
DIGITAL TTL/DTL TRIPLETS

Model No.	Delay per line (ns)
14P5	5
14P10	10
14P15	15
14P20	20
14P25	25
14P50	50
14P75	75
14P100	100

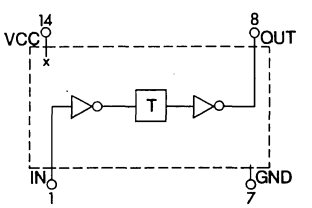


Model No.	Delay (ns)
14LP10	10
14LP15	15
14LP20	20
14LP25	25
14LP50	50
14LP75	75
14LP100	100

SERIES 14LP
LOW POWER SCHOTTKY TRIPLETS

SERIES 14G
DIGITAL TTL/DTL SINGLE OUTPUT

Model No.	Delay (ns)
14G5	5
14G10	10
14G20	20
14G25	25
14G50	50
14G75	75
14G100	100
14G150	150
14G200	200
14G500	500



Model No.	Delay (ns)
14LG10	10
14LG20	20
14LG25	25
14LG50	50
14LG75	75
14LG100	100
14LG150	150
14LG200	200
14LG300	300

SERIES 14LG
LOW POWER SCHOTTKY SINGLE OUTPUT

SPECIFICATIONS:		
	TTL Series	14L Series
Supply Voltage	5V ± 5%	5V ± 5%
Supply Current	70 Ma Max	25 Ma Max
Rise & Fall Time	4 ns Max	6 ns Max
Operating Temp.	0 to 70°C	0 to 70°C
Size	.8 X .4 X .3	.8 X .4 X .3

Delay tolerance: ± 5% or 2 ns whichever is greater

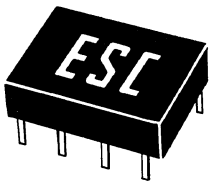
ESC can also supply these devices with ceramic IC's that have been screened to MIL-STD-883 for -55°C to + 125°C operation. Case size will be .8L X .4W X .36H. When ordering add Letter "C" after fourth digit in part number.
Example: 14LP10 convert to 14LPC10.
14T100 convert to 14TC100

Looking for LC Filters? See our page in Section 2700

ESC ELECTRONICS CORPORATION

ESC ELECTRONICS CORPORATION
534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE: (201) 947-0400 ● TWX 710-991-9780
TOLL FREE 800-631-0853 (except N.J.)

LOW PROFILE DIGITAL DELAY LINES

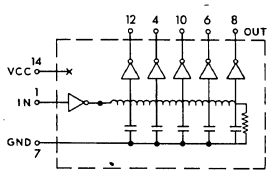


14 PIN

SERIES 9T
TTL/DTL COMPATIBLE 5 TAPS

TTL

Model No.	Delay (ns)	Delay/ Tap (ns)
9T25	25	5
9T30	30	6
9T35	35	7
9T40	40	8
9T45	45	9
9T50	50	10
9T75	75	15
9T100	100	20
9T150	150	30
9T200	200	40



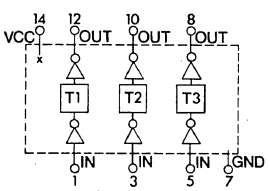
SERIES 9LT
LOW POWER SCHOTTKY 5 TAPS

LOW POWER SCHOTTKY

Model No.	Delay (ns)	Delay/ Tap (ns)
9LT50	50	10
9LT75	75	15
9LT100	100	20
9LT150	150	30
9LT200	200	40

SERIES 9P
TTL/DTL COMPATIBLE TRIPLETS

Model No.	Delay per line (ns)
9P5	5
9P10	10
9P15	15
9P20	20
9P25	25
9P50	50

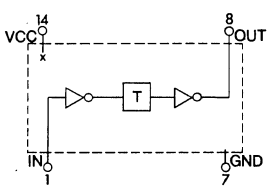


SERIES 9LP
LOW POWER SCHOTTKY TRIPLETS

Model No.	Delay per line (ns)
9LP10	10
9LP15	15
9LP20	20
9LP25	25
9LP50	50

SERIES 9G
TTL/DTL COMPATIBLE SINGLE OUTPUT

Model No.	Delay (ns)
9G5	5
9G10	10
9G20	20
9G25	25
9G50	50
9G100	100
9G200	200



SERIES 9LG
LOW POWER SCHOTTKY SINGLE OUTPUT

Model No.	Delay (ns)
9LG10	10
9LG20	20
9LG25	25
9LG50	50
9LG100	100
9LG200	200

SPECIFICATIONS:		
	TTL Series	9L Series
Supply Voltage	5.0 VDC ± 5%	5.0 VDC ± 5%
Supply Current	70 Ma Max	25 Ma Max
Rise & Fall Time	4.0 ns Max	6.0 ns Max
Operating Temp.	-55°C to + 125°C	-55°C to + 125°C
Size	.80L X .50W X .165H	
Delay Tolerance	± 5% or 2 ns whichever is greater	

These devices are supplied with ceramic IC's that have been screened to MIL-STD-883 for -55°C to + 125°C operation.

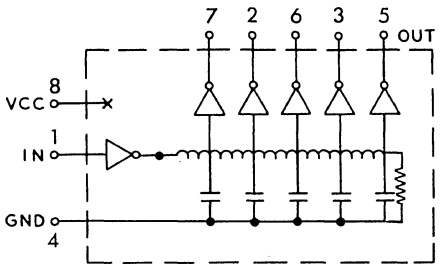
DELAY LINES

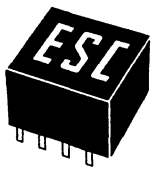
DIGITAL TTL, DTL - 8, 14 AND 30 PIN

SERIES 8T

DIGITAL TTL/DTL COMPATIBLE 5 TAPS 8 PIN PACKAGE

Model No.	Delay (ns)	Delay/ Tap (ns)
8T25	25	5
8T30	30	6
8T40	40	8
8T50	50	10
8T75	75	15
8T100	100	20





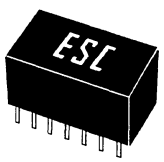
8 PIN

Size: 8 Pin .50L X .40W X .25H

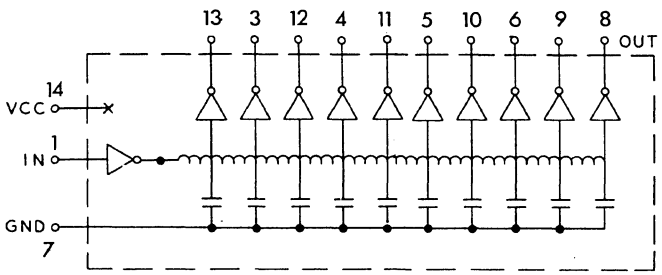
SERIES 10T

DIGITAL TTL/DTL COMPATIBLE 10 TAPS 14 PIN PACKAGE

Model No.	Delay (ns)	Delay/ Tap (ns)
10T50	50	5
10T60	60	6
10T70	70	7
10T80	80	8
10T90	90	9
10T100	100	10
10T150	150	15
10T200	200	20
10T250	250	25
10T500	500	50



14 PIN

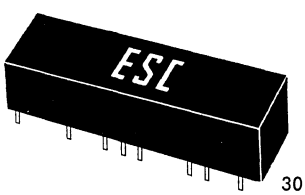


Size: 14 Pin .80L X .40W X .32H

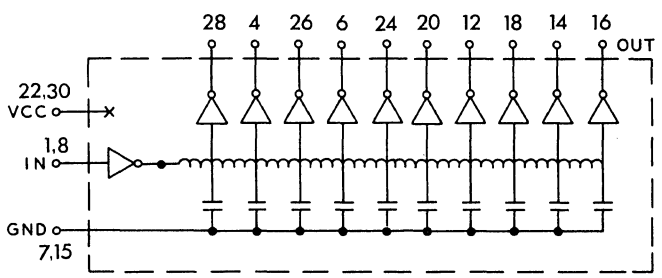
SERIES 30T

DIGITAL TTL/DTL COMPATIBLE 10 TAPS 30 PIN PACKAGE

Model No.	Delay (ns)	Delay/ Tap (ns)
30T50	50	5
30T60	60	6
30T70	70	7
30T80	80	8
30T90	90	9
30T100	100	10
30T150	150	15
30T200	200	20
30T250	250	25
30T500	500	50
30T1000	1000	100



30 PIN



Size: 30 Pin 1.70L X .40W X .30H

Looking for LC Filters? See our page in Section 2700

SPECIFICATIONS:

- Supply voltage: 5V ± 5%
- Logic 1 input current: 50 µA max.
- Logic 0 input current: 2 MA max.
- Logic 1 voltage out: 2.4V min.
- Logic 0 voltage out: 0.5V max.
- Operating temperature: 0 to + 70°C
- Fan-out capabilities (max): 10 TTL loads/tap, 20 TTL loads/unit
- Delay tolerances: ± 2 ns or ± 5% whichever is greater
- Rise Time: 4 ns max
- Series 8T and 30T available for -55°C to + 125°C operation. Add letter "C" after "T" when specifying. Series 30T height will increase to .36.

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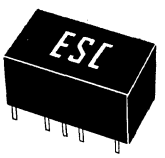
TOLL FREE 800-631-0853 (except N.J.)

ECL "10,000" DIGITAL DELAY LINES

These ECL Hybrid Delay Lines are contained in a 16 Pin DIP Package using ECL "10,000" Series Circuits

SPECIFICATIONS:

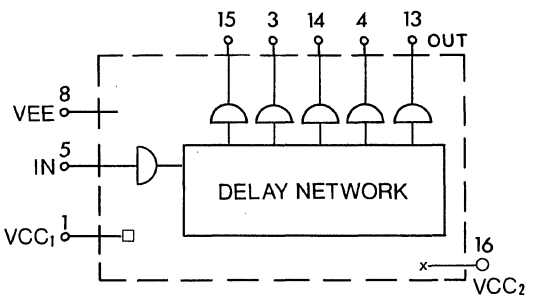
- Logic 1 (output): -.96 V min.
- Logic 0 (output): -1.65 V max.
- Delay tolerances: ± 1 ns below 20 ns delay; ± 1 ns or ± 5% whichever is greater above 20 ns delay.
- Operating temp: -0°C to + 70°C
- Storage temp. range: -55°C to + 125°C
- Size: .8L X .4W X .36H



16 PIN

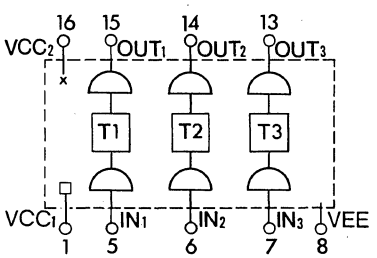
SERIES 16EC
ECL COMPATIBLE 5 TAPS

Model No.	Delay (ns)	Delay/ Tap (ns)
16EC10	10	2
16EC15	15	3
16EC20	20	4
16EC25	25	5
16EC30	30	6
16EC40	40	8
16EC50	50	10
16EC60	60	12
16EC80	80	16
16EC100	100	20



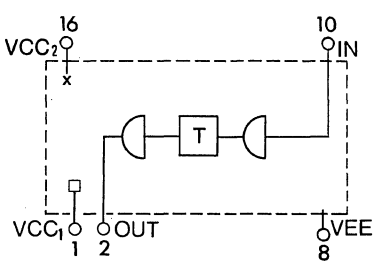
SERIES 16EP
ECL COMPATIBLE TRIPLETS

Model No.	Delay per line (ns)
16EP5	5
16EP10	10
16EP15	15
16EP20	20
16EP25	25
16EP50	50



SERIES 16EG
ECL COMPATIBLE SINGLE OUTPUT

Model No.	Delay (ns)
16EG5	5
16EG10	10
16EG15	15
16EG20	20
16EG25	25
16EG50	50
16EG75	75
16EG100	100



DELAY LINES

TTL DIGITAL PROGRAMMABLE DELAY LINES

This series of programmable hybrid delay lines utilize TTL Schottky circuits.

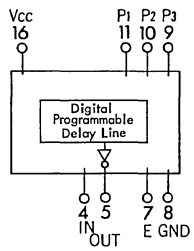
The PTT's are offered in 3, 4 & 6 Bit Series.

SERIES PTT3

TTL COMPATIBLE 3 BIT PROGRAMMABLE DELAY LINE

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PTT3-1	7 ± 2	14	1 ± .5
PTT3-2		21	2 ± .5
PTT3-3		28	3 ± .6
PTT3-4		35	4 ± .8
PTT3-5		42	5 ± 1
PTT3-6		49	6 ± 1
PTT3-7		56	7 ± 1
PTT3-8		63	8 ± 1
PTT3-9		70	9 ± 1
PTT3-10		77	10 ± 1

16 Pin DIL



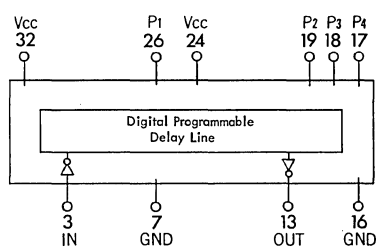
Size: .80L X .40W X .28 H

SERIES PTT4

TTL COMPATIBLE 4 BIT PROGRAMMABLE DELAY LINE

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PTT4-1	15 ± 2	30	1 ± .5
PTT4-2		45	2 ± .5
PTT4-3		60	3 ± .6
PTT4-4		75	4 ± .8
PTT4-5		90	5 ± 1
PTT4-6		105	6 ± 1
PTT4-7		120	7 ± 1
PTT4-8		135	8 ± 1
PTT4-9		150	9 ± 1
PTT4-10		165	10 ± 1

32 Pin DIL



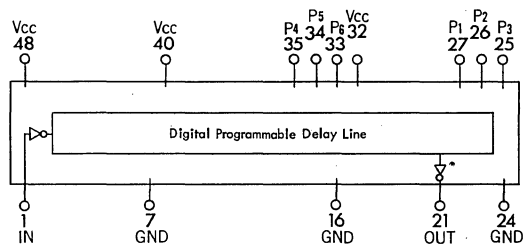
Size: 1.75L X .40W X .28 H

SERIES PTT6

TTL COMPATIBLE 6 BIT PROGRAMMABLE DELAY LINE

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PTT6-1	20 ± 2	83	1 ± .5
PTT6-2		146	2 ± .5
PTT6-3		209	3 ± .6
PTT6-4		272	4 ± .8
PTT6-5		335	5 ± 1

48 Pin DIL



Size: 2.55L X .40W X .28 H

SPECIFICATIONS:

- Logic 1 (output): 2.4 min
- Logic 0 (output): .50 VDC max
- Operating Temp. Range: 0°C to + 70°C *
- Storage Temp. Range: -55°C to + 125°C

*For -55°C to + 125°C operation - Contact Plant

TEST CONDITIONS:

- Vcc = 5 VDC ± 5% Temp. 25°C
- Td measured at the 1.5V level outputs loaded with 15pf.

Looking for LC Filters? See our page in Section 2700

ESC ELECTRONICS CORPORATION

ESC ELECTRONICS CORPORATION
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TOLL FREE 800-631-0853 (except N.J.)

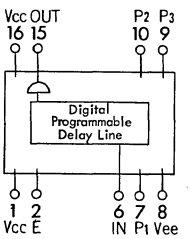
ECL DIGITAL PROGRAMMABLE DELAY LINES

This series of programmable hybrid delay lines utilize ECL 10,000 Series IC's.
The PEC's are offered in 3, 4 & 6 Bit Series.

SERIES PEC3
3 BIT PROGRAMMABLE DELAY LINES

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PEC3-1	3 ± 2	10	1 ± .5
PEC3-2		17	2 ± .5
PEC3-3		24	3 ± .6
PEC3-4		31	4 ± .8
PEC3-5		38	5 ± 1

16 Pin DIL

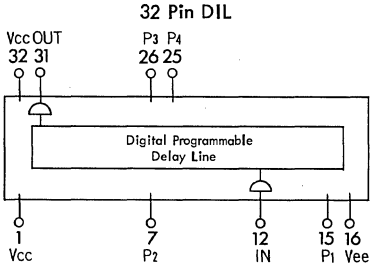


Size: .825L X .40W X .36H

SERIES PEC4
4 BIT PROGRAMMABLE DELAY LINES

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PEC4-1	10 ± 2	25	1 ± .5
PEC4-2		40	2 ± .5
PEC4-3		55	3 ± .6
PEC4-4		70	4 ± .8
PEC4-5		85	5 ± 1

32 Pin DIL

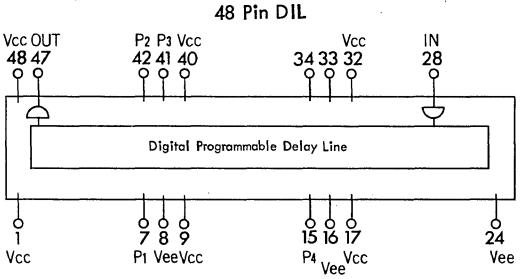


Size: 1.75L X .40W X .36H

SERIES PEC6
6 BIT PROGRAMMABLE DELAY LINES

Model No.	Zero Step Delay (ns)	Maximum Delay (ns) (nom)	Delay per step (ns)
PEC6-1	8 ± 2	71	1 ± .5
PEC6-2		134	2 ± .5
PEC6-3		197	3 ± .6
PEC6-4		260	4 ± .8
PEC6-5		323	5 ± 1

48 Pin DIL



Size: 2.50L X .40W X .36H

SPECIFICATIONS:

- Logic 1 (output): -.96V min
- Logic 0 (output): -1.65V max
- Operating Temp.Range: -0°C to + 70°C
- Storage Temp.Range: -55°C to + 125°C

TEST CONDITIONS:

- Input Pulse Width: 1.2 X max delay time
- Input Pulse Spacing: 5 X max delay time
- Input Rise Time: 2 ns max
- Input Pulse Voltage: 1.0V (-.75V to -1.75V)
- Vee: -5.2VDC
- Output connected to -2VDC through 100 ohms.
- Time delays measured at -1.3 Volt Level.

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- Thick Film Substrates
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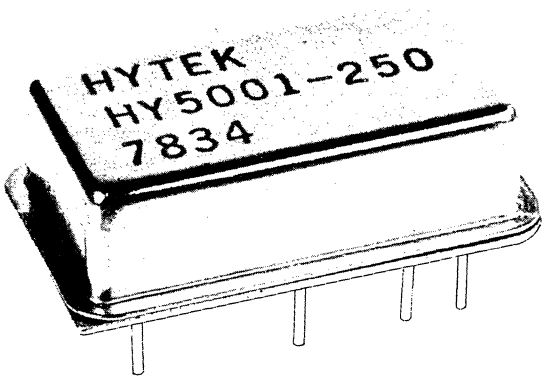
MULTI-TAPPED DIGITAL DELAY LINES (25- to 250-ns models)

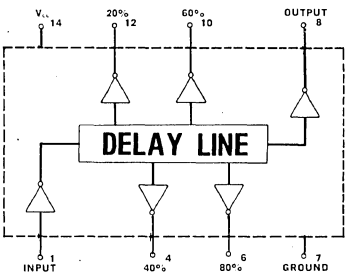
HY-5001 HY-5010

Ideal for Dynamic RAM Timing in Commercial and Military Memory Circuits

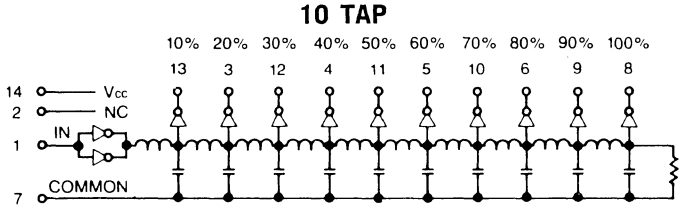
- ±5% total delay accuracy
- Schottky buffered inputs and outputs
- Pin-for-pin compatibility with other lead manufacturers
- Off-the-shelf delivery of standard ranges
- Fast rise time (4ns max.)
- 14 pin, low profile, hermetic, metal dip package
- Inherent hybrid accuracy and reliability



5 TAP



10 TAP



5 TAP

Part No.	Total Delay Time*	Delay Increment at Each Tap
HY-5001-025	25ns	5ns
HY-5001-030	30ns	6ns
HY-5001-035	35ns	7ns
HY-5001-040	40ns	8ns
HY-5001-045	45ns	9ns
HY-5001-050	50ns	10ns
HY-5001-075	75ns	15ns
HY-5001-100	100ns	20ns
HY-5001-150	150ns	30ns
HY-5001-200	200ns	40ns
HY-5001-250	250ns	50ns

10 TAP

Part No.	Total Delay Time*	Delay Increment at Each Tap
HY-5010-050	50ns	5ns†
HY-5010-100	100ns	10ns
HY-5010-150	150ns	15ns
HY-5010-200	200ns	20ns
HY-5010-250	250ns	25ns

†Delay from input to first tap is 7 ns min.
*Measured at 1.5V point on leading edge.

DESCRIPTION

Hytek's Model HY5001 Multi-Tapped Delay Lines are Schottky TTL buffered to provide precise timing delays without additional components. Users can select models with total delays of 25 to 250ns with taps in 10% or 20% increments.

Maximum delay line reliability is assured by the use of a hybrid circuit enclosed in a hermetic metal package. The thick film design provides for most efficient internal integration and guarantees manufacturing repeatability.

These units can be used directly with TTL, high-speed TTL, and DTL circuits. The outputs have a fast rise time independent of the delay and have standard TTL fanout capabilities.

The delay lines are packaged in a low-profile, 14 lead DIP configuration. The units are manufactured and tested to meet the best commercial standards.

Custom multiple- and single-tapped delay lines are offered in ranges of 5 to 1000ns with tap values as required.

hytek microsystems incorporated
16780 LARK AVENUE, LOS GATOS, CALIFORNIA 95030
PHONE (408) 358-1991

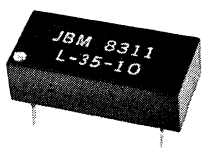
Active & Passive Delay Lines

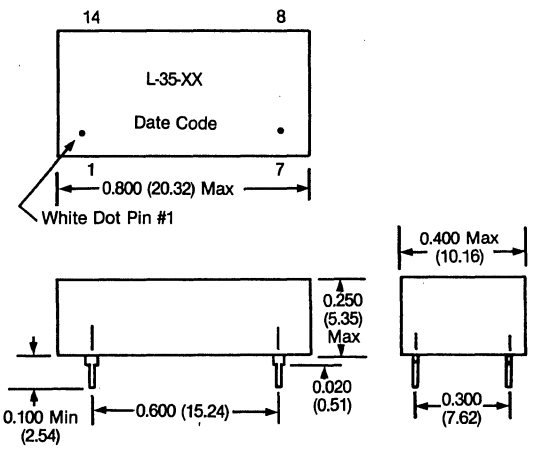
JBM produces one of the industry's broadest lines of active (digital) and passive magnetic delay lines for use in computers, communications equipment, military instrumentation, etc. In addition to hundreds of standard models, we offer extensive capabilities for the design and production of custom units for special applications.

ACTIVE DELAY LINES

STYLE L-35 Untapped (14 Pin Outline)

TOTAL DELAY (nsec)	RISE TIME (ns MAX) (.8 to 2.0V)	JBM P/N L-35-XX
5 ±1ns	2.0	L-35-00
7		L-35-01
10		L-35-02
15		L-35-03
20 ±1ns		L-35-04
25 ±5%		L-35-05
30		L-35-06
40		L-35-07
50		L-35-08
70		L-35-09
100		L-35-10
150		L-35-11
200	3.0	L-35-12
300	3.5	L-35-13
400	4.0	L-35-14
500	4.0	L-35-15
600	4.5	L-35-25
700	4.5	L-35-26
750	4.5	L-35-27
800	5.0	L-35-28
900	5.0	L-35-29
1000 ±5%	5.0	L-35-30





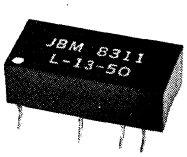
Consult factory for other parameters and tolerances and low power (LS) version (L-57-XX).

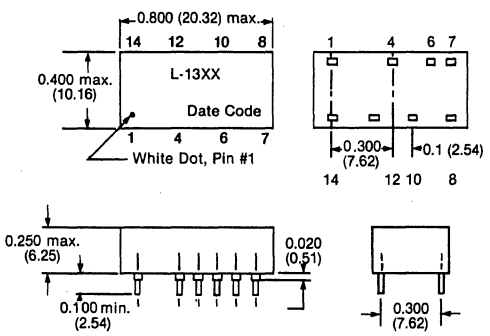
STYLE L-13
5 Equally Spaced Taps (14 Pin Outline)

TOTAL DELAY (nsec ± 5%)	TAP INTERVALS (nsec ± 3 ns*)	RISE TIME (ns MAX) (0.8 to 2.0V)	JBM PART NUMBER L- L-13 (14) PIN	L-45 (16) PIN
25	5	2.0	L-13-50	L-45-50
30	6	2.0	L-13-51	L-45-51
35	7	2.0	L-13-52	L-45-52
40	8	2.0	L-13-53	L-45-53
45	9	2.0	L-13-54	L-45-54
50	10	2.0	L-13-55	L-45-55
75	15	2.0	L-13-56	L-45-56
100	20	2.0	L-13-57	L-45-57
150	30	2.5	L-13-58	L-45-58
200	40	3.0	L-13-59	L-45-59
250	50	3.0	L-13-60	L-45-60
300	60	3.5	L-13-250	L-45-250
350	70	3.5	L-13-251	L-45-251
400	80	4.0	L-13-252	L-45-252
450	90	4.0	L-13-253	L-45-253
500	100	4.0	L-13-254	L-45-254
600	120	4.5	L-13-255	L-45-255
700	140	4.5	L-13-256	L-45-256
750	150	4.5	L-13-257	L-45-257
800	160	5.0	L-13-258	L-45-258
900	180	5.0	L-13-259	L-45-259
1000	200	5.0	L-13-260	L-45-260

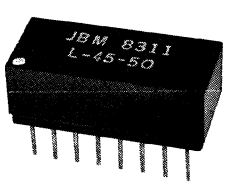
*or ±5% whichever is greater.

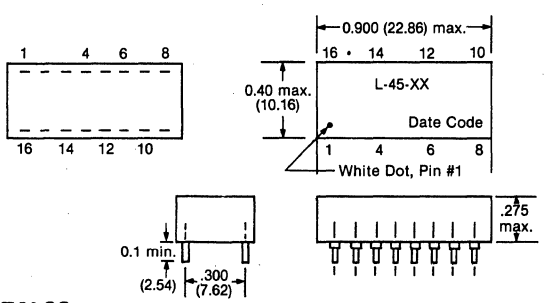
Consult factory for other parameters and tolerances and low power (LS) versions.





STYLE L-45
5 Equally Spaced Taps (16 Pins)





ABOVE RATINGS & PACKAGES TYPICAL. SEND FOR COMPLETE CATALOG

JBM Electronics, Inc. • 531 Front Street • Manchester, NH 03102 • 603-623-0222
Telex No. 953134 TWX No. 710-220-8978

Active & Passive Delay Lines

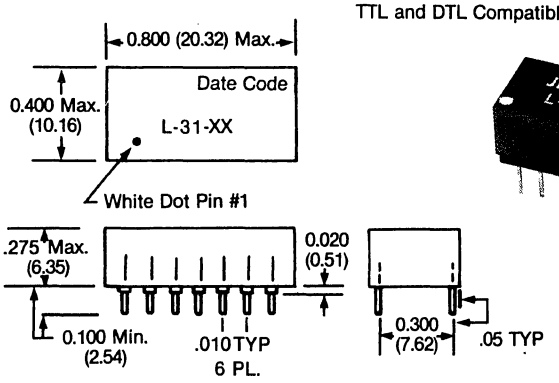
ACTIVE DELAY LINES

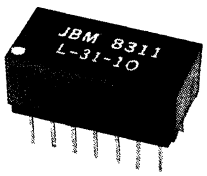
TOTAL DELAY (nsec ± 5%)	TAP INTERVALS (nsec ± 3 ns*)	RISE TIME (ns MAX) (0.8 to 2.0V)	JBM P/N L-31-XX
50	5.0	2.0	L-31-50
75	7.5	2.0	L-31-51
100	10.0	2.0	L-31-52
125	12.5	2.5	L-31-53
150	15.0	2.5	L-31-54
175	17.5	3.0	L-31-55
200	20.0	3.0	L-31-56
250	25.0	3.0	L-31-57
300	30.0	3.5	L-31-58
350	35.0	3.5	L-31-59
400	40.0	4.0	L-31-60
450	45.0	4.0	L-31-61
500	50.0	4.0	L-31-62
600	60.0	4.5	L-31-63
700	70.0	4.5	L-31-64
750	75.0	4.5	L-31-65
800	80.0	5.0	L-31-66
900	90.0	5.0	L-31-67
1000	100.0	5.0	L-31-68

*or ±5% whichever is greater.
Consult factory for other parameters and tolerances.

STYLE L-31 10 Equally Spaced Taps (14 Pins)

TTL and DTL Compatible

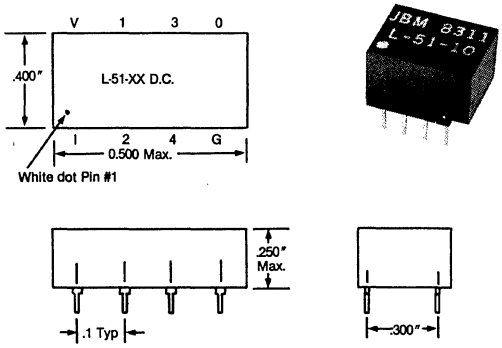




TOTAL DELAY (nsec ± 5%)	TAP INTERVALS (nsec ± 3 ns*)	RISE TIME (ns MAX) (0.8 to 2.0V)	JBM P/N L-51-XX
25	5.0	2.0	L-51-50
30	6.0	2.0	L-51-51
35	7.0	2.0	L-51-52
40	8.0	2.0	L-51-53
45	9.0	2.0	L-51-54
50	10.0	2.0	L-51-55
75	15.0	2.0	L-51-56
100	20.0	2.0	L-51-57
150	30.0	2.5	L-51-58
200	40.0	3.0	L-51-59
250	50.0	3.0	L-51-60
300	60.0	3.5	L-51-61
350	70.0	3.5	L-51-62
400	80.0	4.0	L-51-63
450	90.0	4.0	L-51-64
500	100.0	4.0	L-51-65

*or ±5% whichever is greater.
Consult factory for other parameters and tolerances.

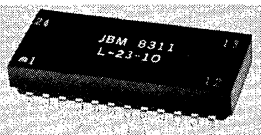
STYLE L-51 5 Equally Spaced Taps (8 Pins)



PASSIVE DELAY LINES

STYLE L-21 (14 Pin DIP) & STYLE L-22 (16 Pin DIP)

10 Equally Spaced Taps



STYLE L-23
(20 Equally Spaced Taps)

STYLE L-26 (14 Pin SIP)
10 Equally Spaced Taps

STYLE L-33 (14 Pin DIP) & STYLE L-34 (16 Pin DIP)

10 Equally Spaced Taps

ABOVE RATINGS & PACKAGES TYPICAL. SEND FOR COMPLETE CATALOG

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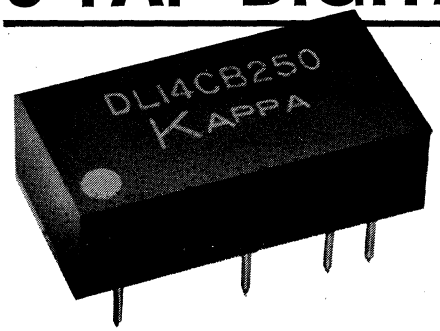
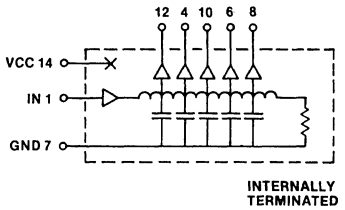
SERIES DL14 COMPUTER GRADE

5-TAP DIGITAL DELAY MODULE



FEATURES

- TTL and DTL compatible
- 14-pin package
- 5 equally spaced taps
- Operating Temperature Range: 0°C to +70°C
- Risetime: 4ns max. (See Notes 2 and 3)



PART NUMBER	Total Delay (ns)(1)(3) ±5%	Tap Delay (ns)(1)(3) ±5% or ±2ns, WIG(4)
CB250	25	5
CB500	50	10
CB101	100	20
CB151	150	30
CB201	200	40
CB251	250	50
CB301	300	60
CB351	350	70
CB401	400	80
CB451	450	90
CB501	500	100
CB601	600	120
CB701	700	140
CB801	800	160
CB901	900	180
CB102	1000	200

Notes:
(1) Delays measured at 1.5V level on leading edge only.
(2) Risetime measured from 0.75V to 2.4V.
(3) Measured with no loads on taps.
(4) Tap tolerances referenced from input.

INPUT TEST CONDITIONS

Pulse Voltage: 3.2V
Rise time: 2ns
Supply Current: (typical) 60mA
Pulse Width: 40% minimum of total delay

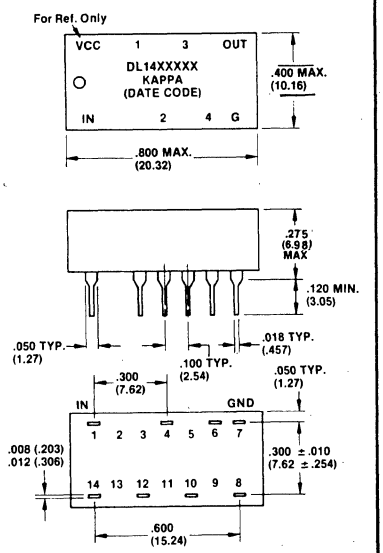
ELECTRICAL CHARACTERISTICS

Supply voltage (Vcc): 5.0V (±0.25V)
Logic 1 Input Current: 50uA max.
Logic 0 Input Current: −2mA max.
Logic 1 Voltage Output: 2.4V min.
Logic 0 Voltage Output: 0.4V max.

DRIVE CAPABILITIES

Logic 0 Output:
10 TTL Loads/Tap max.
20 TTL Loads/Unit max.
Logic 1 Output: 20 TTL Loads/Unit max.

MARKING & DIMENSIONS in Inches and (mm)

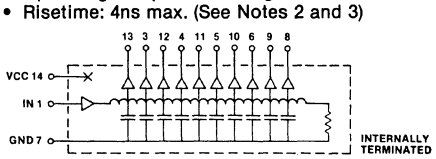


SERIES DL15 COMPUTER GRADE

10-TAP DIGITAL DELAY MODULE

FEATURES

- TTL and DTL compatible
- 14-pin package
- 10 equally spaced taps
- Operating Temperature Range: 0°C to +70°C
- Risetime: 4ns max. (See Notes 2 and 3)



PART NUMBER	Total Delay (ns)(1)(3) ±5%	Tap Delay (ns)(1)(3) ±5% or ±2ns, WIG(4)
CC500	50	5
CC101	100	10
CC151	150	15
CC201	200	20
CC251	250	25

Notes:
(1) Delays measured at 1.5V level on leading edge only.
(2) Risetime measured from 0.75V to 2.4V.
(3) Measured with no loads on taps.
(4) Tap tolerances referenced from input.

INPUT TEST CONDITIONS

Pulse Voltage: 3.2V
Rise time: 2ns
Supply Current: (typical) 60mA
Pulse Width: 40% minimum of total delay

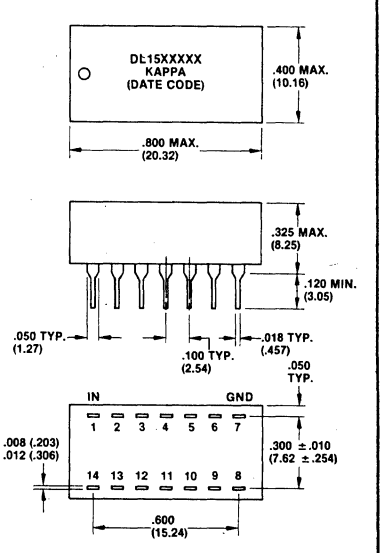
ELECTRICAL CHARACTERISTICS

Supply voltage (Vcc): 5.0V (±0.25V)
Logic 1 Input Current: 50uA max.
Logic 0 Input Current: −2mA max.
Logic 1 Voltage Output: 2.4V min.
Logic 0 Voltage Output: 0.4V max.

DRIVE CAPABILITIES

Logic 0 Output:
10 TTL Loads/Tap max.
20 TTL Loads/Unit max.
Logic 1 Output: 20 TTL Loads/Unit max.

MARKING & DIMENSIONS in Inches and (mm)



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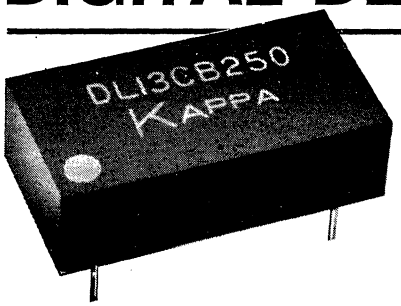
SERIES DL13 COMPUTER/MILITARY GRADE (14-PIN)

DIGITAL DELAY MODULE



FEATURES

- TTL and DTL compatibility
- STANDARD 14-pin Package
- 3 ns typ. Risetime (4 ns max.).
- Operating Temperature Range:
  0°C to +70°C (Computer-Grade)
  −55°C to +125°C (Military-Grade)

SERIES DL13 SPECIFICATIONS

Delay Times (ns): 25, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000 (other values available upon request).

Delay Tolerance: ±5% or ±2ns, whichever is greater (tighter tolerances upon request).

INPUT TEST CONDITIONS:

Pulse Voltage: 3.2V
Risetime: ≤2.0 ns
Supply Current: 60 mA typ.
Pulse Width: 40% minimum of total delay

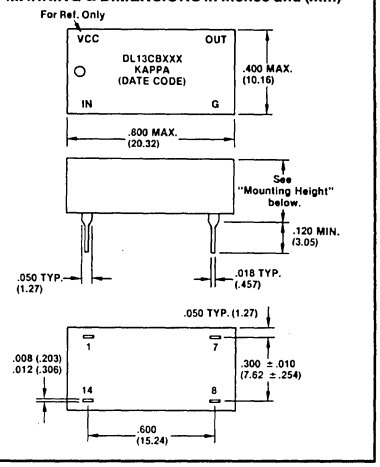
ELECTRICAL CHARACTERISTICS:

Computer-Grade (Military-Grade)
Supply Voltage: 5.0V ±0.25V (±0.50V)
Logic 1:
Input Voltage: 2.0V min.
Input Current: 50μA max.
Output Voltage: 2.7V min. (2.5V min.)
Output Current: 2.5mA typ., 4.0mA max.
Logic 0:
Input Voltage: 0.8V max.
Input Current: −2.0 mA max.
Output Voltage: 0.5V max.
Output Current: 5 mA typ., 9 mA max.

DRIVE CAPABILITIES

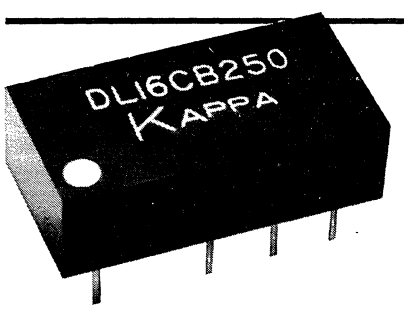
Logic 1 Output: 10 TTL Loads/Unit max.
Logic 0 Output: 10 TTL Loads/Unit max.

MARKING & DIMENSIONS in Inches and (mm)



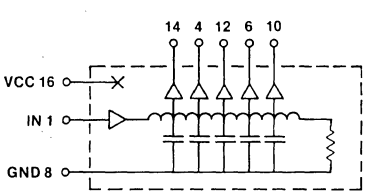
SERIES DL16 COMPUTER/MILITARY GRADE (16-PIN)

5-TAP DIGITAL DELAY MODULE



FEATURES

- TTL and DTL compatibility
- STANDARD 16-pin Package
- 3 ns typ. Risetime (4ns max.).
- Operating Temperature Range:
  0°C to +70°C (Computer-Grade)
  −55°C to +125°C (Military-Grade)
- 5 equally spaced Taps



INTERNALLY TERMINATED

SERIES DL16 SPECIFICATIONS

Total Delay Times(ns): 25, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000 (other values available upon request).

Total Delay Tolerance: ±5% or ±2ns, whichever is greater (tighter tolerances available upon request).

Tap Delay: 20% of nominal Total Delay Time.

Tap Tolerance: ±5% or ±2ns, whichever is greater; referenced from input.

INPUT TEST CONDITIONS:

Pulse Voltage: 3.2V
Risetime: ≤2.0 ns
Supply Current: 60 mA typ.
Pulse Width: 40% minimum of total delay

ELECTRICAL CHARACTERISTICS:

Computer-Grade (Military-Grade)
Supply Voltage: 5.0V ±0.25V (±0.50V)

Logic 1:

Input Voltage: 2.0V min.
Input Current: 50μA max.
Output Voltage: 2.7V min. (2.5V min.)
Output Current: 2.5mA typ., 4.0mA max.

Logic 0:

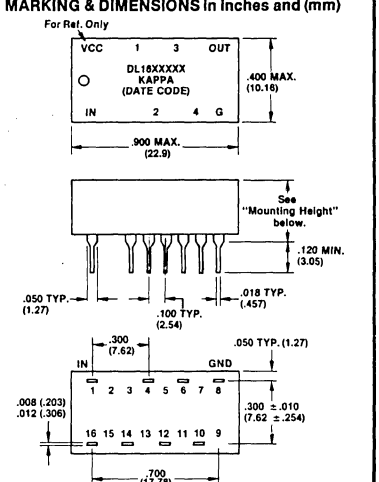
Input Voltage: 0.8V max.
Input Current: −2.0 mA max.
Output Voltage: 0.5V max.
Output Current: 5 mA typ., 9 mA max.

DRIVE CAPABILITIES

Logic 0 Output: 10 TTL Loads/Tap max.
20 TTL Loads/Unit max.

Logic 1 Output: 20 TTL Loads/Unit max.

MARKING & DIMENSIONS in Inches and (mm)



PART NUMBER EXAMPLE

DL13(16) M C 250 *

BASIC SERIES #

"C" = Computer-grade
"M" = Military-grade

MOUNTING HEIGHT
"B" = 0.275" (6.98mm) max.*
"C" = 0.325" (8.26mm) max.
*Computer-grade only.

DELAY TIME: Expressed in nanoseconds (ns). First two digits are significant figures. Last digit specified number of zeroes to follow.

OPTIONS: "X" = IC ONLY screened to MIL-STD-883 method 1015 and MIL-M-38510, part no. JM38510/07003
"Z" = Final Product screened to MIL-STD-883, Method 1011 also includes "X" OPTION SCREENING.

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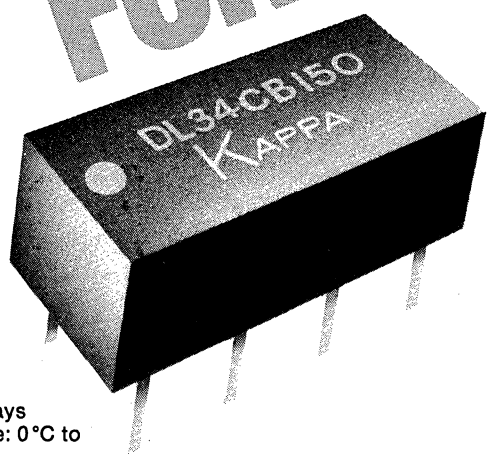
SERIES DL34 COMPUTER GRADE

TRIPLE-IN-LINE TTL LOGIC DELAY MODULE

NEW FOR 1983



KAPPA PART # XXXXXXXXX	DELAY TIME (ns)
DL34CB050	5 ± 1.5
DL34CB100	10 ± 1.5
DL34CB150	15 ± 2.0
DL34CB200	20 ± 1.5
DL34CB250	25 ± 2.0
DL34CB300	30 ± 2.5
DL34CB350	35 ± 2.0
DL34CB400	40 ± 3.0
DL34CB450	45 ± 3.0
DL34CB500	50 ± 2.5
DL34CB600	60 ± 4.0
DL34CB700	70 ± 3.0
DL34CB800	80 ± 4.0
DL34CB900	90 ± 7.0
DL34CB101	100 ± 5.0
DL34CB125	125 ± 6.0
DL34CB151	150 ± 11.0
DL34CB175	175 ± 8.5
DL34CB201	200 ± 10.0
DL34CB225	225 ± 1.5
DL34CB251	250 ± 12.5

(1) Delays measured at 1.5V level on leading edge only with no loads on taps.

(2) Risetime measured from 0.75V to 2.4V level.

FEATURES

- 14-Pin DIP Package
- Risetime 4ns Maximum
- Three Independent Equal Delays
- Operating Temperature Range: 0°C to +70°C
- TTL and DTL Compatible

INPUT TEST CONDITIONS

V_C: 5.0 ±0.25V
Supply Current: I_{CCH} = 90mA max.
I_{CCL} = 115mA max.
Pulse Voltage: 3.2V
Risetime: 2.0 ns
Pulse Width: 100% min. of Delay
Duty Cycle: 33% or less

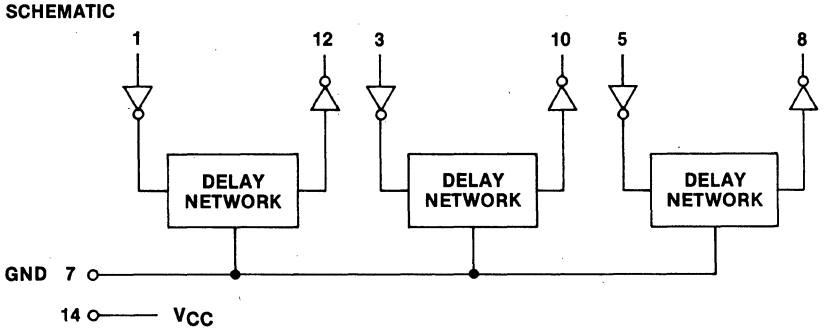
ELECTRICAL SPECIFICATIONS

Logic 1: 50μA max., 2.0V min.
Logic 0: −2.0mA max., 0.8V max.
Logic 1 Voltage Output: 2.4V min.
Logic 0 Voltage Output: 0.4V max.

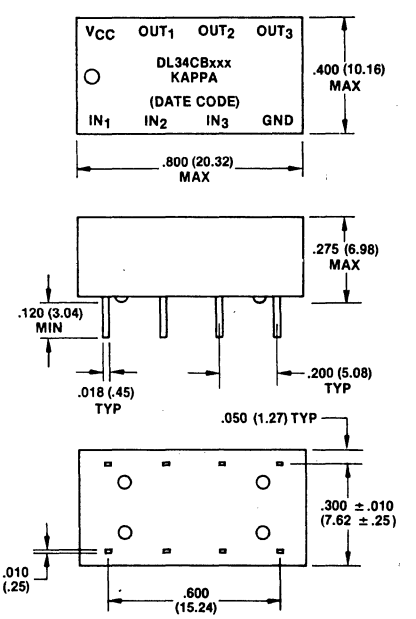
DRIVE CAPABILITIES

10 TTL loads per line

SCHEMATIC



MARKING & DIMENSIONS in inches & (mm)



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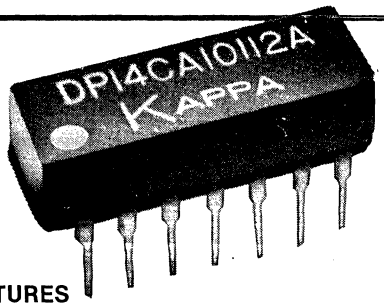
SERIES DP14C COMPUTER GRADE
14-PIN DIP DELAY LINE
(available in full-MIL conformance as Series DP14M)



FEATURES
- TTL and DTL compatible
- Meets applicable requirements of MIL-D-23859
- 5/1 Delay-to-Risetime Ratio
- 10 Equally Spaced Taps
- Wide Operating Temperature Range
- Low cost

ELECTRICAL SPECIFICATIONS
Total Delay: 10 to 1000 ns
Tap Delays: 10% increments standard (other increments available upon request)
Risetime: 20% maximum of total delay (see Table 1)
Characteristic Impedance: 50 to 500 ohms (±10%)
Attenuation: 2dB maximum (see Table 1)
Distortion: ±10% maximum
Temperature Coefficient of Delay: 100ppm/°C max.
Operating Temperature Range: −55°C to +125°C
Storage Temperature Range: −65°C to +130°C
Insulation Resistance: 1000 megohms min. @ 50VDC @ 25°C
Dielectric Strength: 50VDC

MECHANICAL SPECIFICATIONS
Case Configuration: See FIGURE 2
Case Material: Molded Epoxy
Terminals: Flat, DIP-type (See FIGURE 2)
Terminal Material: Kovar or equivalent, tin-plated
Pin Connections: See TABLE II
Potting: 100% filled with a two-component epoxy
Marking: Includes manufacturer's name, part number, and date code (See FIGURE 2)

PART NUMBER EXAMPLE
Typical part number is a combination of the Basic Series Number, Mounting Height Code, Delay Time, Impedance, and Pin Sequence Code.

EXAMPLE: DP14CA10112A

(100ns, 100 ohm, 0.200" (5.08mm) Max. Height, using the code "A" Pin Sequence).

DP14C A 101 12 A

BASIC SERIES NUMBER

MOUNTING HEIGHT CODE (See TABLE III)

DELAY TIME: Expressed in nanoseconds (ns). First two digits are significant figures. Last digit specifies number of zeros to follow.

IMPEDANCE: Expressed in ohms (Ω). First digit is significant. Last digit specifies number of zeros to follow.

PIN SEQUENCE CODE (See TABLE II). "STANDARD" Pin Sequence if omitted.

TABLE I

Td (ns)(1) (±5%)	Td/tap (ns)(2) (3) (±10%)	Tr (ns) MAX.	ATTENUATION (%) TYPICAL per IMPEDANCE (Ω)				
			50	100	200	300	500
10	1	3		5			
20	2	5.5	3	5	5		
30	3	6.5	3	5	5		
40	4	8	3	5	5	5	
50	5	10	3	5	5	5	7
60	6	12	3	5	5	5	7
75	7½	15	3	5	5	5	7
100	10	20	3	5	5	7	7
120	12	24	3	5	6	7	8
150	15	30	3	5	6	7	8
180	18	36	4	5	6	7	8
200	20	40	4	5	6	7	8
220	22	44	4	5	6	7	8
250	25	50	4	5	6	7	8
300	30	60		5	8	10	10
375	37½	75		7	8	10	10
500	50	100		8	10	12	12
600	60	120				15	15
750	75	150				15	20
1000	100	200					20

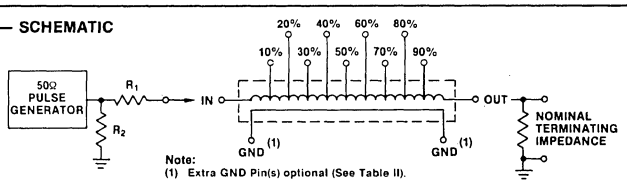
(1) Or ±2ns, whichever is greater. (2) Or ±1ns, whichever is greater. (3) For 10-tap lines only.

TABLE II. PIN-NUMBER SEQUENCE*

CODE	IN	10%	20%	30%	40%	50%	60%	70%	80%	90%	OUT	GND
Standard	14	2	12	3	11	4	5	10	6	9	7	1, 8
A	1	2	13	3	12	4	10	5	9	6	7	14
B	2	3	4	5	6	7	9	10	11	12	13	1, 14
C	7	9	6	10	5	11	12	3	13	2	14	1, 8
D	1	13	2	12	3	11	4	10	5	9	6	7, 8, 14
E	2	3	4	5	6	7,8	9	10	11	12	13	1, 14
F	1	13	2	12	3	11	4	10	5	9	6	7
G	2	13	3	12	4	11	5	10	6	9	7	8, 14
H	2	3	4	5	6	7	9	10	11	12	13	1
I	1	13	2	12	3	11	5	10	6	9	7	8, 14
J	1	2	13	3	12	4	10	5	9	6	7	8, 14
K	1	—	—	—	—	—	—	—	—	—	7	14
L	2	—	—	—	—	—	—	—	—	—	13	1, 14
M	7	—	—	—	—	—	—	—	—	—	14	1, 8
N	1	—	—	—	—	—	—	—	—	—	6	7, 8, 14
P	1	—	—	—	—	—	—	—	—	—	6	7
Q	2	—	—	—	—	—	—	—	—	—	7	8, 14
R	2	—	—	—	—	—	—	—	—	—	13	1
T	1	—	—	—	—	—	—	—	—	—	7	8, 14
U	2	3	4	5	6	8	9	10	11	12	13	1, 7
V	2	3	4	5	6	8	9	10	11	12	13	1
W	1	13	2	12	3	11	4	10	5	9	6	7, 14

*Other pin sequences available upon request.

FIGURE 1 — SCHEMATIC

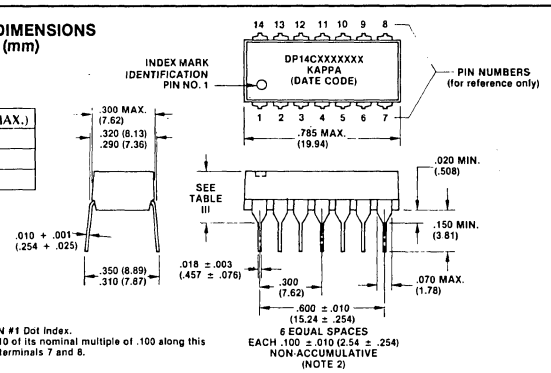


Note:
(1) Extra GND Pin(s) optional (See Table II).

FIGURE 2 — MARKING & DIMENSIONS in inches and (mm)

TABLE III. MOUNTING HEIGHT

CODE	DIMENSION (MAX.)
A	.200 (5.08)
B	.250 (6.35)
C	.300 (7.62)



Notes:
(1) A notch may be substituted for PIN #1 Dot Index.
(2) Each terminal is located with ± .010 of its nominal multiple of .100 along this longitudinal dimension relative to terminals 7 and 8.

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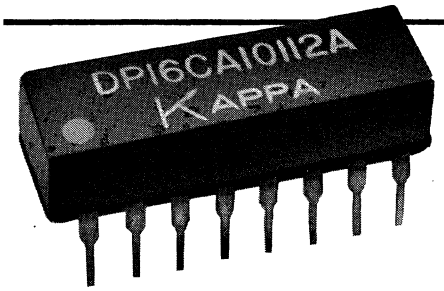
SERIES DP16C COMPUTER GRADE
16-PIN DIP DELAY LINE
(available in full-MIL conformance as Series DP16M)



FEATURES

- TTL and DTL compatible
- Meets applicable requirements of MIL-D-23859
- 5/1 Delay-to-Risetime Ratio
- 10 Equally Spaced Taps
- Wide Operating Temperature Range
- Low cost

ELECTRICAL SPECIFICATIONS

Total Delay: 10 to 1000 ns
Tap Delays: 10% increments standard (other increments available upon request)
Risetime: 20% maximum of total delay (see Table 1)
Characteristic Impedance: 50 to 500 ohms (±10%)
Attenuation: 2dB maximum (see Table 1)
Distortion: ±10% maximum
Temperature Coefficient of Delay: 100ppm/°C max.
Operating Temperature Range: −55°C to +125°C
Storage Temperature Range: −65°C to +130°C
Insulation Resistance: 1000 megohms min. @ 50VDC @ 25°C
Dielectric Strength: 50VDC

MECHANICAL SPECIFICATIONS

Case Configuration: See FIGURE 2
Case Material: Molded Epoxy
Terminals: Flat, DIP-type (See FIGURE 2)
Terminal Material: Kovar or equivalent, tin-plated
Pin Connections: See TABLE II
Potting: 100% filled with a two-component epoxy
Marking: Includes manufacturer's name, part number, and date code (See FIGURE 2)

PART NUMBER EXAMPLE

Typical part number is a combination of the Basic Series Number, Mounting Height Code, Delay Time, Impedance, and Pin Sequence Code.

EXAMPLE: DP16CA10112A
(100ns, 100 ohm, 0.200" (5.08mm) Max. Height, using the code "A" Pin Sequence).

DP16C A 101 12 A

- **DP16C** — **BASIC SERIES NUMBER**
- **A** — **MOUNTING HEIGHT CODE** (See TABLE III)
- **101** — **DELAY TIME:** Expressed in nanoseconds (ns). First two digits are significant figures. Last digit specifies number of zeros to follow.
- **12** — **IMPEDANCE:** Expressed in ohms (Ω). First digit is significant. Last digit specifies number of zeros to follow.
- **A** — **PIN SEQUENCE CODE** (See TABLE II).

TABLE I

Td (ns)(1) (±5%)	Td/tap (ns)(2) (3) (±10%)	Tr (ns) MAX.	ATTENUATION (%) TYPICAL per IMPEDANCE (Ω)				
			50	100	200	300	500
10	1	3		5			
20	2	5.5	3	5	5		
30	3	6.5	3	5	5		
40	4	8	3	5	5	5	
50	5	10	3	5	5	5	7
60	6	12	3	5	5	5	7
75	7½	15	3	5	5	5	7
100	10	20	3	5	5	7	7
120	12	24	3	5	6	7	8
150	15	30	3	5	6	7	8
180	18	36	4	5	6	7	8
200	20	40	4	5	6	7	8
220	22	44	4	5	6	7	8
250	25	50	4	5	6	7	8
300	30	60		5	8	10	10
375	37½	75		7	8	10	10
500	50	100		8	10	12	12
600	60	120				15	15
750	75	150				15	20
1000	100	200					20

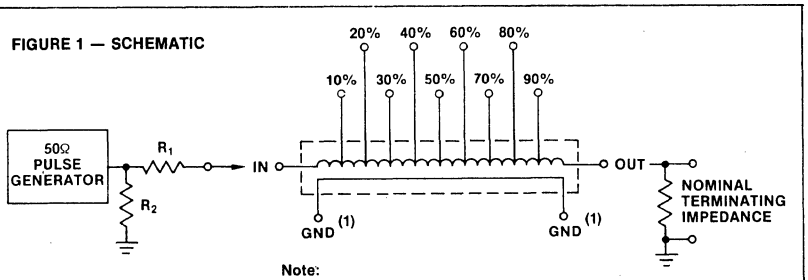
(1) Or ±2ns, whichever is greater. (2) Or ±1ns, whichever is greater. (3) For 10-tap lines only.

TABLE II. PIN-NUMBER SEQUENCE*

CODE	IN	10%	20%	30%	40%	50%	60%	70%	80%	90%	OUT	GND
A	15	2	14	3	13	4	5	11	6	10	7	1, 9
B	1	15	2	14	3	13	4	12	5	11	6	8
C	1	15	3	14	4	13	5	12	6	11	8	9, 16

*Other pin sequences available upon request.

FIGURE 1 — SCHEMATIC

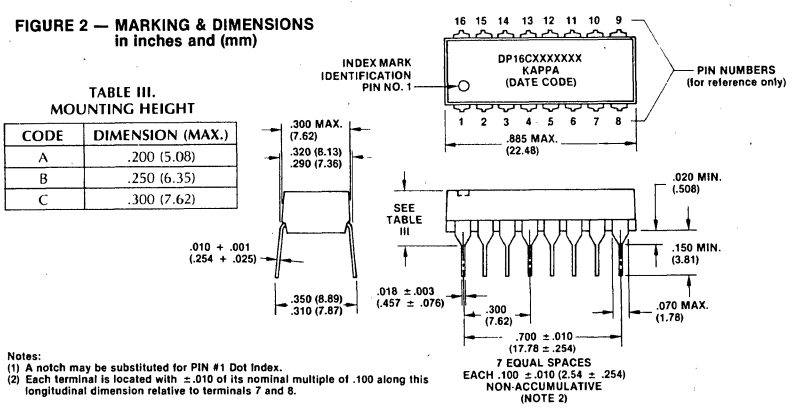


Note:
(1) Extra GND Pin(s) optional (See Table II).

FIGURE 2 — MARKING & DIMENSIONS in inches and (mm)

TABLE III. MOUNTING HEIGHT

CODE	DIMENSION (MAX.)
A	.200 (5.08)
B	.250 (6.35)
C	.300 (7.62)



Notes:
(1) A notch may be substituted for PIN #1 Dot Index.
(2) Each terminal is located with ±.010 of its nominal multiple of .100 along this longitudinal dimension relative to terminals 7 and 8.

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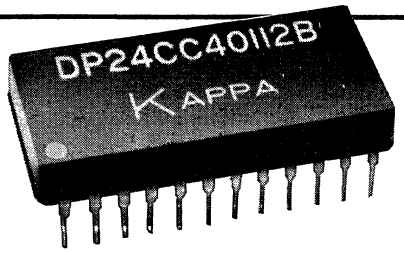
SERIES DP24C COMPUTER GRADE
24-PIN DIP DELAY LINE
(available in full-MIL conformance as Series DP24M)



ELECTRICAL SPECIFICATIONS

Total Delay: 20 to 2000 ns
Tap Delays: 5% increments standard (other increments available upon request)
Risetime: 10% maximum of total delay (see Table 1)
Characteristic Impedance: 50 to 200 ohms (±10%)
Attenuation: 2dB maximum (see Table 1)
Distortion: ±10% maximum
Temperature Coefficient of Delay: 100ppm/°C max.
Operating Temperature Range: −55°C to +125°C
Storage Temperature Range: −65°C to +130°C
Insulation Resistance: 1000 megohms min. @ 50VDC @ 25°C
Dielectric Strength: 50VDC

MECHANICAL SPECIFICATIONS

Case Configuration: See FIGURE 2
Case Material: Molded Epoxy
Terminals: Flat, DIP-type (See FIGURE 2)
Terminal Material: Kovar or equivalent, tin-plated
Pin Connections: See TABLE II
Potting: 100% filled with a two-component epoxy
Marking: Includes manufacturer's name, part number, and date code (See FIGURE 2)

TABLE I

PART NUMBER	Td (ns)(1) (±5%)	Td/tap (ns)(2) (±10%)	Tr (ns) (Max.)	Zo (ohms) (±10%)
20051	20	1	3	
40051	40	2	4	
60051	60	3	6	
80051	80	4	8	
10151	100	5	10	50
20151	200	10	20	
20012	20	1	3	
40012	40	2	4	
60012	60	3	6	
80012	80	4	8	
10112	100	5	10	
20112	200	10	20	
30112	300	15	30	100
40112	400	20	40	
50112	500	25	50	
60112	600	30	60	
80112	800	40	80	
10212	1000	50	100	
12212	1200	60	120	
15212	1500	75	150	
40022	40	2	4	
60022	60	3	6	
80022	80	4	8	
10122	100	5	10	
20122	200	10	20	
30122	300	15	30	200
40122	400	20	40	
50122	500	25	50	
60122	600	30	60	
80122	800	40	80	
10222	1000	50	100	
12222	1200	60	120	
15222	1500	75	150	
20222	2000	100	200	

Notes: (1) Or ±2ns, whichever is greater. (2). Or ±1ns, whichever is greater.

TABLE II. PIN-NUMBER SEQUENCE*

CODE	TAP #	IN	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	OUT	GND
A		2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	1, 24
B		2	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	22	23	12
C		1	2	3	4	5	6	7	8	9	10	11	14	15	16	17	18	19	20	21	22	23	12, 24

*Other pin sequences available upon request.

FIGURE 1 — SCHEMATIC

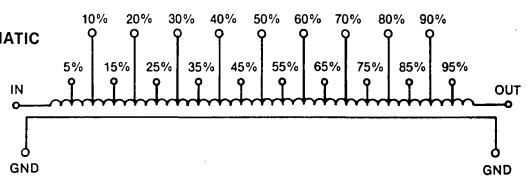


FIGURE 2 — MARKING & DIMENSIONS in inches and (mm)

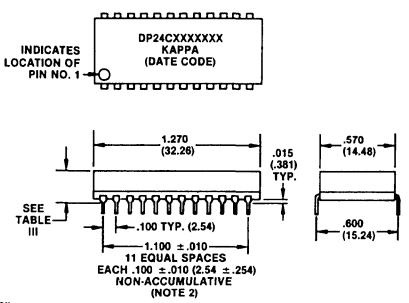


TABLE III. MOUNTING HEIGHT

CODE	DIMENSION (MAX.)
B	.250 (6.35)
C	.300 (7.62)

Notes:
(1) A notch may be substituted for PIN #1 Dot Index.
(2) Each terminal is located with ±.010 of its nominal multiple of .100 along this longitudinal dimension relative to terminals 12 and 13.

HOW TO ORDER

1. Select MOUNTING HEIGHT CODE from Table III.
2. Select PART NUMBER CODE from Table I.
3. Select PIN-NUMBER SEQUENCE CODE from Table II.
4. Construct the MODEL NUMBER. (See example below.)

This example, Model DP24CB-40112B, identifies a 400ns, 100-ohm line with 0.300" mounting height and the "B" pin-number sequence.

DP24C C 40112 B

DP24C	C	40112	B
BASIC SERIES NUMBER	MOUNTING HEIGHT CODE (Table III)	PART NUMBER (Table I)	PIN-NUMBER SEQUENCE (Table II)

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SERIES SP07 COMPUTER GRADE

7-PIN SIP DELAY LINE

NEW FOR 1983

FEATURES

- 7-Pin SIP Package
- Five (5) Equally-Spaced Delay Taps
- Operating Temperature Range: 0°C to +70°C
- Low Output Distortion — ±10% Max.
- 5 ns to 100 ns Delay Range (other values available upon request)

ELECTRICAL SPECIFICATIONS

Total Delay: 5 to 100 ns
Tap Delays: 20% increments
Risetime: See Table 1
Characteristic Impedance: 50 to 100 ohms (±10%)
Attenuation: 5% maximum
Distortion: ± 10% maximum
Temperature Coefficient of Delay: 100ppm/°C max.

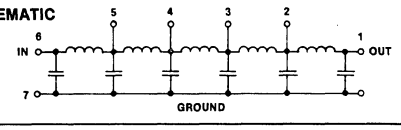
MECHANICAL SPECIFICATIONS

Case Configuration: See Dimension Drawing
Case Material: Molded Epoxy
Terminals: Flat, DIP-type (See Dimension Drawing)
Terminal Material: Kovar or equivalent, tin-plated
Potting: 100% filled with a two-component epoxy
Marking: Includes manufacturer's name, part number, and date code (See Dimension Drawing)

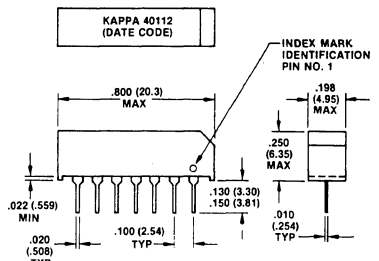
TABLE I

TOTAL DELAY (ns)	TAP DELAY (ns)	RISETIME (ns) MAX	DC RESISTANCE (Ω) MAX. PER IMPEDANCE (Ω)	
			50	100
5 ±0.5	1 ±0.3	2.0	0.3	0.5
10 ±1.0	2 ±0.4	3.3	0.5	1.0
20 ±1.5	4 ±0.6	6.0	0.8	1.5
30 ±2.0	6 ±1.0	9.0	1.2	2.5
40 ±2.5	8 ±1.5	12.0	1.8	4.0
50 ±3.0	10 ±1.8	15.0	2.3	5.0
60 ±3.5	12 ±2.0	18.0	2.5	
70 ±4.0	14 ±2.0	22.0	3.5	
80 ±4.5	16 ±2.0	24.0	4.2	
90 ±5.0	18 ±3.0	27.0	4.5	
100 ±5.0	20 ±3.0	28.0	5.2	

SCHEMATIC



MARKING & DIMENSIONS
In Inches and (mm)



PART NUMBER EXAMPLE

Typical part number is a combination of the Basic Series Number, Mounting Height Code, Delay Time, and Impedance

EXAMPLE: SP07CB10051

SP07C B 100 51

BASIC SERIES NUMBER

MOUNTING HEIGHT CODE

DELAY TIME: Expressed in nanoseconds (ns)
First two digits are significant figures.
Last digit specifies number of zeros to follow

IMPEDANCE: Expressed in ohms (Ω).
First digit is significant
Last digit specifies number of zeros to follow.

SERIES SP14 COMPUTER GRADE

14-PIN SIP DELAY LINE

NEW FOR 1983

FEATURES

- 14-Pin SIP Package
- Ten (10) Equally-Spaced Delay Taps
- Low Attenuation — 5% Maximum
- Optional Internal Termination

ELECTRICAL SPECIFICATIONS

Total Delay: 10 to 200 ns
Tap Delays: 10% Increments
Risetime: 20% maximum of total delay (see Table II)
Characteristic Impedance: 50 to 100 ohms (±10%)
Distortion: 10% maximum
Temperature Coefficient of Delay: 100ppm/°C max.
Operating Temperature Range: 0°C to +70°C
Storage Temperature Range: −55°C to +125°C

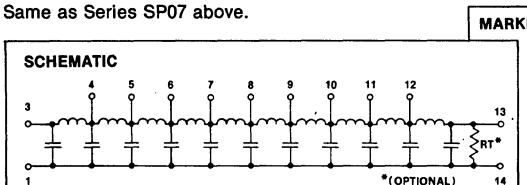
MECHANICAL SPECIFICATIONS

Same as Series SP07 above.

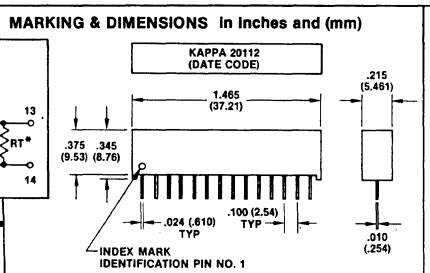
TABLE II

TOTAL DELAY (ns) ±5%	TAP DELAY (ns) ±10%	RISETIME (ns) MAX	DC RESISTANCE (Ω) MAX. PER IMPEDANCE (Ω)	
			50	100
100	1.0	2.0	1.0	
20	2.0	4.0	1.0	4.0
30	3.0	6.0	1.0	
40	4.0	8.0	1.0	4.0
50	5.0	10.0	1.0	
60	6.0	12.0	2.0	4.0
70	7.0	14.0	2.0	
80	8.0	16.0	2.0	4.0
90	9.0	18.0	2.0	
100	10.0	20.0	2.0	4.0
120	12.0	24.0		6.0
140	14.0	28.0		6.0
160	16.0	32.0		6.0
180	18.0	36.0		6.0
200	20.0	40.0		6.0

SCHEMATIC



MARKING & DIMENSIONS In Inches and (mm)



PART NUMBER EXAMPLE

Typical part number is a combination of the Basic Series Number, Mounting Height Code, Delay Time, and Impedance

EXAMPLE: SP14CD10051T

SP14C D 100 51 T

BASIC SERIES NUMBER

MOUNTING HEIGHT CODE

DELAY TIME: Expressed in nanoseconds (ns)
First two digits are significant figures.
Last digit specifies number of zeros to follow

IMPEDANCE: Expressed in ohms (Ω).
First digit is significant.
Last digit specifies number of zeros to follow.

INTERNAL TERMINATION: (OPTIONAL)

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CUSTOM MINIATURE & PRECISION DELAY LINES...

Optimization of Most Critical Parameters as Required.

Over the past two decades, **Kappa** has optimized, packaged, and critically tested literally thousands of specific variations of several hundred different passive and hybrid delay lines: fixed tapped, continuously adjustable, and electrically trimmable (varactor-tuned) lines; over virtually the complete signal spectrum from control (subaudio), through audio, sonar, RF, HF, and a wide variety of pulse rates widths and duty cycles.

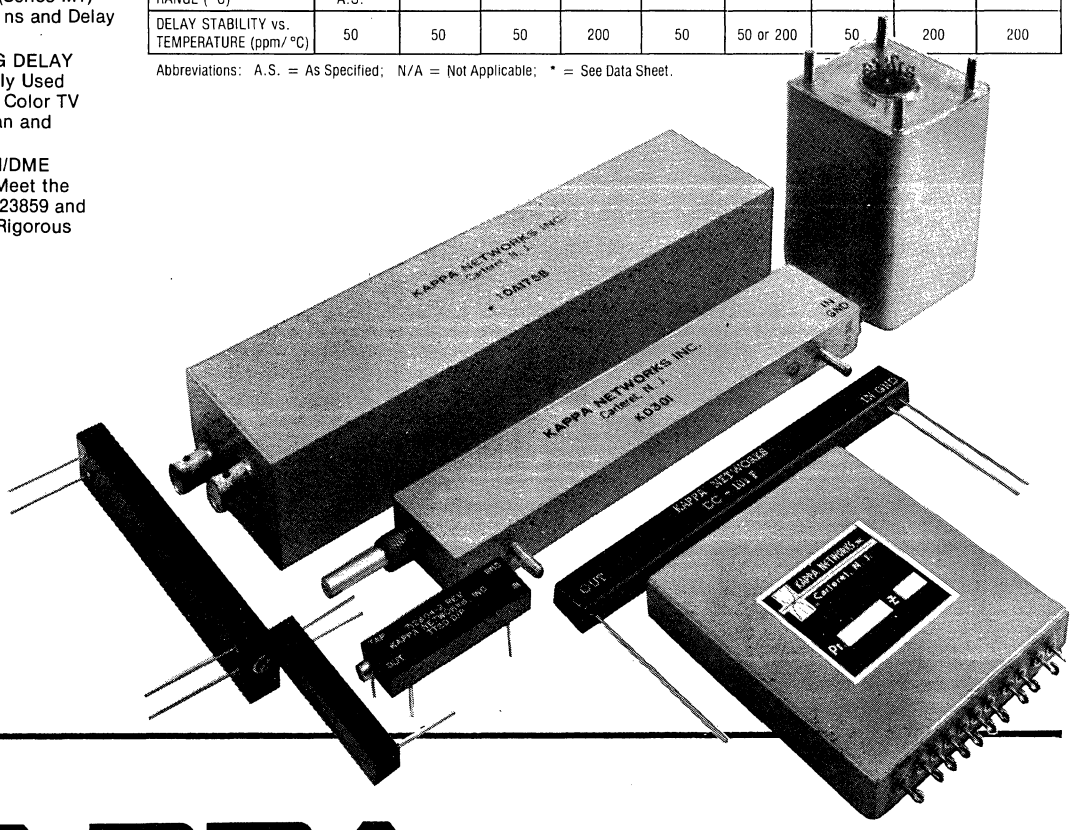
Typical design families include:

- PRECISION SONAR DELAY LINES (Series A) 500 μsec to 10^6 μsec ±1%; linear to ±0.05%
- LOW-DISTORTION LINES (Series D) Delay-to-Rise-time Ratio: 50 max.; Bandwidth: 50 MHz max.
- MINIATURE CONTINUOUSLY VARIABLE DELAY TRIMMERS (Series TT) Size: ¼ Cubic Inch; up to 120 ns; resolution ≤0.25 ns.
- SUPER-η™ DELAY LINES (Series H) Embody New Design Principle Providing the Highest Efficiency Yet Obtainable in Lumped-Constant Delay lines.
- MINITRIM DELAY LINE (Series MT) Resolution Less Than .5 ns and Delay Ranges Up to 300 ns.
- VIDEO BROADCASTING DELAY LINES (Series BC) Widely Used in the Most Demanding Color TV Applications in American and European Systems
- TRANSPONDER/TACAN/DME (Series C) Designed to Meet the Requirements of MIL-D-23859 and to Withstand the Most Rigorous Military Environments.

ELECTRICAL SPECIFICATIONS

DESCRIPTION	PRECISION AUDIO/SONAR	VIDEO BROADCAST	LOW DISTORTION	STD. DIST. CONSTANT	SUPER η	CONTINUOUS VARIABLE	STD. LUMPED CONSTANT	MINI ® TRIM	TINY ® TRIM
SERIES NUMBER	A	BC	D	DC	H	K	LC	MT	TT
DELAY RANGE (in microseconds)	500 to 10^6	.05 to 10	up to 100	up to 3	.5 to 500	up to .5	.05 to 10^6	up to .25	up to .12
STANDARD DELAY TOLERANCES (±%)	1	2	1	5	5	+10 −0	5	+10 −0	+10 −0
IMPEDANCE RANGE (in ohms)	500 to 10K	75	100 to 1K	300 to 2K	50 to 2K	100 to 1K	100 to 20K	50 to 1K	300 to 500
STANDARD IMPEDANCE TOLERANCES (±%)	5	2	5	10	5	10	5	10	10
DELAY RESOLUTION	N/A	N/A	N/A	N/A	N/A	> of .1% or 1 ns	N/A	.25ns	.25ns
DELAY-to-RISETIME RATIO (max.)	N/A	N/A	50	11	150	8	200	7	4
DELAY LINEARITY (±%)	.05 to .25	.025 to 1	.25	N/A	1	N/A	.5	N/A	N/A
BANDWIDTH (max.)	70 KHz	20 MHz	50 MHz	30 MHz	10 MHz	25 MHz	250 MHz	100 MHz	70 MHz
ATTENUATION (in dB)	A.S.	A.S.	A.S.	*	A.S.	*	A.S.	<.5 dB	<25 dB
DISTORTION (±%)	N/A	A.S.	.1 to 2	*	10	15	10	15	15
DIELECTRIC STRENGTH (VDC)	100	100	100	100 or A.S.	100 or A.S.	100 or A.S.	A.S.	100	100
OPERATING TEMP. RANGE (°C)	−55/+85 A.S.	−55/+125	−55/+125	−55/+125	−55/+125	−55/+125	−55/+125	−55/+125	−55/+125
DELAY STABILITY vs. TEMPERATURE (ppm/°C)	50	50	50	200	50	50 or 200	50	200	200

Abbreviations: A.S. = As Specified; N/A = Not Applicable; * = See Data Sheet.

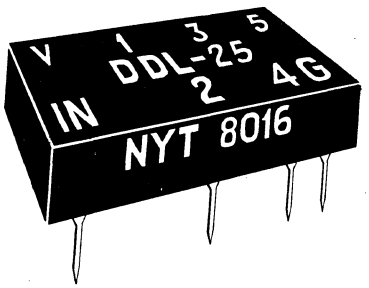


KAPPA NETWORKS, INC.

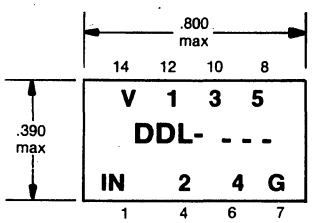
U.S.A. Factory Direct: 165 Roosevelt Ave., Carteret, NJ 07008, Phone (201) 541-1600, Toll Free 800-223-0603, Telex 139408, KAPPA CRET
West Coast Office: 300 Cypress Ave., Alhambra, CA 91801, Phone (213) 283-2048. West Coast Distributor: Phone (213) 283-2058.

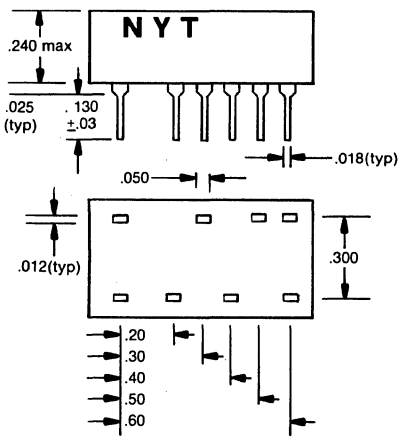
Nytronics Components Group, Inc.
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

ACTIVE DIGITAL DELAY LINE



Nytronics Components Group, Inc. Digital Delay Lines provide a solution to terminating, driving and loading problems traditionally associated with delay line applications.





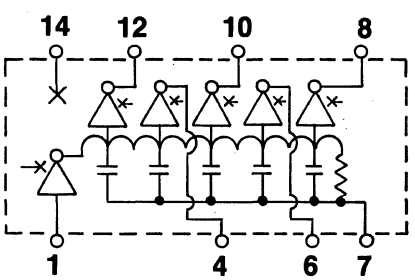
Eighteen (18) standard delay lines are offered ranging from 25ns to 500ns. Other combinations available include:

- Intermediate total delay values
- Non-symmetrical tapping points
- 2 or 3 delay lines per unit
- Closer tap and total delay tolerances
- Specified fall times and trailing edge delay times

Nytronics Components Group, Inc. Delay Line Engineering stands ready to help solve your delay line applications problems.

DIGITAL DELAY LINES FEATURE:

1) TTL Driven Inputs
2) TTL Bufrered Outputs
3) Internal Terminations
4) Low Profile Packages (.240″)
5) 14-Pin, DIP-IC Compatible
6) Output Rise Time 4.0ns max. (0.75v to 2.40v)



PART NUMBER	TOTAL DELAY (NS) (1) (2)	TAP DELAY (NS) (1) (2)	INPUT PULSE WIDTH (NS MINIMUM)
DDL-25	25	5	10
DDL-30	30	6	12
DDL-35	35	7	14
DDL-40	40	8	16
DDL-45	45	9	18
DDL-50	50	10	20
DDL-75	75	15	30
DDL-100	100	20	40
DDL-125	125	25	50
DDL-150	150	30	60
DDL-175	175	35	70
DDL-200	200	40	80
DDL-250	250	50	100
DDL-300	300	60	120
DDL-350	350	70	140
DDL-400	400	80	160
DDL-450	450	90	180
DDL-500	500	100	200

(1) Measured at 1.5V level leading edge; Vcc = 5.00VDC; No loads; at +25°C.
(2) Nominal delay, ±2NS or ±5%, whichever is greater; reference to input.

ELECTRICAL CHARACTERISTICS

(VIH) High-Level Input Voltage	2.0 to 5.0V
(IIH) High-Level Input Current	50ua Max.
(VIL) Low-Level Input Voltage	0.8V Max.
(IIL) Low-Level Input Current	−2ma Max.
(VOH) High-Level Output Voltage	2.4V Min.
(VOL) Low-Level Output Voltage	0.4V Max.
High-Level Output Drives	20 TTL Loads/Unit Max.
Low-Level Output Drives	10 TTL Loads/Tap Max. 20 TTL Loads/Unit Max.

RECOMMENDED OPERATING CONDITIONS

(Vcc) Supply Voltage	5.00 ±0.25VDC
(Icc) Supply Current	60ma (typ.)
(TRin) Input Rise Time	3ns.
(TWin) Input Pulse Width	40% of Delay
(Ein) Input Pulse Voltage	3.20VDC
Operating Temperature	0°C to 70°C
Storage Temperature	−55°C to +125°C

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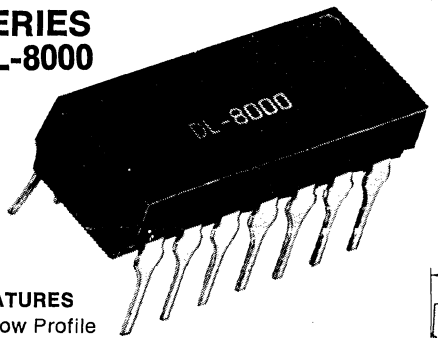
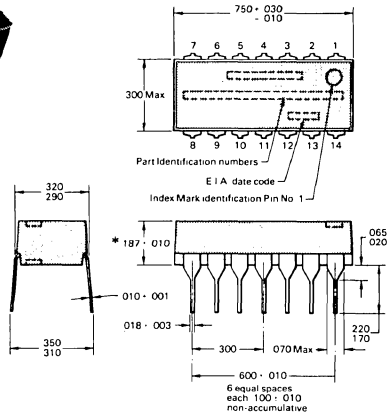
ORANGE STREET, DARLINGTON, S. C. 29532
(803) 393-5421 — TWX 810-665-2182

LUMPED CONSTANT DELAY LINE

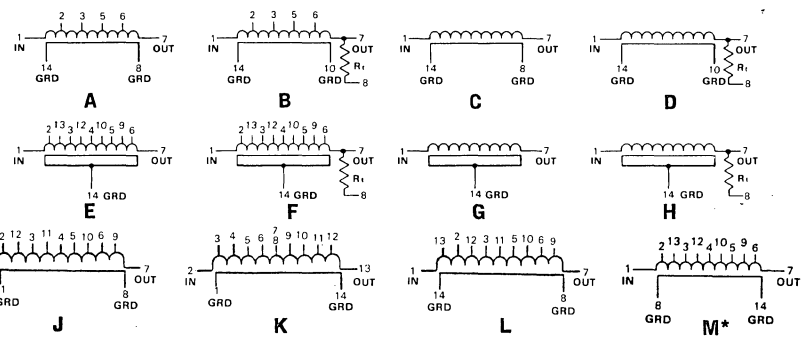
SERIES DL-8000





FEATURES

- Low Profile
- 14-Lead, DIP-IC Compatible Packages
- Standard Delay Times from 5 nsec to 500 nsec
- Standard Impedances of 50, 100, 200, 360 and 500 ohms
- Standard and Special Attenuations
- Easy to Order Special Models
- Drift Elimination by Lumped Constant Design
- Meets or Exceeds Applicable Requirements of MIL-STD-202 and MIL-STD-833
- Epoxy Transfer Molding for Cost/Delivery Time Savings
- Economy and Prompt Delivery on Standard Models
- High Reliability, Precision Performance, Broad Temperature Range Stability, Long Storage and Operational Life



R_t = Terminating Resistor (value of Z_o) ±5%, ⅛ watt, carbon.

Taps in equal increments of total delay.

* BUILT TO MEET MILITARY SPECIFICATION MIL-D-23859/23C

HOW TO ORDER

To allow the greatest possible range of parameters, the following ordering system should be followed on both standard and special orders.

Example: DL-8000-045-09-100-05 A
14-Pin Lumped Constant Dual In-Line Delay Line, 45 nsec T_d, 9 nsec T_r, 100 ohm impedance, 5% (Max.) attenuation, internal configuration "A."

DL-8000 045 09 100 05 A

PLACE 1
Base No. DL-8000 = 14-pin, Lumped Constant Dual In-Line Delay Lines (6 characters and dash)

PLACE 2
Delay Time (T_d)
Standard Models:
005 = 5 nsec, 050 = 50 nsec.
150 = 150 nsec, etc., from above table (3 digits)
Special Orders:
Enter full 3-digit nsec value (e.g., 075)

PLACE 3
Rise Time (T_r)
Standard Models:
Enter nsec digit
Value from table
(e.g., 2.0, 6.5, 40)
Special Orders:
Enter desired rise time in nsec (2 or more digits)

PLACE 4
Impedance (Z_o)
Standard Models:
050 = 50 ohms, 200 = 200 ohms
100 = 100 ohms, 360 = 360 ohms
(3 digits)
Special Orders:
Enter full 3-digit Ohm value (e.g., 075)

PLACE 5
Attenuation
Standard Models:
Enter 2-digit percent value from table (e.g., 05, 10)
Special Orders:
Enter Max. allowable percent attenuation (2 digits)

PLACE 6
Internal Configuration
Enter Schematic reference Letters (1 letter)

Formerly Manufactured By McGraw-Edison Comp.: Edison Electronics Division
DAVEN DESIGN

Insulation Resistance: 100,000 megohms at 25°C.

Dielectric Withstanding Voltage 250VDC @ 50 milliamps, 5 sec Min.

Temperature Coefficient (Typ.): 100ppm/°C.

STANDARD DL-8000 MODELS

Delay Time (T_d), nsec*	Rise Time (T_r), Max nsec	% Attenuation Max Per Impedance†				
		50 ohms	100 ohms	200 ohms	360 ohms	500 ohms
5	02	3	5	5	5	7
10	03	3	5	5	5	7
15	04	3	5	5	5	7
20	05.5	3	5	5	5	7
25	05	3	5	5	5	7
30	06.5	3	5	5	5	7
35	07	3	5	5	5	7
40	08	3	5	5	5	7
45	09	3	5	5	5	7
50	10	3	5	5	5	7
55	11	3	5	5	5	7
60	12	3	5	5	5	7
65	13	3	5	5	5	7
70	14	3	5	5	5	7
75	15	3	5	5	5	7
80	16	3	5	5	5	7
85	17	3	5	5	5	7
90	18	3	5	5	5	7
95	19	3	5	5	5	7
100	20	3	5	5	5	7
110	22	3	5	6	7	8
120	24	3	5	6	7	8
130	26	3	5	6	7	8
140	28	3	5	6	7	8
150	30	3	5	6	7	8
160	32	3	5	6	7	8
170	34	3	5	6	7	8
180	36	3	5	6	7	8
190	38	3	5	6	7	8
200	40	3	5	6	7	8
210	45	5	5	6	7	8
220	45	5	5	6	7	8
230	50	5	5	6	7	8
240	50	5	5	6	7	8
250	50	5	5	6	7	8
260	55	5	5	6	7	8
270	55	5	5	6	7	8
280	60	5	5	6	7	8
290	60	5	5	6	7	8
300	60	5	5	6	7	8
310	65	5	7	8	10	10
320	65	5	7	8	10	10
330	70	5	7	8	10	10
340	70	5	7	8	10	10
350	70	5	7	8	10	10
360	75	5	7	8	10	10
370	75	5	7	8	10	10
380	80	5	7	8	10	10
390	80	5	7	8	10	10
400	80	5	7	8	10	10
410	85	5	8	10	10	10
420	85	5	8	10	10	10
430	90	5	8	10	10	10
440	90	5	8	10	10	10
450	90	5	8	10	10	10
460	95	5	8	10	10	10
470	95	5	8	10	10	10
480	100	5	8	10	10	10
490	100	5	8	10	10	10
500	100	5	8	10	10	10

* ±5% Tolerance for 40 through 500 nsec T_d.
2 nsec for 5 through 40 nsec T_d.

† ±10% Impedance Tolerance.

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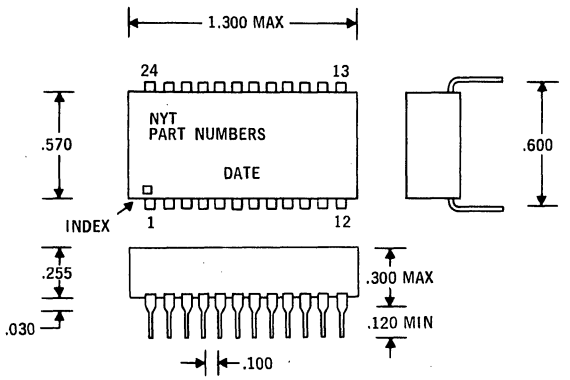
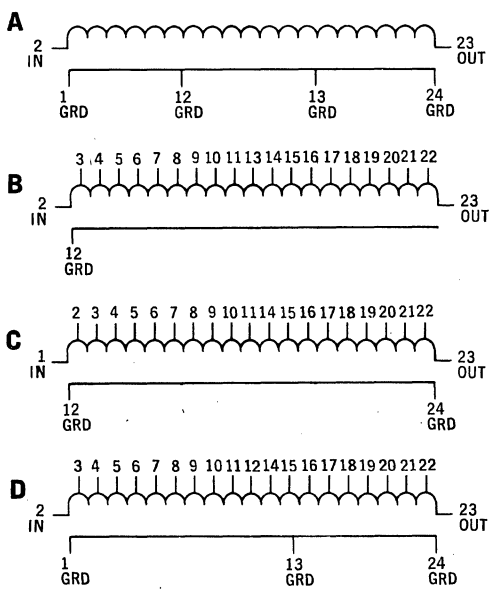
DELAYS TO 7000 ns
FAST RISE TIMES

DL-2400 SERIES

FEATURES

- Standard 24 Pin Dip
- Epoxy Encapsulated
- Operating Temp. −55°C to +125°C
- Hi-Pot = 100VDC
- Up to 20 Outputs
- Temp. Coeff. of Delay
  Up to 1000ns = 100ppm/°C
  Above 1000ns = 200ppm/°C
- Easy to Order Specials
- 1%, 2%, and Other Tolerances Available
- Many Other Delays, Impedances, and Rise Times Available
- Many Other Schematics Available





Delay Time (Td), nsec*	Rise Time (Tr), Max nsec	% Attenuation Max. per Impedance†				
		50 ohms	100 ohms	200 ohms	360 ohms	500 ohms
50	5	6	6	8	—	—
100	10	6	8	8	8	8
150	15	8	8	8	8	8
200	20	8	8	8	8	10
250	25	8	8	8	10	10
300	30	8	8	8	10	10
400	40	8	8	10	10	10
500	50	8	8	10	10	10
600	60	8	8	10	10	10
700	70	8	8	10	10	10
800	80	8	10	10	10	15
900	90	8	10	10	10	15
1000	100	8	10	10	10	15
1500	150	—	10	10	15	15
2000	200	—	10	15	15	15
3000	300	—	—	15	15	15
4000	400	—	—	15	15	15
5000	500	—	—	—	15	15
6000	600	—	—	—	15	—
7000	700	—	—	—	15	—

* ±5% Tolerance
† ±10% Impedance Tolerance.
Taps in equal increments of total delay.

HOW TO ORDER

To allow the greatest possible range of parameters, the following ordering system should be followed on both standard and special orders.

EXAMPLE: DL-2400-1000-100-100-10A

24-Pin Lumped Constant Dual In-Line Delay Line, 1000 nsec Td, 100 nsec Tr, 100 ohm impedance, 10% (Max.) attenuation, internal configuration "A".

DL-2400 — 1000 — 100 — 100 — 10 — A

PLACE 1
Base No. DL-2400 24-Pin, Lumped Constant Dual In-Line Delay Lines (6 Characters and dash)

PLACE 2
Delay Time (Td)
Standard Models:
005 = 5 nsec, 050 = 50 nsec, 150 = 150 nsec, 1500 = 1500 nsec, etc., from above table (3 digits or more)

PLACE 3
Rise Time (Tr)
Standard Models:
Enter nsec digit Value from table (e.g. 05, 50, 500, etc.)
Special Orders:
Enter desired rise time in nsec (2 or more digits)

PLACE 4
Impedance (Z_o)
Standard Models:
050 = 50 ohms, 200 = 200 ohms, 100 = 100 ohms, 360 = 360 ohms (3 digits)
Special Orders:
Enter full 3-digit Ohm value (e.g. 075)

PLACE 5
Attenuation
Standard Models:
Enter 2-digit percent value from table (e.g., 06, 10)
Special Orders:
Enter Max. allowable percent attenuation (2 digits)

PLACE 6
Internal Configuration
Enter Schematic reference Letters
A, B, C or D (1 letter)

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

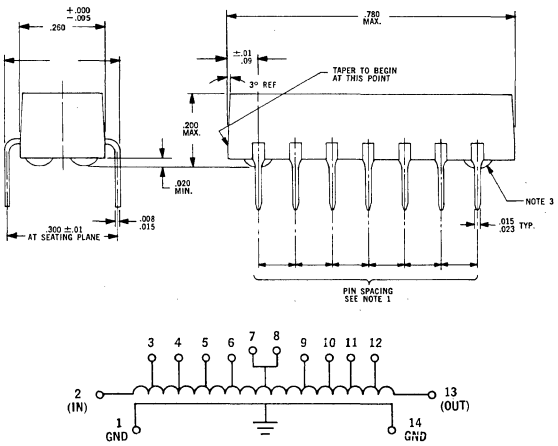
Technitrol, Inc.

PASSIVE DELAY LINES
DUAL-IN-LINE

Part No.	Delay* (NS)	Rise Time (NS-Max)	Impedance (Ohms) ±10%	DCR (Ohms Max.)	Tap Delay (NS)
LF10D1	10	2.2	100	1.0	1.0
LF10E1	12.5	2.5	100	1.0	1.25
LF10F1	20	4.0	100	1.5	2.0
LF10G1	25	5.0	100	1.5	2.5
LF10K1	50	10.0	100	2.5	5.0
LF10M1	100	20.0	100	5.0	10.0
LF10P1	200	40.0	100	11.5	20.0

* Tolerance: ±5%, or ±2 NS W.I.G.
Also available in 50 ohm, 200 ohm impedance.
Other values of delay, taps on application.

DISTORTION: Pre-Pulse ±10% Max.
Pulse ±10% Max.
INSULATION RESISTANCE: 10K megohms at 100 VDC
HIPOT: 100 VDC
TEMPERATURE COEFFICIENT: 100 PPM/°C
TEMPERATURE RANGE: −55°C to +125°C



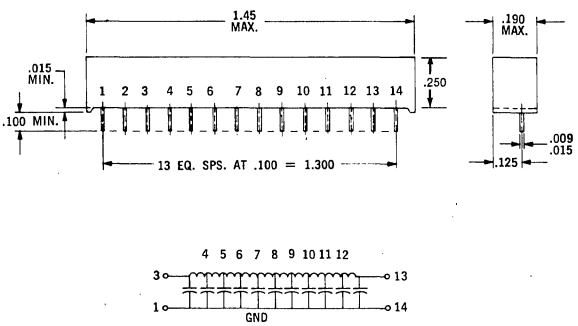
Lead material Kovar tintillate plated

SINGLE-IN-LINE DELAY LINE

Part No.	Delay* (NS)	Rise Time (NS-Max)	Impedance (Ohms) ±10%	DCR (Ohms Max.)	Tap Delay (NS)
SF10D1	10	2.0	100	1.0	1.0
SF10F1	20	4.0	100	1.0	2.0
SF10G1	25	5.0	100	1.0	2.5
SF10K1	50	10.0	100	1.5	5.0
SF10M1	100	20.0	100	3.2	10.0
SF10J1	200	40.0	100	4.1	20.0
SF10Q1	250	50.0	100	5.0	25.0
SF10R1	500	100.0	100	7.5	50.0
SF10S1	1000	200.0	100	10.0	100.0

* Tolerance: ±5%, or ±2 NS W.I.G.
Also available in 50, 75, 200 ohm characteristic impedance, typical distortion ±10% max.

INSULATION RESISTANCE: 10K megohms at 100 VDC
HIPOT: 100 VDC
TEMPERATURE COEFFICIENT: 100 PPM/°C
TEMPERATURE RANGE: −55° to +125°C



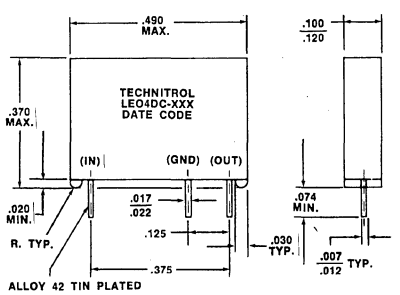
Lead material Kovar tintillate plated
Standoff configuration may vary.

SLIM PAC DELAY LINE

Part No.	Delay (NS) ±.5 NS	Rise Time (NS) Max.
LE04DC-05	.5	2.0
LE04DC-10	1.0	2.0
LE04DC-15	1.5	2.0
LE04DC-20	2.0	3.0
LE04DC-25	2.5	3.0
LE04DC-30	3.0	3.0
LE04DC-35	3.5	3.0
LE04DC-40	4.0	3.0
LE04DC-45	4.5	3.0
LE04DC-50	5.0	3.5
LE04DC-55	5.5	3.5
LE04DC-60	6.0	3.5
LE04DC-65	6.5	3.5
LE04DC-70	7.0	3.5
LE04DC-75	7.5	4.0
LE04DC-80	8.0	4.0
LE04DC-100	10.0	4.0

ELECTRICAL CHARACTERISTICS

- Impedance (Z_O): 93 ohms ± 10%
- Input Rise Time: 1 NS max.
- RDC: 1 ohm max.
- Hi Pot: 50 VDC max.
- Temperature Coefficent: 100 PPM/°C max.
- Insulation Resistance: 10 KMΩ min.
- Also available (Z_O): 50, 100, 150Ω



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Specialists in transformers and completely transfer molded, welded DIP delay lines under 3/16" high

Technitrol, Inc.

CHIP CARRIER DELAY LINE

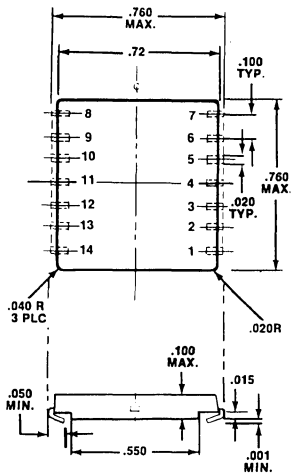
Part No.	Total Delay T_D (NS)	Rise Time T_R (NS)	RDC (ohms)
CF10D1	10.0	2.2	1.0
CF10F1	20.0	4.0	2.0
CF10G1	25.0	5.0	3.0
CF10K1	50.0	10.0	5.0
CF10M1	100.0	20.0	8.0
CF10N1	125.0	25.0	9.0
CF10P1	150.0	30.0	10.0
CF10Q1	200.0	40.0	12.0

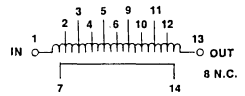
ELECTRICAL CHARACTERISTICS

- Impedance (Z_O): 100 ohms ±10%
- Tap Delay: Every 10% of total delay
- Distortion: ±10%
- Temperature Coefficient (T_D): 100 PPM/°C
- Delay Tolerance: ±1.0 NS or 5% W.I.G.
- Input Pulse Width: Minimum 3 times output rise time
- Input Rise Time: 2 NS maximum
- Also available: 50 ohm and 200 ohm impedance

FEATURES

- Compact module .10″ high
- Ten tap line provides delays from 10 NS to 200 NS
- Designed to use with TTL logic
- Can be mounted in standard chip carrier socket
- Designed for surface mounting using reflow soldering
- Military temperature range −55°C to +125°C





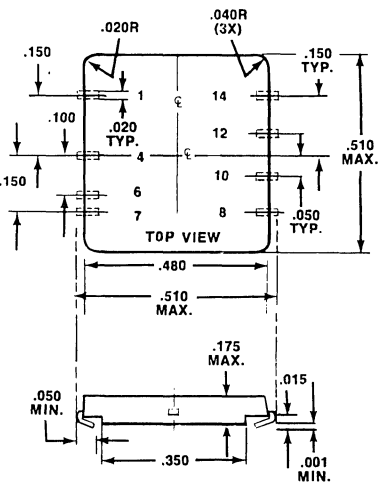
Also available in
¾ sq. x .100 for 0° to +70°C
¾ sq. x .175 for −55°C to +125°C

CHIP CARRIER TTL DELAY MODULE

CHIP CARRIER TTL DELAY MODULE CHARACTERISTICS

Part No.	NANOSECONDS T_D1	T_D2	T_D3	T_D4	T_D5	All Taps (Max.) T_R+	T_R-
BTTLDL020	10.0	12.5	15.0	17.5	20.0	2.0	2.0
BTTLDL025	5.0	10.0	15.0	20.0	25.0	2.0	2.0
BTTLDL050	10.0	20.0	30.0	40.0	50.0	2.0	2.0
BTTLDL075	15.0	30.0	45.0	60.0	75.0	2.0	2.0
BTTLDL100	20.0	40.0	60.0	80.0	100.0	2.0	2.0
BTTLDL125	25.0	50.0	75.0	100.0	125.0	2.0	2.0
BTTLDL150	30.0	60.0	90.0	120.0	150.0	2.0	5.0
BTTLDL200	40.0	80.0	120.0	160.0	200.0	2.0	5.0

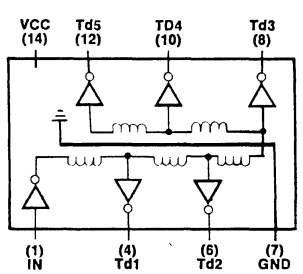
Delay Characteristics @ V_{CC} = 5.0V, 25°C no load
Delay Tolerance ±2 NS or 5% whichever is greater



Recommended Operating Conditions	Min.	Typ.	Max.	Unit
Supply Voltage V_{CC} Operating Free Air	4.5	5.0	5.5	Volts
Temperature Range	0	25	70	°C

OTHER AVAILABLE MODULES

- **Standard commercial** — (listed) Commercial grade IC's (plastic package), temperature range 0° to +70°C.
- **Commercial with additional testing** — Per customer specification; add suffix "MY" to part number.
- **Military** — Temperature range −55°C to +125°C, ceramic package IC to meet MIL-STD-883 but not screened to that specification. Add suffix "M" to part number.
- **Military Hi-Rel** — Temperature range −55°C to +125°C, ceramic package IC meeting MIL-STD-883 and 38510/Mach IV program screened and burned in; add suffix "MX" to part number.
- **Low power Schottky** — LS hex inverters used.
- **Single output versions** — No taps.
- **Multiple (up to 3) individual lines per module** — Can be same or different delays.
- **Unequal taps** — Within a single line.
- **Programmable delay modules**



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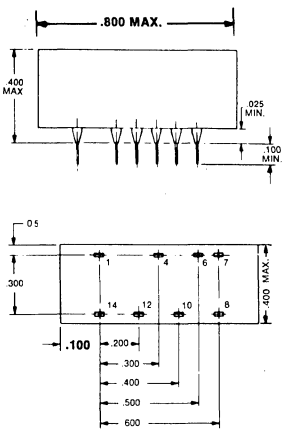
Technitrol, Inc.

HIGH PERFORMANCE TTL DELAY MODULE STANDARD 5 TAP

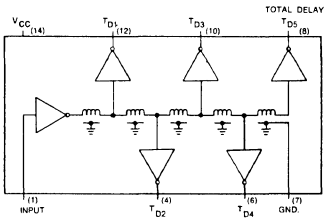
DELAY CHARACTERISTICS

Part No.	NANOSECONDS T_{D1}	T_{D2}	T_{D3}	T_{D4}	T_{D5}	All Taps T_R+ & T_R-
TTLDL020	10.0 ±1.5	12.5 ±1.5	15.0 ±1.5	17.5 ±1.5	20.0 ±1.5	≤2.0 ≤2.0 nsec.
TTLDL025	5.0 ±1.5	10.0 ±1.5	15.0 ±1.5	20.0 ±1.5	25.0 ±1.5	≤2.0 ≤2.0 nsec.
TTLDL050	10.0 ±1.5	20.0 ±1.5	30.0 ±1.5	40.0 ±2.0	50.0 ±2.5	≤2.0 ≤2.0 nsec.
TTLDL075	15.0 ±1.5	30.0 ±1.5	4.50 ±2.25	60.0 ±3.0	75.0 ±3.75	≤2.0 ≤2.0 nsec.
TTLDL100	20.0 ±1.5	40.0 ±2.0	60.0 ±3.0	80.0 ±4.0	100.0 ±5.0	≤2.0 ≤2.0 nsec.
TTLDL125	25.0 ±1.5	50.0 ±2.5	75.0 ±3.75	100.0 ±5.0	125.0 ±6.25	≤2.0 ≤2.0 nsec.
TTLDL150	30.0 ±1.5	60.0 ±3.0	90.0 ±4.5	120.0 ±6.0	150.0 ±9.0	≤2.0 ≤5.0 nsec.
TTLDL200	40.0 ±2.0	80.0 ±4.0	120.0 ±6.0	160.0 ±8.0	200.0 ±10.0	≤2.0 ≤5.0 nsec.
TTLDL250	50.0 ±2.5	100.0 ±5.0	150.0 ±7.5	200.0 ±10.0	250.0 ±12.5	≤2.0 ≤5.0 nsec.
TTLDL500	100.0 ±5.0	200.0 ±10.0	200.0 ±15.0	400.0 ±20.0	500.0 ±25.0	≤2.0 ≤9.0 nsec.

Delay Characteristics @ V_{cc} = 5.0V, 25°C no load



Recommended Operating Conditions	Min.	Typ.	Max.	Unit
Supply Voltage V_{cc}	4.5	5.0	5.5	Volts
Operating Free Air Temp. Range	0	25	75	°C



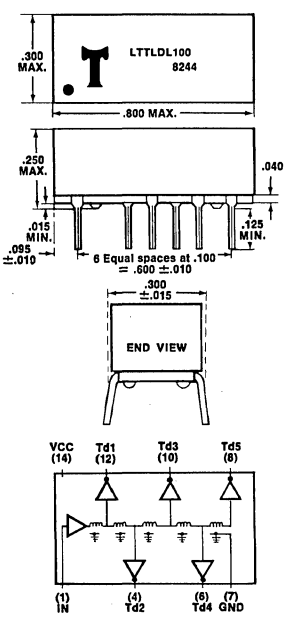
CONNECTION DIAGRAM
5 TAP VERSION

STANDARD TTL DELAY MODULE

LOW PROFILE TTL DELAY MODULE CHARACTERISTICS

Part No.	NANOSECONDS T_{D1}	T_{D2}	T_{D3}	T_{D4}	T_{D5}	All Taps (Max.) T_R+	T_R-
LTTLDL025	5.0	10.0	15.0	20.0	25.0	2.0	2.0
LTTLDL050	10.0	20.0	30.0	40.0	50.0	2.0	2.0
LTTLDL075	15.0	30.0	45.0	60.0	75.0	2.0	2.0
LTTLDL100	20.0	40.0	60.0	80.0	100.0	2.0	2.0
LTTLDL125	25.0	50.0	75.0	100.0	125.0	2.0	2.0
LTTLDL150	30.0	60.0	90.0	120.0	150.0	2.0	5.0
LTTLDL200	40.0	80.0	120.0	160.0	200.0	2.0	5.0
LTTLDL250	50.0	100.0	150.0	200.0	250.0	2.0	5.0
LTTLDL500	100.0	200.0	200.0	400.0	500.0	2.0	9.0

Delay Characteristics @ V_{cc} = 5.0V, 25°C no load
Delay Tolerance ±2 NS or 5% whichever is greater



Recommended Operating Conditions	Min.	Typ.	Max.	Unit
Supply Voltage V_{cc}	4.5	5.0	5.5	Volts
Operating Free Air Temp. Range	0	25	70	°C

TTL DELAY MODULES

TTL Delay Modules are designed to be used directly with super high speed TTL, standard TTL, and DTL logic circuits. They provide many timing applications without any or with minimum interface.

TTL Delay Modules can be cascaded to get any combination of delay without degrading output rise time (T_R+ or T_R-). The delay to rise time ratio (T_D/T_R) of individual modules is very high (approximately 50:1) and improves with cascading modules.

Output rise times of each module are independent of input rise times up to 50 nsec. TTL Delay Modules are encapsulated by transfer molding. They are pin compatible with 74/54 Series TTL/SSI 14 Lead DIP Circuits.

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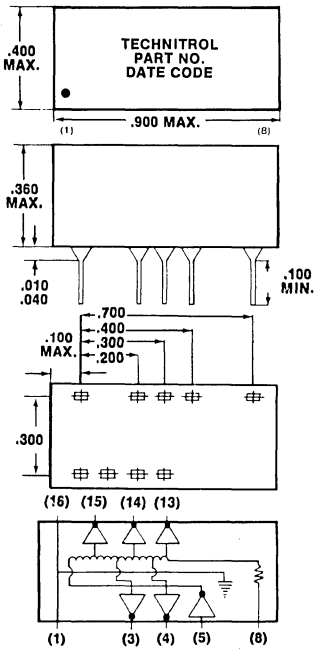
Technitrol, Inc.

ECL DELAY MODULE

DELAY CHARACTERISTICS

Part No.	NANOSECONDS T_D1	T_D2	T_D3	T_D4	T_D5	All Taps (Max.) T_R+	T_R-*
ECLDL025	5 ±1	10 ±1	15 ±1	20 ±1	25 ±1	4	4
ECLDL050	10 ±1	20 ±1	30 ±1.5	40 ±2	50 ±2.5	4	4
ECLDL075	15 ±1	30 ±1.5	45 ±2	60 ±3	75 ±3.75	5	5
ECLDL100	20 ±1	40 ±2	60 ±3	80 ±4	100 ±5	6	6
ECLDL125	25 ±1	50 ±2.5	75 ±3.75	100 ±5	125 ±6.0	7	7
ECLDL150	30 ±1.5	60 ±3.0	90 ±4.5	120 ±6	150 ±7.5	7	7
ECLDL200	40 ±2	80 ±4	120 ±6	160 ±8	200 ±10	8	8
ECLDL250	50 ±2.5	100 ±5	150 ±7.5	200 ±10	250 ±12.5	10	10
ECLDL300	60 ±3	120 ±6	180 ±9	240 ±12	300 ±15	15	15
ECLDL350	70 ±3.5	140 ±7	210 ±10.5	280 ±14	350 ±17.5	15	15
ECLDL400	80 ±4	160 ±8	240 ±12	320 ±16	400 ±20	15	15
ECLDL450	90 ±4.5	180 ±9	270 ±13.5	350 ±18	450 ±22.5	20	20
ECLDL500	100 ±5	200 ±10	300 ±15	400 ±20	500 ±25	20	20

* T_R = Measured from 20% to 80%



ELECTRICAL CHARACTERISTICS

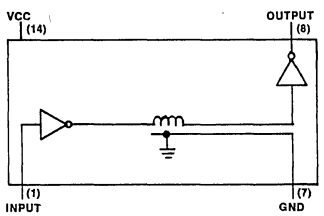
Over operating temperature range and Vee = −5.2 ±0.01V with 500 liner FPM air flow and all output terminals with 50 to −2.0 VDC.

Symbol	Parameter	Min.	Max.	Unit	Test Conditions
I_{EE}	Supply Current		75	MA	
I_{IH}	Input Current HIGH		425	MA	V_{IH} = −.810V
I_{LH}	Input Current LOW	.5		MA	V_{IL} = −1.850V
V_{OH}	Logic "1" Output Voltage	−1.060	−0.700	VDC	V_{IH} = −0.810
V_{OL}	Logic "O" Output Voltage	−1.890	−1.615	VDC	V_{IL} = −1.850

All specifications are subject to change without notice.

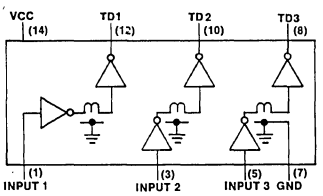
Recommended Operating Conditions	Min.	Typ.	Max.
Vee	−5.72	−5.2	−4.68
Operating Temp Range With Airflow 500 LFPM	−30°C	25°C	80°C
Fan Out			85 ECL Loads

SINGLE OUTPUT



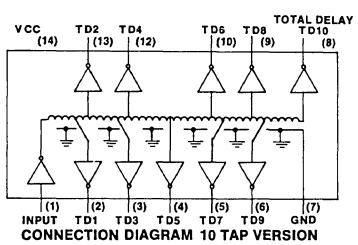
Buffered delay lines available from 5 NS to 500 NS only pins used brought out specification similar to standard 5 tap units.
Part Number TTLISXXX XXX = Delay, 025 etc.

TRIPLE OUTPUT



Delay Modules are now available in 10 tap versions from 50 to 500 NS total delay. Specifications are comparable to the standard 5 tap units. The physical outline is the same as the 5 tap with the exception of 5 additional pins as noted in the connection diagram.
Part Number TTL3SXXX, = Delay.

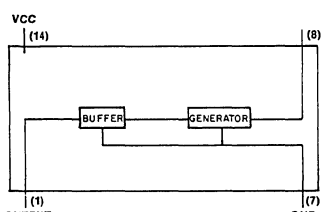
TEN TAP



CONNECTION DIAGRAM 10 TAP VERSION

TTL buffered delay lines available with 3 individual inputs and outputs in delays from 5 NS to 250 NS (each delay).
Part Number TTLDDXXX, XXX = Delay each section.

SQUARE WAVE OSCILLATOR



TTL Square Wave Oscillators are available in the range of 2 MHz to 100 MHz. Frequency tolerance ±2%. Physical outline same as 5 tap standard TTL delay line.
Part Number TTLOSXXX, XXX = Frequency.

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EEM PRODUCT SELECTION GUIDES

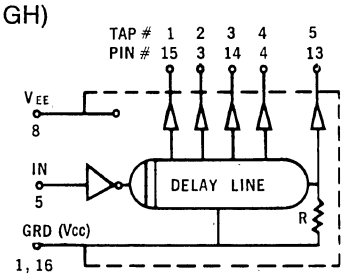
Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

valor 30 YEAR ANNIVERSARY (1953-1983) ELECTRONICS, INC.

DELAY LINES

ECL DIGITAL DELAY LINES 16 PIN DIP PACKAGE (.400 WIDE x .800 LONG x .300 HIGH)

- ECL 10K compatible, input and output buffered
- Delay tolerance ±5% or ±2 Ns whichever is greater
- Typical delays shown — other delays available
- 20% taps; 70 ECL fan-out capacity
- Fast rise time on all outputs — 4 Ns typ.
- Operating temperature range −30°C to +85°C
- Supply voltage − 5.2 VDC



Pull down resistor on output taps not provided inside unit.

Part Number	Total Delay (Ns)	Delay Per Tap (Ns)
DE-0010	10	2
DE-0025	25	5
DE-0050	50	10
DE-0100	100	20
DE-0150	150	30
DE-0200	200	40
DE-0250	250	50
DE-0500	500	100
DE-1000	1000	200

TTL DIGITAL DELAY LINES 10 TAP AND 5 TAP

SPECIFICATIONS

Supply Voltage: 4.75 to 5.25V

Supply Current: 120 mA max. (10 Tap), 65 mA max. (5 Tap)

Input Pulse: +3.2V

Input Rise Time: 3 Ns

Pulse width: Min. 25% of total delay (10 Tap); 80% (5 Tap)

Schottky TTL buffered

Output Rise Time: 4 Ns Typ.

Operating Temp. Range: 0°C/70°C standard (−55°C/125°C available)

Logic 0 loading: 10 TTL loads/Tap max.

Logic 1 loading: 20 TTL loads/Tap max.

PIN CONNECTIONS
14 PIN DIP
(10 TAP)
1 Input
13 10% Delay
3 20% Delay
12 30% Delay
4 40% Delay
11 50% Delay
5 60% Delay
10 70% Delay
6 80% Delay
9 90% Delay
8 Output
7 Ground
14 Vcc

10 Tap Digital Delay Lines in 14 Pin Package

Valor P/N	Total Delay Nsec ±5%	Delay/Tap Nsec (1)(2)
DL-2181	50	5
DL-2182	100	10
DL-2183	150	15
DL-2184	200	20
DL-2185	250	25
DL-2186	300	30
DL-2187	350	35
DL-2188	400	40
DL-2189	500	50

PIN CONNECTIONS
16 PIN DIP
1 Input
14 20% Delay
4 40% Delay
12 60% Delay
6 80% Delay
10 Output
8 Ground
16 Vcc

5 Tap TTL/DTL Digital Delay Lines 16 Pin DIP

Valor P/N	Total Delay Nsec ±5%	Delay/Tap Nsec (1)(2)
DL-1803	25	5
DL-1804	50	10
DL-1805	100	20
DL-1806	150	30
DL-1807	200	40
DL-1808	250	50
DL-1809	500	100

PIN CONNECTIONS
14 PIN DIP
(5 TAP)
1 Input
12 20% Delay
4 40% Delay
10 60% Delay
6 80% Delay
8 Output
7 Ground
14 Vcc

5 Tap TTL Digital Delay Lines 14 Pin DIP

Valor P/N	Total Delay Nsec ±5%	Delay/Tap Nsec (1)(2)
DL-1883	25	5
DL-1884	50	10
DL-1885	100	20
DL-1886	150	30
DL-1887	200	40
DL-1888	250	50
DL-1889	500	100

PACKAGE DIMENSIONS FOR TTL LINES .400 WIDE x .800 LONG x .300-.325 HIGH

PASSIVE DELAY LINES 14 PIN DIP

- PRECISION DELAYS
- 10 TAPS
- 14 PIN DIP PACKAGE
- TTL, ECL COMPATIBLE

SPECIFICATIONS

Temperature: −55°C to +125°C

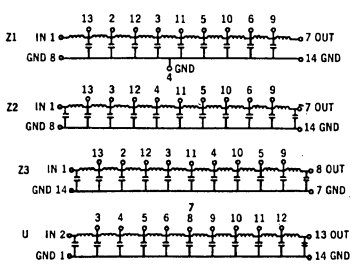
Voltage: Test —100 volts dc max.
Working — 50 volts dc max.

Delay Time: Td ±5%

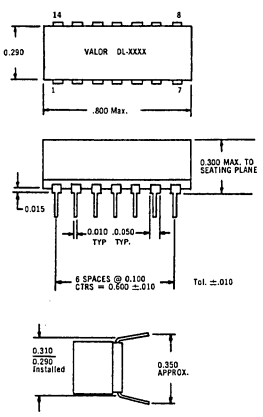
Impedance Zo: ±10%

Temp. Coefficient of Delay: 50 ppm typ.

TERMINATIONS



PACKAGE OUTLINE



Lumped Constant Delay Lines 14 Pin DIP

Part No.	Total Delay Nsec	Tap to Tap Nsec	Impedance Zo ohms	Rise Time Nsec Max.	Dist. % Max.	Attn. % Max.	Termination
DL-1717	10	1.0 ± .25	50	3.0	10	1	Z1
DL-1721	20	2.0 ± .5	50	4.5	10	2	Z2
DL-1619	50	5.0 ±1.0	50	8.5	10	4	U
DL-1706	10	1.0 ± .25	100	3.5	10	1	Z2
DL-1715	20	2.0 ± .5	100	4.5	10	2	Z2
DL-1707	25	2.5 ± .5	100	5.0	10	2	Z2
DL-1708	50	5.0 ±1.0	100	7.5	10	2	Z2
DL-1598	50	5.0 ±1.0	100	8.5	10	2	U
DL-1720	75	7.5 ±1.5	100	12.5	10	4	U
DL-1586	80	8.0 ±2	100	13.0	10	4	Z3
DL-1595	100	10.0 ±2	100	14.0	10	10	Z3
DL-1597	100	10.0 ±2	100	17.0	10	5	U
DL-1716	100	10.0 ±2	100	15.0	10	5	Z2
DL-1709	125	12.5 ±2	100	21.0	10	5	U
DL-1704	150	15.0 ±2	100	25.0	10	5	U
DL-1848	150	15.0 ±2	100	25.0	10	5	Z2
DL-1893	200	20.0 ±3	100	34.0	10	10	U
DL-1601	250	25.0 ±3	100	42.0	10	12	U

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CAPITAL OF THE WORLD

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For technical assistance, call 613-392-2581.

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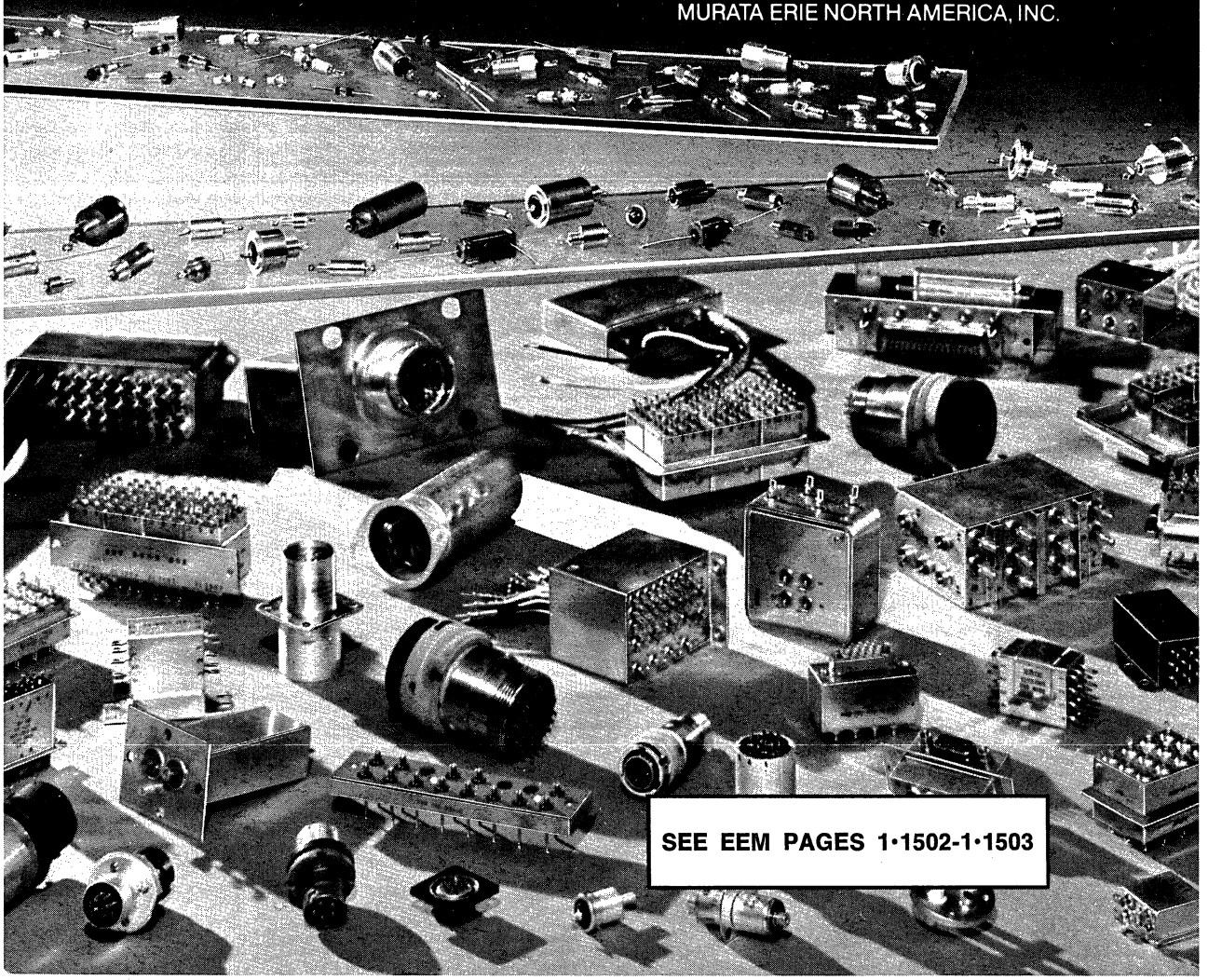


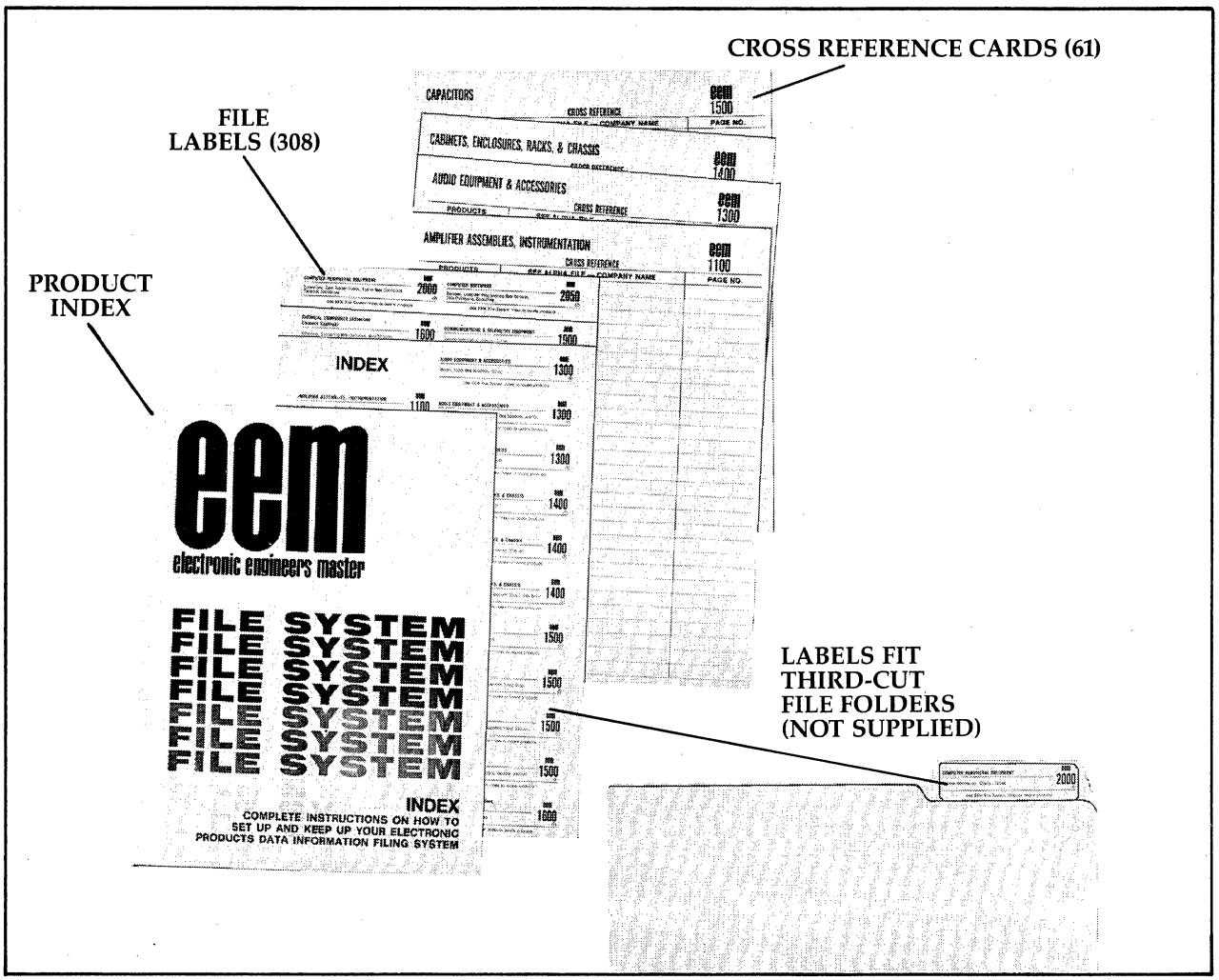
SEE EEM PAGES 1•1502-1•1503

eem filters selection guide

Manufacturer	Low Pass	High Pass	Band Pass (Incl. SAW)	Band Reject	AF	RF	VHF/UHF	IF	Active
Allen Avionics	1•1477, 1•1479, 1•1480	1•1477, 1•1480	1•1477, 1•1478, 1•1481	1•1477			1•1477, 1•1478, 1•1480		
A.P. Circuit	1•1483	1•1483	1•1483	1•1483					1•1483
Chesterfield Products	1•1484	1•1484	1•1484	1•1484					
Comstron		1•1485*	1•1485*	1•1485*		1•1485*		1•1485*	1•1485*
Data Delay Devices	1•1487	1•1487	1•1487	1•1487		1•1487			1•1487
Electronic Precision Comp.	1•1490*	1•1490*	1•1490*	1•1490*	1•1490*			1•1485*	1•1490*
ESC Electronics	1•1491*	1•1491*	1•1491*	1•1491*			1•1491*		
Hertz Filters	1•1496*	1•1496*	1•1496*			1•1496*			
Hisonic			1•1497*			1•1497*			
KR Electronics	1•1499	1•1499	1•1499	1•1499		1•1499		1•1499	
Precision Filters									1•1516
Sawtek Inc.			1•1518, 1•1519						
Spectrum Control						1•1521			
TRW Inductive Prods.	1•1531	1•1531	1•1531	1•1531					
TTE, Inc.	1•1534	1•1535	1•1532, 1•1533	1•1533		1•1532	1•1532		1•1533, 1•1534
Vernitron Piezoelectric								1•1536*	

Manufacturer	Variable	Coaxial	Crystal	Digital	LC	Linear Phase	EMI/RFI	Video	Equalizer	Ceramic
Allen Avionics					1•1477-1•1481	1•1479		1•1477	1•1477	
AMP							1•1482			
A.P. Circuit	1•1483			1•1483						
Chesterfield Products									1•1484	
Comstron					1•1485*				1•1485*	
Corcom							1•1486			
Delta Electronic USA							1•1488, 1•1489			
Electronic Precision Comp.					1•1490*				1•1490*	
ESC Electronics					1•1491*					
Fil-Coil							1•1492*, 1•1493*			
Filter Concepts							1•1494, 1•1495			
Hertz Filters					1•1496*	1•1496*				
Hisonic			1•1497*							
JMK Inc.							1•1498			
KR Electronics					1•1499	1•1499			1•1499	
MCI Inc.							1•1500, 1•1501			
Murata Erie							1•1502, 1•1503			
Panel Components							1•1504-1•1512			
Potter Co.							1•1514-1•1515			
Precision Filters	1•1516			1•1516						
RFI Corp.							1•1517			
Spectrum Control		1•1521, 1•1523			1•1523		1•1521*-1•1529*			
Vernitron Piezoelectric										1•1536*

* Indicates MIL



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

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The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

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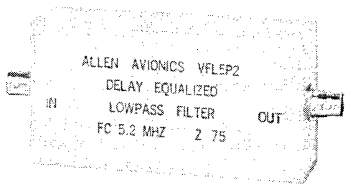
VIDEO FILTERS

DELAY EQUALIZED NTSC LOWPASS FILTERS —VFL SERIES

For the video field, we have built many lowpass filters having sharp roll-offs and good passband delay linearity with cut-off frequencies from .1 MHz to 10 MHz. The most popular of these are used to attenuate the harmonics of the NTSC color sub-carrier frequency 3.58 MHz. The most commonly used filters in this group are tabulated below:

VFL SERIES

Part No.	Maximum .25db Attenuation @ Frequency (MHz)	Maximum 3db Attenuation @ Frequency (MHz)	Minimum 45db Attenuation @ Frequency (MHz)	Approximate Passband Delay (Nanoseconds)
VFL1P7	1.75	1.92	2.41	1691
VFL2P2	2.25	2.45	3.10	1325
VFL2P7	2.75	3.00	3.77	1082
VFL3P2	3.20	3.50	4.40	928
VFL3P5	3.50	3.84	4.82	846
VFL3P8	3.80	4.16	5.22	781
VFL4P5	4.50	4.93	6.19	659
VFL5P2	5.20	5.70	7.16	570
VFL6P0	6.00	6.58	8.27	494
VFL6P5	6.50	7.12	8.95	457



Size: 4" x 2" x 1¼" in metal can with BNC Connectors.

Impedance = 75 ohms.
Maximum Insertion Loss @ 100 KHz = 1db.
Maximum Passband Ripple = ±.25db.
Maximum Delay Variation = ±3% to −.25db frequency.

NOW AVAILABLE:

Complete family of Delay Equalized Lowpass Filters with amplitude and delay characteristics similar to the above tabulated filters. These filters are offered at any cut-off frequency from 1 KHz to 10 MHz. Impedance (depending on cut-off frequency) ranges from 50 to 5000 ohms. Complete specifications are available in our extensive filters catalog.

A complete Video Delay Lines & Filters Catalog also available.

ALSO AVAILABLE NTSC FILTERS:

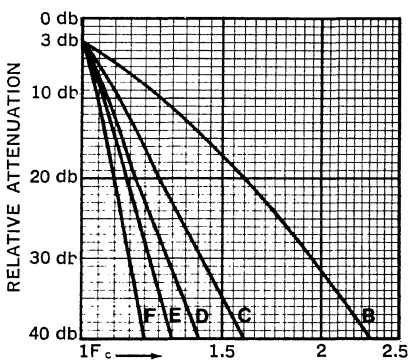
- "VCL" Series Sharpest Lowpass Delay Equalized Filters.
- "VFB3P6" Bandpass Filters to isolate chrominance information.
- "VFR" Series Reject Filters for rejection of color information to provide isolation from luminance signal.

SUB-MINIATURE FILTERS

FROM 5 MHz TO 500 MHz • PASSIVE L-C FILTER DESIGN

LOW PASS FILTERS

50 OHMS — ½db MAX. RIPPLE — ½db MAX. INSERTION LOSS



Shape Factor (See Graph)	20db	40db	Size
B	1.60	2.30	SA
C	1.25	1.60	SA
D	1.15	1.40	SB
E	1.14	1.30	SB
F	1.10	1.20	SC

FEATURING:

- Small size, lightweight.
- Low insertion loss — ½db Max.
- .5db Maximum Ripple.
- SMA Connectors standard.
- Order any cut-off frequency from 5 to 500 MHz.
- Good temperature stability.

ORDERING PROCEDURE:

Filter Type	Cut-Off Frequency	Shape Factor B, C, D, E, F (See Graph)	S (for SMA Connectors) *P (for Printed Circuit Mtg.)

EXAMPLES: ML — 500P — B — S
ML — 5P55 — D — P

Cut-off frequency can be any 3 digit number from 5 to 500 MHz. "P" represents decimal point and must be used in 2nd, 3rd or 4th location.

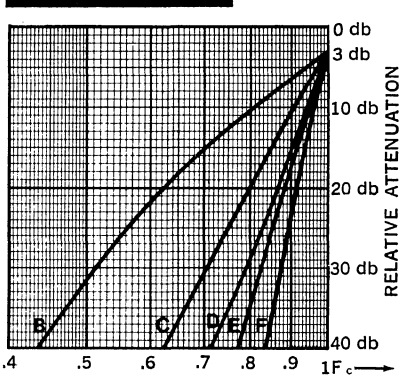
Examples: 5P55 = 5.55 MHz
58P7 = 58.7 MHz
500P = 500 MHz

* PC Mounting optional for cut-off frequencies of 100 MHz or less.

SIZE (INCHES)
Units normally supplied in metal cans with SMA Connectors on each end (.5" x .5").
SA — .80 x .50 x .50
SB — 1.00 x .50 x .50
SC — 1.25 x .50 x .50

HIGH PASS FILTERS

50 OHMS — 1db MAX. RIPPLE — 1db MAX. INSERTION LOSS



Shape Factor (See Graph)	20db	40db	Size
B	.625	.435	SA
C	.800	.625	SA
D	.870	.714	SB
E	.877	.769	SB
F	.909	.833	SC

FEATURING:

- Small size, lightweight.
- Low insertion loss — 1db Max.
- 1db Maximum Ripple.
- SMA Connectors standard.
- Order any cut-off frequency from 5 to 500 MHz.
- Good temperature stability.

ORDERING PROCEDURE:

Filter Type	Cut-Off Frequency	Shape Factor B, C, D, E, F (See Graph)	S (for SMA Connectors) *P (for Printed Circuit Mtg.)

EXAMPLES: MH — 500P — E — P
MH — 58P7 — F — S

Cut-off frequency can be any 3 digit number from 5 to 500 MHz. "P" represents decimal point and must be used in 2nd, 3rd or 4th location.

Examples: 5P55 = 5.55 MHz
58P7 = 58.7 MHz
500P = 500 MHz

* PC Mounting optional for cut-off frequencies of 50 MHz or less.

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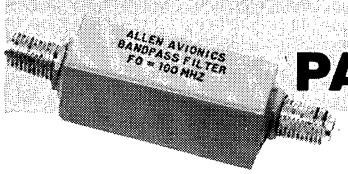
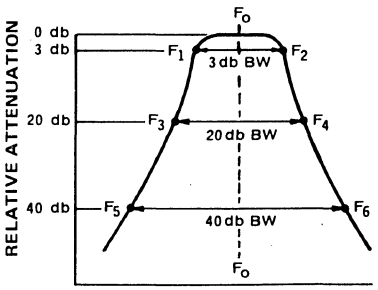
SUB-MINIATURE BANDPASS FILTERS FROM 10MHz to 500MHz PASSIVE L-C FILTER DESIGN



50 Ohms—1db Maximum Ripple

All of our filters are specified as having a minimum bandwidth at the −3db points and a maximum bandwidth at the −20 and −40db points. These filters are no exception. Most of the bandpass filters on this page do not exhibit arithmetic or geometric symmetry. However, to insure our customers of a simple method of determining their requirements, we are specifying the −3db, −20db and −40db bandwidths as if all had arithmetic symmetry. This will guarantee that at least ½ of the 3db passband will exist on each side of the center frequency. The −20db and −40db points will be no greater than ± ½ of their respective bandwidth away from the center frequency.



F_1 to F_o and F_o to $F_2 > ½$ 3db bandwidth
F_3 to F_o and F_o to $F_4 < ½$ 20db bandwidth
F_5 to F_o and F_o to $F_6 < ½$ 40db bandwidth

ORDERING PROCEDURE

Filter Type	Center Frequency (F_o)	3db Bandwidth (F_c)=$\frac{F_o}{Q}$	Shape Factor (See Table)	S (for SMA Connectors) *P (for Printed Circuit Mtg.)
	Can be any 3 digit number from 10 to 500MHz. "P" represents decimal point and must be used in 2nd, 3rd or 4th location.	Can be any 3 digit number up to 125MHz (a center frequency of 500MHz with a Q of 4). "P" represents decimal point & must be used in one of the 4 locations. The specified bandwidth must be within the limits of the tabulated Q. (See examples below.)		

EXAMPLE: MB − 99P5 − 4P50 − A − S

This Part No. describes a bandpass filter having its center frequency at 99.5MHz and having a 3db bandwidth of 4.50MHz with an "A" shape factor and SMA Connectors. Note in tabulation below that for a center frequency of 100MHz, and a shape factor of "A", a Q of up to 30 is realizable.

EXAMPLE: MB − 10P0 − P200 − A − S

This Part No. describes a bandpass filter having its center frequency at 10.0MHz and having a 3db bandwidth of .200MHz with an "A" shape factor and SMA Connectors. Note in tabulation below that for a center frequency of 10MHz, and a shape factor of "A", a Q of 50 is realizable.

*PC Mounting optional for center frequencies of 100MHz or less.

Shape Factor	20db / 3db	40db / 3db
A	3.6	8.0
B	2.6	4.8
C	2.3	3.4
D	2.0	2.6

SIZE (INCHES)
Units normally supplied in metal cans with SMA Connectors on each end (.5" x .5").
SA − .80 x .50 x .50
SB − 1.00 x .50 x .50
SC − 1.25 x .50 x .50

Center Frequency (Fo)	Q Range Fo / 3db BW	Shape Factor	Insertion Loss (db)	Size
10MHz	10-25	A	3-8	SA
	25-50	A	7-15	SA
	8-25	B	4-9	SB
	25-35	B	8-15	SB
	6-15	C	3-7	SB
	15-30	C	6-13	SB
	4-10	D	2-7	SC
	10-15	D	6-12	SC
25MHz	10-25	A	3-8	SA
	25-50	A	7-15	SA
	8-25	B	4-9	SB
	25-35	B	8-15	SB
	6-15	C	3-7	SB
	15-30	C	6-13	SB
	4-10	D	2-7	SC
	10-15	D	6-12	SC
50MHz	10-25	A	4-8	SA
	25-45	A	7-15	SA
	8-25	B	5-9	SB
	25-30	B	8-15	SB
	6-15	C	3-7	SB
	15-25	C	6-13	SB
	4-10	D	3-8	SC
	10-15	D	6-12	SC

Center Frequency (Fo)	Q Range Fo / 3db BW	Shape Factor	Insertion Loss (db)	Size
75MHz	10-25	A	4-8	SA
	25-40	A	7-15	SA
	8-15	B	5-9	SB
	15-25	B	8-13	SB
	6-15	C	4-7	SB
	15-20	C	6-12	SC
	4-10	D	3-8	SC
	10-15	D	6-12	SC
100MHz	10-25	A	4-8	SA
	25-30	A	7-13	SA
	8-15	B	5-9	SB
	25-22	B	8-13	SB
	6-10	C	4-6	SB
	10-15	C	5-10	SC
	4-10	D	4-8	SC
	10-15	D	6-12	SC
150MHz	10-15	A	4-8	SA
	15-25	A	7-13	SA
	8-15	B	5-9	SB
	15-20	B	8-13	SB
	6-10	C	4-6	SB
	10-15	C	5-10	SC
	4-10	D	4-8	SC
	10-15	D	6-12	SC

Center Frequency (Fo)	Q Range Fo / 3db BW	Shape Factor	Insertion Loss (db)	Size
200MHz	10-15	A	4-8	SA
	15-20	A	7-12	SA
	8-12	B	5-9	SB
	12-15	B	8-13	SB
	6-10	C	4-6	SB
	10-13	C	5-10	SB
	4-10	D	4-8	SC
	10-13	D	6-12	SC
250MHz	10-15	A	4-8	SA
	15-20	A	7-12	SA
	8-12	B	5-9	SB
	12-15	B	8-13	SB
	6-10	C	4-6	SB
	10-12	C	5-10	SB
	4-10	D	4-8	SC
	10-12	D	6-12	SC
300MHz to 500MHz	10-15	A	4-8	SA
	8-12	B	5-9	SB
	12-15	B	8-13	SB
	6-10	C	4-6	SB
	10-12	C	5-10	SB
	4-10	D	4-8	SC
	10-12	D	6-12	SC

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SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

CUSTOM-BUILT L-C FILTERS LINEAR PHASE LOWPASS

LINEAR PHASE LOWPASS FILTERS

Types:
Bessel, Gaussian, Equal Phase Ripple and Transitional (Gaussian to 6 db).

Frequency Range:
400Hz to 50MHz.

Impedance Range:
50 ohms to 20K ohms.

Low Delay and Phase Distortion in Passband.

Very Low Pulse Distortion (Low Overshoot).

Construction:
Epoxy encapsulated or sealed in metal can.

DELIVERY: PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 7 DAYS

The lowpass filters listed below are typical units that we build. We do manufacture linear phase lowpass filters with any cut-off frequency between 1KHz and 50MHz.

SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

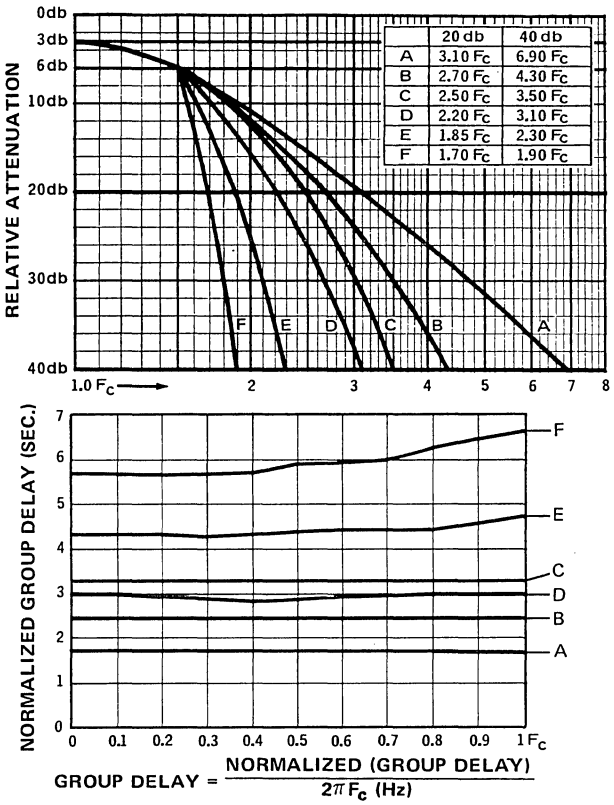
K — 1.50 x 1.000 x .800
L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

The graph at right illustrates ideal delay characteristics.
Consult table below for typical realizable values.

Shape Factor	Max. Phase Distortion	Maximum Overshoot	Typical Delay Variation
A	±2°	1.5%	3%
B	±2°	1.5%	3%
C	±2°	1.5%	3%
D	±3°	3%	8%
E	±7°	6%	13%
F	±12°	9%	17%



½ db MAXIMUM RIPPLE — 1 db MAXIMUM INSERTION LOSS

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size Range
1KHz	500-10K	A	X
	500-10K	B	Y, Z
	500-10K	C	Z
	500-10K	D	Y
	500-10K	E	Y, Z
	500-10K	F	Z
5KHz	50-20K	A	X
	50-20K	B	Y, Z
	50-15K	C	Y, Z
	50-20K	D	Y
	50-20K	E	Y, Z
	50-10K	F	Z
10KHz	50-10K	A	W, X
	50-10K	B	X, Y
	50-10K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X, Y
	50-10K	F	Y, Z
50KHz	50-10K	A	W, X
	50-10K	B	X
	50-5K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X, Y
	50-10K	F	X, Y
100KHz	50-10K	A	U, W
	50-5K	B	W, X
	50-5K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X
	50-10K	F	X, Y

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size Range
500KHz	50-3K	A	U, W
	50-3K	B	W
	50-1K	C	W, X
	50-5K	D	W
	50-5K	E	W, X
	50-5K	F	X, Y
750KHz	50-2.5K	A	U, W
	50-2.5K	B	W, X
	50-1K	C	X, Y
	50-5K	D	U, W
	50-5K	E	W, X
	50-5K	F	X
1MHz	50-500	A	L
	50-500	B	M
	50-500	C	M
	50-500	D	W
	50-500	E	W, X
	50-500	F	X
2MHz	50-500	A	L
	50-500	B	M
	50-500	C	M
	50-500	D	W
	50-500	E	W, X
	50-500	F	W, X
5MHz	50-500	A	L
	50-500	B	M
	50-200	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size Range
7.5MHz	50-500	A	K
	50-250	B	L
	50-100	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M
10MHz	50-100	A	K
	50-100	B	L
	50-100	C	M
	50-100	D	L
	50-100	E	M
	50-100	F	M
20MHz	50-100	A	K
	50-100	B	L
	50-100	D	L
	50-100	E	M
	50-100	F	N
30MHz	50-100	A	K
	50-100	B	L
	50-100	D	L
	50-100	E	M
	50-100	F	N
40MHz	50	A	K
	50	B	L
	50	D	L
	50	E	M
	50	F	M
50MHz	50	A	K
	50	D	L
	50	E	M
	50	F	M

SHARP DELAY EQUALIZED LOWPASS FILTERS

By the utilization of delay equalization techniques, Allen Avionics now designs and manufactures a complete line of sharper cut-off, flat delay lowpass filters than shown above. We offer these with 40db to 3db ratios as small as 1.22 and delay distortion of less than 10%.

ALLEN AVIONICS, INC.
224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: (516) 248-8080 OR (516) 747-5450

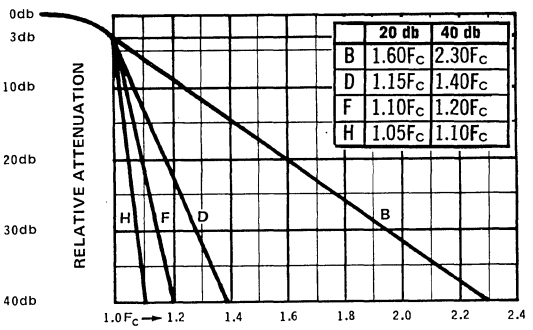
SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

CUSTOM-BUILT LOWPASS & HIGHPASS L-C FILTERS

FAST DELIVERY ON PROTOTYPES

Types: Butterworth, Tchebycheff, Gaussian, Bessel and Elliptic Function.
Frequency Range: 200 Hz to 200 MHz.
Construction: Epoxy encapsulated or sealed in metal can.
The Lowpass and Highpass Filters listed below are typical units that we build. We do manufacture units with shape factors and cut-off frequencies in-between those listed.

LOW PASS FILTERS



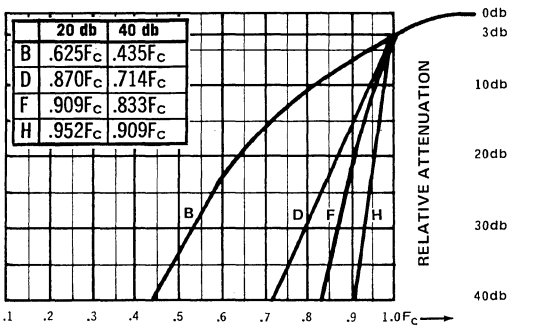
	20 db	40 db
B	1.60Fc	2.30Fc
D	1.15Fc	1.40Fc
F	1.10Fc	1.20Fc
H	1.05Fc	1.10Fc

SIZE (INCHES)

Sealed in Metal Can with B.N.C. Connectors:
L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:
S — 1.25 x .875 x .625
U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

HIGH PASS FILTERS



	20 db	40 db
B	.625Fc	.435Fc
D	.870Fc	.714Fc
F	.909Fc	.833Fc
H	.952Fc	.909Fc

1 db MAXIMUM RIPPLE — 2 db MAXIMUM INSERTION LOSS

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
200 Hz	500-1500	B	Z
		D	Z
400 Hz	500-3K	B	Y
		D	Z
1 kHz	500-10K	B	Y
		D	Z
		F	Z
2.5 kHz	500-20K	B	Y
		D	Z
		F	Z
5 kHz	50-20K	B	Y
		D	Z
	150-20K	F	Z
7.5 kHz	50-20K	B	Y
		D	Z
	150-20K	F	Z
10 kHz	50-10K	B	X
		D	Z
	150-10K	F	Z
25 kHz	50-10K	B	X
		D	Z
	150-10K	F	Z
50 kHz	50-10K	B	X
		D	Z
	150-10K	F	Y
		H	Z
75 kHz	50-10K	B	W
		D	Y
	150-10K	F	Y
		H	Z
100 kHz	50-10K	B	W
		D	Y
		F	Y
		H	Z
200 kHz	50-10K	B	U
		D	W
	50-5K	F	Y
		H	Z
300 kHz	50-5K	B	U
		D	W
	50-5K	F	Y
		H	Z

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
400 kHz	50-5K	B	U
		D	W
		F	Y
		H	Z
500 kHz	50-5K	B	U
		D	W
		F	Y
		H	Z
600 kHz	50-2.5K	B	U
		D	W
	50-2K	F	Y
		H	Z
700 kHz	50-2.5K	B	U
		D	W
	50-2.0K	F	Y
		H	Z
800 kHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	Z
900 kHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	Y
1 MHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	O
2 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
3 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
4 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
5 MHz	50-250	B	S
		D	W
	50-100	F	X
		H	O
6 MHz	50-100	B	S
		D	U
		F	X
		H	O

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
7 MHz	50-100	B	S
		D	U
		F	M
		H	O
8 MHz	50-100	B	S
		D	U
		F	M
		H	O
9 MHz	50-100	B	S
		D	U
		F	M
		H	N
10 MHz	50-100	B	S
		D	S
		F	M
		H	N
15 MHz	50-100	B	S
		D	S
		F	M
		H	N
20 MHz	50-100	B	S
		D	S
	50	F	M
		H	N
25 MHz	50	B	S
		D	S
		F	M
		H	N
30 MHz	50	B	S
		D	S
		F	M
35 MHz	50	B	L
		D	M
		F	M
40 MHz	50	B	L
		D	M
		F	M
50 MHz	50	B	L
		D	M
		F	N
75 MHz	50	B	M
		D	N
* 100 MHz to 400 MHz	50	B	M

* Lowpass only.

REQUEST THE MOST COMPREHENSIVE L-C FILTERS CATALOG

ALLEN AVIONICS, INC.

224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

SEE OUR PAGES UNDER
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Call/Write for Most Comprehensive L-C Filters Catalog in Industry

Allen Avionics is staffed and organized to provide precision L-C Filters and Delay Lines with fast delivery. Your most difficult engineering problems are solved by our high level engineering staff in conjunction with sophisticated computer programs, enabling rapid filter design determination.

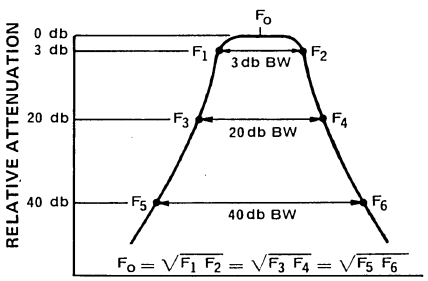
Allen Avionics computer designs are generated for the four basic filter types: Lowpass, Highpass, Bandpass, and Bandstop. These are built-in Butterworth, Tchebycheff, Elliptical, Gaussian, and Bessel functions. All Allen Avionics products are manufactured in the U.S.A.

BANDPASS

FAST DELIVERY ON PROTOTYPES

Types: Butterworth, Tchebycheff, and Elliptic Function.
Frequency Range: 400 Hz to 30 MHz.
Impedance Range: 50 ohms to 10K ohms.
Construction: Epoxy encapsulated or sealed in metal can.
Order any center frequency required. Interpolation between frequencies listed below is valid.

Shape Factor	20 db BW / 3 db BW	40 db BW / 3 db BW
Ao	3.65	7.85
B	1.60	2.50
C	1.45	1.85
E	1.20	1.45



1 db MAXIMUM RIPPLE

SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250
P — 6.00 x 1.500 x 1.250
Q — 7.00 x 1.500 x 1.250
NN — 4.00 x 4.000 x 1.250
OO — 5.00 x 4.000 x 1.250

Encapsulated in Epoxy Container:

V — 1.75 x 1.750 x .875
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Y_1 — 4.00 x 2.000 x 1.250
Z — 4.50 x 2.500 x 1.375

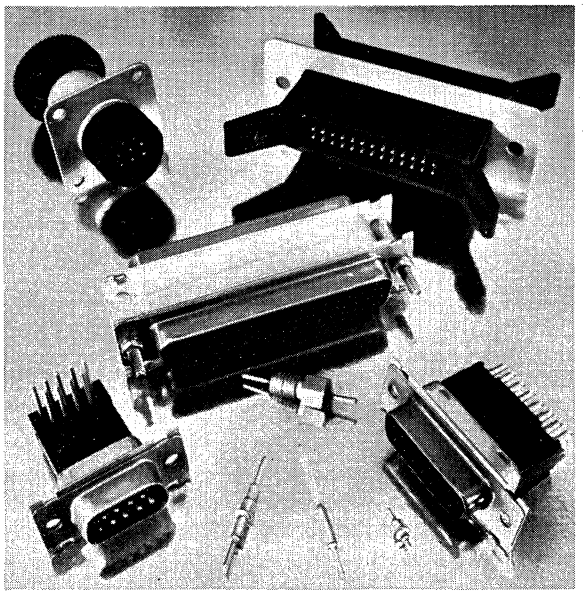
Center Frequency (Fo)	Q Range Fo / 3 db BW	Impedance Range (Ohms)	Shape Factor	Insertion Loss	Size
400 Hz	1-10	1K-10K	Ao	2-8 db	Y_1
1 kHz	1-20	1K-10K	Ao	2-8 db	Y, Y_1
	1-8	1K-10K	B	4-8 db	Z
5 kHz	1-25	500-10K	Ao	1-8 db	X, Y, Y_1
	1-10	500-10K	B	2-8 db	Y_1, Z
	1-5	1K	C	3-8 db	Z
10 kHz	1-50	100-1K	Ao	1-8 db	X, Y, Y_1
	1-25	100-10K	B	2-8 db	Y, Y_1, Z
	1-20	100-500	C	3-8 db	Y_1, Z
	1-5	500	E	4-8 db	Z
25 kHz	1-50	100-10K	Ao	1-8 db	W, X, Y
	1-40	100-5K	B	2-8 db	X, Y, Y_1
	1-25	100-500	C	3-8 db	Y_1, Z
	1-5	100-500	E	4-8 db	Z
50 kHz	1-50	100-5K	Ao	1-8 db	W, X, Y
	1-40	100-500	B	2-8 db	X, Y, Y_1
	1-25	100-250	C	3-8 db	Y_1, Z
	1-5	100-500	E	4-8 db	Z
75 kHz	1-50	100-5K	Ao	1-8 db	W, X, Y
	1-30	100-500	B	2-8 db	X, Y, Y_1
	1-25	100-250	C	3-8 db	Y_1, Z
	1-6	50-200	E	4-8 db	Z
100 kHz	1-50	100-5K	Ao	1-8 db	W, X, Y
	1-35	50-150	B	2-8 db	X, Y, Y_1
	1-25	50-100	C	3-8 db	Y_1, Z
	1-8	50-100	E	4-8 db	Z
200 kHz	1-50	50-5K	Ao	1-7 db	V, W, X
	1-25	50-50K	B	2-7 db	W, X, Y
	1-25	50-100	C	3-7 db	X, Y, Y_1
	1-8	50-100	E	4-7 db	Y_1, Z
300 kHz	1-50	50-5K	Ao	1-7 db	V, W, X
	1-25	50-5K	B	2-7 db	W, X, Y
	1-15	50-100	C	3-7 db	Y, Y_1
	1-6	50-100	E	4-7 db	Z
400 kHz	1-50	50-5K	Ao	1-8 db	V, W, X
	1-25	50-5K	B	2-8 db	W, X, Y
	1-12	50-100	C	3-8 db	Y_1, Z
	1-6	50-100	E	4-8 db	Z
500 kHz	1-50	50-5K	Ao	1-8 db	V, W, X
	10-25	50-5K	B	2-8 db	W, X, Y
	1-12	50-100	C	3-8 db	X, Y, Y_1
	1-5	50-100	E	4-8 db	Y, Z
750 kHz	1-50	50-2K	Ao	1-10 db	W, X, Y
	1-25	50-5K	B	2-8 db	X, Y, Y_1
	1-10	50-2K	C	3-8 db	Y, Y_1
	1-3	50-100	E	4-8 db	Y_1, Z

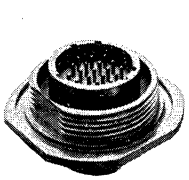
OUR COMPLETE CATALOG INCLUDES LINEAR PHASE LOWPASS & BANDPASS, BAND REJECT, SHARP CUT-OFF LOWPASS & HIGHPASS & VIDEO FILTERS.

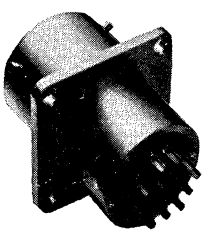
REQUEST CATALOG

Center Frequency (Fo)	Q Range Fo / 3 db BW	Impedance Range (Ohms)	Shape Factor	Insertion Loss	Size
1 MHz	1-50	50-100	Ao	1-10 db	W, X, Y
	1-25	50-100	B	2-8 db	X, Y, N
	1-10	50-100	C	3-8 db	M, N. O
	1-5	50	E	3-8 db	NN
2 MHz	1-50	50-100	Ao	1-10 db	M, N, O
	1-25	50-100	B	2-8 db	N, O, P
	1-10	50-100	C	3-8 db	N, O, P
	1-5	50	E	3-8 db	P, NN
3 MHz	1-50	50-100	Ao	1-10 db	M, N, O
	1-20	50-100	B	2-8 db	N, O, P
	1-10	50-100	C	3-8 db	N, O, P
	1-5	50	E	3-8 db	P, NN
4 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-20	50	B	2-8 db	N, O, P
	1-10	50	C	3-8 db	N, O, P
	1-3	50	E	3-8 db	P, NN
5 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-20	50	B	2-8 db	N, O, P
	1-10	50	C	3-8 db	N, O, P
	1-3	50	E	3-8 db	P, NN
7.5 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-15	50	B	2-8 db	N, O, P
	1-10	50	C	3-8 db	N, O, P
	1-3	50	E	3-8 db	P, NN
10 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-20	50	B	2-8 db	N, O, P
	1-12	50	C	3-8 db	O, P, Q
	1-6	50	E	3-8 db	Q, NN, OO
15 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-15	50	B	2-8 db	N, O, P
	1-10	50	C	2-6 db	O, P, Q
	1-3	50	E	3-7 db	Q, NN, OO
20 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-15	50	B	2-6 db	N, O, P
	1-10	50	C	2-6 db	O, P, Q
	1-5	50	E	3-7 db	Q, NN, OO
25 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-15	50	B	2-6 db	N, O, P
	1-10	50	C	2-6 db	Q, NN
	1-3	50	E	3-7 db	Q, NN, OO
30 MHz	1-50	50	Ao	1-10 db	M, N, O
	1-12	50	B	2-6 db	N, O, P
	1-6	50	C	3-7 db	P, Q, NN
	1-3	50	E	3-7 db	Q, NN, OO

AMP Makes the Difference in Filters







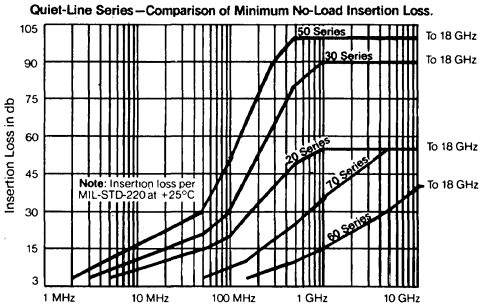
All the above connectors are available in filtered version.

Proven, Inexpensive Filtering. AMP Quiet Line Filters provide proven, inexpensive filtering of conducted electro-magnetic interference (EMI) and general system noise. Available as loose pieces or as components of preassembled connectors, AMP Quiet Line Filters are divided into Standard and Premium groups. Standard series filters are appropriate for most commercial applications. Generally, Premium series filters offer higher operating voltage maximums, withstand higher operating temperatures and provide higher dielectric withstanding voltage and insulation resistance. Also, Premium series filters are subjected to environmental testing typical of components for military applications.

Standard and Premium filter groups are divided as follows: Within the Standard group there are three series having normal capacitance (20, 30 and 50 series having 1000, 2000 and 3000 picofarads min., respectively). Within the Premium group there are three series having normal capacitance (20P, 30P and 50P series having 1500, 3000 and 4000 picofarads min., respectively).

Standard low capacitance filters are divided into two series: The 60 series having 175 picofarads max., and 70 series having 400 picofarads max.

Quiet-Line Series—Comparison of Minimum No-Load Insertion Loss.

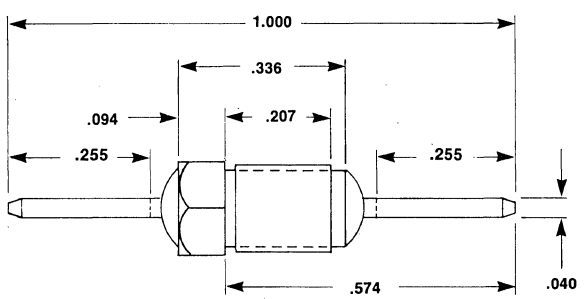


Filter Pins

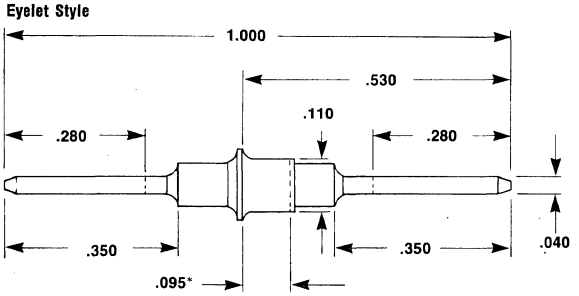
Style	"20" Series Part No.	"30" Series Part No.	"50" Series Part No.	"60" Series Part No.	"70" Series Part No.
Bolt (8-32)	859619-1	859618-1	859617-1	859659-1	859658-1
Bolt (12-32)	—	859645-1	859646-1	—	859681-1
Eyelet	859616-1	859615-1	859614-1	859656-1	859655-1
Pin/Sleeve	859613-1	859612-1	859611-1	859653-1	859652-1

"30" Series Filters
(Shown as typical)

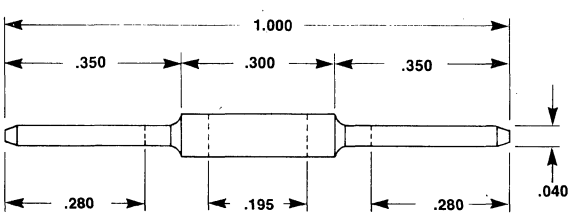
Bolt Style
(8-32 Thread Size)



Eyelet Style



Pin/Sleeve Style



Request Catalog No. 78-487 and 80-565 for complete listing

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

Specifications subject to change. Consult AMP Incorporated for latest design specifications.

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AMP INCORPORATED

Active Electronic Filters

Instruments and custom-built modules. Expert assistance in filter selection. Fast prototype service.

NEW! HYBRID CONSTRUCTION PROGRAMMABLE FILTERS

High-Pass
Low-Pass
Band-Pass
Band-Reject
By-Pass

AP 200L SERIES
5.5 lbs. 3 kg.

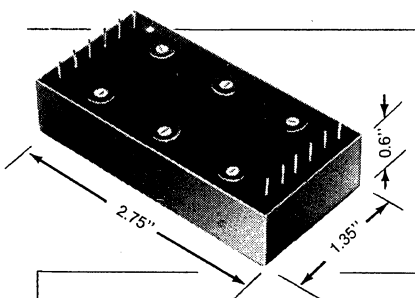
Dual Channel Rack Mount Available

VARIABLE FREQUENCY INSTRUMENTS FEATURE:

- Low Noise (50 micro Volt RMS)
- High Input, Low Output impedance
- 0 dB insertion loss or +20 dB Preamplifier
- 24 dB / octave slope
- Frequency range 0.01 Hz to 5 MHz
- Portable battery operated option

Partial List of Models	FUNCTION Low Pass	High Pass	Band Pass	Band Reject	Tuning Range	
APVL-43-5	✓				0.02Hz–2KHz	A
APVL-44-5	✓				0.2Hz–20KHz	A
APVL-45-5	✓				2.0Hz–200KHz	A
APVH-43-5		✓			0.02Hz–2KHz	A
APVH-44-5		✓			0.2Hz–20KHz	A
AP255-5	✓	✓	✓	✓	0.2Hz–20KHz	B
AP260-5	✓	✓	✓	✓	0.1Hz–10KHz	B
AP265-5	✓	✓	✓	✓	0.02Hz–2KHz	B
AP280-5	✓	✓	✓	✓	2.0Hz–200KHz	B
AP220-5	✓	✓	✓	✓	20Hz–2MHz	B
AP 301			✓		0.1–10KHz	B
AP 401			✓	✓	0.1–10KHz	B

A: Rack mounted option - 4 channel std.
B: Rack mounted option - 2 channel std.



6 pole Band Pass Band Reject with trimming potentiometers for fine tuning

FILTER MODULES

FIXED FREQUENCIES • EXTERNALLY TUNEABLE
DUAL IN LINE CONSTRUCTION

Feature Low Noise, High Input, Low Output Impedance. O insertion Loss.

- Low-Pass
- High-Pass
- Band-Pass
- Band Reject

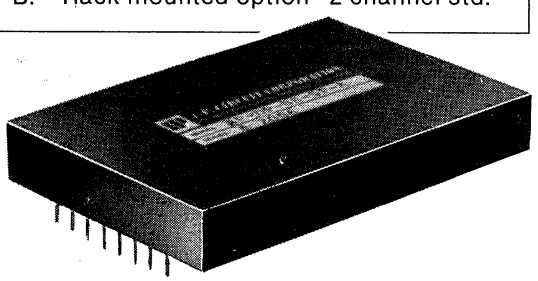
STD. FREQUENCIES:
0.01 Hz—500 KHz
4 pole 24 dB/octave or
6 pole 36 dB/octave or
8 pole 48 dB/octave

High Q Band reject including 60 Hz noise elimination filter.

Signal conditioning units assembled to customer specifications.

Ultra low power options available

For a complete catalog and additional information write to Dept. P.



Programmable Filters

Model AP-DP-8S-5P

Cut off Frequency	Bit 3	Bit 2	Bit 1
f_o	0	0	0
$2f_o$	0	0	1
$4f_o$	0	1	0
$8f_o$	0	1	1
$16f_o$	1	0	0
$32f_o$	1	0	1
$64f_o$	1	1	0
$128f_o$	1	1	1

Voltage Tunable Filters*

MODEL AP-6VC

6 Pole Voltage-Controlled

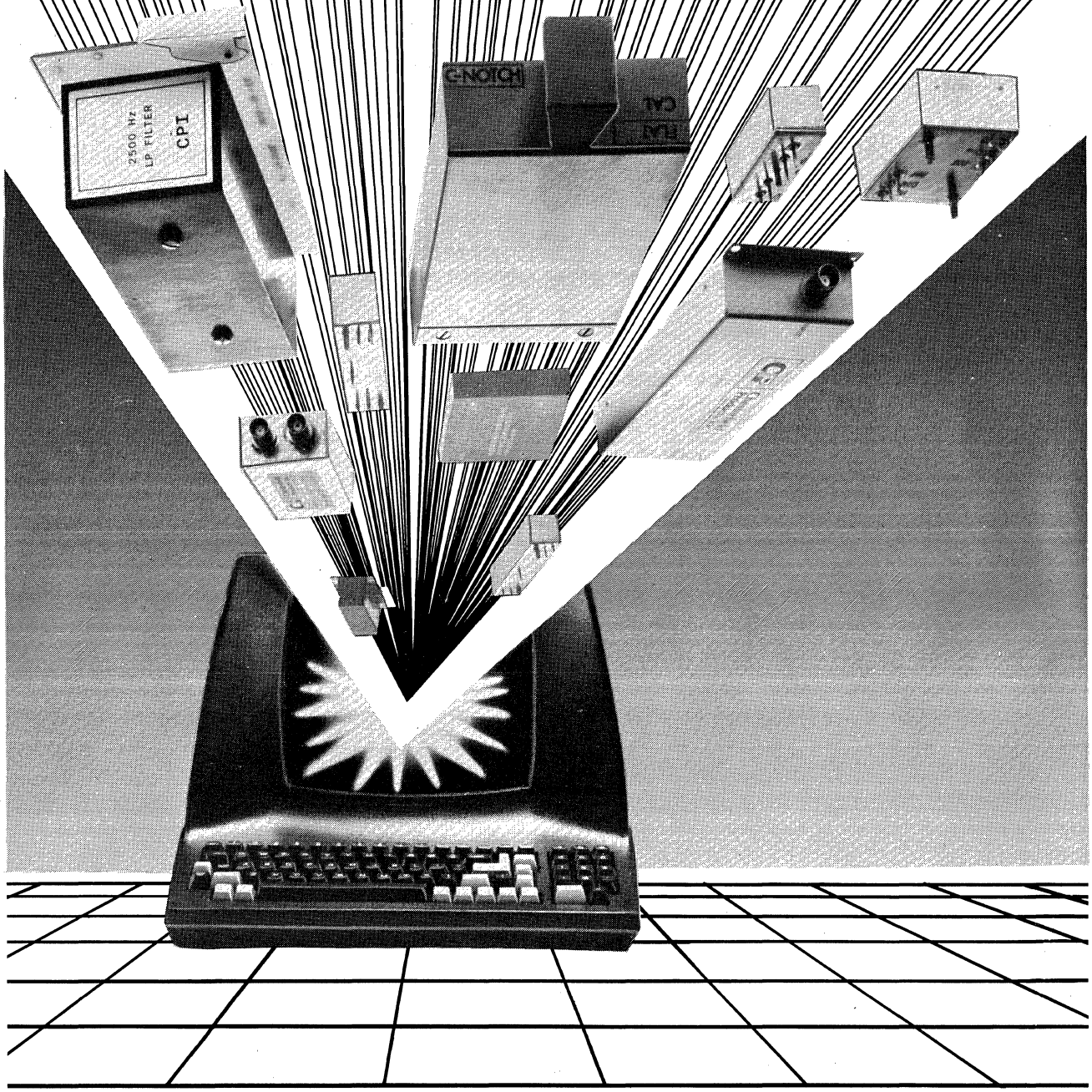
- Low-Pass
- High-Pass
- Band-Pass
- Band-Reject

**Particularly useful as Antialiasing Filters*

A. P. CIRCUIT CORPORATION

513 EAST 86th STREET, NEW YORK, N.Y. 10028 • TEL: 212 / 737-1348

CUSTOM LC FILTERS,
WITH OFF-THE-SHELF AVAILABILITY



LOW PASS, HIGH PASS, BAND PASS, BAND STOP, EQUALIZERS, WEIGHTING, ROOFING, C-NOTCH, C-MESSAGE AND JUNCTION FILTERS.

CP Chesterfield Products/inc.

THE LEADER IN LC FILTERS

37 Midland Avenue, Elmwood Park, NJ 07407

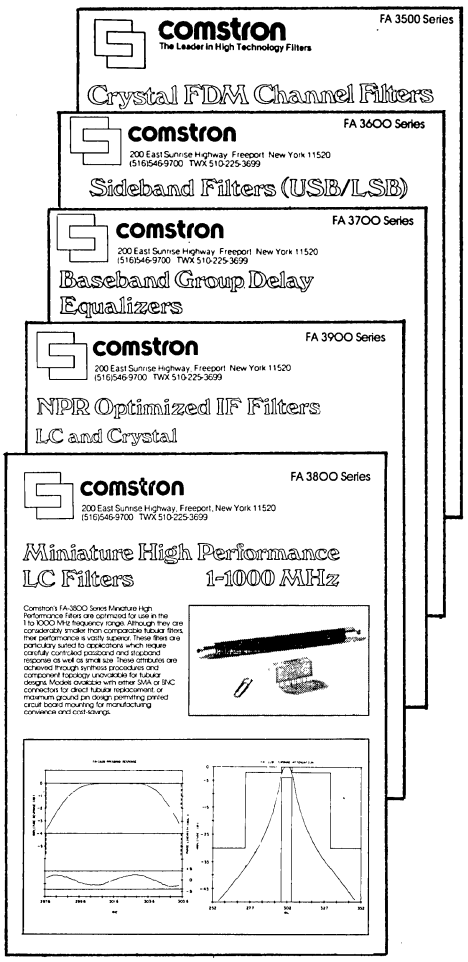
Telephone: 201/797-9655

comstron corporation

TECHNOLOGY " + " FILTERS

The Extra Edge in Systems Performance DC to 1 GHz

Comstron has developed optimum frequency or time domain filters to produce near theoretical system performance. These technology + filters are available as catalog items or custom tailored to your needs.



Design

Comstron has implemented modern network synthesis and physical realization techniques to the point where highly reliable, compact, LC and crystal filters are available – quickly and economically. Proprietary computer analysis, modeling, and optimization programs efficiently arrive at near-optium solutions to spectral, time domain, and stochastic problems. The Company's Enhanced Synthesis Program (ESP), Filter Optimization Program (FOP) and Parameter Optimization Program (POP) provide design parameters for systems oriented functions. Requirements for group delay equalization, wide band arithmetic symmetry, x/sin x amplitude correction, corrected Nyquist filters, phase compensation, and time domain response designs are routinely and efficiently handled.

Test

The Company's commitment to excellence is evident in its extensive test facilities. Automatic computer based network analyzers cover the frequency range from dc to 1.3 GHz with full plotting and printer output capability. Parameters which are automatically measured include amplitude response, phase response, group delay, and return loss. Time domain testing can also be performed to verify impulse response or response to complex waveforms.
Computer directed environmental testing allows unattended measurements of performance over temperature on a production basis. Comstron's proprietary Automatic Filter Test (AFT) programs permits rapid and accurate generation of acceptance test procedures as well as full documentation and data files when required.

Quality Control

Comstron maintains a Quality Control Department that ensures compliance with MIL-I-45208A and MIL-Q-9858A when applicable. Microscopic inspection, controlled environment, material control and traceability, solder training programs, and strict configuration management all contribute to producing an exceptionally reliable product.
The quality control program is continuously monitored. Over the years since its inception, Comstron has assembled a dedicated, conscientious staff whose pride of workmanship and customer loyalty is the keynote of the Company.

Standard Filter Catagories

- FDM Channel
- Quad Phase Matched
- Miniature L.C.
- USB/LSB
- Fiber Optic Repeater
- Group Delay Equalizer
- NPR Optimized
- Pulse Response Optimized
- Nyquist
- Video
- Speech Plus
- Group/Super Group/Master Group/Pilot Notch
- 70/140 MHz Satellite IF Filters
- 70 MHz Switchable Equalizer (Delay or Amplitude)

Send for our complete Data Sheets.

Call Comstron for applications assistance for your LC and Crystal Filter requirements.

comstron corporation

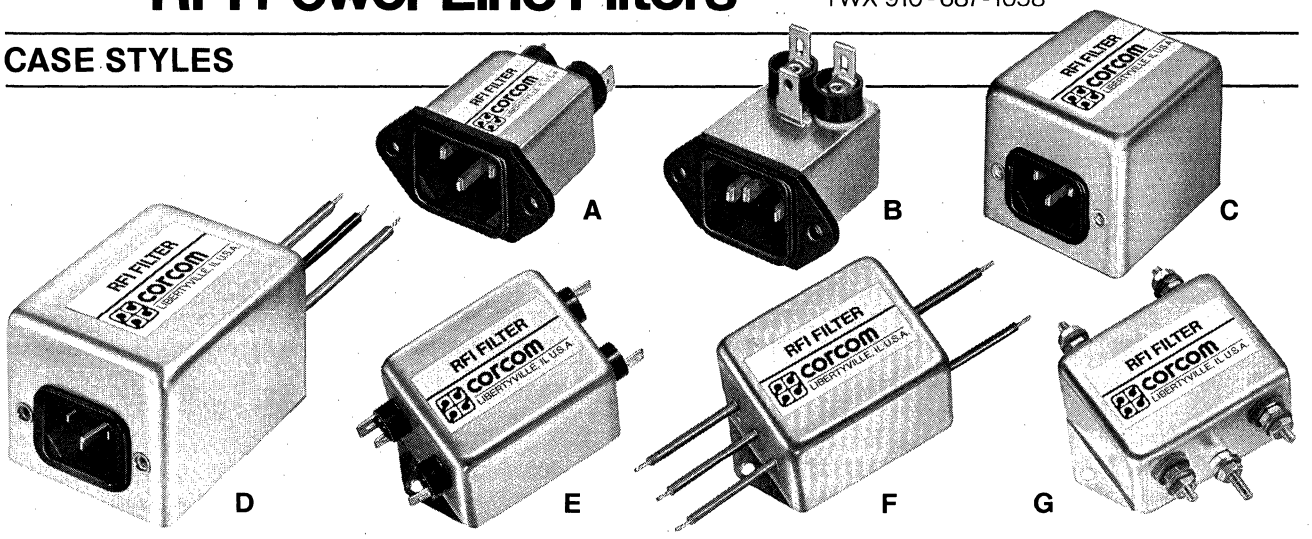
200 East Sunrise Highway, Freeport, New York 11520
(516)546-9700 TWX 510-225-3699

corcom

RFI Power Line Filters

World Leader In RFI Technology
1600 Winchester Road
Libertyville, IL 60048 USA
312-680-7400
TWX 910-687-1058

CASE STYLES



CORCOM'S FAMILY OF PRODUCTS

B Series
General purpose common mode filters.
Available in case styles E, F, and G.
Current ratings: 1, 2, 3, 5, 10, 20, 30 amps.

EF Series
Attenuation performance similar to B series, small package with IEC connector. Available in case styles A and B.
Current ratings: 1, 3, 6 amps.

ED Series
Enhanced common mode plus differential mode performance in the EF package.
Available in case styles A and B.
Current ratings: 1, 3, 6 amps.

K Series
General purpose common mode performance (similar to B and EF) plus differential mode performance. Available in case styles C, E, F, and G.
Current ratings: 1, 2, 3, 5, 10, 20, 30 amps.

R Series
Dual section filter for high common and differential mode performance in low impedance equipment such as synchronous motors. Available in case styles C, E, F, and G.
Current ratings: 1, 2, 3, 5, 10, 20 amps.

SK Series
Enhanced common mode performance from high inductance; enhanced differential mode performance from high capacitance; peak current capability; best suited to high impedance loads. Available in case styles C, E, and F.
Current ratings: 3, 6, 10 amps.

EH Series
Special purpose filters for medical equipment that must comply with the extremely low leakage current requirements of UL544, Patient Care category. Available in case styles A, B, and E.
Current rating: 6 amps.

S, V, W Series
In addition to common mode attenuation, these units provide significantly higher differential mode inductance. Available in case style E.
Current ratings: 3, 6, 10, 20 amps.

S—Differential mode performance with common mode attenuation optimized for 150kHz to 30MHz.

V—Additional differential mode element over the S series for use with low impedance equipment.

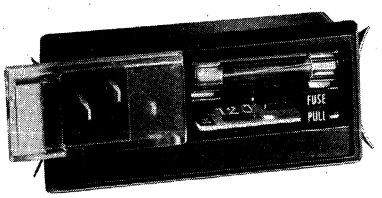
W—Differential mode performance of V series with common mode enhancement in the mid and high frequency ranges, for use with high impedance equipment.

EP Series
Dual section filter for low impedance loads with high performance common and differential mode attenuation from 150kHz to 30MHz for switching power supplies.
Available in case styles C, E, and F.
Current ratings: 3, 6, 10 amps.

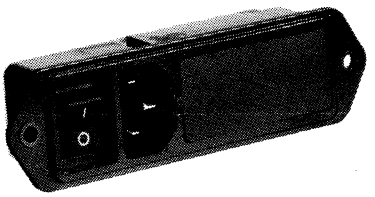
Q Series
High performance unit with peak current capability, common/differential mode attenuation and impedance optimized for VDE emission control of switching power supplies from 10kHz to 30MHz.
Available in case styles D, E, and F.
Current rating: 3 amps.

SP Series
Dual section filter with enhanced common mode attenuation compared to the EP through application of additional line-to-ground capacitance. Available in case style E.
Current ratings: 3, 6, 10 amps.

J SERIES AND M SERIES/POWER ENTRY MODULE



J Series/Voltage Selecting and Fused Connector
Developed for the manufacturer who markets products worldwide, the VS & F Connector eliminates the need for internal wiring changes, special power supplies or the need for stocking different line cords. Designed with an internationally approved line cord connector, a fuse holder and a unique voltage selector card. Available unfiltered or filtered.



M Series/Power Entry Module
Corcom's Power Entry Module is the new generation of Corcom's VS & F Connector. Incorporated into one unit are the following:
- IEC Line Cord Connector
- Fuseholder, capable of using one U.S. or two European fuses
- Optional DPST Power On/Off Rocker Switch
- Optional 2-Voltage or 4-Voltage Card Selection

© Corcom Inc.

data delay devices, inc.

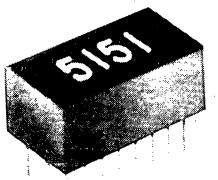
385 Lakeview Ave., Clifton, N.J. 07011
Tel: (201) 772-1106

SHORT FORM CATALOG

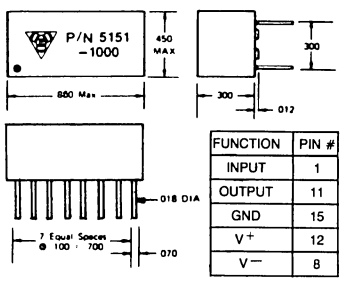
DIP-ACTIVE FILTERS SERIES 5151-5353

SPECIFICATIONS

- **Transfer characteristics** — Butterworth
- **Gain in pass-band** — 0 db ± .2 db.
- **Cut-off frequency accuracy** — ± 2% @ -3 db.
- **Maximum input voltage** — 10 volts peak.
- **Skirt Attenuation** — 24 db / octave.
- **DC drift** — 20uV / °C typical.
- **Supply Voltage** — ±15V typical (±9V to ±18V operational).
- **Temperature range** — 0° to +70°C (standard); -55°C to + 125°C (on request).
- **Temperature Coefficient** — .03% / °C. Better on request.
- **Power Consumption** — 200MW Maximum.



LOW-PASS FILTERS				HIGH-PASS FILTERS			
PART NO.	3 db FREQUENCY (HZ)	PART NO.	3 db FREQUENCY (HZ)	PART NO.	3 db FREQUENCY (HZ)	PART NO.	3 db FREQUENCY (HZ)
5151-1	1	5151-400	400	5353-10	10	5353-2,500	2,500
5151-10	10	5151-1,000	1,000	5353-100	100	5353-3,250	3,250
5151-20	20	5151-1,200	1,200	5353-160	160	5353-4,000	4,000
5151-40	40	5151-2,500	2,500	5353-400	400	5353-13,000	13,000
5151-50	50	5151-4,000	4,000	5353-500	500	5353-16,000	16,000
5151-100	100	5151-5,000	5,000	5353-1,000	1,000	5353-20,000	20,000
5151-200	200	5151-20,000	20,000	5353-1,800	1,800		



FUNCTION	PIN #
INPUT	1
OUTPUT	11
GND	15
V+	12
V−	8

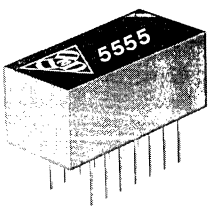
NOTE: The above table gives only a small number of designs available. Many other designs are availabe on request. Any frequency from 1HZ to 25KHZ can be selected. To make a part number, simply use the basic series number and the cut-off frequency.

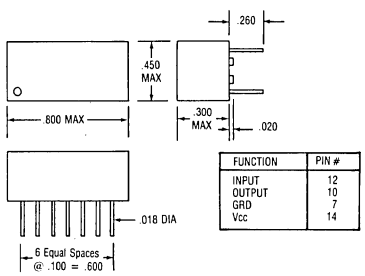
BAND-PASS FILTER SERIES 5555

PART NO.	fc(Hz)	PART NO.	fc(Hz)	PART NO.	fc(Hz)
5555-360	360	5555-1260	1260	5555-2280	2280
5555-420	420	5555-1320	1320	5555-2340	2340
5555-480	480	5555-1336	1336	5555-2400	2400
5555-540	540	5555-1380	1380	5555-2460	2460
5555-600	600	5555-1440	1440	5555-2520	2520
5555-560	660	5555-1477	1477	5555-2580	2580
5555-697	697	5555-1500	1500	5555-2640	2640
5555-720	720	5555-1560	1560	5555-2700	2700
5555-770	770	5555-1620	1620	5555-2760	2760
5555-780	780	5555-1633	1633	5555-2820	2820
5555-840	840	5555-1680	1680	5555-2280	2880
5555-852	852	5555-1740	1740	5555-2940	2940
5555-900	900	5555-1800	1800	5555-3000	3000
5555-941	941	5555-1860	1860	5555-3060	3060
5555-960	960	5555-1920	1920	5555-3120	3120
5555-1020	1020	5555-1980	1980	5555-3180	3180
5555-1080	1080	5555-2040	2040	5555-3240	3240
5555-1140	1140	5555-2100	2100	5555-3300	3300
5555-1200	1200	5555-2160	2160	5555-3360	3360
5555-1209	1209	5555-2220	2220		

SPECIFICATIONS

- **Response:** See graph.
- **Gain @ fc:** 10 db typical.
- **Center Frequency Accuracy:** ±1%.
- **Input Voltage:** 1v rms Max.
- **Supply Voltage:** 15Vdc.
- **Temperature Range:** 0° to 70°C.
- **Temperature Coefficient:** .03%/°C.
- **Power Consumption:** 625 MW @ 25°C.
- **Output Load:** 600 Min.

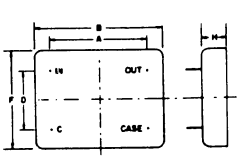


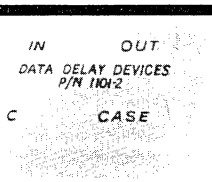


FUNCTION	PIN #
INPUT	12
OUTPUT	10
GRD	7
Vcc	14

LOW PROFILE FILTERS SERIES 1100

CASE Metal flat case to reduce hum pick-up.
PINS Straight pins for PC mounting





LOW-PASS

PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1101-1	10K	DC to 460Hz	600Hz	40db above 750Hz	1
1101-2	600	DC to 3KHz	3.4KHz	40db above 4.2KHz	1
1101-3	10K	DC to 4.4KHz	5KHz	43db above 6.3 KHz	1
1101-4	1K	DC to 9KHz	10KHz	43db above 12.8KHz	1
1101-5	600	DC to 15KHz	18KHz	43 db above 23KHz	1
1101-6	600	DC to 43KHz	50KHz	43db above 64KHz	2

BROAD BAND-PASS

PART NO.	Imp. IN/OUT	PASS-BAND	STOP-BAND (36db) BELOW	STOP-BAND (36db) ABOVE	CASE NO.
1103-1	10K	1KHz to 2KHz	0.5KHz	4KHz	3
1103-2	10K	2KHz to 4KHz	1KHz	8KHz	3
1103-3	10K	4KHz to 8KHz	2KHz	16KHz	3
1103-4	10K	10KHz to 20KHz	5KHz	40KHz	4

HIGH-PASS

PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1102-1	10K	300Hz & above	200Hz	40db below 140Hz	1
1102-2	10K	600Hz & above	400Hz	40db below 280Hz	1
1102-3	10K	1.2KHz & above	800Hz	40db below 560Hz	1
1102-4	10K	3KHz & above	2KHz	40db below 1.4KHz	2
1102-5	10K	6KHz & above	4KHz	40db below 2.8KHz	2

CASE DIMENSIONS

CASE	A		B		D		F		H	
NO.	IN.	M.M.	IN.	M.M.	IN.	M.M.	IN.	M.M.	IN.	M.M
1	1.4	35.56	1.875	47.63	1.4	35.56	2.0	50.8	0.5	12.70
2	1.4	35.56	2.0	50.8	0.8	20.32	1.5	38.1	0.375	9.53
3	1.4	35.56	2.0	50.8	0.8	20.32	1.5	38.1	0.5	12.70
4	0.8	20.32	1.25	31.75	1.0	25.4	1.75	44.45	0.375	9.53

DATA DELAY DEVICES INC. • 385 Lakeview Avenue, Clifton, N.J. 07011 • (201) 772-1106

DELTA EMI POWER LINE FILTERS

DB Series
These filters are designed as general purpose filters which can be used in a wide variety of electrical and electronic equipment. DB series filters effectively provide EMI suppression of line-to-ground noise in a small size at lowest cost.

DC Series, SC Series
DC series and SC series filters are designed to reduce conducted noise to acceptable limits for switching power supplies that have to comply with VDE and FCC requirements, and are suitable for custom designs. Both filters provide ground-lead inductors to attenuate high frequency line-to-ground noise. DC series filters are designed for high impedance loads and SC series filters for low impedance loads.

DD Series, SD Series
These filters are also designed to reduce conducted noise to acceptable limits for switching power supplies that have to comply with VDE and FCC requirements. Besides being suitable for custom designs, DD series are designed for high impedance loads while SD series are designed for low impedance loads.

DE Series
DE Series filters are compact and reliable at lowest cost. With an IEC power line connector, they are designed as general purpose filters providing effective EMI suppression of line-to-ground noise.

SE Series
SE series filters are designed to reduce conducted noise to acceptable limits for switching power supplies that have to comply with VDE and FCC requirements. These filters are suitable for custom design. IEC power line connector used.

DK Series
DK series filters are very effective in suppressing line-to-line and line-to-ground EMI noise. They are used in computers, peripheral equipment and industrial applications where pulsed, continuous and/or intermittent noise is present.

DP Series
DP series filters are designed to reduce conducted noise to acceptable limits for switching power supplies that have to comply with VDE and FCC requirements. They are designed to provide high insertion loss for line-to-line and line-to ground emission throughout the frequency range.

DR Series
DR Series filters provide premium performance in suppressing line-to-line and line-to-ground noise at moderate cost. They are very suitable for low impedance load equipment where EMI noisy environments are present and can be used in many kinds of industrial equipment and computers where pulsed, continuous and/or intermittent EMI noise is present.

DELTA
ELECTRONIC INDUSTRY USA
1355 Yosemite Way
Hayward, CA 94545
TEL: (415) 785-5231
TLX: 4992342 DELTAITTHY

Specifications For All Series
Rated voltage: 115/250 VAC

Operating frequency: 50-60 Hz

Maximum leakage current: each line to ground:
115V 60 Hz — 0.5 mA
250V 50 Hz — 0.5 mA
measured according to UL 1283 PAR. 24

High pot test, 1 minute line to ground: 2250 VDC
line to line: 1450 VDC

Minimum insertion loss (dB)
Common mode, 50 ohms system

Frequency MHz	.15	.20	.50	10	30
DB series	25	28	30	50	50
DC, SC series	30	30	35	50	50
DD, SD series	30	35	40	55	50
DE series	20	23	30	55	55
SE series	25	35	45	60	50
DK series	25	28	30	50	50
DP series	60	60	75	50	40
DR series	45	45	60	50	50

Differential mode, 50 ohms system

Frequency MHz	.15	.50	1.0	10	30
DC, SC series	20	40	45	50	50
DD, SD series	20	40	45	55	50
SE series	10	20	25	55	55
DK series	20	45	60	55	50
DP series	50	70	70	60	50
DR series	30	50	70	65	50

Main Features of Delta EMI Filters
DELTA EMI filters are designed and built in full conformance with UL Standard 1283, CSA Standard C22.2 No. 0.4 and VDE 0565 parts 1, 2 and 3. All EMI filters are UL recognized ( ), most have CSA ( ) approval, and VDE approval is in process for the entire line. Latest agency approvals are detailed in our complete catalog, available upon request.

All filters are built with a specially designed core cover that automatically maintains sufficient creepage distance between compensation choke windings. All terminals have an anti-rotation feature and are designed to maintain sufficient creepage distance between terminal and ground.

All electrical connections are soldered and mechanically secured. Every filter must pass 100% hipot, current leakage and insertion loss tests before shipment.

Custom Designs
Contained herein is Delta's complete line of standard filters. If our standard products cannot solve your particular EMI problems, our engineers will work with you to design and fabricate custom filters that are tailored to your specific requirements.

Service and Support
Delta filters are stocked at selected distributors nationwide, and our local sales representatives in your area are ready to help you select the right Delta filter for your requirements. Please contact our Customer Service Department at (415) 785-5231 for further information.

Delta's Part Numbering System
Delta's part numbering system is made up of three elements which, when properly sequenced, fully and easily identify the required filter.
For example:

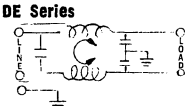
05	DB	AG3W2
CURRENT RATING	SERIES	MECHANICAL CONSTRUCTION

Current Rating: AC RMS
e.g.: 05 = 5 Amps AC RMS

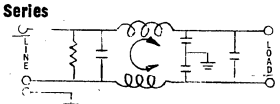
Series: Electrical Circuits — see adjacent table

Mechanical Construction:
A = Case Style — see examples on adjacent page
G = Lug
W = PVC Wire
S = Screw
e.g.: G3W2 = 3 lugs + 2 lead wires

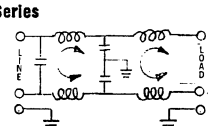
Electrical Schematics
DB, DE Series



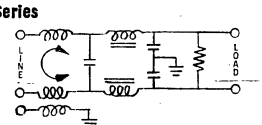
DK Series



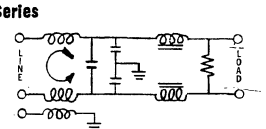
SE Series



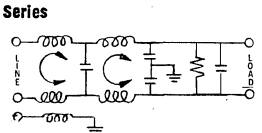
DC Series



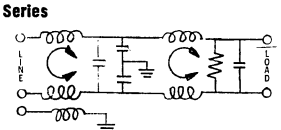
SC Series



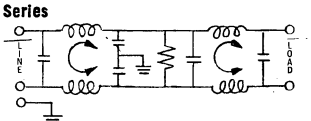
DD Series



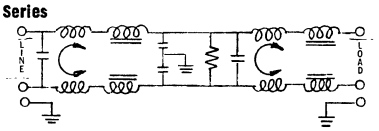
SD Series



DR Series



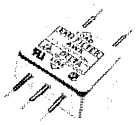
DP Series

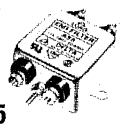


DELTA EMI POWER LINE FILTERS

AG5

AG3W2


AW5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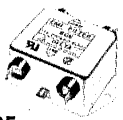
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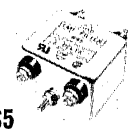
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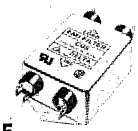
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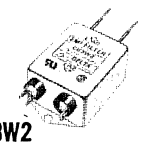
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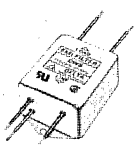
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CS5

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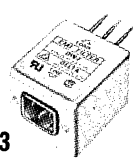
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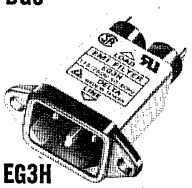
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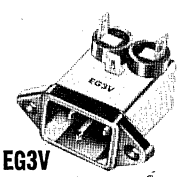
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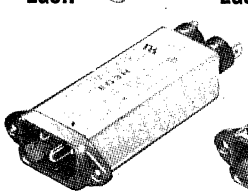
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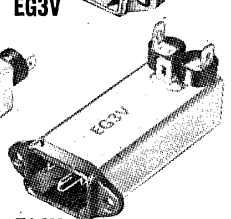
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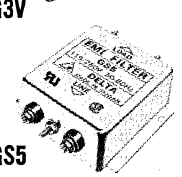
GG5


GS5

DB Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
1A	01DB AG5	2.13	2.05	0.63
	01DB AG3W2	1.51	2.50	0.63
	01DB AW5	0.94	2.50	0.63
	01DB DG3	3.20	2.20	1.25
	01DB DW3	2.16	2.20	1.25
2A	02DB AG5	2.13	2.50	0.63
	02DB AG3W2	1.15	2.50	0.63
	02DB AW5	0.94	2.50	0.63
	02DB DG3	3.20	2.20	1.25
	02DB DW3	2.61	2.20	1.25
3A	03DB AG5	2.52	2.50	0.75
	03DB AG3W2	1.94	2.50	0.75
	03DB AW5	1.31	2.50	0.75
	03DB DG3	3.20	2.20	1.25
	03DB DW3	2.61	2.20	1.25
5A	05DB AG5	2.52	2.50	0.75
	05DB AG3W2	1.94	2.50	0.75
	05DB AW5	1.31	2.50	0.75
	05DB DG3	3.20	2.20	1.25
	05DB DW3	2.61	2.20	1.25
	05DB AS5A	3.35	2.75	1.13
10A	10DB AG5	2.52	2.50	1.16
	10DB AG3W2	1.94	2.50	1.16
	10DB AW5	1.31	2.50	1.16
	10DB AS5	2.64	2.50	1.16
20A	20DB AG5	3.23	2.75	1.13
	20DB AS5	3.35	2.75	1.13

DC & SC Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
3A	03DC CG5	3.73	2.00	1.50
	03SC CG5	3.73	2.00	1.50
	03DC CW5	3.32	2.00	1.50
	03SC CW5	3.32	2.00	1.50
6A	06DC CG5	3.73	2.00	1.50
	06SC CG5	3.73	2.00	1.50
	06DC CW5	3.32	2.00	1.50
	06SC CW5	3.32	2.00	1.50
10A	10DC CG5	3.73	2.00	1.75
	10SC CG5	3.73	2.00	1.75
	10DC CW5	3.32	2.00	1.75
	10SC CW5	3.32	2.00	1.75

DD & SD Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
3A	03DD CG5	3.73	2.00	1.50
	03SD CG5	3.73	2.00	1.50
	03DD CW5	3.32	2.00	1.50
	03SD CW5	3.32	2.00	1.50
6A	06DD CG5	3.73	2.00	1.50
	06SD CG5	3.73	2.00	1.50
	06DD CW5	3.32	2.00	1.50
	06SD CW5	3.32	2.00	1.50
10A	10DD CG5	3.73	2.00	1.75
	10SD CG5	3.73	2.00	1.75
	10DD CW5	3.32	2.00	1.75
	10SD CW5	3.32	2.00	1.75

DE Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
1A	01DE EG3H	2.08	1.97	0.88
	01DE EG3V	1.53	1.97	0.88
3A	03DE EG3H	2.08	1.97	0.88
	03DE EG3V	1.53	1.97	0.88
6A	06DE EG3H	2.08	1.97	0.88
	06DE EG3V	1.53	1.97	0.88

SE Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
1A	01SE EG3H	3.65	1.97	0.88
	01SE EG3V	3.04	1.97	0.88
3A	03SE EG3H	3.65	1.97	0.88
	03SE EG3V	3.04	1.97	0.88
6A	06SE EG3H	3.65	1.97	0.88
	06SE EG3V	3.04	1.97	0.88

DK Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
1A	01DK AG5	2.97	2.75	0.88
	01DK AG3W2	2.36	2.75	0.88
	01DK AW5	1.81	2.75	0.88
	01DK DG3	3.20	2.20	1.25
	01DK DW3	2.61	2.20	1.25
2A	02DK AG5	2.97	2.75	0.88
	02DK AG3W2	2.36	2.75	0.88
	02DK AW5	1.81	2.75	0.88
	02DK DG3	3.20	2.20	1.25
	02DK DW3	2.61	2.20	1.25
3A	03DK AG5	2.97	2.75	1.13
	03DK AG3W2	2.36	2.75	1.13
	03DK AW5	1.81	2.75	1.13
	03DK DG3	3.20	2.20	1.25
	03DK DW3	2.61	2.20	1.25
5A	05DK AG5	2.97	2.75	1.13
	05DK AG3W2	2.36	2.75	1.13
	05DK AW5	1.81	2.75	1.13
	05DK AS5	3.35	2.75	1.13
	05DK DG3	3.20	2.20	1.25
	05DK DW3	2.61	2.20	1.25
10A	10DK AG5	3.23	2.75	1.13
	10DK AG3W2	2.62	2.75	1.13
	10DK AW5	2.06	2.75	1.13
	10DK AS5	3.35	2.75	1.13
	10DK DG3	3.64	2.20	1.25
	10DK DW3	3.10	2.20	1.25
	10DK DG3S	3.20	2.20	1.25
	10DK DW3S	2.61	2.20	1.25
20A	20DK BG5	3.23	3.32	1.50
	20DK BS5	3.35	3.32	1.50

DP Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
3A	03DP CG5	6.48	2.00	1.75
	03DP CW5	6.00	2.00	1.75
	03DP CG5S	3.73	2.00	1.75
	03DP CW5S	3.32	2.00	1.75
	03DP DG3	3.20	2.20	1.75
	03DP DW3	2.61	2.20	1.75
6A	06DP CG5	6.48	2.00	2.25
	06DP CW5	6.00	2.00	2.25
10A	10DP CG5	6.48	2.00	2.75
	10DP CW5	6.00	2.00	2.75

DR Series

CURRENT RATING	P/N	SIZE (INCH) L	W	H
1A	01DR CG5	3.23	1.75	1.13
	01DR CG3W2	2.99	1.75	1.13
	01DR CW3	2.75	1.75	1.13
	01DR DG3	4.33	2.17	1.25
	01DR DW3	3.75	2.17	1.25
2A	02DR CG5	3.23	1.75	1.13
	02DR CG3W2	2.99	1.75	1.13
	02DR CW5	2.75	1.75	1.13
	02DR DG3	4.33	2.17	1.25
	02DR DW3	3.75	2.17	1.25
3A	03DR CG5	3.73	2.00	1.13
	03DR CG3W2	3.52	2.00	1.13
	03DR CW5	3.32	2.00	1.13
	03DR DG3	4.33	2.17	1.25
	03DR DW3	3.75	2.17	1.25
5A	05DR CG5	3.73	2.00	1.13
	05DR CG3W2	3.52	2.00	1.13
	05DR CW5	3.32	2.00	1.13
	05DR DG3	4.33	2.17	1.25
	05DR DW3	3.75	2.17	1.25
10A	10DR CG5	3.73	2.00	1.50
	10DR CG3W2	3.52	2.00	1.50
	10DR CW5	3.32	2.00	1.50
	10DR CS5	3.85	2.00	1.50
	10DR DG3	4.33	2.17	1.25
	10DR DW3	3.75	2.17	1.25
20A	20DR GG5	5.12	4.12	1.50
	20DR GS5	5.23	4.12	1.50

DELTA
ELECTRONIC INDUSTRY USA
1355 Yosemite Way
Hayward, CA 94545
TEL: (415) 785-5231
TLX: 4992342 DELTAITTHY

epc CORPORATION

MANUFACTURERS OF ACTIVE AND PASSIVE FILTERS—DC TO 50MHz.

LOWPASS, HIGHPASS, BANDPASS, BANDREJECT CUSTOM OR STANDARD DESIGNS.

FILTER TYPES

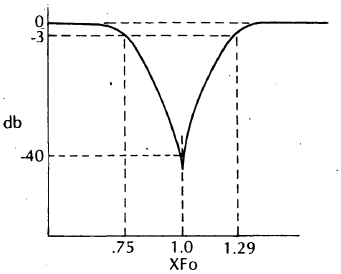
- Elliptic
- Chebychev
- Butterworth
- Bessel
- Gaussian
- Legendre
- Inverted Chebychev
- Audio Frequency
- Equalizers
- Harmonic
- IF
- Video
- Telemetering
- Tone, Telegraph
- Constant group delay
- Wideband Band Pass
- Phase matched
- Attenuation matched

Components manufactured to rigid MIL-STD specifications with operating temperature range from −55°C to + 125°C.

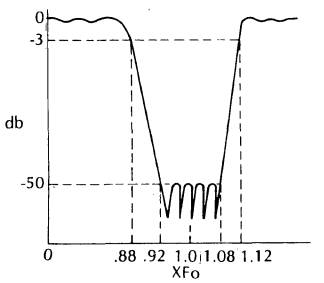
CUSTOM BUILT FILTERS PROMPT DELIVERY

The filters listed here are some of the typical units we build. We can design filters to your exact specifications. Call for more information.

ACTIVE NOTCH FILTER

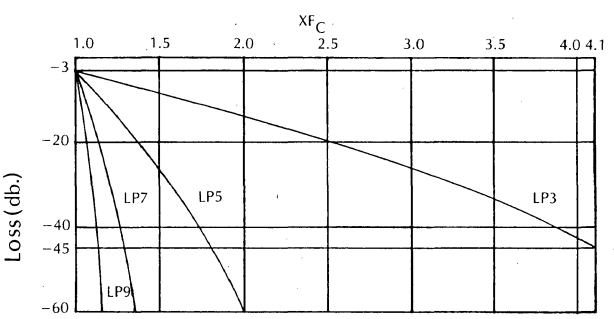


LC BAND REJECT FILTER



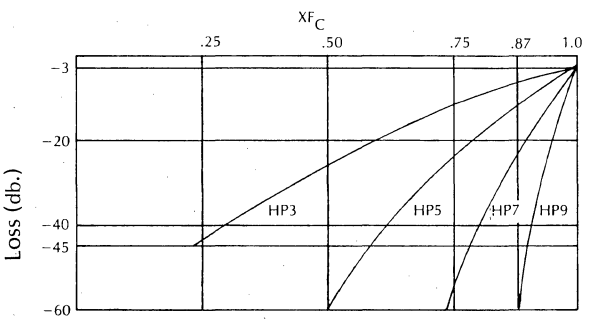
LC LOW PASS SERIES

SERIES TYPE	STOPBAND	MAX. CASE DIMENSIONS
LP3	>45db @ 4.1 Fc & above	1x1x.6"
LP5	>60db @ 2 Fc & above	1.25x1.25x.6"
LP7	>60db @ 1.35 Fc & above	1.5x1.5x.6"
LP9	>60db @ 1.15 Fc & above	2x1.75x.6"



LC HIGH PASS SERIES

SERIES TYPE	STOPBAND	MAX. CASE DIMENSIONS
HP3	>45db @ .24 Fc & below	1x1x.6"
HP5	>60db @ .5 Fc & below	1.25x1.25x.6"
HP7	>60db @ .74 Fc & below	1.5x1.5x.6"
HP9	>60db @ .87 Fc & below	2x1.75x.6"



LC NARROW BANDPASS SERIES

SERIES TYPE	PERCENT BANDWIDTH (3DB)	PASSBAND 3DB. MAX @	STOPBAND >60DB. @
NB-2	±2	.98 Fo & 1.02 Fo	.85 Fo & below 1.17 Fo & above
NB-3	±3	.97 Fo & 1.03 Fo	.80 Fo & below 1.25 Fo & above
NB-4	±4	.96 Fo & 1.04 Fo	.74 Fo & below 1.35 Fo & above

LC WIDEBAND BANDPASS SERIES

SERIES TYPE	PERCENT BANDWIDTH (3DB)	PASSBAND 3DB. MAX. @	STOPBAND >60 DB. @
WB-25	25	.87 Fo & 1.14 Fo	.58 Fo & below 1.70 Fo & above
WB-50	50	.78 Fo & 1.28 Fo	.38 Fo & below 2.60 Fo & above
WB-100	100	.62Fo & 1.62 Fo	.21 Fo & below 4.65 Fo & above

CASE DIMENSIONS: 2"x1.75"x.6" MAX

ELECTRONIC PRECISION COMPONENTS CORPORATION

11 SANDFORD BLVD., MT. VERNON, N.Y. 10550 • TELEPHONE (914) 664-2333

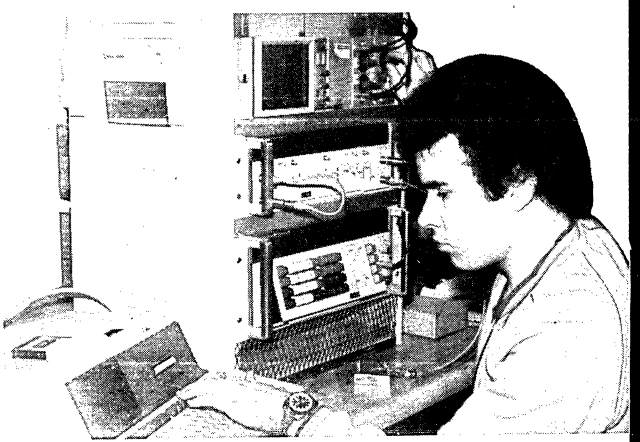
ESC ELECTRONICS CORPORATION

534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE: (201) 947-0400 ● TWX 710-991-9780

TOLL FREE
800-631-0853
(except N.J.)

LC FILTERS
DC TO 500 MHZ

30 Year Leadership in Quality and Reliability!



Covering a range of DC to 500 Mhz, ESC designs and manufactures a wide variety of LC filters for commercial and military high reliability applications. Starting with computer aided design through final test on ESC's computer controlled Network Analyzer, ESC's long history of quality and experience assures maximum component efficiency and reliability. ESC has established controlled manufacturing facilities with certified operators to produce components to all levels of reliability from missile applications to space probe environments. Conformance to MIL-F-18327 is normal and to MIL-Q-9858A as required.

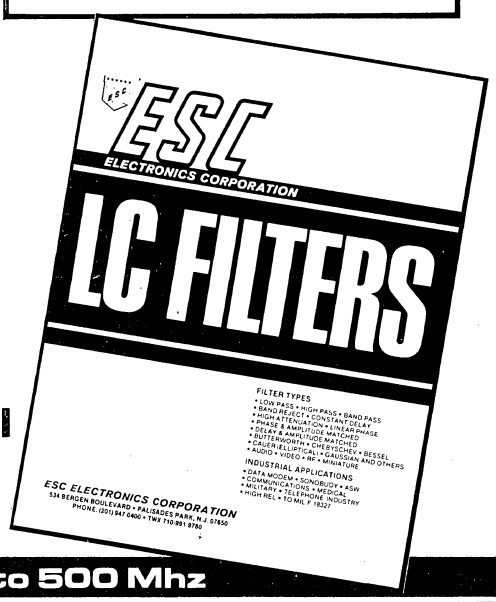
Dual-in-Line (14 Pin) LC Filters-Miniature
Size: .76L X .46W X .28H, From 1Khz to 10 Mhz.
Series DIFL20 - Low Pass, 20db Stopband at $1.4f_c$
Series DIFL39 - Low Pass, 39db Stopband at $2.5f_c$
Series DIFLP - Linear Phase, 30db at $5.0f_c$
Series DIFH20 - High Pass, 20db at $.715f_c$
Series DIFH39 - High Pass, 39db at $.4f_c$

Flatpack LC Filter Series-2Khz at 50 Khz
Epoxy molded for P.C. Board mounting, maximum height of .350 and volume of .35 to .55 cubic inches.
Series FL - Low Pass, 130db/octave roll-off
Series MFL - Low Pass, 100db/octave roll-off
Series MFH - High Pass, 100db/octave roll-off
Series CF - 15% Band Pass
Series DF - 20% Band Pass
Series LF - 60% Band Pass

High Frequency Filter Series-Reduced Sizes
Series HFLD - Low Pass 50 to 500 Mhz
60db Stopband $1.4f_c$ and above
Size: 2.1 X .65 X .30
Series HFLB - Low Pass 50 to 500 Mhz
60db Stopband $1.2f_c$ and above
Size: 2.5 X 1.0 X .30
Series HF - Band Pass 50 to 200 Mhz
Size: 2.1 X .65 X .30

FILTER TYPES
• LOW PASS • HIGH PASS • BAND PASS
• BAND REJECT • CONSTANT DELAY
• HIGH ATTENUATION • LINEAR PHASE
• PHASE & AMPLITUDE MATCHED
• DELAY & AMPLITUDE MATCHED
• BUTTERWORTH • CHEBYSCHEV • BESSEL
• CAUER (ELLIPTICAL) • GAUSSIAN AND OTHERS;
• AUDIO • VIDEO • RF • MINIATURE...

INDUSTRIAL APPLICATIONS
• DATA MODEM • SONOBUOY • ASW
• COMMUNICATIONS • MEDICAL
• MILITARY • TELEPHONE INDUSTRY
• HIGH REL • TO MIL-F-18327



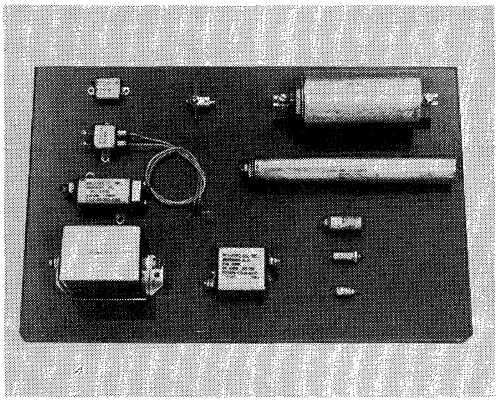
Write or call for catalog!

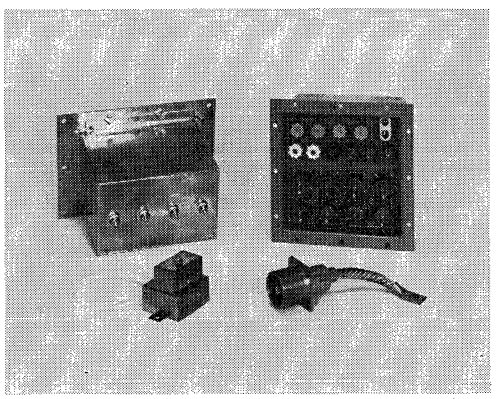
Looking for Delay Lines? See our pages in Section 2350

LC FILTERS DC to 500 Mhz

FIL-COIL RFI/EMC EXCELLENCE

ELECTRONIC FILTERS FOR MILITARY, INDUSTRIAL AND COMMERCIAL USERS





- **FILTERS FOR POWER LINE**
- **SECURE COMMUNICATIONS**
- **SCREEN ROOM**
- **RFI/EMC FILTERS**
- **FIL-COIL COMMUNICATION & SIGNAL LINE FILTERS**
- **TELEPHONE LINE FILTERS**
- **RF FILTERED & SHIELDED CIRCUIT BREAKER PANEL BOXES**

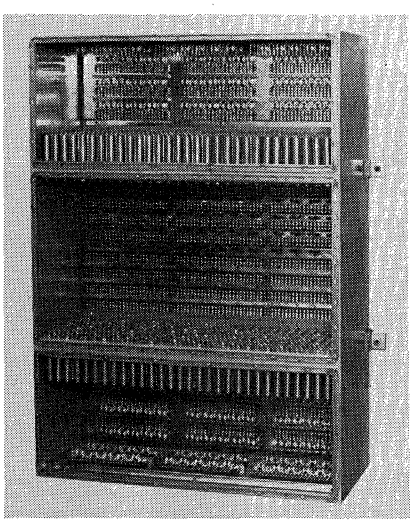
Frequency Range — 0 Hz to over 50 GHz

Current Range — 0 Amps to over 1500 Amps

Voltage Ratings — Up to 2400 V.A.C.: 10,000 V.D.C.

Quality 1. Complies with MIL-F-15733E
2. Where required, manufactured to UL, QPL, CSA, VDE and other international testing standards

UL APPROVED



EMP Power and Signal Filters for government and NATO communication centers. Designed for EMP protection per DCPA and NICSMA guidelines. Two classes of filters are available:

Class A — Power Line and Control Cables

Class B — Signal Line and Communication Cable

Dimension: (unit shown) 5′ x 4′ x 2′

DESCRIPTION: Current carrying conductors protected by MOV, GAS-GAP and ZENER DIODES selected i/a/w electrical ratings. Elements are factory mounted and wired in filter cabinets.

fil-coil

FIL-COIL COMPANY, INC.
800 AXINN AVENUE, GARDEN CITY, NY 11530 • (516) 294-5445

LOW PRICE — ON SHELF — STANDARDS CERTIFICATION

FIL-COIL RFI/EMI POWER LINE FILTERS

Electrical Specifications

LEAKAGE CURRENT:
Line to Ground
@ 115 VAC 60 Hz — .65 mA
@ 250 VAC 50 Hz — 1.25 mA

TEST VOLTAGE:
Line to Ground — 2250 VDC
Line to Line — 1450 VDC

OPERATING FREQUENCY: 50-400 Hz

RATED VOLTAGE: 115-250 VAC

Usage

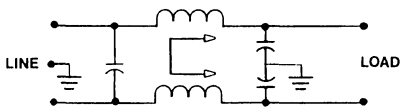
FCEIA SERIES (Econo-Universal)
Line to Ground Protection

FCEIJ Series (Econo-Super)
Line to Line and
Line to Ground Protection

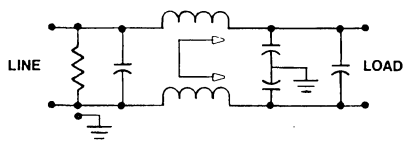
FCEIG SERIES (Econo-Med)
Patient Care Equipment

Customers Inquiry Should Specify:
Rated Voltage, Current, Line Freq., Max. Operating Ambient Temp. @ Rated Current, Max. Leakage Current (Line to Ground), Humidity Range, Current Overload, Dimensions, HiPot (Line to Ground and Line to Line), Insulation Resistance, Insertion Loss.

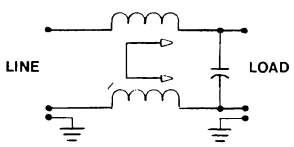
FCEIA SERIES



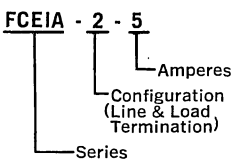
FCEIJ SERIES



FCEIG SERIES



Fil-Coil Numbering Code

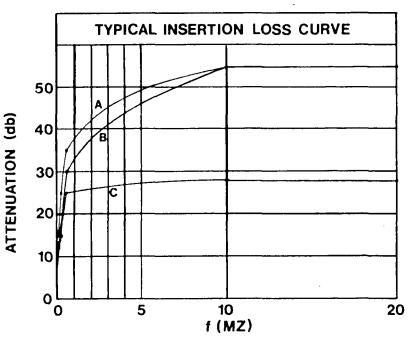


Fil-Coil Series will carry U.L., CSA, VDE, SEV, SEMCO, ASA, CISPR approvals as required and will meet FCC Rules, Part 15, subpart "J".

MIL-STD-220 Insertion Loss (db)

Amp	Frequency MHz .15	.2	.5	10	20
1, 3 (A)	20	25	35	55	55
2, 5, (B) 10, 20	15	20	30	55	55
30 (B)	15	20	30	55	55
6 (C)	12	15	25	28	28

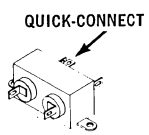
Typical Insertion Loss Curve



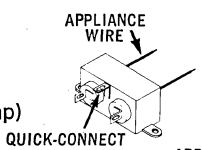
Recognized Components, Electromagnetic Noise Filter (UL 1283), for use in:
Data Processing (UL-478)
Medical & Dental (UL-544)
Office Appliance (UL-114)
Graphic Arts (UL-775)
Teaching & Instruction (UL-960)

Configurations

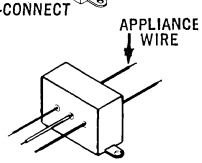
FCEIG-1
(6 Amp only)
FCEIA-1
FCEIJ-1
(1, 2, 3, 5, 10, 20 Amp)



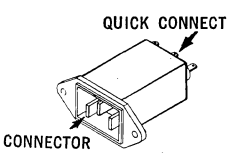
FCEIA-2
FCEIJ-2
(1, 2, 3, 5, 10 Amp)



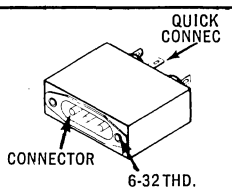
FCEIA-3
FCEIJ-3
(1, 2, 3, 5, 10 Amp)



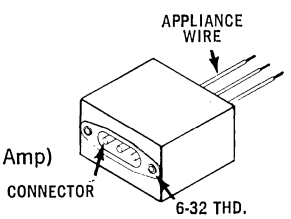
FCEIG-4
(6 Amp only)



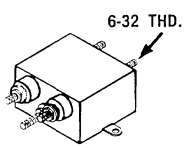
FCEIA-4
FCEIJ-4
(1, 2, 3, 5, 10 Amp)



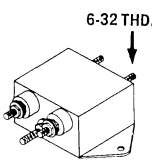
FCEIA-5
FCEIJ-5
(1, 2, 3, 5, 10 Amp)



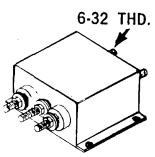
FCEIA-6
(10, 20 Amp)
FCEIJ-6
(10 Amp only)



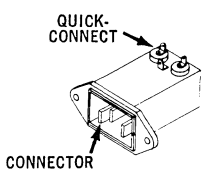
FCEIJ-7
(20 Amp only)



FCEIA-8
(30 Amp only)
FCEIJ-8
(30 Amp)



FCEIG-9
(6 Amp only)

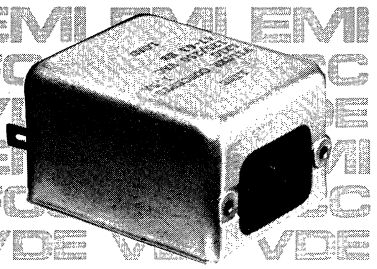


fil-coil

ECONOMY INTERNATIONAL, INC.
800 AXINN AVE., GARDEN CITY, NY 11530 • TELEPHONE (516) 333-8444

HIGH-PERFORMANCE APPLICATION ENGINEERED EMI FILTERS

- PERFORMANCE PROVEN & TESTED with OEM & custom design switching and linear power supplies
- INDUSTRY'S WIDEST SELECTION OF EMI filters for switchers requiring single or multiple phase AC power



SE SERIES
SWITCHING POWER SUPPLY FILTER

Our most compact and economical T section filter for applications using switching power supplies and required to meet FCC conducted EMI specifications.

SE Series EMI filters are designed to provide balanced differential and common mode insertion loss for reliable performance at 450KHz and above with the typical off line type switcher.

Available as a standard product in 3 Amp to 50 Amp versions, the SE is also a proven problem solver in applications where EMI susceptability is the prime concern.

Part No.	Current	Case	Leakage*
SE3	3A	2.75x1.75x.87	0.8 mA
SE7	7.5A	2.75x2.0x1.25	0.8mA
SE15	15A	3.31x2.0x1.5	0.8mA
SE30	30A	4.0x2.8x2.0	1.6mA
SE50	50A	5.5x3.0x2.7	1.6mA

Rated Voltage: 250VAC 47-63Hz
Test Voltages: Line To Line: 1.5 KVDC
Line To Gnd: 2.2 KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L/G	7db	15db	50db	65db	65db	55db
L/L	7db	15db	50db	60db	55db	50db

SF SERIES
HIGH PERFORMANCE SWITCHING SUPPLY FILTER

Designed for applications required to meet the VDE conducted EMI spectrum, the SF Series filter offers extended low frequency performance.

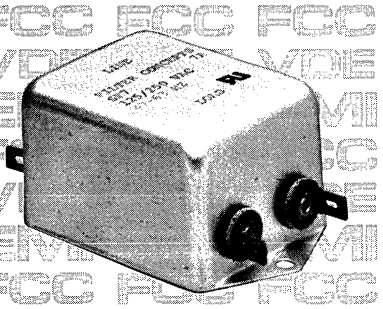
SF Series T section filters are designed to effectively attenuate differential and common mode noise from switching supplies down to the 150KHz enforced limit of VDE 0871 and 0875 spectrums.

SF filters, with their extra performance, can also provide the added margin needed to meet FCC requirements when working with unusually noisy equipment.

Part No.	Current	Case	Leakage*
SF3	3A	2.75x2.0x1.25	0.8mA
SF7	7.5A	3.56x2.0x1.5	0.8mA
SF15	15A	4x2.87x2.0	0.8mA
SF30	30A	5.5x3.0x2.75	1.6mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L/G	8db	45db	65db	65db	65db	60db
L/L	15db	45db	60db	60db	65db	60db



TF SERIES
HIGH PERFORMANCE LOW LEAKAGE SWITCHING SUPPLY FILTER

High performance low leakage T section filter provides extended low frequency attenuation for applications required to meet enforced VDE conducted EMI spectrums.

TF Series filters provide the balanced differential and common mode performance plus the low leakage current often required for products using off line switching power supplies.

The extra performance of the TF filter can also provide the additional margin needed to meet FCC specs when working with unusually noisy equipment.

Part No.	Current	Case	Leakage*
TF1	1A	2.75x1.75x.87	.45mA
TF2	2A	2.75x1.75x1.12	.45mA
TF3	3A	2.75x2.0x1.25	.45mA
TF5	5A	3.31x2.0x1.5	.45mA
TF10	10A	6.0x2.0x1.5	.45mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L/G	10db	48db	>65db	>65db	>65db	60db
L/L	12db	40db	55db	60db	60db	60db

SX SERIES
PREMIUM SWITCHING POWER SUPPLY FILTER

With an extra 15 db to 20 db of performance at 150KHz, our SX Series filters solve severe conducted EMI problems in equipment required to meet the enforced spectrum of VDE 0871 and 0875 (150KHz to 30MHz).

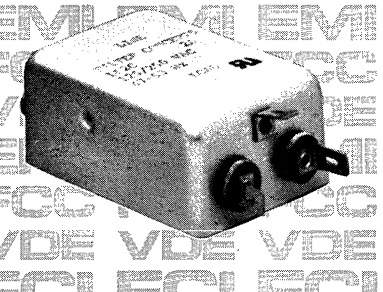
SX Series T section filters are designed to remain effective independent of wide variations in line and load impedance and noise characteristics.

Available in load current ratings from 3 Amps to 60 Amps, the SX Series maintains its high level of performance independent of current ratings.

Part No.	Current	Case	Leakage*
SX3	3A	3.31x2.0x1.5	0.8mA
SX7	7.5A	5.0x2.0x2.0	0.8mA
SX15	15A	5.5x3.0x2.75	1.6mA
SX30	30A	8.25x3.0x2.75	1.6mA
SX60	60A	12.0x6.5x4.5	2.4mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L/G	20db	60db	>65db	>65db	60db	55db
L/L	30db	60db	>65db	>65db	60db	50db



DF SERIES
SWITCHING POWER SUPPLY OUTPUT FILTER

Differential and common mode filter for the regulated DC outputs of switchers allows error free operation of low level analog circuitry.

DF Series filters are designed to work with the logic and drive voltages of typical peripheral devices such as disc drives or to isolate the power for these devices from other noisy system components.

Part No.	Current	Case	Leakage*
DF104	10 Amps	2.75x2.0x1.25	N/A
DF106	10 Amps	3.31x2.0x1.50	N/A

Rated Voltage: 50VDC
Test Voltage: Line To Gnd: 100VDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L/G	15db	25db	35db	50db	50db	50db
L/L	3db	15db	35db	45db	50db	50db

Includes a minimum of 10mfds at the load.

*Each line to Gnd @ 250 VAC/50 Hz

FCI reserves the right to make specification changes without notice. Consult the factory for current information.

FCI FILTER CONCEPTS INC.
2008-D South Yale, Santa Ana, CA 92704
(714) 545-7003

HIGH-PERFORMANCE APPLICATION ENGINEERED EMI FILTERS

- PERFORMANCE PROVEN & TESTED with OEM & custom design switching and linear power supplies
- INDUSTRY'S WIDEST SELECTION OF EMI filters for switchers requiring single or multiple phase AC power

LF SERIES
LOW LEAKAGE PI SECTION FILTER FOR SWITCHERS

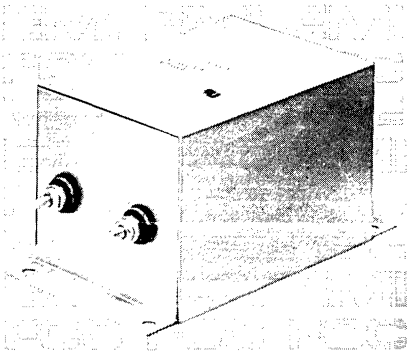
High performance low leakage Pi section filter offers enhanced differential insertion loss in an inexpensive compact package.

The LF Series is designed to work with the existing input filter of an off line switcher or the input power transformer of a switching regulator. The LF filter improves common mode performance and provides the extra differential insertion loss often required in these applications to meet FCC or VDE specifications.

Part No.	Current	Case	Leakage*
LF2	2A	2.75x1.75x.87	.45mA
LF3	3A	2.75x2.0x1.25	.45mA
LF7	7A	3.31x2.0x1.5	.45mA
LF15	15A	4.0x2.87x2.0	.45mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L_G	18db	30db	42db	50db	50db	50db
L_L	6db	30db	60db	60db	60db	60db



LX SERIES
PREMIUM LOW LEAKAGE PI SECTION FILTER FOR SWITCHERS

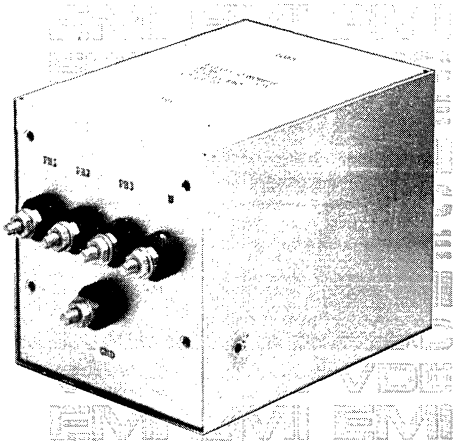
Providing significant performance from 10KHz to 30 MHz, the LX Series filter is designed for applications required to meet the proposed 10KHz to 150KHz extension of VDE 0871 and 0875 spectrums and FCC electrical equipment and appliance specs.

The LX Series EMI filter is designed to work with the existing filter in a switching supply or as a stand alone unit. It provides the extra differential and common mode low frequency insertion loss required while maintaining good high frequency characteristics.

Part No.	Current	Case	Leakage*
LX1	1.5A	2.75x2.0x1.25	0.45mA
LX3	3A	3.31x2.0x1.5	0.45mA
LX7	7.5A	4.0x2.87x2.0	0.8mA
LX15	15A	6.0x3.0x2.75	1.2mA

Rated Voltage: 250VAC 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L_G	30db	40db	50db	50db	50db	50db
L_L	40db	>65db	>65db	>65db	>65db	60db



3E SERIES
3 PHASE T SECTION FILTER

High performance with switching power supplies in 3 phase Wye or Delta configurations is offered by this Series.

3E Series T section filters are proven performers with single or multiple switching supplies in balanced or unbalanced load configurations. An alternate AC power cord ground termination isolates high frequency ground noise via a low reactance series inductor. Available in current ratings up to 60 Amps per phase (180 Amps total), 3E filters are also very effective in solving EMI susceptability problems in numerical control and other types of machinery.

Part No.	Current	Case	Leakage*
3E20	20A/PH	4.81x4.0x4.0	2.0mA
3E30	30A/PH	4.81x4.0x4.0	2.0mA
3E60	60A/PH	9.12x5.0x4.5	3.0mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L_G	3db	25db	55db	60db	50db	50db
L_L	12db	22db	50db	55db	50db	50db

3F SERIES
HIGH PERFORMANCE 3 PHASE FILTER

Extended low frequency performance is offered for 3 phase applications required to meet VDE conducted EMI spectrums with switch mode power supplies.

3F Series T section filters effectively attenuate differential and common mode noise from switching power supplies down to the 150 KHz enforced limit of VDE 0871 and 0875 spectrums.

3F filters, with their extra performance, can also provide the added margin needed to meet FCC requirements when working with unusually noisy equipment.

Part No.	Current	Case	Leakage*
3F15	15A/PH	6.5x4.0x4.0	2.0mA
3F30	30A/PH	9.12x5.0x4.5	2.5mA
3F60	60A/PH	13.25x6.0x5.0	3.0mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L_G	10db	50db	>65db	>65db	>65db	60db
L_L	15db	50db	60db	60db	60db	55db

GF SERIES
L SECTION FILTER WITH SYSTEM GROUND ISOLATOR

A system filter with good general purpose performance, the GF Series was designed for AC input and distribution applications.

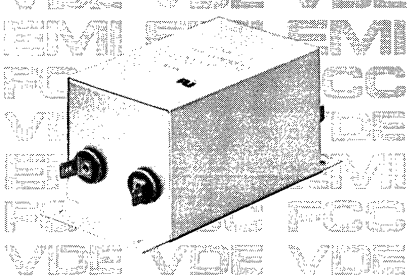
GF filters include an alternate ground termination for the AC power cord. This termination isolates high frequency noise from the AC mains via a low reactance series inductor. This high frequency ground isolator is very effective in inter-connected systems where AC power is derived from multiple outlets.

Part No.	Current	Case	Leakage*
GF10	10A	3.31x2.0x1.5	1.0mA
GF20	20A	4.0x2.87x2.0	1.0mA
GF30	30A	4.0x2.87x2.0	1.5mA

Rated Voltage: 250VAC, 47-63Hz
Test Voltages: Line To Line: 1.5KVDC
Line To Gnd: 2.2KVDC
Insertion Loss: (50 ohms)

	.05MHz	.15MHz	.50MHz	1.5MHz	5.0MHz	20MHz
L_G	10db	22db	32db	45db	50db	40db
L_L	15db	25db	35db	35db	30db	40db

*Each line to Gnd @ 250 VAC/50 Hz



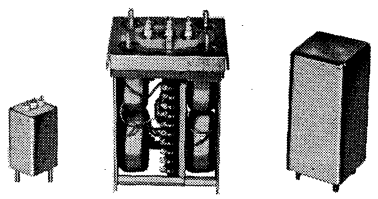
FCI reserves the right to make specification changes without notice.
Consult the factory for current information.

(714) 545-7003

FILTER CONCEPTS INC.
2008-D South Yale, Santa Ana, CA 92704

HERTZ FILTERS

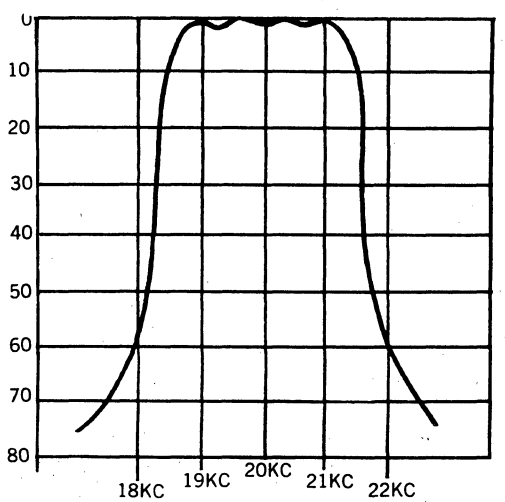
BAND PASS FILTERS CUSTOM DESIGNED TO FILL YOUR NEEDS



Hertz Filter Corporations' engineering department is made up entirely of specialists in the field of custom design of band pass filters. They are all fully experienced and prepared to help you solve your filter problems. Call or write Hertz for reliable service and prompt delivery.

FEATURES

1. Filters, Band Pass, Passive
2. Center Frequencies — 50 Hz to 50 Meg Hz
3. Shape factors — better than 2.0 for ratios of 60 db to 3 db
4. Bandwidth to center frequency ratio — up to 10%
5. Phase linearity — within 10° through passband
6. Low passband insertion loss
7. Better than 80 db attenuation 50% above and below center frequency
8. Input and output impedances as required
9. Low input and output impedances in stop band
10. Low passband ripple
11. L, C, and R elements only



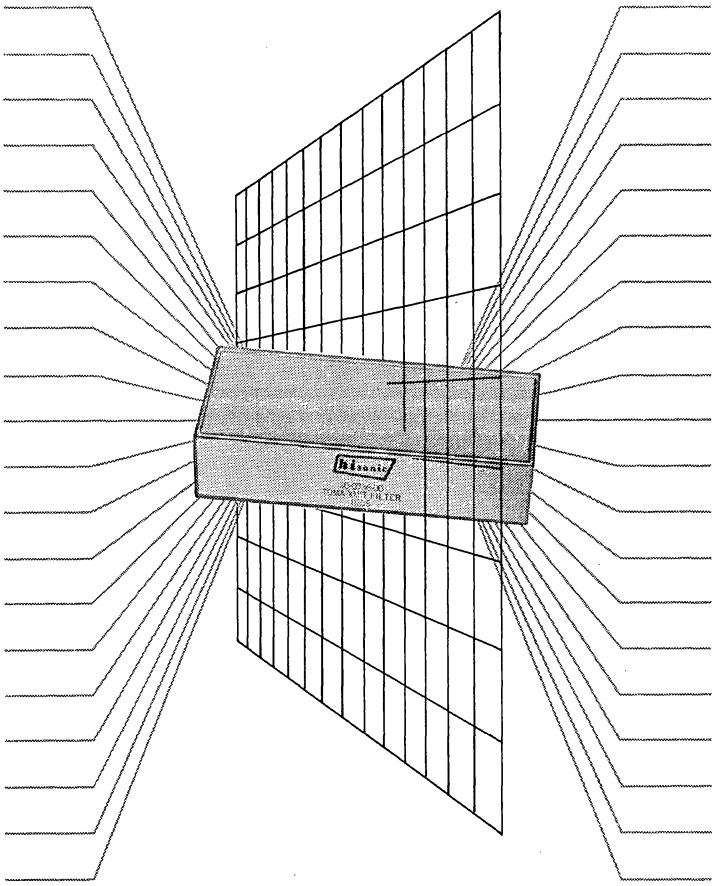
PARTIAL LIST OF HERTZ FILTERS
(all filters in accordance with MIL-F-18327)

BAND PASS PART NO.	PASS BAND	STOP BAND	Z_o	I.L.@CF	SIZE
BP-7907-1	3db(150-300)Hz	60db(50-850)Hz	600	1db	2 x 2¼ x 4
BP-7907-2	3db(300-600)Hz	60db(110-1700)Hz	600	1db	2 x 2¼ x 4
BP-7907-3	3db(600-1200)Hz	60db(210-3400)Hz	600	1db	2 x 2¼ x 4
BP-7907-4	3db(1.2-2.4)KHz	60db(.43-6.8)KHz	600	1db	2 x 2¼ x 4
BP-7907-5	3db(2.4-4.8)KHz	60db(.85-13.5)KHz	600	1db	2 x 2¼ x 4
BP-7907-6	3db(4.8-9.6)KHz	60db(1.7-27)KHz	600	1db	2 x 2¼ x 4
BP-7907-7	3db(8.9-11.2)KHz	60db(3.1-32)KHz	600	1db	2 x 2 x 3
BP-7996-1	3db(825-1,175)Hz	40db(650-1,350)Hz	30K	3db	1 x 2¼ x 4½
BP-8004-10	3db(8-26)KHz	30db(4-30)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-11	3db(19.5-33.5)KHz	30db(16.5-36.5)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-12	3db(26.25-40.25)KHz	30db(23.25-43.25)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-13	3db(32.6-52.6)KHz	30db(27.6-57.6)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-7897-1	3db(37.5-40.5)KHz	30db(34.5-43.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-2	3db(40.5-43.5)KHz	30db(37.5-46.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-3	3db(43.5-46.5)KHz	30db(40.5-49.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-4	3db(46.5-49.5)KHz	30db(43.5-52.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-5	3db(49.5-52.5)KHz	30db(46.5-55.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-6	3db(52.5-55.5)KHz	30db(49.5-58.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-7	3db(55.5-58.5)KHz	30db(52.5-61.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-8	3db(58.5-61.5)KHz	30db(55.5-64.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-9	3db(61.5-64.5)KHz	30db(58.5-67.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-10	3db(64.5-67.5)KHz	30db(61.5-70.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-11	3db(67.5-70.5)KHz	30db(64.5-73.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-12	3db(70.5-73.5)KHz	30db(67.5-76.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-13	3db(73.5-76.5)KHz	30db(70.5-79.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-14	3db(76.5-79.5)KHz	30db(73.5-82.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-15	3db(79.5-82.5)KHz	30db(76.5-85.5)KHz	10K/1K	4db	1¼ x 1¼ x 2

LOW PASS PART NO.	PASS BAND	STOP BAND	Z_o	SIZE
LP-7907-1	4db@300Hz, 1db@225Hz	60db@850Hz	600	2 x 2 x 3
LP-7907-2	4db@600Hz, 1db@450Hz	60db@1700Hz	600	2 x 2 x 3
LP-7907-3	4db@1.2KHz, 1db@.9KHz	60db@3.4KHz	600	2 x 2 x 3
LP-7907-4	4db@2.4KHz, 1db@1.8KHz	60db@6.8KHz	600	2 x 2 x 3
LP-7907-5	4db@4.8KHz, 1db@3.6KHz	60db@13.5KHz	600	2 x 2 x 3
LP-7907-6	4db@9.6KHz, 1db@7.2KHz	60db@27KHz	600	2 x 2 x 3
LP-7907-7	4db@11.2Hz, 1db@10KHz	60db@32KHz	600	1⅜ x 1⅝ x 2¾
LP-7996-1	5db@1,175Hz, 2db@1,000Hz	40db@650Hz	30K	1⅜ x 1⅝ x 2¾
LP-8004 10	5db@26KHz, 1db@17KHz	30db@30KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-11	5db@33.5KHz, 1db@26.5KHz	30db@36.5KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-12	5db@40.25KHz, 1db@33.25KHz	30db@43.25KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-13	5db@52.6KHz, 1db@42.6KHz	30db@57.6KHz	10K/2K	1¼ x 1¼ x 2

PART NO. HIGH PASS	PASS BAND	STOP BAND	Z_o	SIZE
HP-7907-1	4db@150Hz, 1db@225Hz	60db@50Hz	600	2 x 2 x 3
HP-7907-2	4db@300Hz, 1db@450Hz	60db@110Hz	600	2 x 2 x 3
HP-7907-3	4db@600Hz, 1db@900Hz	60db@210Hz	600	2 x 2 x 3
HP-7907-4	4db@1.2KHz, 1db@1.8KHz	60db@.43KHz	600	2 x 2 x 3
HP-7907-5	4db@2.4Hz, 1db@3.6KHz	60db@.85KHz	600	2 x 2 x 3
HP-7907-6	4db@4.8Hz, 1db@7.2KHz	60db@1.7KHz	600	2 x 2 x 3
HP-7907-7	4db@8.9KHz, 1db@10KHz	60db@3.1KHz	600	1⅜ x 1⅝ x 2¾
HP-7996-1	5db@825Hz, 2db@1,000Hz	40db@1,350Hz	30K	1⅜ x 1⅝ x 2¾
HP-8004-10	5db@8KHz, 1db@17KHz	30db@4KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-11	5db@19.5KHz, 1db@26.5KHz	30db@16.5KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-12	5db@26.25KHz, 1db@33.25KHz	30db@23.25KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-13	5db@32.6KHz, 1db@42.6KHz	30db@27.6KHz	10K/2K	1¼ x 1¼ x 2

HERTZ FILTER CORPORATION
3 AERIAL WAY • SYOSSET, NEW YORK 11791
TELEPHONE (516) 822-4770



HISONIC... pioneers in filter network design.

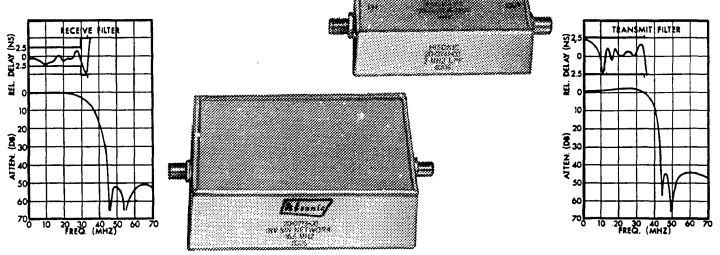
Communications are dependable only with quality components.

The staff at Hisonic, Inc. includes pioneer specialists with over 31 years experience in filter network design. It also includes mathematicians whose backgrounds of program development enable them to achieve design excellence in producing filters for your "out of this world" requirements . . . They use late generation computers, programmed to pre-test any design network. All types of packaging are available.

CUSTOM FILTERS

Modern Filters for Satellite Communication:

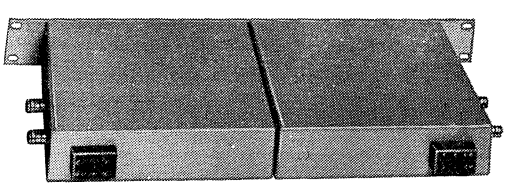
Special Attenuation shapes and controlled delay can be furnished to provide optimum transmission characteristics for TDMA Signals. BNC, SMA, or PC Terminations.



Telephone Interconnect Filters:

Base Group Interconnect 60-108 KHZ
P/N 20-0999-00

Super Group Interconnect 312-552 KHZ
P/N 20-0651-02



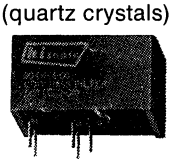
Base Band Separation Filters:

Supergroup 1-2	Supergroup 2-3
0-300 KHZ LP	0-552 KHZ LP
312-12000 KHZ HP	564-12000 KHZ HP
P/N 20-0998-00	P/N 20-0688-02

Many others available or we'll custom design. Let us know your needs.

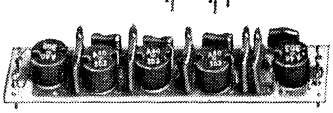
Many other Specialized Applications:

- Ultra-sharp transition characteristics (quartz crystals)
- Controlled Delay • Controlled Phase
- Special Attenuation Shapes



We Also Make:

- Conventional Filters
- Filters to MIL-F-18327



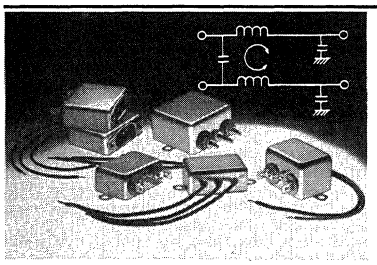
OTHER PRODUCTS: (Mil Spec & Commercial) Power & Precision Inductors • Transformers • Tuned Circuits • Amp/phase Equalizers • Lumped Constant Delay Lines

hisonic inc.

Hisonic, Inc.
249 N. Troost
Dept. EM-83
P.O. Box 1130
Olathe, Kansas 66061
PHONE: 913-782-0012
TELEX: 4-2562

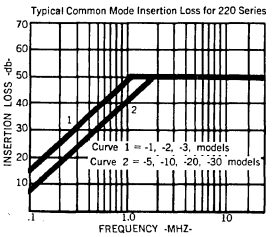
JMK INCORPORATED filters

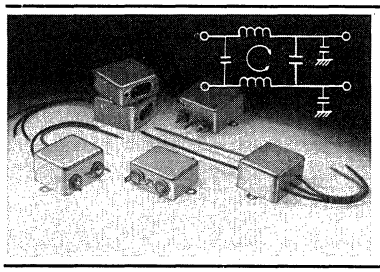
JMK has the filter just right for your power application. Whether it has to do with audio systems, lab test equipment, medical equipment, printers, power converters, video displays, modems, processors, cash registers, pinball machines, televisions, aircraft power supplies, or whatever your specific application may be, we have the filter.



220 Series

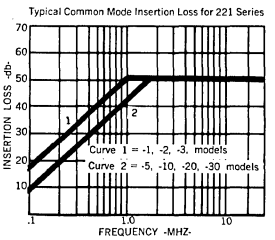
The 220 series is designed to give excellent filtering of "common mode," line-to-ground interference on computer-peripheral and other electronic hardware. Line-to-ground interference is the most common interference experienced and is generally the major source of "interference caused" malfunctions.

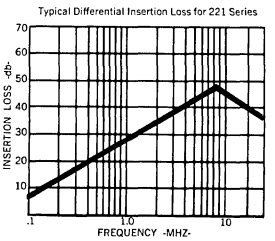


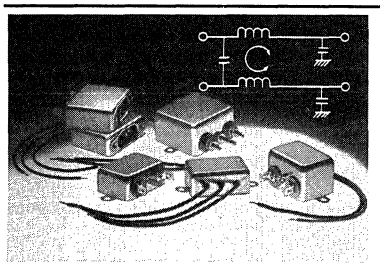


221 Series

The 221 series has the same "common mode" performance as the 220 series but the circuit has been modified to give substantial "differential mode" rejection of noise caused by switching transistors and power supply diodes.

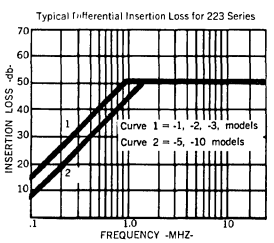


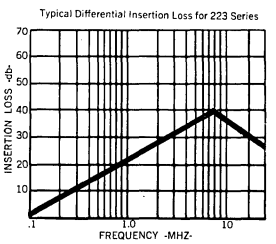


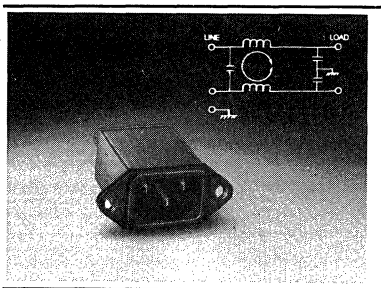


223 Series

The 223 series in intended as an economical compromise between the 220 and 221 series. This filter has the same "common mode" performance as the 220 model with approximately one-half the differential attenuation of the 221 series.

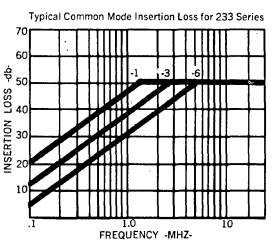


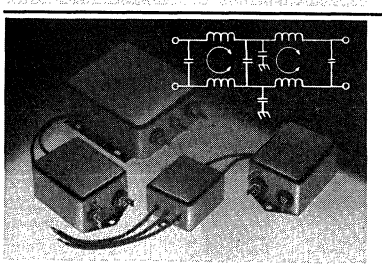




233 Series

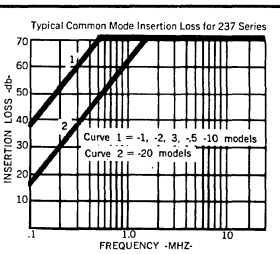
The 233 series filter is a compact filter with an integral IEC connector. This filter gives effective line-to-ground insertion loss and has low leakage current to meet VDE, SEV and other safety organization requirements. If you want an integral filter and connector ask your representative or contact the factory. Many of our other filters can be made available with the IEC connector.

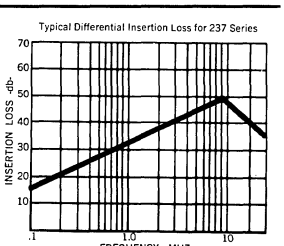


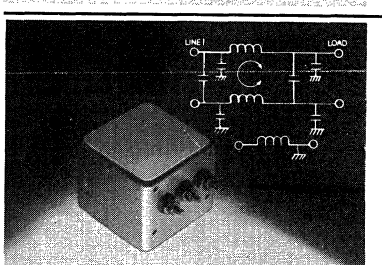


237 Series

This series is a high performance package where filtering requirements are more stringent than those associated with the 220 or 221 series. This package incorporates very high attenuation of both "common mode" and "differential mode" interference yet the cost for such attenuation is moderate.

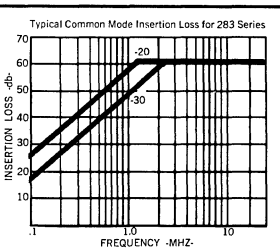


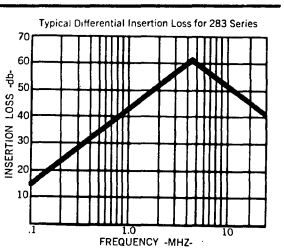




283 Series

The 283 series is a compact single phase high current filter. This filter is rated for 20 and 30 amps and has god common mode and differential mode insertion loss. This filter has a ground coil for high frequency ground isolation which may be included or omitted as desired.





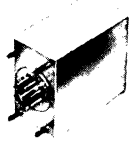
JMK INCORPORATED • 11 CALDWELL DRIVE • AMHERST NH 03031 • (603) 883-6496

KR ELECTRONICS, INC. 91 Avenel Street, Avenel, New Jersey 07001 • (201) 636-1900

LOW PASS FILTERS

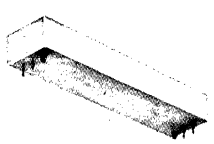
Frequency Range: DC to 50MHz
Impedance Range: 1 ohm to ∞
Stop Bands: 10 to 80db

BAND PASS FILTERS



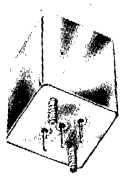
Frequency Range: DC to 50MHz
Band Width: 1% to >100%
Stopband: 10 to 80db
Impedance Range: 1 ohm to ∞

HIGH PASS FILTERS



Frequency Range: DC to 50MHz
Impedance Range: 1 ohm to ∞
Stop Bands: 10 to 80db

BAND REJECT FILTERS



Frequency Range: DC to 50MHz
Band Width: 1% to >100%
Stop Band: 10 to 80db
Impedance Range: 1 to ∞

Custom LC Filters

☐ Filters ☐ Attenuation Equalizers ☐ Group Delay Equalizers ☐ Cable Equalizers ☐ Phase Equalizers ☐ Phase and Attenuation Matched ☐ Delay Lines

Computer-Assisted Design

Shown here are some typical examples of our LC filter design capabilities. Through the use of in-house computers, plus computer time-sharing, we can quickly generate and evaluate such output data as frequency vs. impedance, attenuation, phase, group delay and phase delay in order to provide an immediate quotation.

KR Electronics has computer programs for:

1. Analysis of network behavior to determine attenuation, phase, group delay, transient response and response to a step function and a tone burst.
2. Predistortion of a network and synthesis of a network directly from the poles and zeros.
3. Designing equal ripple group delay networks from your error curve.
4. Determining a network's tolerance sensitivity and reliability.
5. Determining degree of success that can be achieved in production of matched networks.

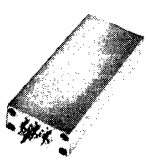
Some of the specialized test equipment used:

1. Computer controlled HP 3042A automatic test set can supply tabular or graphic data with each unit.
2. Programmable synthesizer, phase, gain test sets.
3. Swept low frequency group delay and attenuation test set.
4. Spectrum analyzer.
5. Swept high frequency test set.

DIP Filters

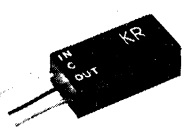
For information on our complete line of DIP filters, send for comprehensive catalog.

MATCHED PHASE & ATTENUATION



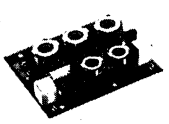
Typical Specifications:
Phase Matched ± 2½° in Pass Band
Attenuation Matched ±.25db In Pass Band for use in Sonar & other multi channel systems.

MAXIMUM FLAT DELAY (BESSEL) FILTER



Size (Typical): .75" x .75" x 1.5"
Frequency Range: 1.5KHz to 1MHz
Z Range: 50 to 10 K
Overshoot: <1%
Delay Flat: <2% to Fc

LINEAR GROUP DELAY VIDEO FILTER



Typical Specifications:
L.P. Cutoff: 4.5 MHz
I.L.: <1db
Passband Ripple: <±.1db
Pass Band Delay Distortion: <25 nsec.
Stopband: >25db

GROUP DELAY & ATTENUATION EQUALIZER NETWORK

To correct system introduced delay distortion & attenuation roll off.

Constant Group Delay Filters

Computer-designed and checked to give equal ripple delay over the pass band insuring exact delay and attenuation characteristics.

Frequency Range: DC to 50 MHz
Impedance Range: 1 ohm to ∞
Temperature Range: —55°C to +125°C.
Complete Encapsulation
Hermetic Seal
P.C. Board Construction
Case Configuration:
Stock or Custom Designed
P.C. Card
Dual In-Line
Standard Hardware Program

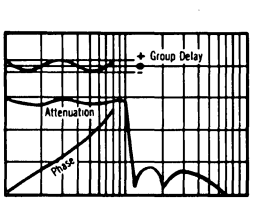
All filters conform to applicable mil specifications.

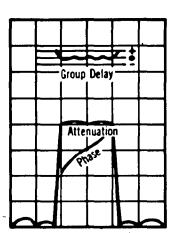
Phase & Attenuation Matching

Differential phase and attenuation matched to eliminate the need for adjustments in multi-channeled systems.

Linear Phase Filters

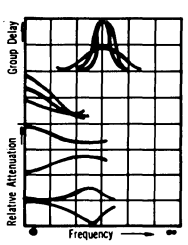
To reduce distortions and lower transient response in modulated systems.





Equalizers

Phase/Delay/Attenuation Computer-designed correction networks derived from system error curves.



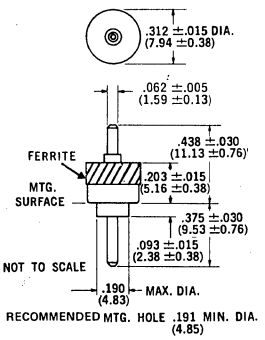
Printed in USA

METUCHEN CAPACITORS INC.

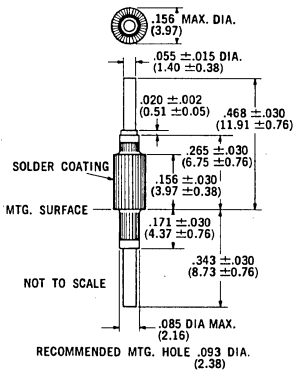
EMI/RFI Suppression Filters
RESIN SEAL THREAD BUSHING

Specifications	Type FCS-C	Type SMFB-A4	Type SMF0-1 / Type SMFB-A1	Type SMFB-A2 / Type SMF0-2
Attenuation 100 MHz - 10 GHz	25 dB @ 25°C 20 dB @ 85°C	50 dB @ 25°C 45 dB @ 125°C	35 dB @ 25°C 35 dB @ 125°C	60 dB @ 25°C 50 dB @ 85°C
Operating Temperature Range	−55°C to +85°C	−55°C to +125°C	−55°C to +125°C	−55°C to +85°C
DC Working Voltage	500 Volts	500 Volts	200 Volts	200 Volts
Feed-Thru Current	25 Amperes	10 Amperes	10 Amperes	10 Amperes
Capacitance (pF)	1000	2500	1300	5500
Feed-Thru Terminal Resistance	0.01 Ohm Maximum			

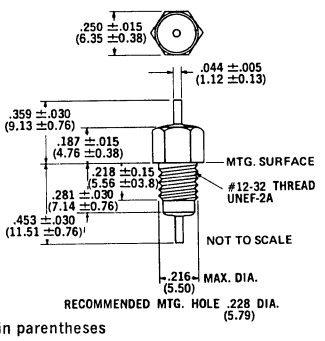
TYPE FCS-C



TYPES SMFO-1, SMFO-2



TYPES SMFB-A1, SMFB-A2, SMFB-A4



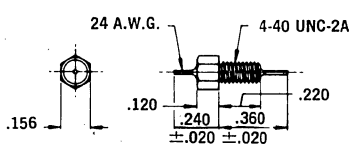
mm are in parentheses

ORDERING INFORMATION

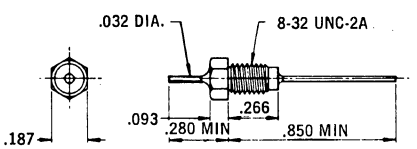
Previous Type Number	Ordering Number
FCS-C	51-722-001 51-722-002 with solder mounting washer
SMFB-A1	51-719-022 with nut and lockwasher
SMFB-A2	51-719-021 with nut and lockwasher
SMFB-A4	51-719-011 with nut and lockwasher

Previous Type Number	Ordering Number
SMF0-1	51-723-303 51-723-304 with solder mounting washer
SMF0-2	51-723-301 51-723-302 with solder mounting washer

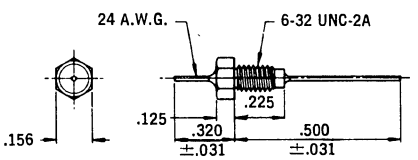
TYPES 51-729



51-712



51-726



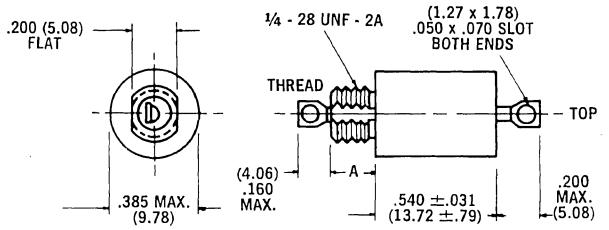
Spectrum Control No.	Rated I_{DC} in Amps	Working Volts, DC +85 °C	Working Volts, DC +125 °C	DCR Max.	Capacitance Reference Only μF	Insertion Loss dB 1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-729-303	10	200	100	.01	.0015	–	5	42	60	65	65
51-729-304	10	200	100	.01	.022	7	27	43	50	60	60
51-726-001	3	200	100	.01	.0015	–	3	42	50	70	70
51-726-002	10	200	100	.01	.022	7	27	43	50	60	60
51-712-001	10	200	100	.01	.0015	–	5	43	50	70	70
51-712-003	10	200	100	.01	.022	10	28	45	50	70	70

All Feed-thru Capacitors and RFI Filters stocked by MCI are manufactured in the U.S.A. by **Spectrum Control Inc. . .**
The world's leading manufacturer of Electro-Magnetic Components. Distributed for Spectrum Control, Inc.

Metuchen Capacitors Inc. / 420 Park Avenue, Perth Amboy, NJ 08861 / (201) 442-0500 / TWX 710-998-0892

METUCHEN CAPACITORS INC.

EMI/RFI Suppression Filters HERMETIC SEAL



50 VDC +85°C L SECTION 28 VDC +125°C

Spectrum Control No.	A Thread Length	Inductor Location	Rated Current	DCR Max.	Insertion Loss dB 30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
51-353-007	.187 (4.75)	Thread	60 ma.	70	44	70	70	70	70	70
51-353-086	.312 (7.92)	End								
51-353-094	.187 (4.75)	Top								
51-353-102	.312 (7.92)	End								
51-353-006	.187 (4.75)	Thread	150 ma.	12	24	52	64	70	70	70
51-353-087	.312 (7.92)	End								
51-353-095	.187 (4.75)	Top								
51-353-103	.312 (7.92)	End								
51-353-005	.187 (4.75)	Thread	250 ma.	4	18	42	56	70	70	70
51-353-088	.312 (7.92)	End								
51-353-096	.187 (4.75)	Top								
51-353-104	.312 (7.92)	End								
51-353-004	.187 (4.75)	Thread	300 ma.	2.3	16	35	44	62	70	70
51-353-089	.312 (7.92)	End								
51-353-097	.187 (4.75)	Top								
51-353-105	.312 (7.92)	End								

50 VDC +85°C L SECTION 28 VDC +125°C

Spectrum Control No.	A Thread Length	Inductor Location	Rated Current	DCR Max.	Insertion Loss dB 30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
51-353-003	.187 (4.75)	Thread	450 ma.	1.2	15	31	37	55	70	70
51-353-090	.312 (7.92)	End								
51-353-098	.187 (4.75)	Top								
51-353-106	.312 (7.92)	End								
51-353-276	.187 (4.75)	Thread	1 amp	.25	15	33	44	70	70	70
51-353-091	.312 (7.92)	End								
51-353-099	.187 (4.75)	Top								
51-353-107	.312 (7.92)	End								
51-353-277	.187 (4.75)	Thread	5 amps	.015	15	28	33	46	70	70
51-353-092	.312 (7.92)	End								
51-353-100	.187 (4.75)	Top								
51-353-108	.312 (7.92)	End								
51-353-001	.187 (4.75)	Thread	10 amps	.01	15	28	33	44	64	70
51-353-093	.312 (7.92)	End								
51-353-101	.187 (4.75)	Top								
51-353-109	.312 (7.92)	End								

mm are in parentheses

Fig #1

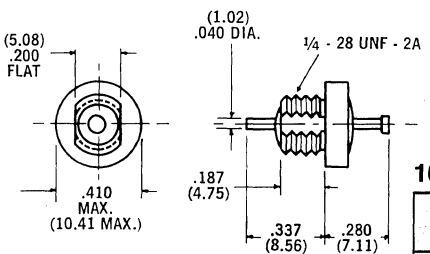
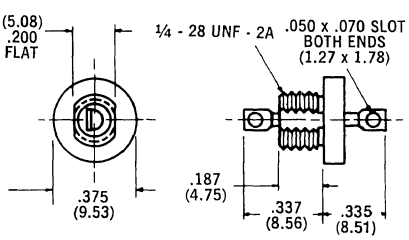
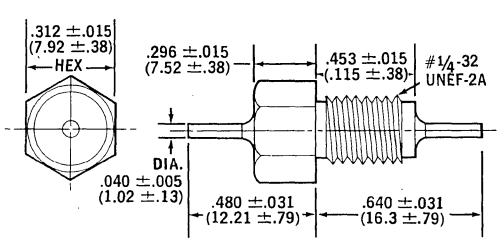


Fig #2



100 VDC +85°C L SECTIONS 125 VAC +125°C

Spectrum Control No.	Rated I_{DC}	Working Volts +85°C	Working Volts +125°C	DCR Max.	Capacitance Reference Only	Insertion Loss dB 30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz	FIG.
51-717-001	15 amps	100 VDC	50 VDC	0.1	1.4 MFD	15	28	33	44	60	70	1
51-717-007	15 amps	125 VAC	125 VAC	0.1	.015 ±20%	—	—	—	10	30	70	1
51-359-001	15 amps	100 VDC	50 VDC	0.1	1.4 MFD	15	28	33	44	60	70	2
51-359-007	15 amps	125 VAC	125 VAC	0.1	.015 ±20%	—	—	—	10	30	70	2



Spectrum Control Number	Rated DC Current	WVDC @ 125°C	DCR	CKT	CAP.	Minimum Insertion Loss dB 1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-732-002	10A	100	.01	L	.1 μF	18	65	70	70	70	70

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The world's leading manufacturer of Electro-Magnetic Components. Distributed for Spectrum Control, Inc.

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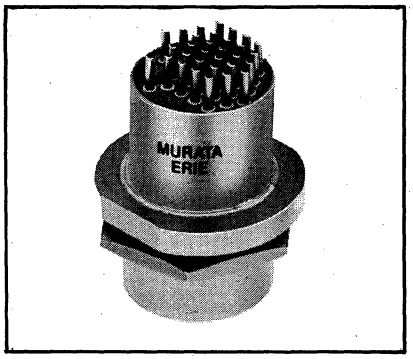
EMI/RFI filter connectors

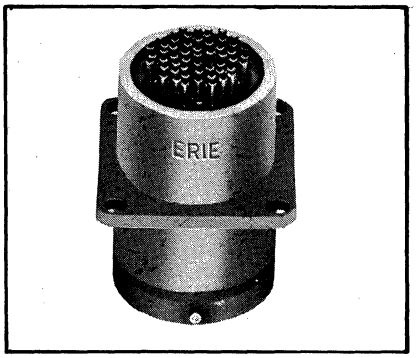
muRata ERIE
MURATA ERIE NORTH AMERICA, INC.

Cylindrical Connectors

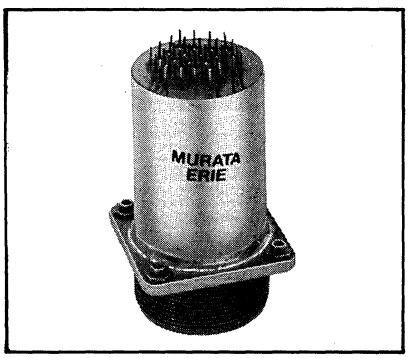
Murata Erie cylindrical filter connectors can be found in numerous military, aerospace and commercial programs and have to be of the highest reliability. Because of the large variations in requirements for specific applications, Murata Erie has a competent staff of applications engineers available to aid in custom designs. Shown are some typical examples of Murata Erie cylindrical filter connectors and the appropriate MIL specifications which they meet.



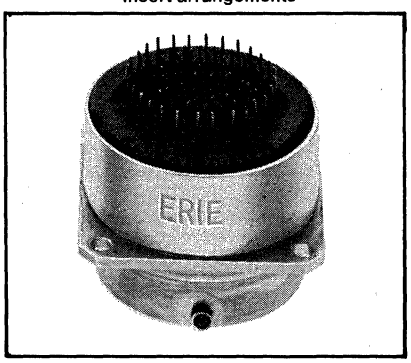
1255-080 Series to MIL-C-83723
Hermetically sealed, 2-61 line insert arrangements



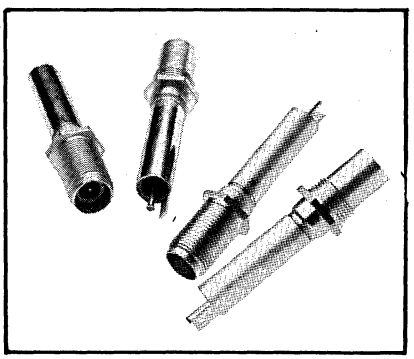
1255-100 Series to MIL-C-26482
Wide capacitance range. Directly replaces ITT "PVJ" and Bendix "FPT"



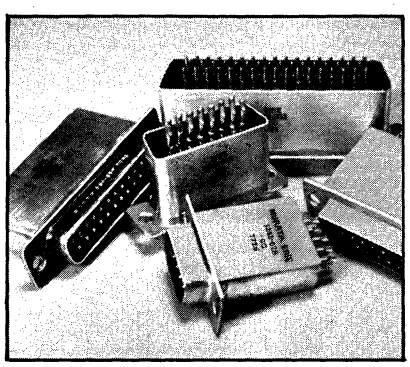
1255-070 Series to MIL-C-5015
Power connector with #12 or #16 contacts



1255-090 Series to MIL-C-38999
Low profile. 3-128 lines with from #12 to #22 contacts



1240-010 Series — UG/U Types
For audio lines. TNC/BNC compatible



"D" Connectors
1255-030 Series to MIL-C-24308

A complete line of high quality subminiature filtered connectors is available in 9, 15, 25, 37, and 50 contact arrangements, per MIL-C-24308. Capable of withstanding MIL-F-15733 testing including vibration and moisture resistance, these rugged assemblies are of a complete solder construction, thereby delivering the highest possible insertion loss at frequencies up to 10 GHz. The rear termination is available in solder-cup, .025″ square wire wrap or .030″ round PC board variations.

CUSTOM DESIGNS

Murata Erie specializes in developing sophisticated circuit designs and creating high component density packaged networks in-house. Our engineering design teams analyze individual customer problems, design specific components or networks to solve the problem, build prototypes and test the complete system. To support the high technological content of these custom networks, the engineering and test capabilities at our facility have become one of the most advanced in the industry today. The reliability of every component and network is assured by a comprehensive battery of tests performed under carefully controlled conditions. Then in-line prototype techniques further validate component performance prior to volume production. These technical support activities permit Murata Erie to respond to customer needs promptly and efficiently with positive performance engineered into the customer's system. If your requirements are unique, if you have a critical space, weight, or environmental problem, Murata Erie can help solve your specific requirements for you with a custom designed filter network.

muRata ERIE

MURATA ERIE NORTH AMERICA, INC. 1148 Franklin Rd., S.E. Marietta, Georgia 30067 Tel: (404) 952-9777 Telex: 54-2329 TWX: 810-766-1531

EMI/RFI filters

MURATA ERIE NORTH AMERICA, INC.

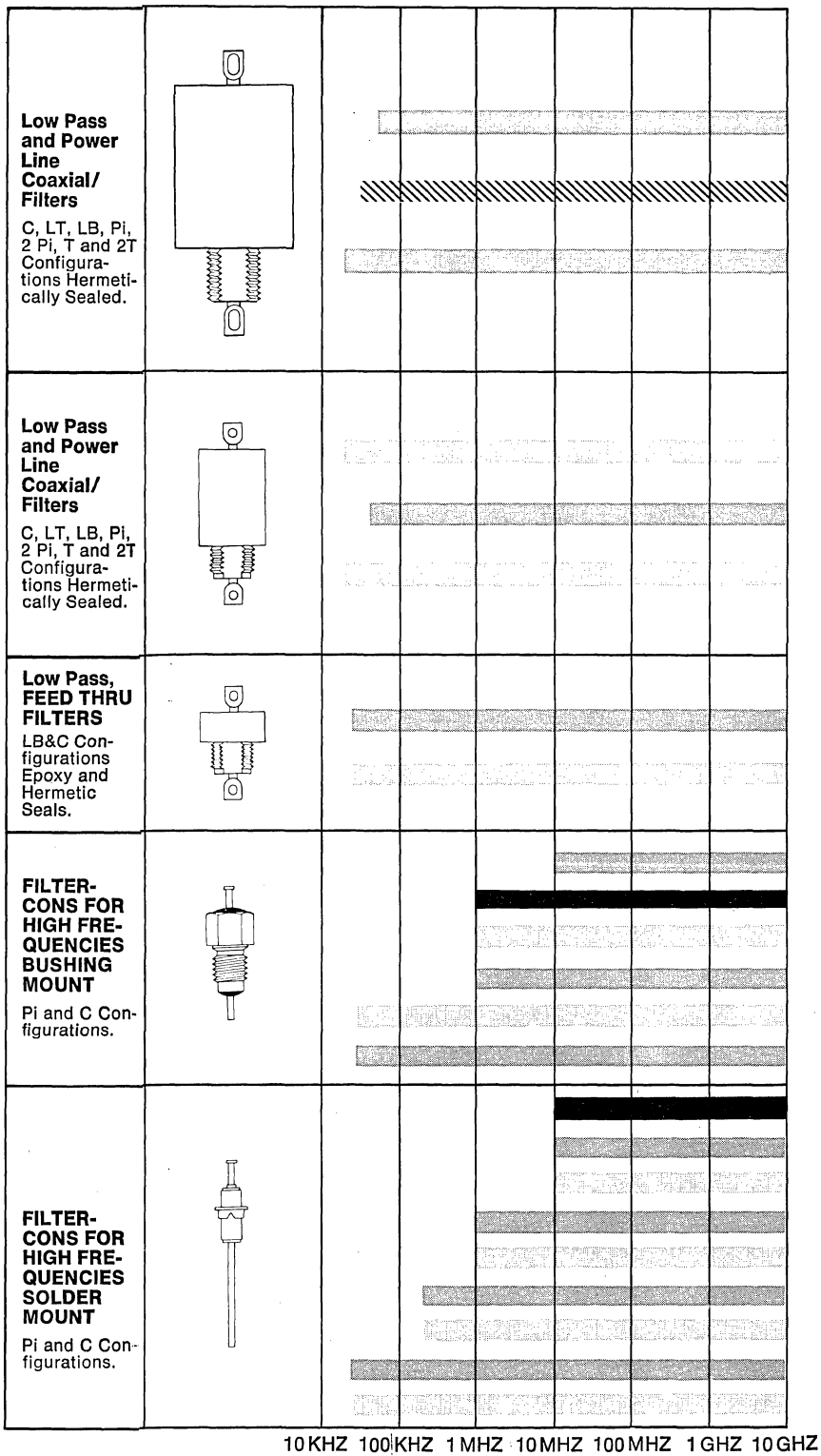
Murata Erie manufactures a complete line of EMI/RFI suppression, low pass filters in Pi, C, L, LT and LB configurations. These units, as well as a complete line of Power Line filters, are offered in both coaxial and bushing mount styles and to MIL-F-15733.

Long term reliability is assured through a quality assurance system meeting or exceeding the requirements of MIL-Q-9859 and DND-1015.

To complement this line of filters, Murata Erie has a complete Customer Service and Customer Engineering staff to provide specific application assistance and custom designs.

Illustrated are typical EMI/RFI filter configurations and their frequency/voltage capabilities.

Typical Filter Configurations vs Frequency



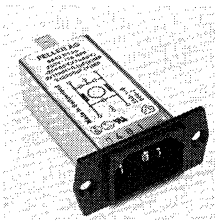
WORKING VOLTAGE

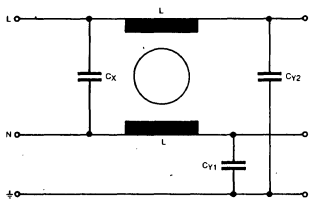
0-100V
100-250V
250-500V
500-2500V

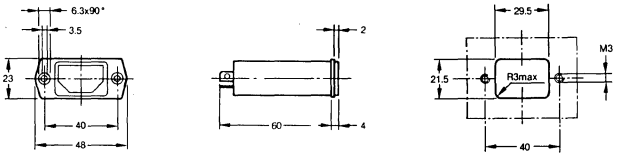
MURATA ERIE NORTH AMERICA, INC. 1148 Franklin Rd., S.E. Marietta, Georgia 30067 Tel: (404) 952-9777 Telex: 54-2329 TWX: 810-766-1531

INTERNATIONAL RFI Power Line Filters

RFI filter with integral AC connector





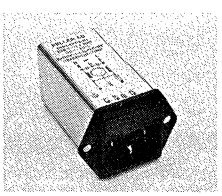


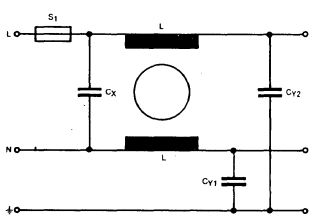
DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Available with 1 meg ohm, ½ watt discharge resistor on special order

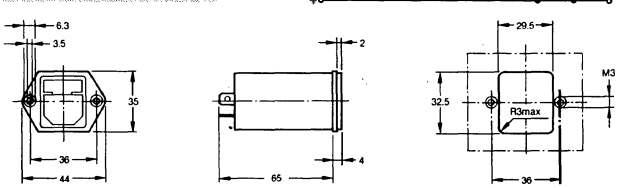
All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
8843.N1.20.60	1	0.5	0.047	2200	11	70	Common Mode	45	58	62	60	62	37
							Differential Mode	10	32	50	72	70	47
8843.N2.20.60	2	0.5	0.047	2200	4	70	Common Mode	36	48	53	53	53	37
							Differential Mode	15	24	40	70	80	45
8843.N4.20.60	4	0.5	0.047	2200	1.6	70	Common Mode	27	38	50	58	62	42
							Differential Mode	10	18	30	60	76	48
8843.N6.20.60	6	0.5	0.047	2200	0.4	70	Common Mode	19	28	38	50	60	55
							Differential Mode	11	19	28	46	55	45

RFI filter with integral AC connector & 5 X 20 mm fuseholder







DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22 with integral 5 X 20 mm fuseholder, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Available with 1 meg ohm, ½ watt discharge resistor on special order

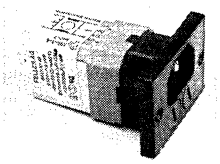
All dimensions in mm.

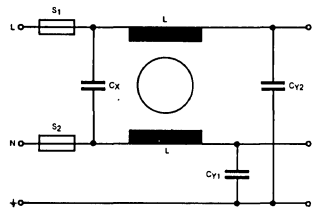
Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
8843.N1.30.60	1	0.5	0.1	2200	11	95	Common Mode	32	52	58	56	58	37
							Differential Mode	10	30	56	61	67	41
8843.N2.30.60	2	0.5	0.1	2200	4	95	Common Mode	32	48	55	57	59	46
							Differential Mode	10	20	42	62	64	52
8843.N4.30.60	4	0.5	0.1	2200	1.6	95	Common Mode	27	36	45	55	61	45
							Differential Mode	11	18	30	57	64	39

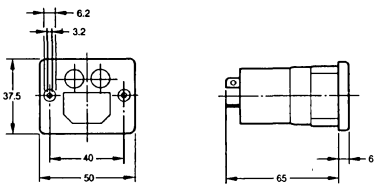
PANEL COMPONENTS CORPORATION P.O. Box 6626M, Santa Rosa, CA 95406 • (707) 523-0600

INTERNATIONAL RFI Power Line Filters

RFI filter with integral AC connector & dual 5 X 20 mm fuseholder







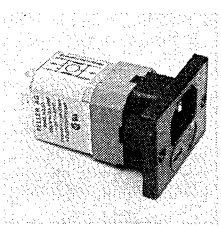
DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range – 25° C to + 85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition: UL*, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22 with dual 5 X 20 mm fuseholders, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Available with 1 meg ohm, ½ watt discharge resistor on special order

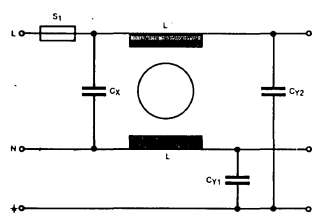
All dimensions in mm.

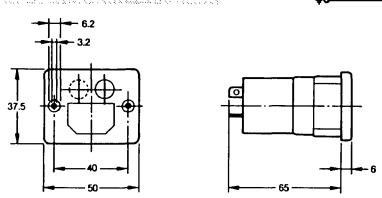
*UL recognized only for 240 VAC two phase applications

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
							Common Mode	43	57	60	55	57	37
8843.N1.40.60	1	0.5	0.1	2200	11	90	Differential Mode	10	32	60	62	63	50
							Common Mode	33	46	50	50	53	42
8843.N2.40.60	2	0.5	0.1	2200	4	90	Differential Mode	8	24	45	57	61	47
							Common Mode	20	32	40	52	60	45
8843.N4.40.60	4	0.5	0.1	2200	1.6	90	Differential Mode	9	20	29	42	52	40

RFI filter with integral AC connector & 50 X 20mm fuseholder







DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range – 25° C to + 85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22 with integral 5 X 20 mm fuseholder, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Available with 1 meg ohm, ½ watt discharge resistor on special order

All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
							Common Mode	42	58	59	56	58	40
8843.N1.50.60	1	0.5	0.1	2200	11	90	Differential Mode	12	30	60	60	61	50
							Common Mode	32	48	56	59	60	46
8843.N2.50.60	2	0.5	0.1	2200	4	90	Differential Mode	10	22	38	47	60	46
							Common Mode	19	30	38	51	60	44
8843.N4.50.60	4	0.5	0.1	2200	1.6	90	Differential Mode	10	20	30	45	51	40

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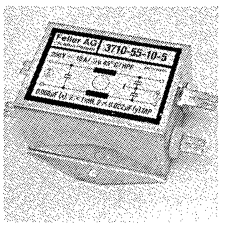
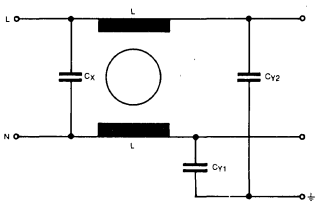
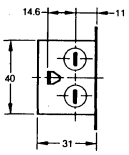
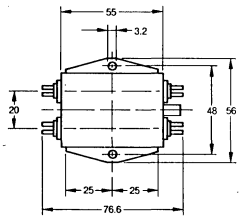
INTERNATIONAL RFI Power Line Filters

RFI filter for internal mounting









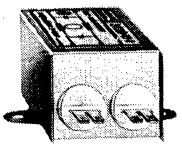
DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range – 25° C to + 85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approval: SEV; pending at UL & VDE
Housing: Rust-protected metal
Contacts: .250 inch universal quick disconnects

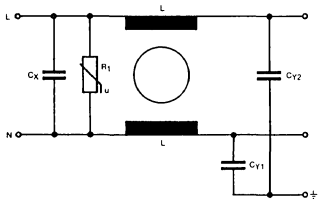
All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
							Common Mode	—	26	40	43	45	40
3710-55-10-05	10	0.5	0.068	2200 pF	1	150	Differential Mode	—	—	17	37	50	50
							Common Mode	—	28	36	42	46	46
3710-55-10-5	10	5	0.068	0.022 μF	1	150	Differential Mode	—	—	10	35	50	50
							Common Mode	—	26	40	42	45	40
3710-55-20-5	20	5	0.068	0.022 μF	0.15	150	Differential Mode	—	—	16	40	50	50

INTERNATIONAL RFI Power Line Filters

RFI filter for internal mounting



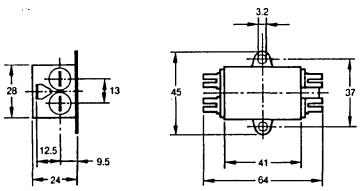


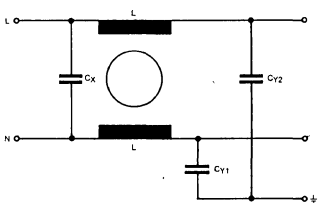
SCHEMATIC: 3710-41 (-1, -3, -6, -10)

DESCRIPTION:

For Class I applications with or without 10 joule, 0.5 watt varistor for surge protection
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approval: SEV; pending at UL & VDE
Housing: Rust-protected metal
Contacts: .250 inch universal quick disconnects

All dimensions in mm.





SCHEMATIC: 3710-41 (-1, -3, -6)-Z

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
3710-41-1	1	0.5	0.015	2200	10	50	Common Mode	—	43	50	50	50	50
							Differential Mode	—	—	17	35	46	46
3710-41-3	3	0.5	0.015	2200	2	50	Common Mode	—	30	40	47	51	49
							Differential Mode	—	—	10	31	45	45
3710-41-6	6	0.5	0.015	2200	0.8	50	Common Mode	—	24	31	40	45	45
							Differential Mode	—	—	10	32	48	48
3710-41-10	10	0.5	0.015	2200	0.4	50	Common Mode	—	17	26	38	46	46
							Differential Mode	—	—	5	26	40	42
3710-41-1-z*	1	0.5	0.015	2200	10	50	Common Mode	—	43	51	51	50	50
							Differential Mode	—	—	26	39	47	47
3710-41-3-z*	3	0.5	0.015	2200	2	50	Common Mode	—	30	41	46	50	48
							Differential Mode	—	—	10	30	42	42
3710-41-6-z*	6	0.5	0.015	2200	0.8	50	Common Mode	—	24	32	40	45	45
							Differential Mode	—	—	10	32	48	48

***with 10 joule, 0.5 watt varistor**

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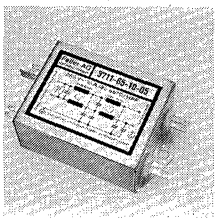
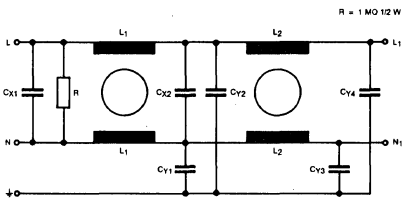
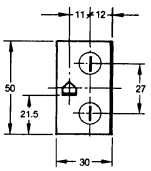
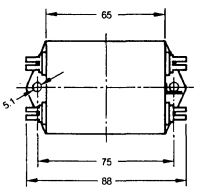
INTERNATIONAL RFI Power Line Filters

RFI filter for internal mounting









DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range – 25° C to + 85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approval: SEV; pending at UL, VDE
Housing: Rust-protected metal
Contacts: .250 inch universal quick disconnects
Two-stage filter with increased common mode insertion loss for switching power supply applications

All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)		Inductor (mH)	Weight (g)	Insertion Loss - dB					
				C_{Y1} & C_{Y2}	C_{Y3} & C_{Y4}				100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
3711-65-3-05	3	0.5	0.1	1500	1000	2	170	Common Mode	—	53	66	66	66	66
								Differential Mode	—	46	60	60	60	60
3711-65-3-5	3	5	0.1	22	1000	2	170	Common Mode	—	60	68	68	68	68
								Differential Mode	—	45	60	60	60	60
3711-65-6-05	6	0.5	0.1	1500	1000	0.8	170	Common Mode	—	49	67	67	67	67
								Differential Mode	—	43	60	60	60	60
3711-65-6-5	6	5	0.1	22	1000	0.8	170	Common Mode	—	58	70	70	70	70
								Differential Mode	—	43	60	60	60	60
3711-65-10-05	10	0.5	0.1	1500	1000	0.4	170	Common Mode	—	50	70	70	70	70
								Differential Mode	—	40	60	60	60	60
3711-65-10-5	10	5	0.1	22	1000	0.4	170	Common Mode	—	55	70	70	70	70
								Differential Mode	—	40	60	60	60	60

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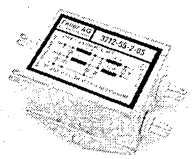
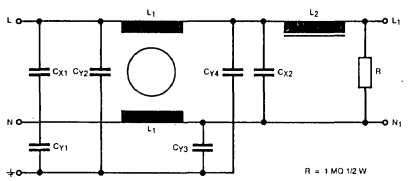
INTERNATIONAL RFI Power Line Filters

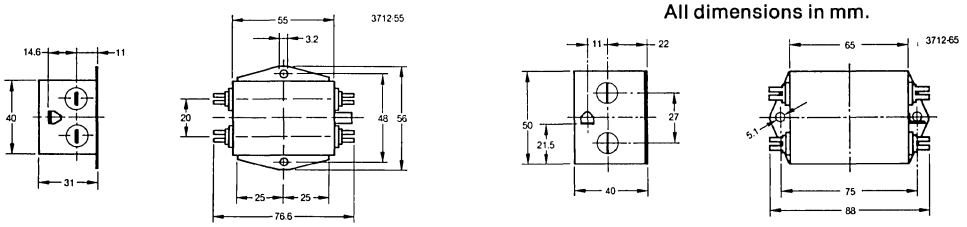
RFI filter for internal mounting





DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approval: SEV; pending at UL & VDE
Housing: Rust-protected metal
Contacts: .250 inch universal quick disconnects
Two-stage filter with increased common and differential mode insertion loss for switching power supply applications

All dimensions in mm.



Part Number	Current Rating (Amps)	Leakage Current (mA max) (@ 250 VAC)	X Capacitors (μF)		Y Capacitors		Inductor (mH)			Weight (g)	Insertion Loss - dB						
			C_{X1}	C_{X2}	C_{Y1} & C_{Y2}	C_{Y3} & C_{Y4}	L_1	L_2	L_3			100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
											Common Mode	—	52	60	60	60	60
3712-55-1-05	1	0.5	0.1	0.47	1500 pF	1500	15	1.0	—	100	Differential Mode	57	67	67	67	67	67
											Common Mode	—	50	70	70	70	70
3712-55-2-05	2	0.5	0.1	0.47	1500 pF	1500	10	0.4	0.4	100	Differential Mode	58	66	66	66	66	66
											Common Mode	—	52	60	60	60	60
3712-65-3-05	3	0.5	0.1	0.47	1500 pF	1500	12	1.0	—	210	Differential Mode	70	74	74	74	74	74
											Common Mode	—	56	66	66	66	66
3712-65-4-3	4	3	0.1	0.6	.010 μF	4700	10	0.8	—	210	Differential Mode	70	75	75	75	75	75
											Common Mode	—	52	65	65	65	65
3712-65-6-3	6	3	0.1	0.6	.010 μF	4700	7	0.3	0.3	210	Differential Mode	60	70	70	70	70	70

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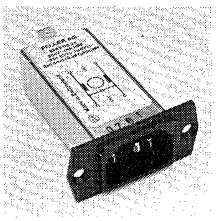
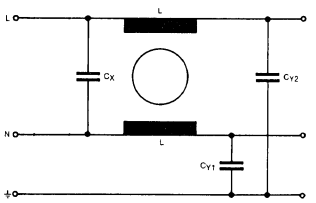
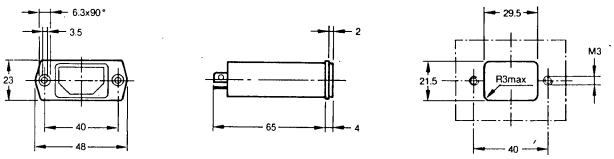
INTERNATIONAL RFI Power Line Filters

Low leakage RFI filter with integral AC connector





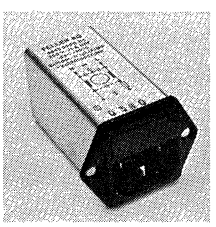


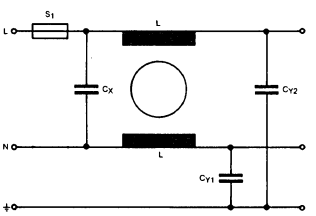
DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Low leakage RFI filter for medical applications

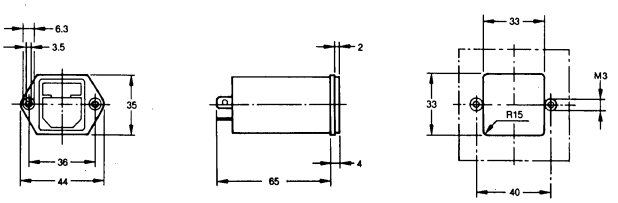
All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (μA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
							Common Mode	34	38	38	42	41	42
8843.N2.23.60	2	80	0.047	470	4	70	Differential Mode	8	15	28	60	67	53
							Common Mode	15	32	31	38	43	50
8843.N6.23.60	6	80	0.047	470	0.8	70	Differential Mode	7	12	20	48	68	66
							Common Mode	23	38	53	47	42	22
8843.N2.24.60	2	5	0.047	—	4	70	Differential Mode	7	18	32	65	72	38
							Common Mode	18	26	32	35	36	24
8843.N6.24.60	6	5	0.047	—	0.8	70	Differential Mode	7	14	23	50	64	38

Low leakage RFI filter with integral AC connector & 50 X 20 mm fuseholder







DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Low leakage RFI filter for medical applications

All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (μA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
							Common Mode	30	43	51	48	48	38
8843.N2.33.60	2	80	0.047	470	4	95	Differential Mode	7	17	39	57	54	45
							Common Mode	24	48	52	47	38	13
8843.N2.34.60	2	5	0.047	—	4	95	Differential Mode	7	18	30	50	57	38

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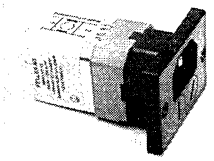
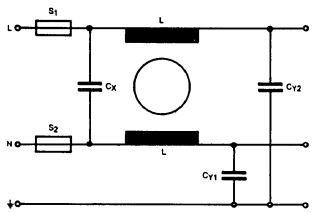
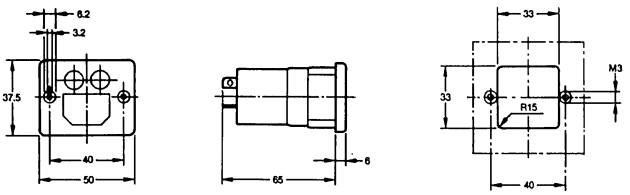
INTERNATIONAL RFI Power Line Filters

Low leakage RFI filter with integral AC connector & 5 X 20 mm fuseholder





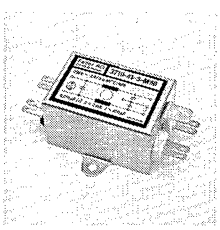


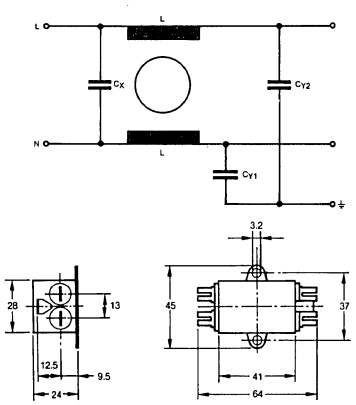
DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approvals, recognition, certification: UL, CSA, VDE, SEMKO, SEV
Housing: Rust-protected metal
Connector: CEE 22, molded from black thermoplastic
Contacts: .250 inch solderable quick disconnects
Low leakage RFI filter for medical applications

All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (μA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
8843.N2.43.60	2	80	0.047	470	4	90	Common Mode	32	50	54	47	45	41
							Differential Mode	10	17	30	52	62	60
8843.N2.44.60	2	5	0.047	—	4	90	Common Mode	30	46	49	40	35	13
							Differential Mode	8	16	30	49	57	42

Low leakage RFI filter for internal mounting





DESCRIPTION:
For Class I applications
Operating voltages up to 250 VAC, 50-60 Hz
Temperature class in accordance with DIN 40040: HPF
Operating temperature range −25° C to +85° C
Ambient temperature for operation at full rated current: 40° C
Test voltage: line-ground & neutral-ground, 2000 VAC, 50 Hz, 1 min.; line-neutral, 1075 VDC, 1 min.
Approval: SEV; pending at UL & VDE
Housing: Rust-protected metal
Contacts: .250 inch universal quick disconnects
Low leakage RFI filter for medical applications

All dimensions in mm.

Part Number	Current Rating (Amps)	Leakage Current (μA max) (@ 250 VAC)	X Capacitors (μF)	Y Capacitors (pF)	Inductor (mH)	Weight (g)	Insertion Loss - dB					
								100kHz	400kHz	1Mz	4mHz	10mHz	100mHz
3710-41-3-M 5	3	5	0.015	—	0.12	45	Common Mode	—	—	20	29	30	29
							Differential Mode	—	—	20	40	55	56
3710-41-3-M 80	3	80	0.015	470	2	45	Common Mode	—	29	37	38	38	39
							Differential Mode	—	—	10	25	26	26

PANEL COMPONENTS CORPORATION P.O. Box 6626M, Santa Rosa, CA 95406 • (707) 523-0600

INTERNATIONAL Power Module

This INTERNATIONAL Power Module combines in one package four basic primary circuit components:

- rocker power switch (push button switch is available as an option)
- fuseholder that accepts either a 5 × 20 mm or ¼ × 1¼ inch fuse
- IEC-320/CEE-22 primary circuit connector
- high performance single-stage RFI power filter

The entire power module is designed from the beginning to satisfy the test requirements of UL, CSA, VDE & SEV. Use of this component can simplify the foreign approval process because it will eliminate the delays and extra costs associated with having unrecognized components tested or in sourcing approved primary circuit components.

The filter itself is designed to provide high attenuation in the range under 500 KHz. This makes it especially effective for use with switching power supplies. Its low leakage allows its use in portable equipment in accordance with VDE and SEV requirements.

Specifications

Part number: 8843.N4.9005.A

Working voltage: 110-250 Volts AC

Frequency: 50-60 Hz

Current (at all voltages in above range) 4 amps

Operating temperature range: – 25 to + 85 °C (VDE class HPF)

Leakage current: less than 0.5 mA at 250 VAC

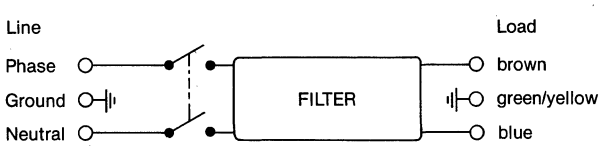
Power dissipation: less than 8 Watts at 4A

Weight: approximately 490 grams (17 oz.)

Method of connection: wire leads: color-coded brown, blue, green/yellow; 20 cm (approx. 7.9 inches) long; wire size is 1.0 mm² (approximately 16 AWG, which is .963 mm²); wire leads are terminated by two Amp connectors, P/N 350536-0005, and one terminal lug on the ground, Amp P/N 2-31890-1.

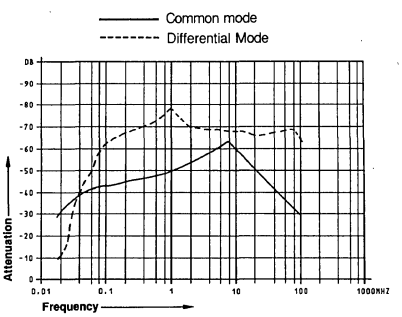
Test agency approvals: SEV and VDE approved; UL recognized; CSA certified

Schematic

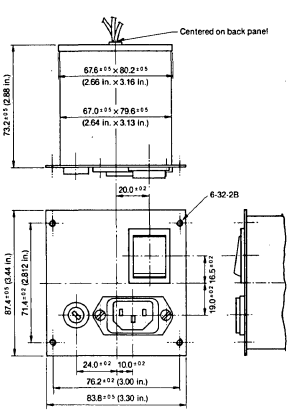


Performance

Common & Differential Mode Insertion Loss
as measured in a 50Ω/50Ω system



Dimensions



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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

POTTER COMPANY
A VARIAN DIVISION

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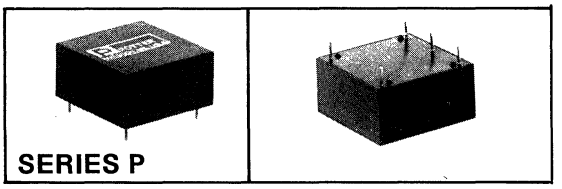
EMI Power Line Filters

SERIES P PRINTED CIRCUIT BOARD FILTERS

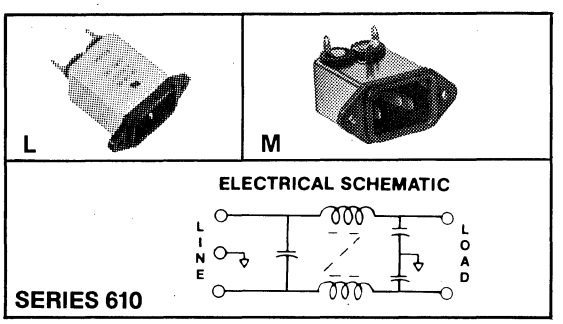
The P Series of EMI filters is designed for use specifically on printed circuit boards. They are housed in a 1¼ x 1¼ x .6 high plastic case, equipped with five .030 diameter tinned copper pins located on a 1" grid. Four stand-off feet are provided to maintain the filter away from the printed circuit board during wave soldering operations. They are available in the 600, 605, 610 and 615 circuit diagrams, in current ratings up to and including 6 amperes. The series is UL recognized and under evaluation at VDE and SEV. **Rated Voltage:** 115-250 VAC, 50-60 Hz. **Max. Leakage Current (Line to Ground):** See individual series for their leakage. **Test Voltage:** Line to ground, 2250 VDC; line to line 1500 VDC.



SERIES 610 INTERNATIONAL FILTERS

The 610 Series was designed specifically to meet the requirements of VDE and features the special IEC international power line connector. The compact construction also complies with IEC, BSI standards. All units are U.L. recognized, CSA certified, SEV, VDE approved. **Rated Voltage:** 115/250 VAC, 50-60 Hz. **Max. Leakage Current: (Line to Ground):** 0.5 mA at 250 VAC. **Test Voltage:** Line to ground, 2250 VDC; line to line, 1500 VDC.

Potter Number	Fig.	Max. Line Current Amps	Size, Inches L. x W. x H.
610G	L	1	1.97x2.06x0.81
610GA1	L	1	1.97x2.06x0.81
610G3	L	3	1.97x2.06x0.81
610GA3	L	3	1.97x2.06x0.81
610G6	L	6	1.97x2.06x0.81
610GA6	L	6	1.97x2.06x0.81
610H	M	1	1.97x2.06x0.81
610HA1	M	1	1.97x2.06x0.81
610H3	M	3	1.97x2.06x0.81
610HA3	M	3	1.97x2.06x0.81
610H6	M	6	1.97x2.06x0.81
610HA6	M	6	1.97x2.06x0.81



SERIES 605 GENERAL PURPOSE FILTERS

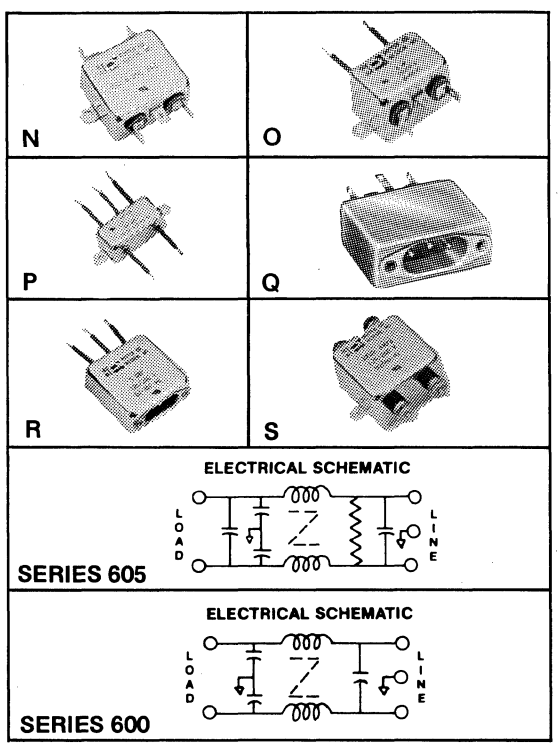
The Series 605 is similar to Series 600, except that it has additional line-to-line components to provide superior attenuation in the differential (line-to-line) mode. The entire series is U.L. recognized. Most models are CSA approved: Styles A, B, and C in 2.5 and 10 Amp versions are VDE approved. **Rated Voltage:** 115/250 VAC, 50-60 Hz. **Max. Leakage Current (Line to Ground):** 0.5 mA at 115 VAC, 60 Hz: 1.0 mA at 250 VAC, 50 Hz. **Test Voltage:** Line to ground, 2250 VDC; line to line, 1500 VDC.

Potter Number	Fig.	Max Line Current Amps	Size, Inches L. x W. x H.
605A2	N	2	2.00x1.75x0.88
605B2	O	2	2.00x1.75x0.88
605C2	P	2	2.00x1.75x0.88
605D2	Q	2	2.00x2.06x0.88
605E2	R	2	2.00x2.06x0.88
605A5	N	5	2.00x1.75x1.13
605B5	O	5	2.00x1.75x1.13
605C5	P	5	2.00x1.75x1.13
605D5	Q	5	2.00x2.06x1.13
605E5	R	5	2.00x2.06x1.13
605A10	N	10	2.00x2.00x1.13
605B10	O	10	2.00x2.00x1.13
605C10	P	10	2.00x2.00x1.13
605D10	Q	10	2.00x2.06x1.25
605E10	R	10	2.00x2.06x1.25
605F10	S	10	2.00x2.00x1.13
605A20	N	20	2.50x2.00x1.50
605F20	S	20	2.50x2.00x1.50

SERIES 600 GENERAL PURPOSE FILTERS

Designed to provide low cost, effective interference control in many varied applications. The entire series is U.L. recognized. Most models are CSA approved. Styles A, B, and C in 2, 5, and 10 Amp versions are VDE approved. **Rated Voltage:** 115/250 VAC, 50-60 Hz. **Max. Leakage Current (Line to Ground):** 0.5 mA at 115 VAC, 60 Hz: 1.0 mA at 250 VAC, 50 Hz. **Test Voltage:** Line to ground, 2250 VDC; line to line, 1500 VDC.

Potter Number	Fig.	Max. Line Current Amps	Size, Inches L. x W. x H.
600A2	N	2	1.75x0.88x0.63
600B2	O	2	1.75x0.88x0.63
600C2	P	2	1.75x0.88x0.63
600D2	Q	2	2.00x1.81x0.75
600E2	R	2	2.00x1.81x0.75
600A5	N	5	1.75x1.25x0.75
600B5	O	5	1.75x1.25x0.75
600C5	P	5	1.75x1.25x0.75
600D5	Q	5	2.00x2.06x0.75
600E5	R	5	2.00x2.06x0.75
600A10	N	10	1.75x1.25x1.13
600B10	O	10	1.75x1.25x1.13
600C10	P	10	1.75x1.25x1.13
600D10	Q	10	2.00x2.06x1.13
600E10	R	10	2.00x2.06x1.13
600F10	S	10	1.75x1.25x1.13
600A20	N	20	2.00x2.00x1.13
600F20	S	20	2.00x2.00x1.13



Available at Authorized Distributors.

POTTER COMPANY
A VARIAN DIVISION

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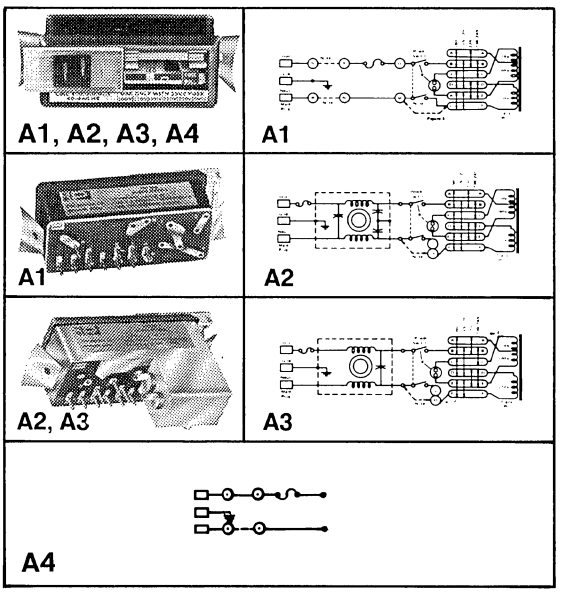
EMI Power Line Filters

SERIES 7100 POWER LINE MODULES

A wide variety of power line voltages is in use around the world. The Power Line Module has been designed to overcome this problem. It provides an AC power receptacle, a fuse holder and ejector, and a line voltage selector. For safety, the power cord must be disconnected before access to the fuse is possible. Then, the transparent cover can be moved to the left, the fuse removed, and the PC selector board removed. The board is then rotated until the desired line voltage is shown on the left, the board and fuse replaced, and the cover closed. The module is then ready for use. All models are U.L. and CSA recognized. Model 7100-0001 is VDE approved. **Rated Current:** 6 Amps. **Operating Voltages:** 100, 115/120, 220, 230/240. **Operating Frequencies:** 48-440 Hz. **Max. Leakage Current at 240 VAC:** Model 7100-0001, 1 microampere: Model 7100-0002, 500 microamperes: Model 7100-0003, 2 microamperes. **Test Voltage:** 2250 VDC.

Potter Number	Fig.	Description
7100-0001	A1	Unfiltered
**7100-0002	A2	Filtered for data processing use
7100-0003	A3	Filtered for medical and dental use
*7100-0005	A4	Unfiltered-unswitched
*7100-0010	A1	Unfiltered - 10 Amps

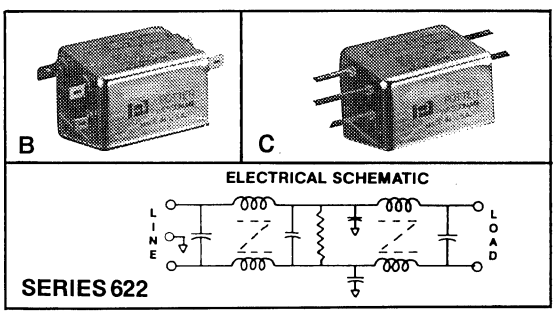
*NOT CSA
**VDE PENDING



SERIES 622 SWITCHING POWER SUPPLY FILTERS

The Series 622 filters are high performance units developed to reduce conducted noise emissions to a level compatible with the requirements of VDE 0875 and proposed FCC standards. High insertion loss is provided for both common mode and differential mode noise from 0.1 MHz through 20 MHz. Recognized by U.L., VDE, SEV, and CSA. **Rated Voltage:** 115/250 VAC, 50-60 Hz. **Max. Leakage Current:** 0.35 MA at 115 VAC, 60 Hz; 0.5 MA at 250 VAC, 50 Hz. **Test Voltage:** Line to ground, 2500 VAC; line to line, 1500 VDC.

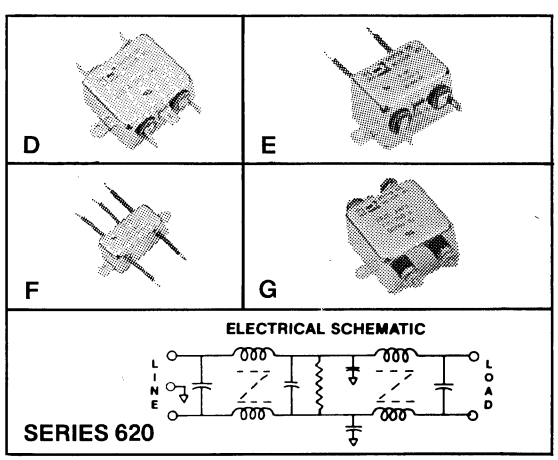
Potter Number	Fig.	Max. Line Current Amps	Size, Inches L. x W. x H
622A3	B	3	2.50x2.00x1.50
622C3	C	3	2.50x2.00x1.50
622A6	B	6	5.25x2.00x2.25
622C6	C	6	5.25x2.00x2.25
622A10	B	10	5.25x2.00x2.75
622C10	C	10	5.25x2.00x2.75



SERIES 620 HIGH PERFORMANCE FILTERS

The Series 620 offers superior performance in line-to-line filtering characteristics. It is recommended for low impedance loads and will handle both pulsed or intermittent interference and continuous noise. **Rated Voltage:** 115/250 VAC, 50-400 Hz. **Max. Leakage Current (Line to Ground):** 0.65 mA at 115 VAC, 60 Hz: 1.25 mA at 250 VAC, 50 Hz. **Test Voltage:** Line to ground, 2250 VDC; line to line, 1500 VDC, U.L. recognized.

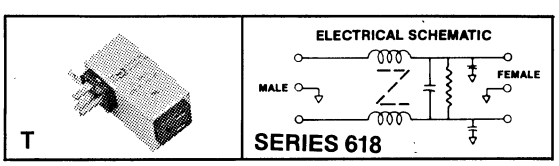
Potter Number	Fig.	Max. Line Current Amps	Size, Inches L. x W. x H.
620A1	D	1	2.00x1.75x1.13
620A2	D	2	2.00x1.75x1.13
620B1	E	1	2.00x1.75x1.13
620B2	E	2	2.00x1.75x1.13
620C1	F	1	2.00x1.75x1.13
620C2	F	2	2.00x1.75x1.13
620A3	D	3	2.50x2.00x1.13
620A5	D	5	2.50x2.00x1.13
620B3	E	3	2.50x2.00x1.13
620B5	E	5	2.50x2.00x1.13
620C3	F	3	2.50x2.00x1.13
620C5	F	5	2.50x2.00x1.13
620A10	D	10	2.50x2.00x1.50
620B10	E	10	2.50x2.00x1.50
620C10	F	10	2.50x2.00x1.50
620F10	G	10	2.50x2.00x1.50
620A20	D	20	3.88x3.32x1.50
620F20	G	20	3.88x3.32x1.50



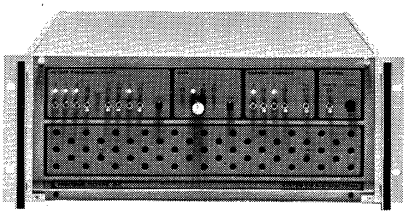
SERIES 618 PLUG-IN FILTERS

A unique and invaluable aid to system installers and end users who find equipment incompatibility at the site. Plug the equipment into the 618 and the 618 into the wall outlet to filter offending noise from such equipment as small motors, light dimmers, switching power supplies, and electromechanical relays. Recognized by **U.L. Rated Voltage:** 125 VAC, 60 Hz. **Max. Leakage Current:** 1.25 mA at 125 VAC. **Test Voltage:** Line to ground, 1500 VDC; line to line, 1500 VDC.

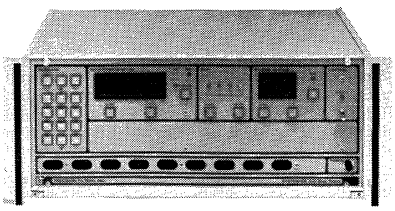
Potter Number	Fig.	Max. Line Current Amps	Size, Inches L. x W. x H.
618M2	T	2	3.00x1.50x1.50
618M5	T	5	3.00x1.50x1.50
618M10	T	10	3.00x1.50x1.50



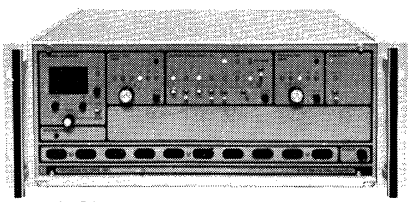
Potter Company P. O. Box 337
A Varian Division North Highway 51 Wesson, MS 39191
(601) 643-2215 TWX: 510-981-4072



Precision 616 provides 1½ digit resolution with 124 programmable cut-off frequencies. Frequency range .01 Hz to 150 kHz. Gain 1, 2, 5 and 10. Linear phase response available. 16 programmable filter channels.



Precision 636 offers 3-digit resolution as standard with 4092 cut-off frequency selections. Optional 3½ digit instrument provides 6141 cut-off frequencies. Convenient keyboard entry and LED displays. 16 programmable filter channels.



16 Channel Filter-Amplifier Precision 416 lets you save 35% by buying one instrument instead of a separate filter and amplifier. 62 programmable cut-off frequencies. DC differential input stage with 100 dB CMRR. Programmable pre-filter and post-filter gain of 1-1000. Overload detectors built in.

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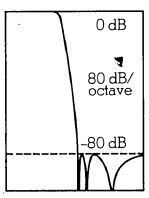

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16 Channel Anti-Alias Filters All come with time delay filters superior to Bessel. All have elliptics with 80 dB/octave attenuation. Typical phase match is ½°, always within 2°.

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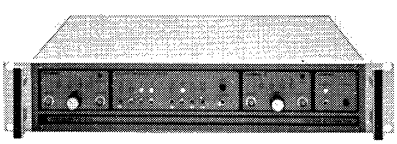

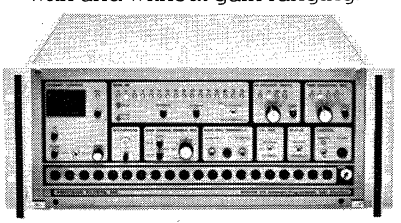

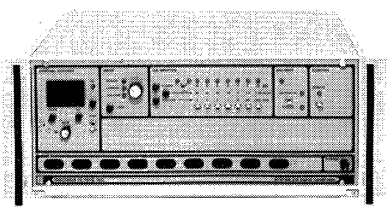

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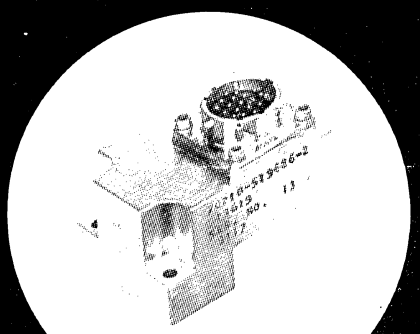

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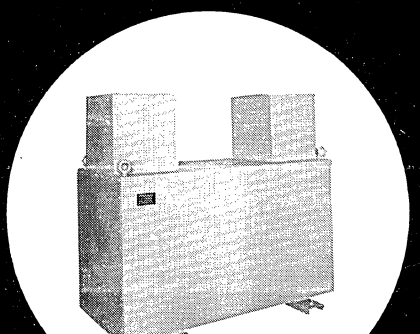

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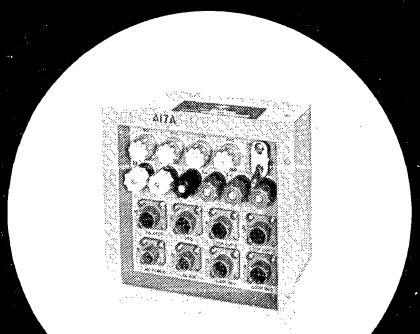

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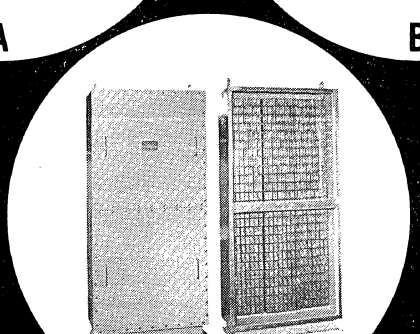

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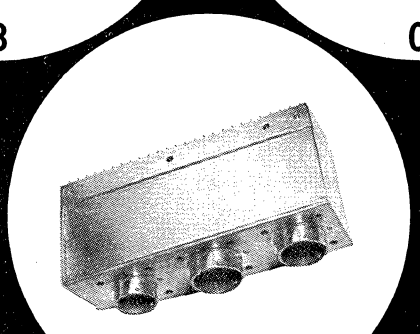

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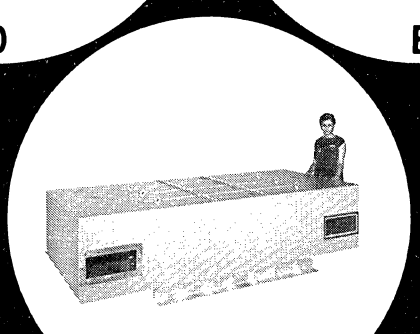

F

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D 1100 circuit signal line filter cabinet.

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SAW Bandpass Filters

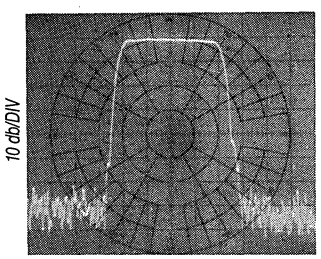
Surface Acoustic Wave Technology provides performance advantages and design flexibility that has proven to be invaluable to engineers in need of reliable, reproducible components featuring linear phase, temperature stability, small size, low shape factor and excellent rejection. Increasingly, SAW technology is meeting the exacting requirements of modern systems with high performance bandpass filters and other state-of-the-art signal processing components such as pulse compressors, delay lines, and resonator products. In addition to this broad product line, Sawtek provides the total engineering support needed to make the proper design trade-offs among key parameters in order to achieve the optimum performance available from SAW technology.

Sawtek produces hundreds of standard SAW products for both low and high volume programs in Cable Television, Satellite Communications, Modems, Radar, EW, and many other signal processing applications. In addition, Sawtek's custom design capability can provide technical assistance and rapid response to new design and production requirements at frequencies from 10 MHz to more than 1 GHz. Sawtek also designs and produces custom subsystems which incorporate SAW components. These include filter banks comprised of cascaded filters packaged in a single assembly, amplifier-filter modules with adjustable gain, and SAW resonator-controlled oscillators. Some of the common SAW bandpass filter products produced by Sawtek and their characteristics are summarized below.

WIDE BANDWIDTH

TVRO and other receiver applications often require wide bandwidth filters designed to provide superior rejection and group delay performance. SAW bidirectional bandpass filters are available with fractional bandwidths as large as 60% at frequencies approaching 1000 MHz. The high coupling materials used to achieve these bandwidths exhibit temperature coefficients of 72 to 94 PPM/°C. Insertion loss from 25 dB to 30 dB is typical of this class of filters in order to optimize group delay and time spurious performance. Shape factors (45 dB:1 dB) normally vary from 1.4:1 to 1.8:1.

Among a family of 70 MHz IF filters that is available off-the-shelf with bandwidths of 10 MHz to more than 36 MHz is the representative filter shown in the photograph below. This device provides a 24 MHz 3-dB bandwidth, 1.35:1 shape factor, and ±10 nsec maximum group delay variation. The packaged filter dimensions are either 0.87" x 0.5" x 0.2" or 0.6" diameter. Similar products are available at many other 1st or 2nd IF frequencies.

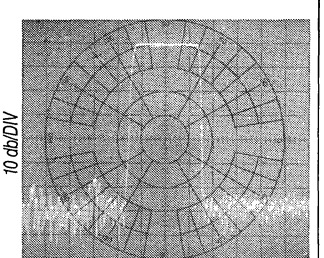


70 MHz
6 MHz/DIV

LOW SHAPE FACTOR

CATV modulator requirements and many similar applications require very low shape factor (45 dB:1 dB) to eliminate adjacent channel interference while preserving linear phase. Sawtek manufactures numerous VSB filters for both U.S. and European CATV requirements. This class of filters exhibits shape factors between 1.15:1 and 1.3:1 with an insertion loss of 20 dB to 30 dB depending on the bandwidth and center frequency. Such low shape factors are offered for fractional bandwidths from approximately 10% to 20%. These performance features are achieved in a 1.5" x 1.0" x 0.2" dual in-line package and clearly demonstrate the size advantages of SAW technology.

A representative filter shown below delivers 5.5 MHz bandwidth at 43.75 MHz center frequency and a shape factor of 1.2:1 with ±1° phase linearity and greater than 60 dB rejection. Other products offered in this bandwidth range include Nyquist filters for CATV demodulators as well as various inexpensive components for modem, translator, and convertor applications with slightly higher shape factor requirements.

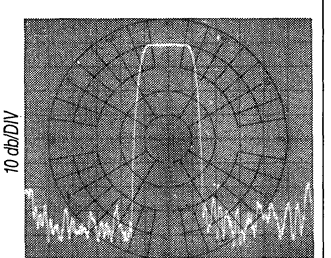


43.75 MHz
2 MHz/DIV

TEMPERATURE STABILITY

Quartz materials are frequently used in narrower band applications where increased stability is necessary. Filters with bandwidths from a few tenths percent to more than 5% are designed for quartz and exhibit total frequency shifts that are smaller than 50 PPM for a 0°C to 60°C commercial temperature range and nominally 200 PPM for most −55°C to +85°C military requirements. Shape factors from 1.5:1 to 3.6:1 are typical for these designs without sacrificing the high rejection expected of SAW devices. Insertion loss is normally 20-25 dB in order to maintain time spurious suppression of 45-50 dB. Bandwidths as large as 30% are implemented using quartz where higher insertion loss is tolerable and quartz performance is necessary. Both bandwidth and shape factor influence filter size, with larger sizes required for narrow bandwidths and low shape factors.

The performance shown below is a 60 MHz center frequency device with a 1.0 MHz bandwidth, 60 dB near-in rejection, and phase linearity of ±2°. The shape factor (55 dB:1 dB) is less than 1.8:1. Sawtek has many existing quartz filter designs at other IF frequencies.

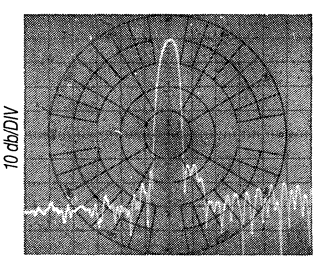


60 MHz
0.5 MHz/DIV

LOW LOSS

Sawtek offers low-loss SAW filters with insertion loss from 4 dB to 10 dB. The achievable insertion loss depends on many interrelated factors including the substrate material chosen, fractional bandwidth, the Q of matching components, the center frequency, and other design and fabrication parameters. This class of filters can also achieve triple transit suppression of 45 to 55 dB without the added insertion loss required for bidirectional filters. Rejection is typically 40 dB to 50 dB with shape factors greater than 1.6:1. These capabilities enable low-loss SAW filters to be used for front-end filters and in other applications where noise figure or dynamic range are limited by filter insertion loss.

The filter example below achieves 5 dB insertion loss on quartz at 261 MHz with a 0.5 MHz bandwidth. Passband ripple is less than 0.04 dB and triple transit suppression exceeds 50 dB. Some standard products are available and Sawtek offers rapid custom design for those applications that require this technique.



261 MHz
1 MHz/DIV

Sawtek maintains a leadership role in SAW technology through the development and production of superior SAW components and a proven track record of delivering these reliable, high performance products on time and at a very competitive price in production quantities. Product reliability for Sawtek's broad range of military and commercial parts is insured by a watchful quality control program that meets even the exacting requirements of military and space applications.

When your system demands the advantages of SAW Technology... Demand Sawtek.

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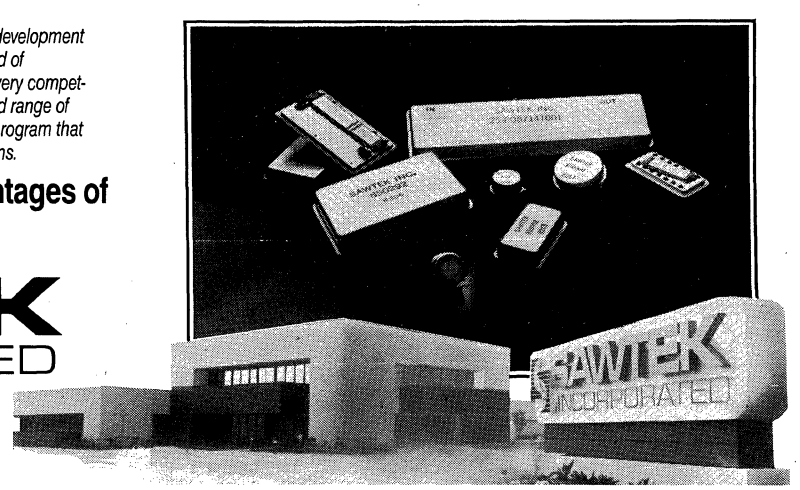


SAW Resonator Products

Surface Acoustic Wave Technology provides performance advantages and design flexibility that has proven to be invaluable to engineers in need of reliable, reproducible components featuring linear phase, temperature stability, small size, low shape factor and excellent rejection. Increasingly, SAW technology is meeting the exacting requirements of modern systems with high performance resonators, resonator filters, oscillators, and other state-of-the-art signal processing components such as pulse compressors, delay lines, and bandpass filter products. In addition to this broad product line, Sawtek provides the total engineering support needed to make the proper design trade-offs among key parameters in order to achieve the optimum performance available from SAW technology.

Sawtek produces hundreds of standard SAW products for both low and high volume programs in Cable Television, Satellite Communications, Modems, Radar, EW, and many other signal processing applications. In addition, Sawtek's custom design capability can provide technical assistance and rapid response to new design and production requirements at frequencies from 10 MHz to more than 1 GHz. Sawtek also designs and produces custom subsystems which incorporate SAW components. These include filter banks comprised of cascaded filters packaged in a single assembly, amplifier-filter modules with adjustable gain, and SAW resonator-controlled oscillators. Some of the common SAW resonator products produced by Sawtek and their characteristics are summarized below.

SAW RESONATORS

Sawtek offers SAW resonators at fundamental frequencies from 100 MHz to more than 1000 MHz. These are high Q components which are primarily intended to be used in oscillators and are also used for both bandpass and notch filters. Sawtek resonators are inherently spur free in oscillator applications, exhibit low motional resistance, and have a pulling range comparable to a 3rd overtone bulk wave crystal. Typical values of R_S range from 15 Ω to 150 Ω and capacitance ratios are nominally 2000:1. Incorporation of special metalization improves oscillator noise performance by permitting drive levels up to +20 dBm. These quartz devices can achieve temperature stability of less than 50 PPM from 0°C to 60°C. Both one-port and two-port configurations are available.

Sawtek maintains a large inventory of pre-tooled SAW resonator crystals including many frequencies for CATV convertor applications. New designs can also be tooled rapidly to meet custom requirements. The 668 MHz resonator shown below is representative of Sawtek's low-cost standard products.

SAW OSCILLATORS

SAW resonator-controlled oscillators are currently produced by Sawtek for military and aerospace systems. Because they are able to operate at fundamentals of over 1000 MHz, SAW oscillators simplify design, reduce cost, and improve noise performance through the elimination of multiplier stages. In many applications it is also possible to achieve adequate power in one stage to directly drive a mixer and thereby eliminate the need for a buffer/amplifier stage.

Typical of the company's oscillator products is a fixed frequency, oven stabilized SAW resonator oscillator at 740 MHz. All spurious and harmonics are down 60 dB; the short-term stability is $\pm 2.5 \times 10^{-10}$ for 1.0 to 25 second averaging times and the phase noise is 120 dBc/Hz for a 2.5 kHz offset. The frequency versus temperature stability of this miniature ovenized unit is ±2 PPM from −15° to +60°C. A maximum power consumption of only 1.75 watts at −15°C ambient is achieved. Sawtek also offers assistance in oscillator design for low-cost consumer and commercial applications and is prepared to help evaluate the suitability of SAW oscillators for each new application.

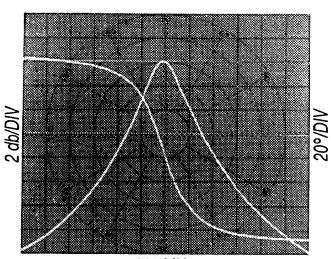
SAW RESONATOR FILTERS

SAW resonator filters provide high rejection and low loss for narrowband applications requiring 0.01% to 0.25% fractional bandwidths. This family of Sawtek's resonator filters is characterized by a "new shape" in narrowband filter technology. The unique shape demonstrated in the performance photographs below arises from the combination of transversal filter and resonator characteristics: the narrowband response produced by the resonant cavity emerges from the broader passband of the input and output transducers.

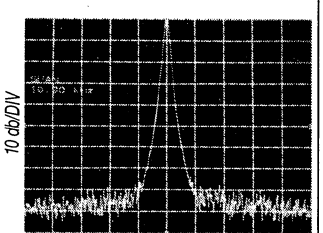
Two pole versions typically exhibit from 2 dB to 5 dB insertion loss with 15 dB to 20 dB near-in rejection and 55 dB to 75 dB ultimate rejection. The two-pole 537 MHz resonator filter shown on the left below has a matched insertion loss of only 4.5 dB, 18 dB close-in rejection, and 60 dB ultimate rejection.

Rejection which is beyond the measurable range of most test instruments can be achieved by cascading these two-pole units into multipole configurations. Depending on the number of poles, this technique provides from 20 dB to 60 dB of near-in rejection, improved shape factor and reduced flyback. Insertion loss generally increases at a rate of less than 1 dB per pole for these filters. The six pole 149.3 MHz filter on the bottom right has an insertion loss of only 5.7 dB and an ultimate rejection of over 100 dB.

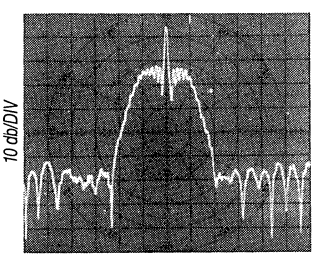
Sawtek's resonator filters are provided in individual two-pole stages in TO-8 and TO-5 packages and in custom modules when several of these 2 pole units are cascaded. Sawtek offers standard resonator filters and also rapid custom design.



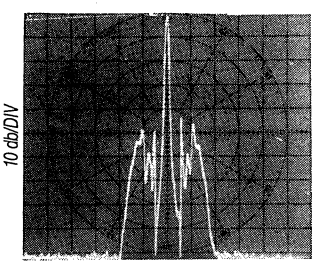
668 MHz
85 KHz/DIV



740 MHz
1 KHz/DIV



537.5 MHz
5 MHz/DIV



149.3 MHz
1.5 MHz/DIV

Sawtek maintains a leadership role in SAW technology through the development and production of superior SAW components and a proven track record of delivering these reliable, high performance products on time and at a very competitive price in production quantities. Product reliability for Sawtek's broad range of military and commercial parts is insured by a watchful quality control program that meets even the exacting requirements of military and space applications.

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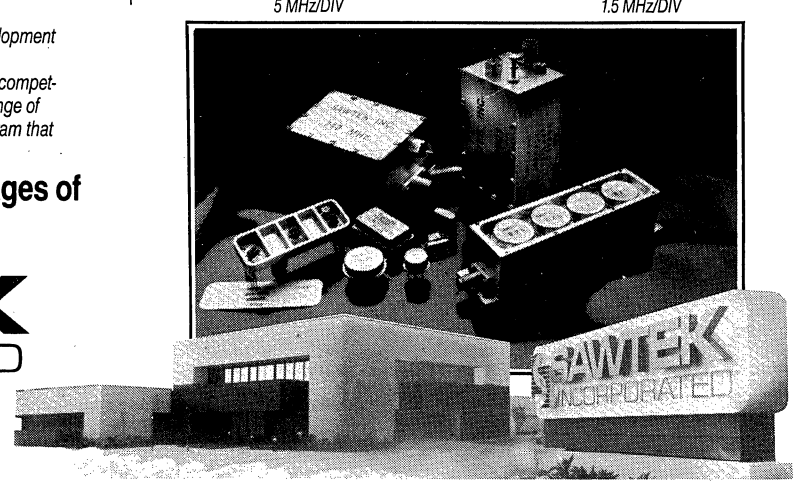

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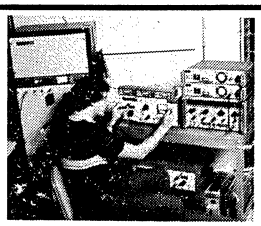

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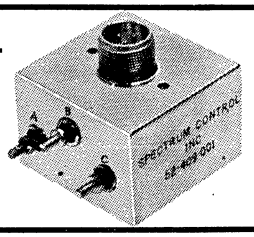

THREADED-MOUNT EMI/RFI HERMETICALLY-SEALED FILTERS AND CAPACITORS.
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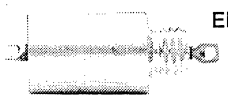
27-0027-43



FILTER PLATE ASSEMBLIES.
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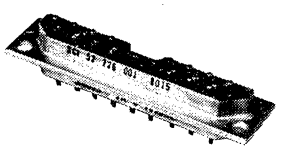

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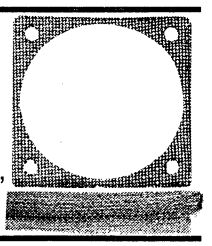

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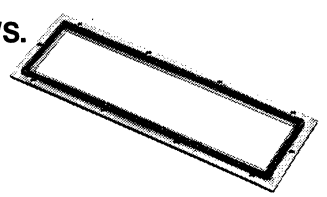
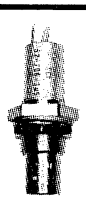
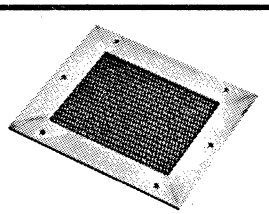


COAXIAL SIGNAL LINE FILTERS.
EEM page **1**•1523
Bulletin: 27-0027-52



EMI/RFI AIR VENT PANELS.
Bulletins: 27-0027-39
27-0027-40 REV.O



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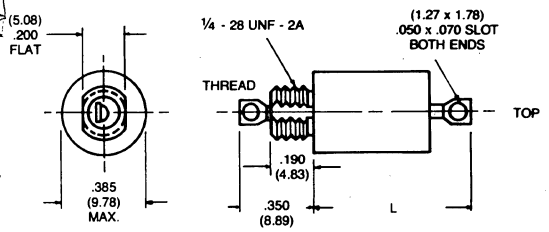
EMI/RFI FILTERS 100 VDC @ 125°C

SPECTRUM CONTROL NUMBER	WVDC 85°C	WVDC 125°C	RATED CURRENT (AMPS)	FILTER CIRCUIT	LENGTH L ±.030 (.76)	DCR OHMS MAX.	INSERTION LOSS DB (FULL LOAD) 75kHz	150kHz	300kHz	1MHz	1GHz
54-367-005	150	100	15	C .45 uF	.372 (9.45)	.005	12	19	25	36	70
51-353-119	150	100	.5	L TOP	.728 (18.49)	.6	24	35	47	65	70
51-353-121	150	100	1	L TOP	.728 (18.49)	.25	15	27	36	57	70
51-353-123	150	100	3	L TOP	.728 (18.49)	.06	6	22	29	44	70
51-353-125	150	100	5	L TOP	.728 (18.49)	.015	12	20	26	37	70
51-311-319	150	100	.5	Pi	.778 (19.76)	.3	33	51	69	80	80
51-311-320	150	100	1	Pi	.778 (19.76)	.25	19	41	60	80	80
51-311-321	150	100	3	Pi	.778 (19.76)	.06	–	16	41	75	80
51-311-322	150	100	5	Pi	.778 (19.76)	.015	–	6	28	65	80
51-351-605	150	100	2	T	1.164 (29.57)	.1	6	25	34	57	80

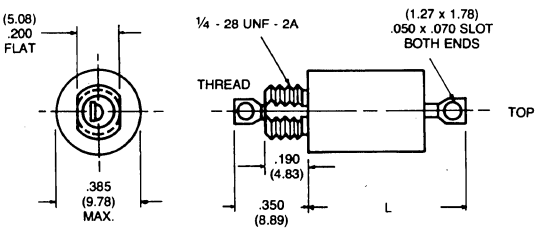
- .375 DIAMETER
- 100 VDC @ 125° C
- Filters are supplied with lockwasher and hex nut.
- Recommended Mounting Torque 48 IN.-OZ. Maximum.
- Silver Plated Cases
- Solder Coated Terminals



EMI/RFI FILTERS 125 VAC 0-400 Hz @ 125°C

SPECTRUM CONTROL NUMBER	RATED CURRENT (AMPS)	FILTER CIRCUIT	LENGTH L ±.030 (.76)	DCR OHMS MAX.	INSERTION LOSS DB (FULL LOAD) 75kHz	150kHz	300kHz	1MHz	1GHz
51-353-110	1	L TOP	.728 (18.49)	.25	8	17	29	50	70
51-353-112	3	L TOP	.728 (18.49)	.05	8	13	20	35	70
51-353-114	5	L TOP	.728 (18.49)	.015	8	12	20	30	70
51-353-116	10	L TOP	.728 (18.49)	.01	5	15	20	30	70
51-311-306	.25	Pi	.778 (19.76)	1.5	15	31	48	70	80
51-311-315	.5	Pi	.778 (19.76)	.6	15	33	50	80	80
51-311-316	1	Pi	.778 (19.76)	.25	–	20	40	70	80
51-311-317	3	Pi	.778 (19.76)	.05	–	–	20	55	80
51-311-318	5	Pi	.778 (19.76)	.02	–	–	–	44	80
51-351-601	4	T	1.164 (29.57)	.063	5	11	18	33	70
51-351-602	2	T	1.164 (29.57)	.10	8	13	21	43	70
54-367-006	15	C .25 uF	.372 (9.45)	.005	10	17	23	33	70
54-367-007	15	C .015 uF	.372 (9.45)	.005	–	–	–	6	60
54-370-006	15	C .50 uF	.561 (14.25)	.005	16	23	28	39	70

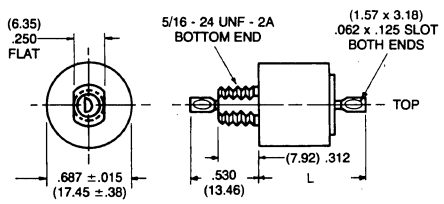
- .375 DIAMETER
- 125 VAC 0-400 Hertz @ 125° C
- Filters are supplied with lockwasher and hex nut.
- Recommended Mounting Torque 48 IN.-OZ. Maximum.
- Silver Plated Cases
- Solder Coated Terminals



EMI/RFI FILTERS 240 VAC 0-60 Hz @ 125°C

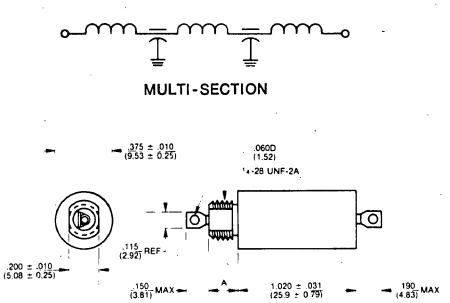
SPECTRUM CONTROL NUMBER	RATED CURRENT (amps)	FILTER CIRCUIT	LENGTH L ±.030 (.76)	DCR OHMS MAX.	INSERTION LOSS DB (FULL LOAD) 75kHz	150kHz	300kHz	1MHz	1GHz
51-320-022	.5	L TOP	.875 (22.23)	.3	25	38	48	70	70
51-320-024	1	L TOP	.875 (22.23)	.21	15	30	38	60	70
51-320-026	3	L TOP	.875 (22.23)	.03	6	19	25	45	70
51-320-028	5	L TOP	.875 (22.23)	.007	6	19	24	37	70
51-323-001	10	L TOP	1.006 (25.55)	.0075	5	14	19	30	70
51-322-011	15	L TOP	1.530 (38.86)	.005	6	19	25	35	70
51-321-316	.5	Pi	1.170 (29.72)	.3	44	61	75	80	80
51-321-317	1	Pi	1.170 (29.72)	.40	35	53	70	80	80
51-321-318	3	Pi	1.170 (29.72)	.03	6	31	55	80	80
51-321-319	5	Pi	1.170 (29.72)	.02	–	17	40	75	80
51-321-306	10	Pi	1.170 (29.72)	.0045	–	6	15	56	80
51-321-610	1	T	1.170 (29.72)	.6	25	49	60	70	70
51-321-611	2	T	1.170 (29.72)	.08	10	28	40	70	70
51-321-617	10	T	1.170 (29.72)	.0075	14	18	24	36	70
54-310-009	15	C .25 uF	.483 (12.27)	.005	12	17	23	34	70

- .687 DIAMETER
- 240 VAC @ 125° C 0-60 Hertz
- Filters are supplied with lockwasher and hex nut.
- Recommended Mounting Torque 60 IN.-OZ. Maximum.
- Silver Plated Cases
- Solder Coated Terminals



MIL-STD-461 FILTERS

	PART NUMBER A = .187	PART NUMBER A = .312	RATED DC AMPS	MINIMUM INSERTION LOSS (db) per MIL-STD-220A, FULL LOAD 10 kHz	14 kHz	30 kHz	150 kHz	300 kHz	1 MHz	10 MHz to 1 GHz	MAX. DCR @ 25°C OHMS
SERIES 2060 50 VDC – 55°C TO 125°C	SCI 2060-XXX										
	002	009	.25	30	50	70	70	70	70	80	12
	003	010	.5	—	20	53	65	70	70	80	3
	004	011	1	—	—	20	55	70	70	80	.75
	005	012	2	—	—	—	42	62	70	80	.189
	006	013	3	—	—	—	33	54	70	80	.081
	007	014	10	7	9	15	29	35	42	70	.006
SERIES 2360 300 VDC 115 VAC 0-400 HZ – 55°C TO 125°C	SCI 2360-XXX										
	002	009	.25	—	10	53	70	70	70	80	12
	003	010	.5	—	—	17	66	70	70	80	3
	004	011	1	—	—	—	32	59	70	80	.75
	005	012	2	—	—	—	6	34	70	70	.189
	006	013	3	—	—	—	3	22	70	70	.081
	007	014	10	—	—	5	14	21	34	55	.006



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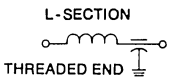
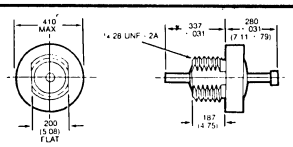
LOW PROFILE L CIRCUIT FILTERS

L-SECTION

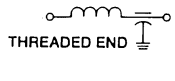


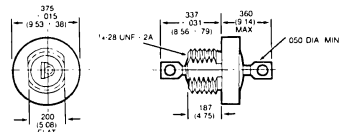


RESIN SEALED

SPECTRUM CONTROL NUMBER	RATED DC CURRENT	WORKING VOLTS		DCR MAX.	REFER CAP.	MINIMUM INSERTION LOSS dB					
		+85°C	+125°			30KHz	150KHz	300KHz	1MHz	10MHz	1GHz
51-717-001	15 amps	100Vdc	50Vdc	.01	1.4 μF	15	28	33	44	60	70
51-717-007	15 amps	125Vac	125Vac	.01	.015μF ±20%	—	—	—	6	25	60

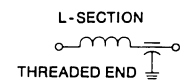
L-SECTION

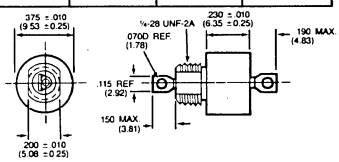




SPECTRUM CONTROL NUMBER	RATED DC CURRENT	WORKING VOLTS		DCR MAX.	REFER CAP.	MINIMUM INSERTION LOSS dB					
		+85°C	+125°			30KHz	150KHz	300KHz	1MHz	10MHz	1GHz
51-359-001	15 amps	100Vdc	50Vdc	.01	1.4 uF	15	28	33	44	60	70
51-359-007	15 amps	125Vac	125Vac	.01	.015μF ±20%	—	—	—	6	25	60

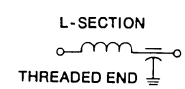
L-SECTION

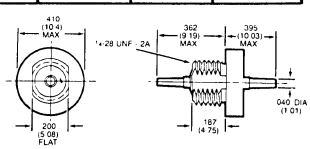




SCI PART NO.		MIN. CAP.	WORKING VOLTAGE		MINIMUM INSERTION LOSS(dB) PER MIL-STD-220A. FULL LOAD. 25°C						
A = .187	A = .312		−55 to +85°C	−55 to +125°C	30KHz	150KHz	300KHz	1MHz	10MHz	1GHz	10GHz
SCI-2350-000	SCI-2350-001	.3 μF	—	115VAC 300Vdc	4.	15	21	31	50	70	80

L-SECTION





SPECTRUM CONTROL NUMBER	RATED DC CURRENT	WORKING VOLTS		DCR MAX.	REFER CAP.	MINIMUM INSERTION LOSS dB					
		+85°C	+125°			30KHz	150KHz	300KHz	1MHz	10MHz	1GHz
51-344-006	15 amps	100Vdc	50Vdc	.01	1.4 μF	15	28	33	44	60	70

COAXIAL SIGNAL LINE FILTERS

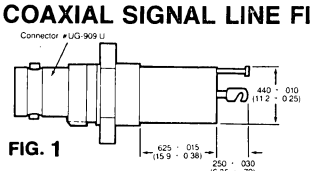


FIG. 1

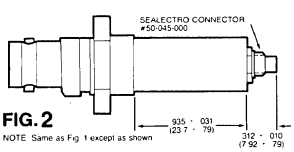


FIG. 2
NOTE Same as Fig. 1 except as shown

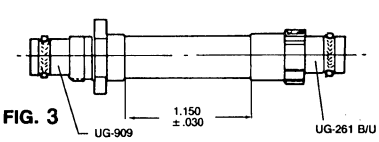


FIG. 3

SPECTRUM CONTROL NUMBER	RATED DC CURRENT	WORKING VOLTS		DCR MAX. Ω	PASS BAND	MINIMUM INSERTION LOSS dB				FIG.
		+85°C	+125°C			20MHz	50MHz	100MHz	1GHz	
52-706-304	30 ma.	—	100Vdc	—	DC-30 MHz<4dB	—	10	30	60	2
52-706-306	30 ma.	—	100Vdc	—	DC-1 MHz<2dB	70	70	70	70	1
52-706-307	30 ma.	—	100Vdc	—	DC-2.5 MHz<2dB	50	70	70	70	2
SPECTRUM CONTROL NUMBER	RATED DC	WORKING VOLTS		DCR MAX. Ω	PASS BAND	MINIMUM INSERTION LOSS dB				FIG.
		+85°C	+125°C			40MHz	60MHz	80MHz	1GHz	
52-706-802	10 ma.	—	100Vdc	.5	<2dB DC to 13 MHz	40	70	80	80	3

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EMI/RFI FEED THROUGH CAPACITORS AND FILTERS

4-40 THREAD 5/32 HEX RESIN SEALED 50, 100 WVDC @ 125°C

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	WVDC @125°C	RATED CURRENT	FIG.	ELECTRICAL CIRCUIT	MINIMUM INSERTION LOSS(dB) PER MIL-STD 220 (NOTE 1) 1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz
54-790-018	1000pF +80% −20%	100V	10A	I	C	—	—	—	11	20	28	28
54-790-019	2700pF +80% −20%	100V	10A	I	C	—	—	9	18	27	33	35
54-790-020	5600pF +80% −20%	100V	10A	I	C	—	—	15	24	33	37	40
54-790-021	.01uF +80% −20%	100V	10A	I	C	—	9	20	29	38	45	50
54-790-022	.027uF +80% −20%	100V	10A	I	C	10	20	30	37	45	50	55
54-790-023	.056uF +100% −0%	50V	10A	I	C	17	26	36	41	45	50	60
51-729-003	.027uF REF.	100V	10A	II	L	10	20	30	37	45	50	60
51-729-303	1500pF REF.	100V	10A	II	π	—	—	5	15	42	65	70
51-729-305	5500pF REF.	50V	10A	II	π	—	7	14	30	55	70	70
51-729-312	.01uF +80% −20%	50V	10A	I	π	—	8	15	40	65	70	70

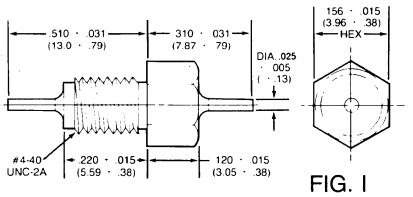

FIG. I

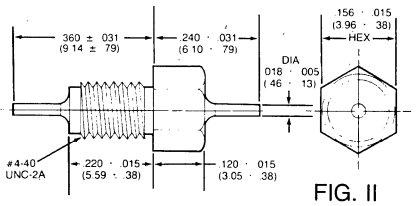

FIG. II

6-32 THREAD 5/32 HEX RESIN SEALED 50, 100 WVDC @ 125°C

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	RATED DC VOLTAGE	RATED CURRENT	FIG.	ELECTRICAL CIRCUIT	MINIMUM INSERTION LOSS(dB) PER MIL-STD 220 (NOTE 1) 1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz
54-779-013	1000pF +100% −0%	100V	10A	I	C	—	—	5	14	24	28	28
54-779-014	2700pF +80% −20%	100V	10A	I	C	—	—	9	18	27	33	35
54-779-015	5600pF +80% −20%	100V	10A	I	C	—	—	15	24	33	37	40
54-779-016	.01uF +80% −20%	100V	10A	I	C	—	9	20	29	38	45	50
54-779-017	.027uF +100% −0%	100V	10A	I	C	10	20	30	37	45	50	55
54-779-018	.056uF +100% −0%	50V	10A	I	C	17	26	36	41	45	50	60
54-779-019	.10uF +100% −0%	50V	10A	I	C	22	31	40	44	47	55	65
51-726-002	.022uF REF.	100V	10A	I	L	7	17	27	34	43	50	60
51-726-001	1500pF REF.	100V	3A	II	π	—	—	5	15	42	65	70
51-726-008	5500pF REF.	50V	3A	II	π	—	7	14	30	55	70	70
51-726-017	9000uF REF.	50V	10A	II	π	—	8	18	45	65	70	70

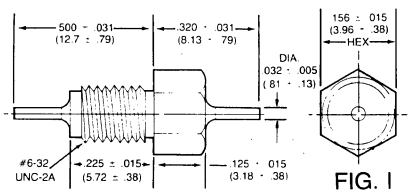

FIG. I

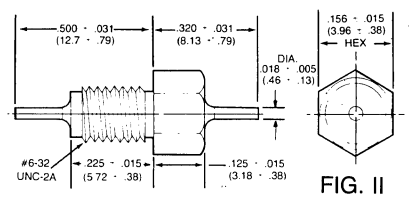

FIG. II

8-32 THREAD 3/16 HEX RESIN SEALED 50, 100, 150, 200 WVDC @ 125°C

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	RATED DC VOLTAGE	RATED CURRENT	FIG.	ELECTRICAL CIRCUIT	MINIMUM INSERTION LOSS(dB) PER MIL-STD 220 (NOTE 1) 100 kHz	1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz	A	B	C	E
54-785-011	2000pF +100% −0%	150V	10A	I	C	—	—	—	8	17	26	32	34	.421 (10.7)	.328 (8.33)	—	—
54-785-012	5000pF +80% −20%	150V	10A	I	C	—	—	6	15	24	33	37	40	.421 (10.7)	.328 (8.33)	—	—
54-785-013	.01uF +80% −20%	100V	10A	I	C	—	—	9	20	29	38	45	50	.421 (10.7)	.328 (8.33)	—	—
54-785-014	.027uF +80% −20%	100V	10A	I	C	—	8	18	28	37	45	50	55	.421 (10.7)	.328 (8.33)	—	—
54-785-015	.056uF +80% −20%	100V	10A	I	C	—	15	24	34	41	45	50	60	.421 (10.7)	.328 (8.33)	—	—
54-785-016	.1uF +80% −20%	100V	10A	I	C	—	20	29	38	44	47	55	65	.421 (10.7)	.328 (8.33)	—	—
54-785-017	.27uF +80% −20%	50V	10A	I	C	10	28	37	45	50	55	60	70	.421 (10.7)	.328 (8.33)	—	—
51-712-003	.022uF REF.	100V	10A	II	L	—	7	17	27	34	43	50	60	.850 (21.6)	.280 (7.11)	.266 (6.76)	.040 (1.02)
51-712-001	1500pF REF.	100V	10A	II	π	—	—	—	5	15	42	65	70	.890 (22.6)	.312 (7.92)	.266 (6.76)	.032 (.81)
51-744-002	5500pF REF.	200V	10A	III	π	—	—	7	14	30	55	70	70	.413 (10.5)	.265 (6.73)	.242 (6.15)	.040 (1.02)
51-712-069	.012uF REF.	50V	10A	III	π	—	5	9	18	45	65	70	70	.413 (10.5)	.265 (6.73)	.266 (6.76)	.032 (.81)

NOTE 1: I.L. WITH RATED CURRENT FOR "C" CIRCUITS AND WITHOUT CURRENT FOR "π" CIRCUITS.

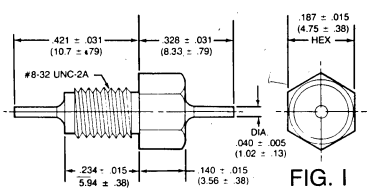

FIG. I

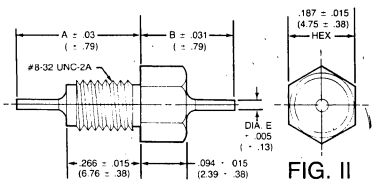

FIG. II

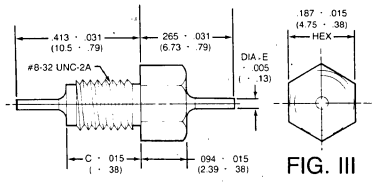

FIG. III

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EMI/RFI FEED THROUGH CAPACITORS

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	RATED DC VOLTAGE	RATED CURRENT	FIG.	MINIMUM INSERTION LOSS (dB) PER MIL-STD 220 (NOTE 1) 100 kHz	1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz
54-804-002-101M	100pF ±20%	250V	10A	I	—	—	—	—	—	—	10	20
54-804-002-471M	470pF ±20%	250V	10A	I	—	—	—	—	—	12	22	30
54-804-002-102P	1000pF +100% −0%	250V	10A	I	—	—	—	—	12	22	30	35
54-833-001	2700pF +100% −0%	250V	10A	I	—	—	—	10	19	27	33	40
54-833-002	6800pF +100% −0%	200V	10A	I	—	—	7	18	28	35	40	45
54-833-003	.01uF +100% −0%	200V	10A	I	—	—	12	22	30	38	45	50
54-833-004	.015uF +100% −0%	200V	10A	I	—	—	15	25	33	40	45	50
54-833-005	.033uF +100% −0%	100V	10A	I	—	—	20	30	40	48	50	55
54-833-006	.068uF +100% −0%	100V	10A	I	—	18	27	37	44	48	55	60
54-833-007	.1uF +100% −0%	50V	10A	I	—	22	30	40	46	50	55	65
54-766-003	.1uF +80% −20%	200V	10A	II	—	20	29	38	44	47	55	65
54-766-004	.27uF +80% −20%	100V	10A	II	8	28	37	45	50	55	60	70
54-766-005	.68uF +80% −20%	100V	10A	II	17	37	44	50	52	60	65	70
54-817-005	1.4uF +100% −0%	50V	10A	III	25	44	52	55	65	70	70	70

12-32 THREAD RESIN SEALED
50, 100, 200, 250 WVDC @ 125°C

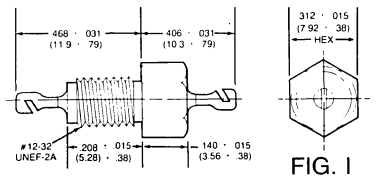

FIG. I

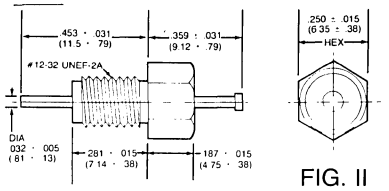

FIG. II

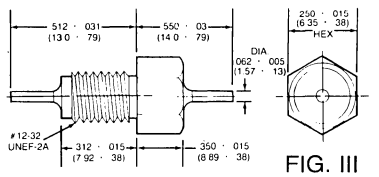

FIG. III

EMI/RFI FILTERS

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	RATED DC VOLTAGE	RATED CURRENT	FIG.	MINIMUM INSERTION LOSS (dB) PER MIL-STD 220 (NOTE 1) 100 kHz	1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz	E	F
51-719-022	1300pF REF.	200V	10A	I	—	—	—	5	10	35	60	70	.040 (1.02)	—
51-714-001	1500pF REF.	250V	10A	II	—	—	—	5	15	43	60	70	.032 (.81)	.250±.015 (6.35±.38)
51-714-003	1500pF REF.	250V	10A	II	—	—	—	5	15	43	60	70	.032 (.81)	.235±.015 (5.96±.38)
51-719-011	2500pF REF.	500V	10A	I	—	—	—	12	20	45	60	70	.040 (1.02)	—
51-714-002	5000pF REF.	100V	10A	II	—	—	7	12	35	60	70	70	.032 (.81)	.250±.015 (6.35±.38)
51-714-004	5000pF REF.	100V	10A	II	—	—	7	12	35	60	70	70	.032 (.81)	.235±.015 (5.96±.38)
51-719-021	5500pF REF.	200V	10A	I	—	—	7	12	25	50	70	70	.040 (1.02)	—
51-719-042	.01uF REF.	200V	10A	I	—	—	10	18	35	60	70	70	.040 (1.02)	—
51-714-058	.025uF REF.	100V	10A	II	—	10	15	40	60	70	70	70	.032 (.81)	.250±.015 (6.35±.38)
51-709-005	.04uF REF.	100V	10A	III	—	15	20	50	65	70	70	70	.032 (.81)	.250±.015 (6.35±.38)
51-709-013	.1uF REF.	50V	10A	III	5	18	40	65	70	70	70	70	.040 (1.02)	.250±.015 (6.35±.38)

12-32 THREAD RESIN SEALED
50, 100, 200, 500 WVDC @ 125°C

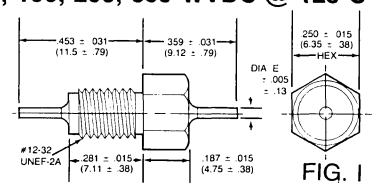

FIG. I

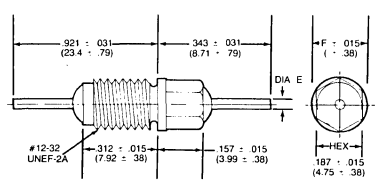

FIG. II

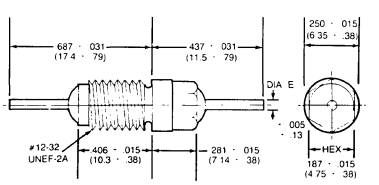

FIG. III

EMI/RFI FILTERS

SCI PART NUMBER	CAPACITANCE AND TOLERANCE	RATED DC VOLTAGE	RATED CURRENT	MINIMUM INSERTION LOSS (dB) PER MIL -STD 220 (NOTE 1) 100 kHz	1 MHz	3 MHz	10 MHz	30 MHz	100 MHz	300 MHz	1-10 GHz
51-732-009	.05uF REF.	100V	10A	—	15	25	55	70	70	70	70
51-732-001	.1uF REF.	100V	10A	5	18	40	65	70	70	70	70
51-732-008	.18uF REF.	50V	10A	8	20	45	70	70	70	70	70

NOTE 1: I.L. WITH RATED CURRENT FOR "C" CIRCUITS AND WITHOUT CURRENT FOR "π" CIRCUITS.

¼-32 THREAD 5/16 HEX
RESIN SEALED
50, 100 WVDC @ 125°C

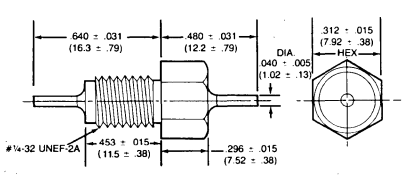

FIG. I

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SOLDER-IN EMI/RFI FILTERS EYELET MOUNT
Pi — SECTION

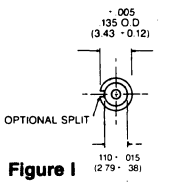
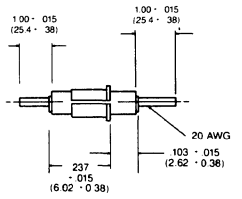


Figure I



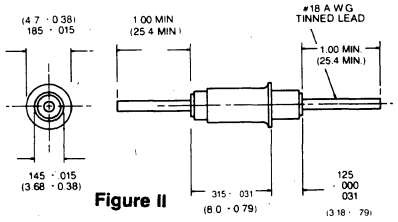


Figure II

SPECTRUM CONTROL NUMBER	FIGURE	DC CURRENT	WVDC 85°C	WVDC 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD-220 10MHz	30MHz	100MHz	300MHz	1-10GHz
51-713-002	I	10A	200	100	1500pF	5	12	40	60	60
51-708-001	II	10A	350	200	3000pF	10	25	50	65	65

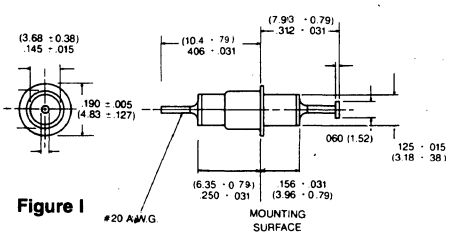


Figure I

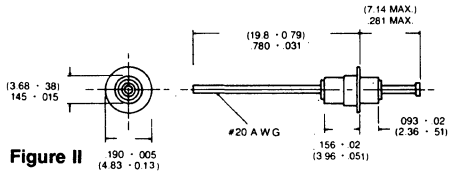


Figure II

SPECTRUM CONTROL NUMBER	FIGURE	DC CURRENT	WVDC 85°C	WVDC 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD-220 3MHz	10MHz	30MHz	100MHz	300MHz	1-10GHz
51-703-001	I	10A	350	200	1500pF	—	8	17	45	65	65
51-707-002	II	10A	250	125	Minimum 1750pF	—	8	17	45	65	65
51-750-301	II	10A	100	70	12000pF	10	25	50	70	70	70
51-750-302	III	10A	100	70	22000pF	12	35	60	70	70	70

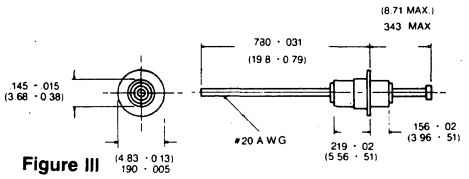


Figure III

SPECTRUM CONTROL NUMBER	FIGURE	DC CURRENT	WVDC 85°C	WVDC 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD-220 10MHz	30MHz	100MHz	300MHz	1-10GHz
51-704-001	I	25A	750	500	3000pF	8	25	50	70	70

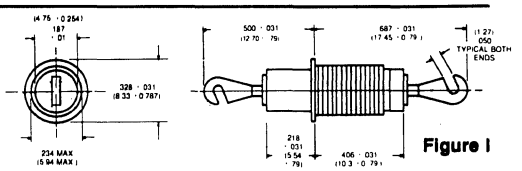
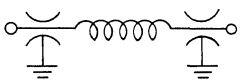
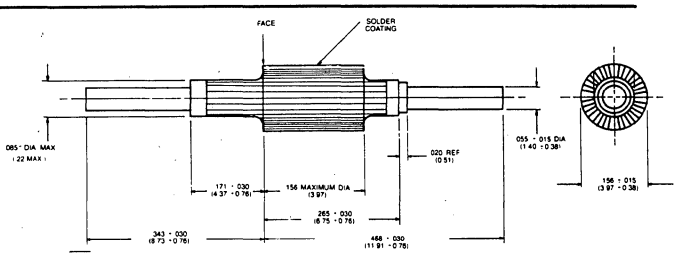


Figure I

SOLDER-IN EMI/RFI FILTER
Pi — SECTION





SPECTRUM CONTROL NUMBER	DC CURRENT	WVDC 85°C	WVDC 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD-220 10MHz	30MHz	100MHz	300MHz	1-10GHz
51-723-301	10A	200	100	5500pF	14	30	55	65	65
51-723-303	10A	300	200	1300pF	5	15	30	45	55

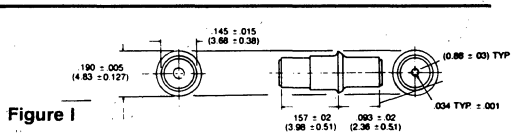


Figure I

LEADLESS FILTERS SOLDER-IN EMI/RFI FILTERS
Pi — SECTION

SPECTRUM CONTROL NUMBER	FIG.	WVDC 85°C	WVDC 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD 220 10MHz	30MHz	100MHz	300MHz	1-10GHz
51-707-004	I	250	125	1750pF	7	18	44	65	65
51-758-301	II	100	70	1750pF	7	18	44	65	65
51-758-302	II	100	70	12,000pF	20	42	60	70	70
51-740-001	III	150	100	2500pF +100% −0%	11	20	45	60	70
51-740-003	IV	300	200	2500pF +85% −0%	11	20	45	60	70

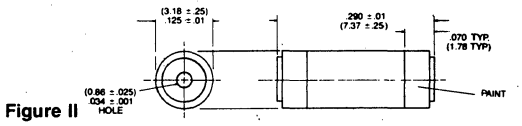


Figure II

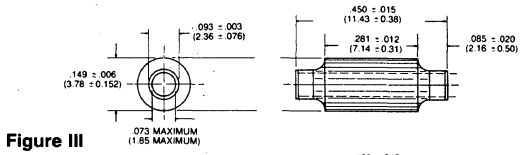


Figure III

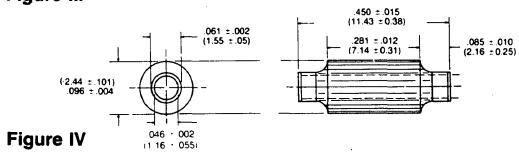


Figure IV

SPECTRUM CONTROL INC.

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SOLDER-IN EMI/RFI FILTERS AND CAPACITORS

Figure I

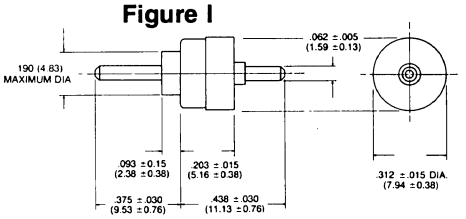


Figure II

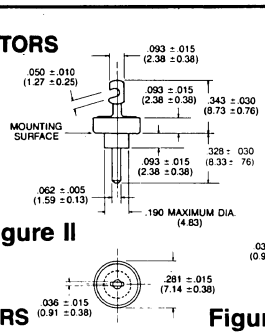


Figure III

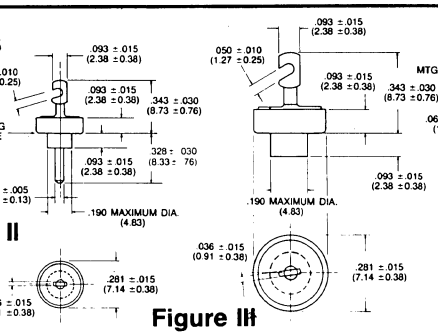
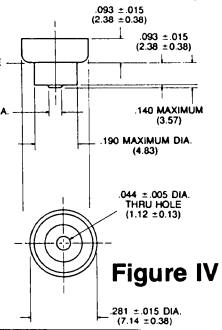


Figure IV



CASE MOUNTED FILTERS AND CAPACITORS

SPECTRUM CONTROL NUMBER	FIG	CKt	HARD-WARE	WVDC 85°C	WVDC 125°C	CAP.	INSERTION LOSS PER MIL-STD 220 1MHz	3MHz	10MHz	30MHz	100MHz	300MHz	1 GHz	NOTE
51-722-001	I	FILTER	NONE	500	250	1000pF(REF)	—	—	4	12	25	35	50	
51-756-004	I	FILTER	NONE	300	200	.015uF(REF)	7	15	27	35	45	50	50	1
51-756-007	I	FILTER	NONE	75	50	.1uF(REF)	22	30	42	45	50	55	55	1
54-794-001	II	FEED THRU	NONE	500	250	100pF±20%	—	—	—	—	5	13	24	2
54-794-002	II	FEED THRU	SOLDER PREFORM	500	250	220pF±20%	—	—	—	—	11	20	30	2
54-803-003	III	STAND* OFF	NONE	500	250	330pF±20%	—	—	—	5	14	23	31	2
54-803-004	III	STAND* OFF	SOLDER PREFORM	500	250	470pF±20%	—	—	—	8	17	25	33	2
54-802-001	IV	FEED THRU	NONE	500	250	1000pF(GMV)	—	—	7	16	27	35	35	2
54-802-002	IV	FEED THRU	SOLDER PREFORM	500	250	1500pF(GMV)	—	4	9	22	28	35	38	2
54-825-004	II	FEED THRU	NONE	300	200	.015uF(MIN.)	9	20	28	38	43	54	63	2
54-825-007	II	FEED THRU	NONE	75	50	.1uF(MIN.)	25	35	45	52	58	70	70	2

*I.L. VALUES NOT APPLICABLE TO STAND OFF CAPACITORS

1 — Minimum Insertion Loss Refer to Page 2
2 — Typical Insertion Loss Refer to Page 2

SOLDER-IN EMI/RFI CAPACITOR

Figure I

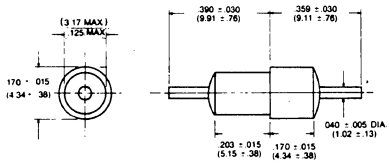


Figure II

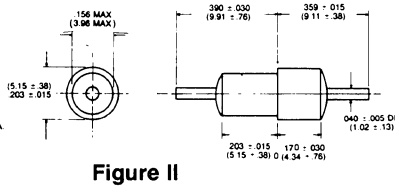
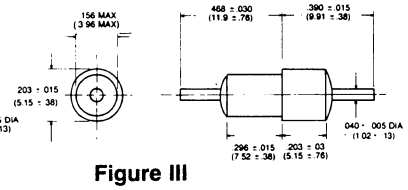


Figure III

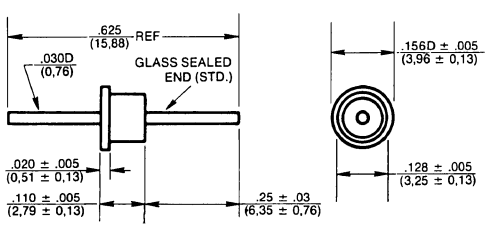


SPECTRUM CONTROL NUMBER	FIG.	DC CUR-RENT	WVDC @ 125°C	CAP.	MINIMUM INSERTION LOSS PER MIL-STD-220 30KHz	100KHz	1MHz	10MHz	30MHz	100MHz	300MHz	1-10GHz	PAGE 2 FOR TYPICAL I.L. CURVE
54-785-002	I	10A	100	.05uFGMV	—	—	16	33	41	45	48	50	FIG. 3
54-786-003	II	10A	50	.3uF	—	13	32	47	54	60	66	70	FIG. 3
54-786-019	III	10A	50	.5uF	—	16	35	50	58	65	68	70	FIG. 3
54-786-004	III	10A	50	1uF	10	20	40	52	60	70	70	70	FIG. 3

SERIES SCI 9900/9910/9920

All units are hermetically sealed (glass to metal) on one end, while the other end is epoxy sealed. These units are also available reversed with the hermetic seal at the opposite end. To order, add "R" to the end of the part number; e.g. SCI 9900-502R.

Installation: Series 9900 units are designed to be soldered in place. Maximum soldering temperature is +200°C (392°F).



SERIES	SCI 9900	SCI 9910	SCI 9920
VOLTAGE	50 WVDC	100 WVDC	200 WVDC 115 VAC 60 Hz
DC AMPS. MAX.	5	5	5
CAPACITANCE (GMV)	100 pF 500 1000 1200 2700 5000 .015 µF	100 pF 500 1000 1200 2700 5000	100 pF 500 1000 1200

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POWER LINE FILTERS FOR SECURE COMMUNICATIONS

Figure I

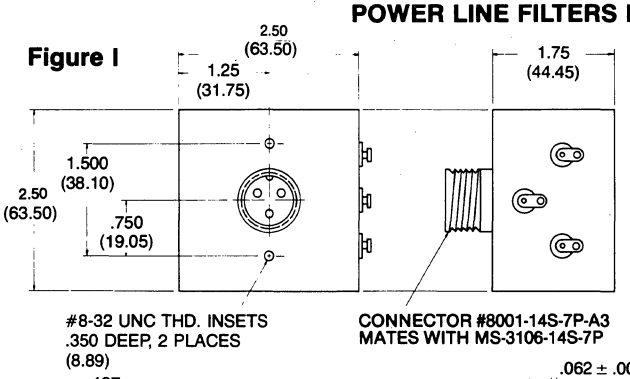


Figure II

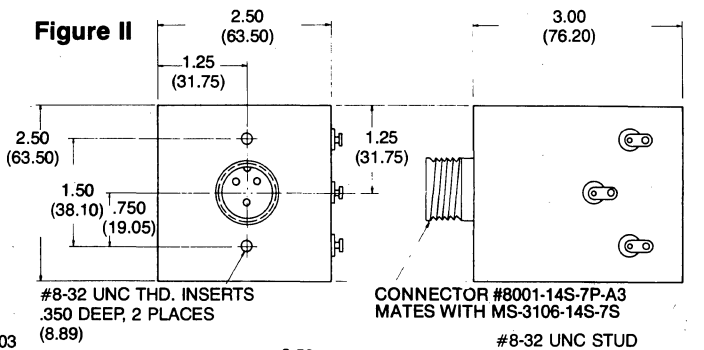


Figure III

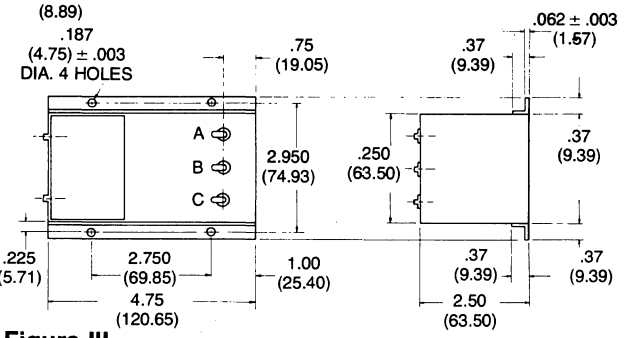
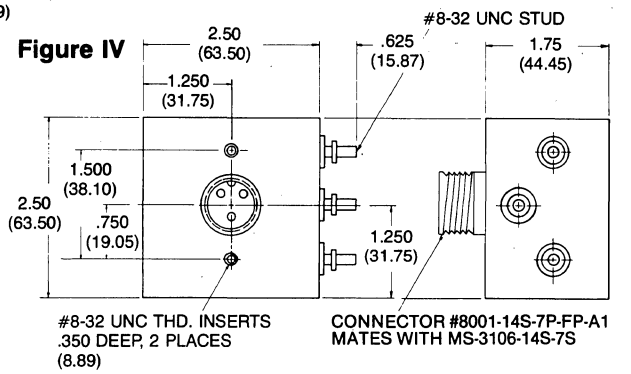
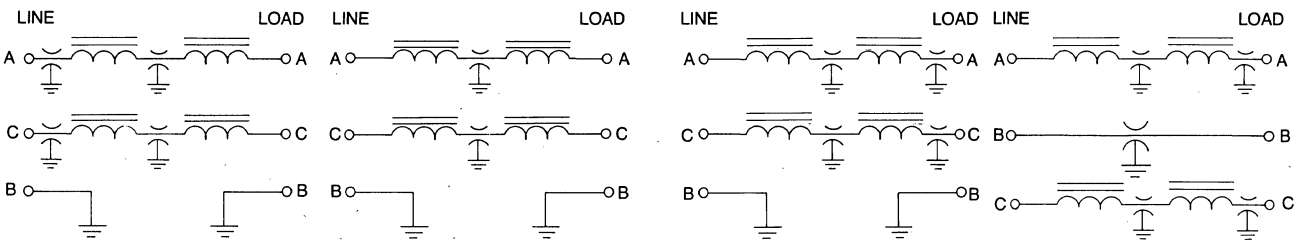


Figure IV





SPECTRUM PART NUMBER	CURRENT RATING	VOLTAGE RATING	TEMPERATURE RANGE	DCR MAX. (ohms)	FIG-URE	SCHE-MATIC	MINIMUM INSERTION LOSS (dB)						
							50 kHz	150 kHz	300 kHz	1 MHz	10 MHz	100 MHz	1 GHz
52-378-001	3 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.3	I	A	40	70	80	80	80	70	70
52-378-002	5 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	I	C	34	64	70	80	80	70	70
52-378-004	5 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	I	A	34	64	70	80	80	70	70
52-378-005	3 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.3	I	C	40	70	80	80	80	70	70
52-387-001	10 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	II	C	34	64	70	80	80	70	70
52-387-003	10 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	II	A	34	64	70	80	80	70	70
52-402-001	10 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	III	C	34	64	70	80	80	70	70
52-402-002	10 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.2	III	D	34	64	70	80	80	70	70
52-409-001	14 amps	240 VAC 60 Hz Line to Line	−55°C to 85°C	.04	IV	B	14	30	45	80	80	70	60

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TYPICAL FILTER PLATE ASSEMBLIES

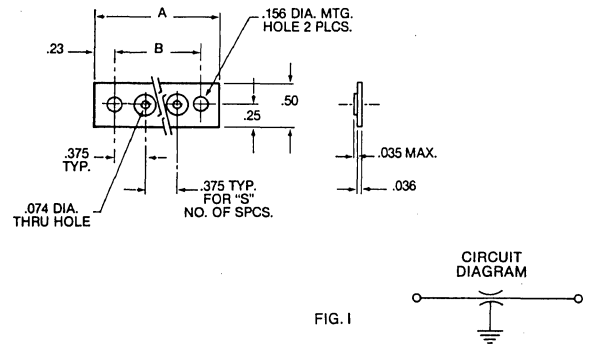


FIG. I

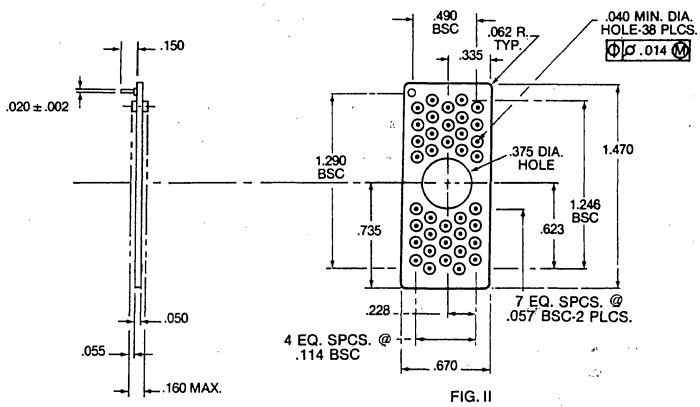
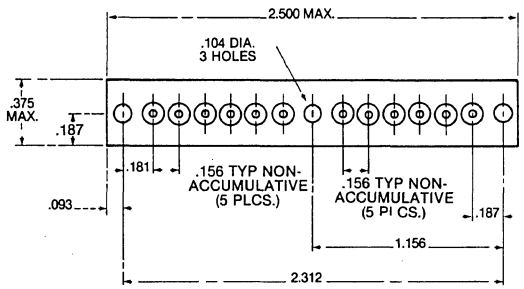
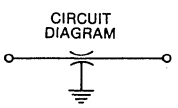


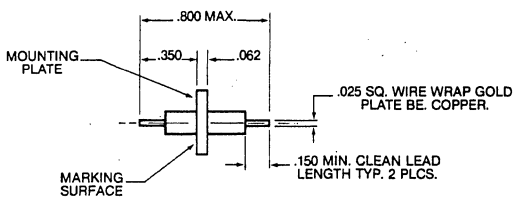
FIG. II

NOTE:
1. TERMINAL STRIP FILTER PLATES ARE COMPATIBLE WITH BEAU SERIES 7200 TERMINAL STRIPS.

FIG	SPECTRUM CONTROL NUMBER	PLATING	CAP GMV.	WORKING VOLTS D.C. +85°C	+125°C	DCR	DIM A	DIM B	NO. OF CIRCUITS	"S" NO. OF SPCS.	TYPICAL INSERTION LOSS 1 MHZ	10 MHZ	100 MHZ	200 MHZ	500 MHZ
I	52-753-001	TIN	1,000 pf	300	200	.01	1.575	1.125	2	1	–	5	26	31	32
I	52-753-002	TIN	1,000 pf	300	200	.01	1.950	1.500	3	2	–	5	26	31	32
I	52-753-003	TIN	1,000 pf	300	200	.01	2.325	1.875	4	3	–	5	26	31	32
I	52-753-004	TIN	1,000 pf	300	200	.01	2.700	2.250	5	4	–	5	26	31	32
II	52-730-001	SILVER	10,000 pf	200	100	.01	–	–	38	–	5	23	40	45	50

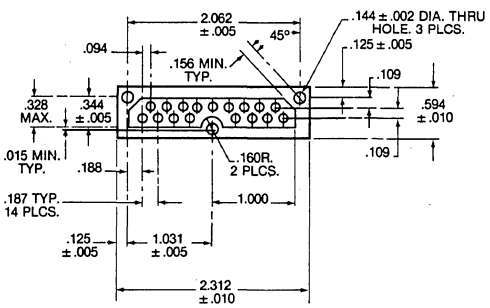


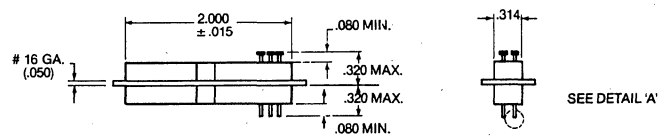


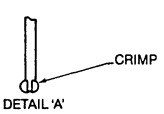


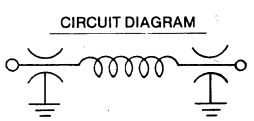
NOTE:
1. MATERIAL: MTG. PLATE: TIN PLATED STEEL.

SPECTRUM CONTROL NUMBER	PLATING	CAP. GMV.	MAX. CURR. AMPS.	WORKING VOLTS D.C. +125°C	DCR	TYPICAL INSERTION LOSS 1 MHZ	10 MHZ	100 MHZ	200 MHZ	500 MHZ
52-743-001	TIN	1,000 pf	3	100	.01	–	5	25	30	33
52-743-002	TIN	.022 uf	3	100	.01	12	30	45	49	58
52-743-003	TIN	.050 uf	3	100	.01	35	50	70	70	70









SPECTRUM CONTROL NUMBER	PLATING	CAP. GMV.	MAX. CURR. AMPS.	WORKING VOLTS D.C. +125°C	DCR	TYPICAL INSERTION LOSS 1 MHZ	10 MHZ	100 MHZ	200 MHZ	500 MHZ
52-726-001	TIN	1,250 pf	5	50	.01	–	6	46	60	70

Custom assemblies available upon request. Contact your Spectrum field engineer or factory for more information.

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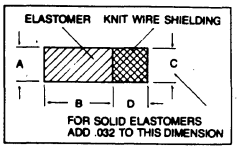
EMI/RFI SHIELDING GASKETS

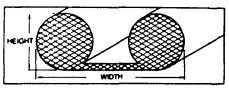
EMI/RFI SHIELD-SEAL STRIP GASKETING



Dimensions in inches and (millimeters)				Neo. Sponge & Monel
A	B	C	D	
.062 (1.57)	.250 (6.35)	.062 (1.57)	.125 (3.18)	57-1516-06038-02
.062 (1.57)	.500 (12.70)	.062 (1.57)	.125 (3.18)	57-1516-06063-02
.125 (3.18)	.625 (15.88)	.125 (3.18)	.125 (3.18)	57-1516-12075-02
.125 (3.18)	.500 (12.70)	.125 (3.18)	.125 (3.18)	57-1516-12063-02
.125 (3.18)	.250 (6.35)	.125 (3.18)	.125 (3.18)	57-1516-12038-02

Spectrum's Shield-Seal provides protection against weather conditions as well as EMI/RFI leakage. The strip is supplied with pressure sensitive adhesive for ease of mounting.

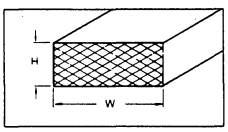
EMI KNITTED WIRE MESH GASKETING
ALL MESH DOUBLE ROUND WITH FIN STRIP



ROUND HEIGHT	CONNECTING WIDTH	MONEL	FERROUS (Copper & Tin Plated)
.125 (3.18)	.500 (12.70)	57-1514-12050-31-000	57-1514-12050-34-000
.125 (3.18)	.625 (15.88)	57-1514-12063-31-000	57-1514-12063-34-000
.125 (3.18)	.750 (19.05)	57-1514-12075-31-000	57-1514-12075-34-000
.125 (3.18)	.875 (22.23)	57-1514-12087-31-000	57-1514-12087-34-000
.125 (3.18)	1.000(25.40)	57-1514-12100-31-000	57-1514-12100-34-000

Spectrum's Double-Round Mesh is for use on flat surfaces where EMI/RFI shielding is the only requirement. Surfaces should be free of oil, grease or paint.

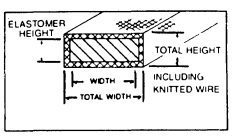
ALL MESH — RECTANGULAR STRIP



HEIGHT H	WIDTH W	MONEL	FERROUS (Copper & Tin Plated)
.062 (1.57)	.250 (6.35)	57-1510-06025-31-000	57-1510-06025-34-000
.098 (2.36)	.125 (3.18)	57-1510-09012-31-000	57-1510-09012-34-000
.125 (3.18)	.125 (3.18)	57-1510-12012-31-000	57-1510-12012-34-000
.125 (3.18)	.250 (6.35)	57-1510-12025-31-000	57-1510-12025-34-000
.125 (3.18)	.500 (12.70)	57-1510-12050-31-000	57-1510-12050-34-000
.125 (3.18)	.750 (19.05)	57-1510-12075-31-000	57-1510-12075-34-000

The rectangular strip is recommended for groove mounting. The spring-like nature of knitted mesh assures consistent contact and long life.

EMI SHIELDING STRIP ELASTOMER CORE RECTANGULAR SHAPED GASKET

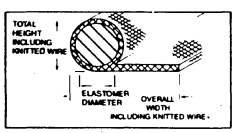


MONEL WIRE

ELASTOMER HEIGHT	TOTAL HEIGHT	ELASTOMER WIDTH	TOTAL WIDTH	SILICONE SPONGE
.125 (3.18)	.160 (4.06)	.250 (6.35)	.285 (7.24)	57-1510-12025-04-000
.250 (6.35)	.285 (7.24)	.250 (6.35)	.285 (7.24)	57-1510-25025-04-000
.250 (6.35)	.285 (7.24)	.500 (12.70)	.535 (13.59)	57-1510-25050-04-000
.500 (12.70)	.535 (13.59)	.500 (12.70)	.535 (13.59)	57-1510-50050-04-000

Spectrum's Elastomer Core Shielding Strip is recommended where low pressure compressibility is required with a high degree of resiliency.

SINGLE FIN SECTION — ELASTOMER CORE

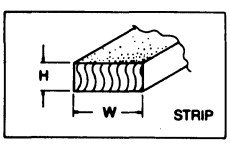


MONEL WIRE

ELASTOMER DIAMETER	TOTAL HEIGHT	OVERALL WIDTH	SILICONE SPONGE
.125 (3.18)	.160 (4.06)	.500 (12.70)	57-1512-12050-04-000
.250 (6.35)	.285 (7.24)	.750 (19.05)	57-1512-25075-04-000
.250 (6.35)	.285 (7.24)	1.000 (25.40)	57-1512-25100-04-000
.500 (12.70)	.535 (13.59)	1.000 (25.40)	57-1512-50100-04-000

Spectrum's Single Fin Shielding Strip is designed to be bolted or cemented in place. The Elastomer Core provides continuous pressure over the entire length of strip.

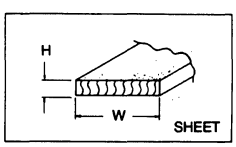
MULTICON STRIP EMI SHIELDING GASKET



HEIGHT H	WIDTH W	SILICONE AND MONEL	
		SOLID	SPONGE
.062 (1.57)	.250 (6.35)	57-1547-06025-03-000	—
.062 (1.57)	.500 (12.70)	57-1547-06050-03-000	—
.093 (2.36)	.250 (6.35)	57-1547-09025-03-000	57-1547-09025-04-000
.093 (2.36)	.500 (12.70)	57-1547-09050-03-000	57-1547-09050-04-000
.125 (3.18)	.125 (3.18)	57-1547-12012-03-000	57-1547-12012-04-000
.125 (3.18)	.250 (6.35)	57-1547-12025-03-000	57-1547-12025-04-000
.125 (3.18)	.500 (12.70)	57-1547-12050-03-000	57-1547-12050-04-000

Spectrums' Multicon offers the best possible shield against environment and EMI/RFI contamination. The hundreds of wire ends provide electrical contact while the silicone forms a moisture barrier.

MULTICON SHEET EMI SHIELDING GASKETS

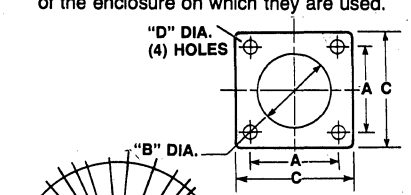


HEIGHT H	WIDTH W	SILICONE AND MONEL	
		SOLID	SPONGE
.062 (1.57)	3.000 (76.2)	57-1547-06300-03-000	—
.093 (2.36)	3.000 (76.2)	57-1547-09300-03-000	57-1547-09300-04-000
.125 (3.18)	3.000 (76.2)	57-1547-12300-03-000	57-1547-12300-04-000

Multicon sheet material can be used as a single gasket or cut to size by the design engineer for prototype efforts.

EMI-RFI SHIELDING CONNECTOR GASKET

Spectrum's Connector Gaskets are offered for use with standard connector sizes in either the multicon material or the radthin. These gaskets insure the EMI/RFI integrity of the enclosure on which they are used.



AN CONNECTOR GASKETS						
SHELL SIZE	DIMENSIONS				MATERIAL PART NUMBER	
	A	B	C	D	MULTICON	RADTHIN
8	.594(15.09)	.500(12.07)	.875(22.23)	.172(4.37)	57-2047-40213-03	57-2040-20381-05
10	.719(18.26)	.625(15.86)	1.000(25.40)	.172(4.37)	57-2047-40214-03	57-2040-20382-05
12	.813(20.65)	.750(19.05)	1.094(27.79)	.172(4.37)	57-2047-40215-03	57-2040-20383-05
14	.906(23.01)	.875(22.23)	1.188(30.16)	.172(4.37)	57-2047-40216-03	57-2040-20384-05
16	.969(24.61)	1.000(25.40)	1.281(32.54)	.172(4.37)	57-2047-40217-03	57-2040-20385-05
18	1.063(27.00)	1.125(28.56)	1.375(34.93)	.203(5.15)	57-2047-40218-03	57-2040-20386-05
20	1.156(29.36)	1.250(31.75)	1.500(38.10)	.203(5.15)	57-2047-40219-03	57-2040-20387-05
22	1.250(31.75)	1.375(34.93)	1.625(41.28)	.203(5.15)	57-2047-40220-03	57-2040-20388-05
24	1.375(34.93)	1.500(33.10)	1.750(44.45)	.203(5.15)	57-2047-40221-03	57-2040-20389-05
28	1.563(39.70)	1.750(44.45)	2.000(50.80)	.203(5.15)	57-2047-40222-03	57-2040-20390-05
32	1.750(44.45)	2.000(50.80)	2.250(57.15)	.219(5.56)	57-2047-40223-03	57-2040-20391-05
36	1.938(49.23)	2.188(55.58)	2.500(63.50)	.219(5.56)	57-2047-40224-03	57-2040-20392-05
40	2.188(55.58)	2.438(61.93)	2.750(69.85)	.219(5.56)	57-2047-40225-03	57-2040-20393-05
44	2.375(60.33)	2.781(70.64)	3.000(76.20)	.219(5.56)	57-2047-40226-03	57-2040-20394-05
48	2.625(66.68)	3.031(76.99)	3.250(82.55)	.219(5.56)	57-2047-40227-03	57-2040-20395-05

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Selection Guide for TRW Filters

Almost 40 years of specialization in selective networks, from image parameter design to modern network synthesis are reflected in the superior performance, miniaturization, stability, and reliability of the electric wave filters produced by TRW/UTC today.

Because of the tremendous variation in requirements of frequency, band width, impedance, shape factor, size configuration, and other special characteristics such as envelope delay distortion, and return loss, TRW Inductive Products' catalog items are only a portion of the filters made. Special "custom" designs to customers' specifications range from DC to 30 MHz, from a volume of less than 0.1 cubic inches to more than 250 cubic inches. They cover applications such as telephone, telegraph, telemetering, multiplexing, carrier elimination and restoration, etc.

FOR SPECIAL DESIGNS the following information must be known: source and load impedances, insertion loss, pass band, stop band, operating level, operating temperature range, and size restrictions, plus any other special requirements such as phase matching, insertion loss matching, or attenuation matching, between units, envelope delay distortion, return loss limits, etc.

Since filters usually contain many precisely adjusted elements and are used in critical applications where continued reliable performance is a necessity, all TRW/UTC filters, both stock and specials, are manufactured and guaranteed to MIL-F-18327.

Units with identical electrical and mechanical characteristics as stock items, except for center frequency on band pass filters, or cutoff frequency on low and high pass filters, are known as stock specials. For example, a band pass filter identical to the BPM series with a center frequency of 2700 Hz would be identified as BPM-2700, a 2700 Hz center frequency band pass filter identical to the MNF series would be identified as MNF-2.7, a low pass similar to LPM series with a 2700 Hz cutoff frequency would be identified as LPM-2700.

FOR WIDE BAND PASS applications (more than an octave wide) low pass and high pass filters may be connected in tandem. For instance, the FLH-5000 in tandem with the FHH-200 will result in an attenuation characteristic flat within 1 dB from 300 to 4200 Hz, approximately 3 dB at 200 and 5000 Hz, 40 dB below 140 Hz, and 43 dB above 6400 Hz.

FOR BAND REJECT applications, the BPM band pass minifilters may be used by connecting as shown on page 47, Fig. A. Generally, on stock filters, variations of ±20% in the source and load impedances will have negligible effect on the attenuation response. FHH, FLH, FLL, BPM, and BMI filters may be used with a much lower source impedance and still give satisfactory results.

The nominal test level, E_9 is 2.0 Volts RMS for all stock filters except 0.5 Volt on the BPM and 1.0 Volt on the LPM.

BAND PASS

Type No.	Center Frequency Range	Band Width	Source (Ohms)	Load (Ohms)	MIL Grade
MNF	400 Hz to 5.4 kHz	±7.5%	10K	10K	7
MNF	7.35 kHz to 70 kHz	±7.5%	10K	10K	7
MNF	93 kHz to 165 kHz	±7.5%	10K	10K	7
MWF	22 kHz to 70 kHz	±15%	10K	10K	7
MWF	93 kHz to 165 kHz	±15%	10K	10K	7
BPM	400 Hz to 20 kHz	±3%	10K	10K or Grid	6
BMI	30 Hz to 50 Hz	±3%	10K	Grid	6
BMI	60 to 400 Hz	±3%	10K	Grid	6
TGT	425 Hz to 3315 Hz	±42.5 Hz	600	600	6
TGR	425 Hz to 3315 Hz	±42.5 Hz	600	600	6

BAND REJECT

Type No.	Frequency Range	Source & Load (Ohms)	MIL Grade
BPM	400 Hz to 20 kHz	10K	6

LOW PASS

Type No.	Cutoff Frequency Range	Source & Load (Ohms)	MIL Grade
LPM	200 Hz to 5 kHz	10K	6
LPM	6 kHz to 15 kHz	10K	6
FLH	600 Hz to 5 kHz	10K	6
FLL	3.5 kHz to 50 kHz	600	6
LMI	50 Hz to 150 Hz	10K	6
LML	500 Hz to 12 kHz	600	6

HIGH PASS

Type No.	Cutoff Frequency Range	Source & Load (Ohms)	MIL Grade
FHH	200 Hz to 10 kHz	10K	6
HMI	50 Hz to 400 Hz	10K	6

TTE™ *miniature* FILTERS

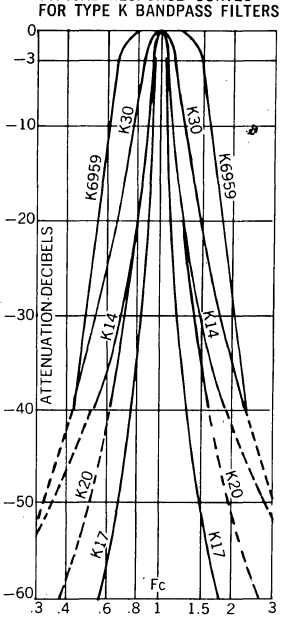
THESE PAGES CATALOG OVER 1,000,000 STANDARD FILTER TYPES — SPECIFY ANY COMBINATION OF FREQUENCY, SOURCE AND LOAD OHMS WITHIN THE MIN-MAX RANGES.

MANY TYPES AVAILABLE FROM STOCK — REQUEST STOCK LIST

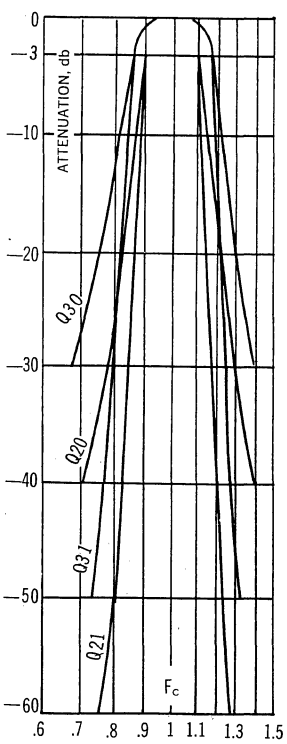
BANDPASS—MINIATURE— ANY FREQUENCY FROM 30Hz TO 20MHz

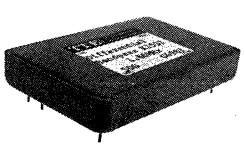
Series	Fc Center Min.	Freq. Range Max.	Bandwidth @ —3db	Stopband Attenuation	Source, Min.	Ohms Max.	Load, Min.	Ohms Max.	Case Chassis	Type/No. PCB
K10B	500Hz	10KHz	±1%Fc	{30db at .92Fc & 1.1Fc &	1K	500K	1K	500K	4	17
K10C	10KHz	100KHz	±1%Fc	{40db at .86Fc & 1.2Fc	500	10K	500	10K	3	11
K10D	100KHz	1MHz	±1%Fc		500	1K	500	1K		11
K10E	1MHz	20MHz	±1%Fc		50	75	50	75		11
K11H	500Hz	10KHz	±1%Fc	{30db at .94Fc & 1.06Fc &	1K	500K	1K	500K	4	17
K11J	10KHz	100KHz	±1%Fc	{40db at .93Fc & 1.1Fc	500	10K	500	10K	3	13
K11K	100KHz	1MHz	±1%Fc		500	1K	500	1K		12/19
K11L	1MHz	20MHz	±1%Fc		50	75	50	75		12/19
K12D	500Hz	10KHz	±2%Fc	30db at .92Fc & 1.1Fc	1K	10K	1K	10K	4	17
K12E	10KHz	100KHz	±2%Fc	30db at .92Fc & 1.1Fc	500	10K	500	10K		12/19
K12F	100KHz	1MHz	±2%Fc	30db at .92Fc & 1.1Fc	500	1K	500	1K		12/19
K12G	1MHz	20MHz	±2%Fc	30db at .92Fc & 1.1Fc	50	75	50	75		12/19
K13A	30Hz	100Hz	±5%Fc	55db at .5Fc & 2Fc	1K	500K	1K	500K	5	
K17A	100Hz	10KHz	±5%Fc	60db at .5Fc & 2Fc	500	10K	500	10K	4	17
K17B	10KHz	100KHz	±5%Fc	60db at .5Fc & 2Fc	100	100K	100	100K	3	19
K17D	300Hz	3KHz	±5%Fc	50db at .5Fc & 2Fc	500	15K	500	15K	3	12
K17E	3KHz	10KHz	±5%Fc	50db at .5Fc & 2Fc	100	50K	100	50K	3	11
K17F	10KHz	100KHz	±5%Fc	60db at .5Fc & 2Fc	500	10K	500	10K		11/19
K17G	100KHz	1MHz	±5%Fc	60db at .5Fc & 2Fc	500	1K	500	1K		11/19
K17H	1MHz	20MHz	±5%Fc	60db at .5Fc & 2Fc	50	75	50	75		11/19
K20E	100Hz	1KHz	±7.5%Fc	40db at .57Fc & 1.75Fc	500	10K	500	10K	4	17
K20F	1KHz	10KHz	±7.5%Fc	40db at .6Fc & 1.67Fc	500	10K	500	10K	3	13
K20G	10KHz	100KHz	±7.5%Fc	40db at .6Fc & 1.67Fc	500	10K	500	10K	3	11
K20H	100KHz	1MHz	±7.5%Fc	40db at .6Fc & 1.67Fc	500	1K	500	1K		11
K20J	1MHz	20MHz	±7.5%Fc	40db at .6Fc & 1.67Fc	50	75	50	75		11
Q20	1KHz	10KHz	±7.5%Fc	40db at .7Fc & 1.4Fc	1K	10K	1K	10K	5	14
Q22	1KHz	10KHz	±7.5%Fc	60db at .75Fc & 1.3Fc	1K	10K	1K	10K	6	17
Q23	10KHz	100KHz	±7.5%Fc	40db at .7Fc & 1.4Fc	600	10K	600	10K	4	13
Q24	10KHz	100KHz	±7.5%Fc	60db at .75Fc & 1.3Fc	600	10K	600	10K	5	16
Q25	100KHz	1MHz	±7.5%Fc	40db at .7Fc & 1.4Fc	500	1K	500	1K		12
Q26	100KHz	1MHz	±7.5%Fc	60db at .75Fc & 1.3Fc	500	1K	500	1K		15/22
Q27	1MHz	20MHz	±7.5%Fc	40db at .7Fc & 1.4Fc	50	75	50	75		12/19
Q28	1MHz	20MHz	±7.5%Fc	60db at .75Fc & 1.3Fc	50	75	50	75		15/22
K30E	100Hz	1KHz	±15%Fc	40db at .4Fc & 2.5Fc	500	10K	500	10K	4	17
K30F	1KHz	10KHz	±15%Fc	40db at .45Fc & 2.2Fc	500	10K	500	10K	3	13
K30G	10KHz	100KHz	±15%Fc	40db at .45Fc & 2.2Fc	500	10K	500	10K	3	11
K30H	100KHz	1MHz	±15%Fc	40db at .45Fc & 2.2Fc	500	1K	500	1K		11
K30J	1MHz	20MHz	±15%Fc	40db at .45Fc & 2.2Fc	50	75	50	75		11
Q30	1KHz	10KHz	±15%Fc	30db at .67Fc & 1.37Fc	1K	10K	1K	10K	5	14
Q32	1KHz	10KHz	±15%Fc	50db at .73Fc & 1.31Fc	1K	10K	1K	10K	6	17
Q33	10KHz	100KHz	±15%Fc	30db at .67Fc & 1.37Fc	600	10K	600	10K	4	13
Q34	10KHz	100KHz	±15%Fc	50db at .73Fc & 1.31Fc	600	10K	600	10K	5	16
Q35	100KHz	1MHz	±15%Fc	30db at .67Fc & 1.37Fc	500	1K	500	1K		12/19
Q36	100KHz	1MHz	±15%Fc	50db at .73Fc & 1.31Fc	500	1K	500	1K		15/22
Q37	1MHz	20MHz	±15%Fc	30db at .67Fc & 1.37Fc	50	75	50	75		12/19
Q38	1MHz	20MHz	±15%Fc	50db at .73Fc & 1.31Fc	50	75	50	75		15/22

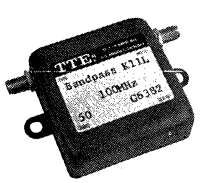
TYPICAL RESPONSE CURVES FOR TYPE K BANDPASS FILTERS



TYPICAL RESPONSE CURVES FOR TYPE Q BANDPASS FILTERS







WIDE BAND FILTERS: TTE has designed and manufactured Filters since 1956. During that time Bandpass Filters with 3dB Bandwidths as great as 3100% have been supplied. A Bandwidth of ±20% or greater can be obtained by ordering TTE standard Highpass and Lowpass filter sections as a composite network. Select numbers from the Series H and J listings on page 3 which give the desired attenuation slopes and combine these numbers. For example to obtain a slope of 40db at 0.65 of the lower frequency cut-off, Fc1, (Highpass section) and 40db at 1.6 of the upper frequency cut-off, Fc2, (Lowpass section) use Highpass model H69 plus Lowpass model J59. The resulting Bandpass number is K6959.**THE HIGHPASS SERIES NUMBER IS FIRST, FOLLOWED BY THE LOWPASS NUMBER.** Types with dissymmetrical attenuation slopes can be combined. Also specify the 3db down cut-off frequencies Fc1 and Fc2, the impedance and PCB case or chassis mount case.

INSERTION LOSSES for bandpass types between equal terminations are from 0.5 to 6db depending upon bandwidth, frequency and size. K10 and K11 types have about 10db insertion loss and K12 types about 6db flat loss. **SPECIALS** are available for center frequencies from 10Hz upward and 60db to 3db bandwidth ratios as sharp as 2.0:1. **TO ORDER** Specials, also specify (5) bandwidth and (6) stop band attenuation required.

TO ORDER BANDPASS FILTERS — Specify (1) TTE Series No., (2) minus 3db frequencies, (3) source impedance, (4) load impedance. **PRICES:** $63 to $200 each.

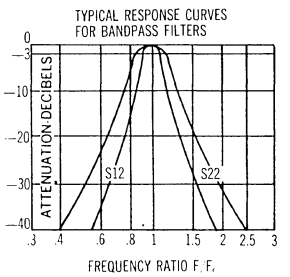
CASE DIMENSIONS AND MOUNTING INFORMATION ARE ON PAGE 1•1535.

TTE™ **TTE, INC. 2214 So. Barry Ave., Los Angeles, CA 90064, (213) 478-8224**

TTE™ *miniature* FILTERS

BANDPASS—SUBMINIATURE FOR FREQUENCIES OF 300Hz TO 20MHz

Series	Fc Center Min.	Freq. Range Max.	Bandwidth @ −3db Max.	Stopband Attenuation	Source, Ohms Min.	Source, Ohms Max.	Load, Ohms Min.	Load, Ohms Max.	Case No.
S10D	300Hz	1KHz	±7.5%Fc	35db at .55Fc & 1.8Fc	10K	10K	10K	10K	231
S11D	1KHz	5KHz	±7.5%Fc	40db at .55Fc & 1.8Fc	1K	10K	1K	10K	231
S12D	5KHz	50KHz	±7.5%Fc	40db at .58Fc & 1.75Fc	1K	10K	1K	10K	231
S12E	5KHz	50KHz	±7.5%Fc	40db at .58Fc & 1.75Fc	1K	1K	1K	1K	230
S13D	50KHz	1MHz	±7.5%Fc	40db at .58Fc & 1.75Fc	500	1K	500	1K	231
S13E	50KHz	1MHz	±7.5%Fc	40db at .58Fc & 1.75Fc	500	1K	500	1K	230
S14D	1MHz	20MHz	±7.5%Fc	40db at .58Fc & 1.75Fc	50	500	50	500	231
S20D	300Hz	1KHz	±15%Fc	40db at .4Fc & 2.5Fc	10K	10K	10K	10K	231
S21D	1KHz	5KHz	±15%Fc	40db at .4Fc & 2.5Fc	1K	10K	1K	10K	231
S22D	5KHz	50KHz	±15%Fc	40db at .4Fc & 2.5Fc	1K	10K	1K	10K	231
S22E	5KHz	50KHz	±15%Fc	40db at .4Fc & 2.5Fc	1K	10K	1K	10K	230
S23D	50KHz	1MHz	±15%Fc	40db at .4Fc & 2.5Fc	500	1K	500	1K	231
S23E	50KHz	1MHz	±15%Fc	40db at .4Fc & 2.5Fc	500	1K	500	1K	230
S24D	1MHz	20MHz	±15%Fc	40db at .4Fc & 2.5Fc	50	500	50	500	231



OTHER BANDPASS FILTERS: Any of the above Bandpass Filters may be specified for the following:

TELEMETERING: Any IRIG Channel.

HIGHPOWER: Any level up to 100 watts; frequencies from 10MHz.

DIFFERENTIAL INPUT/OUTPUTS: Any frequency from 300Hz; any series number.

PHASE MATCHED SETS: Any frequency up to 2MHz; any series number.

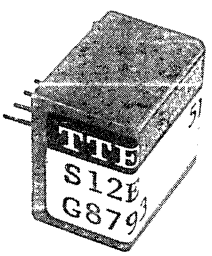
PLEASE CONTACT US WITH YOUR SPECIFICATION.

TO ORDER: Specify the channel, power level or other modification needed.

REMEMBER TO REQUEST THE STOCK LIST.

TO ORDER BANDPASS FILTERS — Specify (1) TTE series number, (2) the center frequency, (3) source impedance and (4) load impedance. **TO ORDER SPECIAL**

BANDWIDTHS also specify (5) the minus 3db frequencies and (6) the stopband frequencies.



BAND REJECTION

Series	Fc Center Min.	Freq. Range Max.	Bandwidth @ −3db	Attenuation	Impedance (ohms) Min.	Impedance (ohms) Max.	Case Chassis	Type/No. PCB
B83A	10Hz	100Hz	.67Fc & 1.5Fc	50db	600	50K	4	
B83B	10Hz	100Hz	.77Fc & 1.3Fc	40db	600	50K	4	
B83C	50Hz	10KHz	.77Fc & 1.3Fc	50db	50	1Meg	4	
B83D	10KHz	100KHz	.77Fc & 1.3Fc	50db	50	1Meg	3	14
B83E	100KHz	1MHz	.77Fc & 1.3Fc	50db	50	50K		13/18
D	10Hz	100KHz	.25Fc & 4Fc	50db	50	1Meg	2	11
F	10Hz	100KHz	.25Fc & 4Fc	60db	50	1Meg	2	11
R20	100Hz	3999Hz	{BW 3db/BW 40db ≤ 5 For BW 40db ≥ 10%Fc		10K	50K		4 or 13
R30	4KHz	10MHz			50	10K		4 or 13

ACTIVE FILTERS

BANDPASS

CENTER FREQ. RANGE: 1Hz to 100KHz
IMPEDANCE RANGE: 0 to 1 Megohm
OPERATING VOLTAGE RANGE: ±5VDC to ±12VDC
GAIN: Unity ±.3dB (other gains may be specified)
DESIGNS: Chebyshev, Butterworth, Elliptic-function and Bessel (3 to 10 poles available for most designs)
CASE: Hermetically sealed steel
Prices are from $35.00 each. The output is non-inverting; However, inverting output may be specified.

BAND REJECTION

NOTCH FREQ. RANGE: 1Hz to 100KHz
IMPEDANCE RANGE: 0 to 1 Megohm
OPERATING VOLTAGE RANGE: ±5VDC to ±12VDC
GAIN: Unity ±.3dB (other gains may be specified)
DESIGNS: Twin-T and wide-band notch filters
CASE: Hermetically sealed steel
Prices are from $35.00 each. The output is non-inverting, inverting output may be specified.

GENERAL FILTER NOTES: TTE Filters are epoxy encased within hermetically sealed steel cases. The case finish is copper plate per MIL-C-14550 under fused tin per MIL-T-10727A. The maximum power output without K12 types are tested at 100mv and B83 types at .77v output for all impedance levels. Terminations are understood to be resistive unless otherwise specified. Mount clear of transformers or other strong magnetic fields. BNC and SMA connectors are available.

TTE™ TTE, INC. 2214 So. Barry Ave., Los Angeles, CA 90064, (213) 478-8224

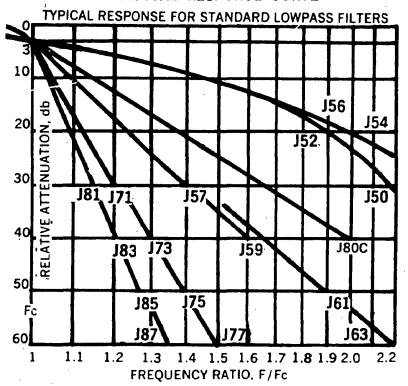
TTE™ *miniature* FILTERS

LOWPASS—MINIATURE

75Hz to 20MHz (*And from 2Hz to 74Hz)

Series No.	Min. Attn. db	Cut-Off Ratio F/Fc
J57E	30	1.4
J59E	40	1.6
J61E	50	1.9
J63E	60	2.2
J71E	30	1.2
J73E	40	1.3
J75E	50	1.4
J77E	60	1.5
J81E	30	1.15
J83E	40	1.20
J85E	50	1.27
J87E	60	1.35
J91E	30	1.10
J93E	40	1.13
J95E	50	1.17
J97E	60	1.20
*J80E	40	2.0

TYPICAL RESPONSE CURVE

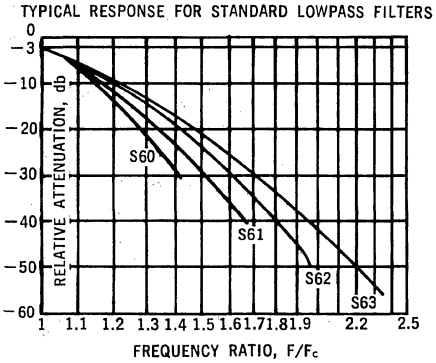


LOWPASS—SUBMINIATURE

1KHz to 20MHz

Series No.	Min. Attn. db	Cut-Off Ratio F/Fc
S60C	30	1.41
S61C	40	1.67
S62C	50	1.96
S63C	60	2.45

TYPICAL RESPONSE FOR STANDARD LOWPASS FILTERS



TO ORDER specify (1) TTE Series No., (2) minus 3db freq., (3) impedance, (4) Case No. **SPECIALS** are available for cut-off frequencies down to 3Hz and above 100MHz. **PRICES:** $32 to $135.

IMPEDANCE GUIDE FOR MINIATURE HIGHPASS AND LOWPASS TYPES

Fc −3db		10Hz 50Hz	50Hz 100Hz	100Hz 500Hz	500Hz 5KHz	5KHz 10KHz	10KHz 100KHz	100KHz 500KHz	500KHz 1MHz	1MHz 5MHz	5MHz 20MHz
Z Min.	Ω	10K	10K	5K	1K	500	100	50	50	50	50
Z Max.	Ω	15K	39K	39K	39K	20K	3K	3K	1K	300	75

IMPEDANCE GUIDE FOR SUBMINIATURE HIGHPASS AND LOWPASS TYPES

Fc −3db		1KHz 5KHz	5KHz 20KHz	20KHz 100KHz	100KHz 500KHz	500KHz 1MHz	1MHz 10MHz	10MHz 20MHz
Z Min.	Ω	10K	1K	300	50	50	50	50
Z Max.	Ω	10K	10K	1K	1K	300	75	50

ACTIVE LOWPASS

−3dB FREQ. RANGE: 1Hz to 100KHz

IMPEDANCE RANGE: 0 to 1 Megohm

OPERATING VOLTAGE: ±5VDC to ±12VDC

GAIN: Unity ±.3dB (other gains may be specified)

DESIGNS: Chebyshev, Butterworth, Elliptic-function and Bessel (3 to 10 poles available for most designs)

CASE: Hermetically sealed steel

Prices are from $35.00 each. The output is non-inverting; However, inverting outputs may be specified.

CASE GUIDE FOR ALL HP & LP FILTERS

Case Type/No. Chs.* Mtg.†	SERIES NUMBER H60-66 J50-56	H67-73 J57-63	H81-87 J71-77	H91-97 J81-87	J91-97	S60-63	J80
2	500Hz to 100KHz	50KHz to 100KHz					
3	100Hz to 200KHz	1KHz to 50KHz	5KHz to 100KHz	5KHz to 100KHz			
4	75Hz to 100Hz	75Hz to 1KHz	1KHz to 5KHz	1KHz to 5KHz	5KHz to 100KHz		
5			100Hz to 1KHz	100Hz to 1KHz	200Hz to 5KHz		10Hz to 75Hz
6					100Hz to 200Hz		2Hz to 10Hz
PCB‡ Mtg. 9	200Hz to 500Hz						
10	500Hz to 100MHz						
11		2KHz to 100MHz	2.5KHz to 100MHz				
12		200Hz to 2KHz	500Hz to 2.5KHz	2.5KHz to 100MHz			
13		100Hz to 200Hz					
15				500Hz to 2.5KHz			
16			200Hz to 500Hz				
17			100Hz to 200Hz	200Hz to 500Hz			
20					1KHz to 10KHz		
22					10KHz to 100MHz		
133							
142							
144							
229						1KHz to 10KHz	
230						10KHz to 1MHz	
231						1KHz to 100MHz	

* Chs. = Chassis † Mgt. = Mounting ‡ PCB = Printed Circuit Board

SOURCE AND LOAD impedances are equal and resistive for standard HP and LP filters. The insertion loss is less than 0.5db for ±10% matching. Typical passband flatness within ±0.2db. Phase linearity is reasonable. Some types are used for pulse transmission. **SPECIALS** for other impedances and unequal terminations are available. Units with cut-off ratios as sharp as 1.06 (0.94 Highpass) are available.

TTE™ TTE, INC. 2214 So. Barry Ave., Los Angeles, CA 90064, (213) 478-8224

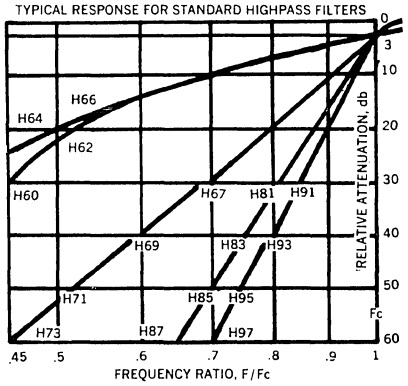
TTE™ *miniature* FILTERS

HIGHPASS—MINIATURE

75Hz to 20MHz

Series	Min. Attn. db	Cut-Off Ratio F/Fc
H60E	30	.45
H62E	40	.35
H64E	50	.25
H66E	60	.15
H67E	30	.70
H69E	40	.60
H71E	50	.52
H73E	60	.45
H81E	30	.81
H83E	40	.75
H85E	50	.70
H87E	60	.65
H91E	30	.85
H93E	40	.80
H95E	50	.75
H97E	60	.70

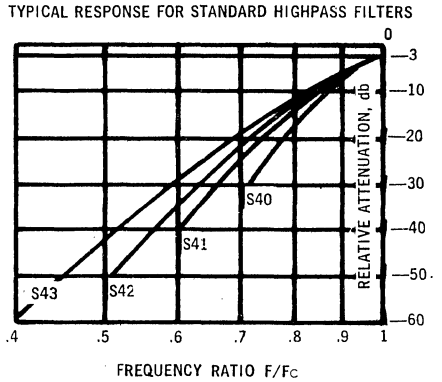
TYPICAL RESPONSE CURVE



HIGHPASS—SUBMINIATURE

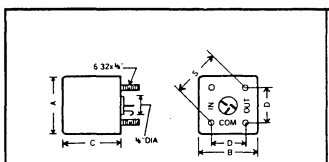
1KHz to 20MHz

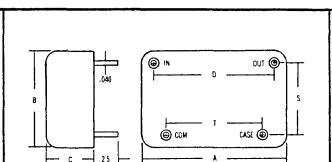
Series	Min. Attn. db	Cut-Off Ratio F/Fc
S40C	30	.7
S41C	40	.59
S42C	50	.51
S43C	60	.40

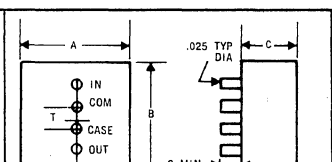


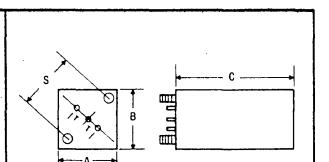
TO ORDER: Specify (1) TTE Series Number, (2) cut-off frequency, (3) source and load impedance. Prices are from $35 to $115.

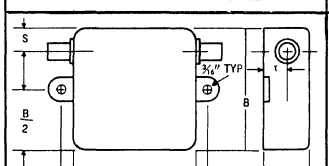
IMPEDANCE GUIDE — PLEASE SEE PAGE 1-1534.

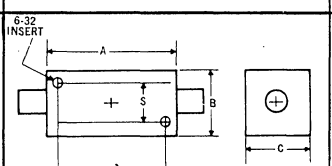


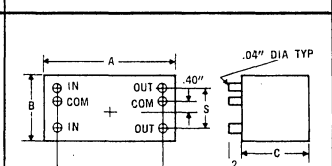


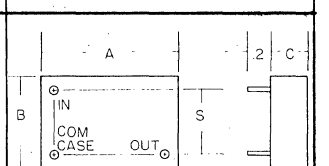












CASE AND MOUNTING DIMENSIONS

	Chassis Cases						PCB Cases									
Dim.	**AG**	**2**	**3**	**4**	**5**	**6**	**9**	**10**	**11**	**12**	**13**	**15**	**16**	**17**	**18**	**19**
A	1.0	1.19	1.31	1.63	1.81	2.06	1.27	1.27	1.88	2.0	2.0	2.96	2.96	2.96	3.0	3.0
B	1.0	1.19	1.31	1.63	1.94	2.31	1.27	1.27	1.44	2.0	2.0	1.93	1.93	1.93	.75	.75
C	1.38	1.25	1.75	2.38	2.44	3.13	1.0	.5	.5	.5	.75	.5	.75	1.25	.75	.5
D	—	.75	—	1.19	1.38/ 1.25	1.69/ 1.44	.9	.9	1.5	1.5	1.5	2.4	2.4	2.4	2.4	2.4
S	.75	—	1.25	—	—	—	.9	.9	1.0	1.5	1.5	1.4	1.4	1.4	.4	.4
T	.22	—	—	—	—	—	.6	.6	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Mtg.	2-4-40 X3/8	(4)	(2)	(4)	(4)	(4)	Printed Circuit Board Mounting									
		6-32 x 3/8 Studs														

	PCB Cases										VHF-UHF Connectors					
Dim.	**20**	**22**	**133**	**136**	**142**	**144**	**229**	**230**	**231**	**9715**	**613A**	**613B**	**718A**	**718B**	**720A**	**720B**
A	5.03	5.03	1.16	1.6	2.2	3.0	.75	.75	1.19	2.96	2.0	2.0	3.0	3.0	5.03	5.03
B	1.42	1.42	.66	1.0	.74	.75	.75	.75	1.19	1.93	2.0	2.0	.75	.75	1.42	1.42
C	.75	.5	.38	.5	.38	.38	.75	.5	.5	.5	.75	.75	.75	.75	.75	.75
D	4.0	4.0	—	—	—	—	—	—	—	2.4	2.38	2.38	—	—	—	—
S	1.0	1.0	.38	.65	.44	.44	—	—	—	1.4	.38	.38	.40	.40	1.0	1.0
T	3.0	3.0	.8	1.3	1.9	2.7	.1	.1	.2	.4	.38 (SMA)	.38 (BNC)	2.0 (SMA)	2.0 (BNC)	4.0 (SMA)	4.0 (BNC)
Mtg.	Printed Circuit Board Mtg.										6-32 Inserts		2	2	4	4

OTHER CONFIGURATIONS ARE AVAILABLE — CONTACT US WITH YOUR SPECIFICATION.

TTE™ TTE, INC. 2214 So. Barry Ave., Los Angeles, CA 90064, (213) 478-8224

from **Vernitron** (the ceramic filters people)

Vernitron CERAMIC LADDER FILTERS — 9, 11 and 17-disc

DESCRIPTION

Miniature ceramic i-f filters are available at reasonable prices for use in Military and commercial equipment. These rugged, light weight, fixed-tuned devices offer excellent selectivity and stability in less than 0.1 cu. in. Standard stop band rejection to 80 dB and center frequency tolerance varies between ± 2 and ± 3 kHz. Tighter tolerances available on special order. These filters are designed for communications circuit applications where precise center frequency tolerance and high stop band rejection are required.

Standard models in 6 dB bandwidths from 2 kHz to 85 kHz are available at 455* kHz center frequency. Input and output impedence is between 1000 and 2000 ohms.

*Also available in 500 kHz center frequency.

APPLICATIONS

These Ladder Filters are ideal for transistorized i-f amplifier circuitry as well as IC's in AM and FM sets. Their small size, ruggedness and high stopband rejection make them particularly suitable for airborne and hand-held transceivers.

FEATURES

- Stopband Rejections to 80 dB
- Small Size
- Lightweight
- Shape Factor ≤ 2:1
- Hermetically Sealed
- Vibration and Shock Resistant
- Excellent Stability
- Fixed-Tuned

100-700 kHz

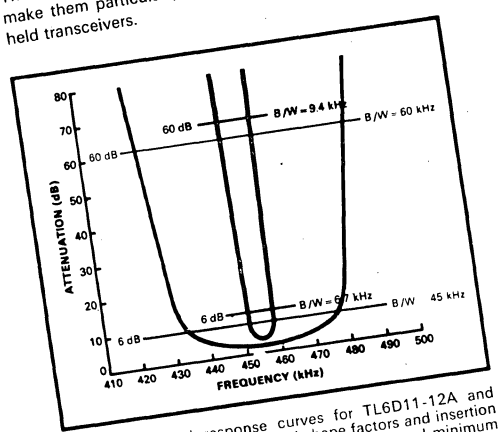
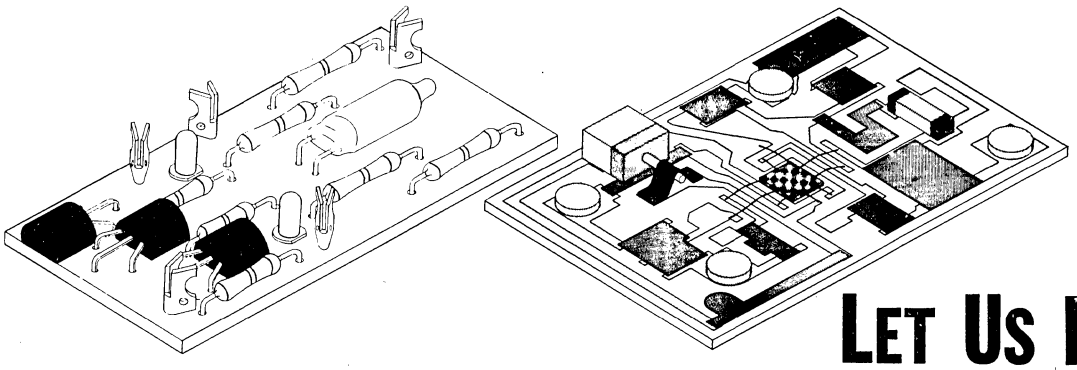


Figure 1. Typical response curves for TL6D11-12A and TL40D11-72A. Note that typical shape factors and insertion losses are considerably better than maximum and minimum values shown in table below.

Vernitron Piezoelectric Division
Ohio 44146 / (216) 232-8600

GENERAL SPECIFICATIONS		9-DISC — 50 dB STOPBAND			11-DISC — 60 dB STOPBAND			17-DISC — 80 dB STOPBAND		
Center Frequency 455 or 500 kHz (capability from 100-700 kHz)	**TYPICAL MODELS**	**TL-10D9 20A**	**TL-16D9 32A**	**TL-20D9 38A**	**TL-6D11 12A**	**TL-16D11 32A**	**TL-30D11 57A**	**TL-2D 5A**	**TL-16D 25A**	**TL-30D 45A**
Stopband Rejection 9-disc — 50 dB; 11-disc — 60 dB; 17-disc — 80 dB	**BANDWIDTH/6dB**	10	16	20	6	16	30	5	16	30
	@27°C /60dB	20	32	38	12	32	57	5	25	45
Stability +0.2%/5 yrs; within ±0.2%/ −40° to +85° C.	**SHAPE FACTOR**	2.0:1	2.0:1	1.9:1	2.0:1	2.0:1	1.9:1	2.5:1	1.6:1	1.5:1
Ripple Bandwidth Dependent, 1 to 3dB	**INSERTION LOSS (dB)**	4	5	5	6	5	5	10	5	5
Operating Range −40° to +85° C.	**IN/OUT IMPEDANCE (OHMS)**	2000	1000	1000	2000	1000	1000	2500	1500	1200
Environmental Meets MIL Std. 202B										

Vernitron Piezoelectric Division
232 Forbes Road / Bedford, Ohio 44146 / (216) 232-8600



LET US BE YOUR MANUFACTURING FACILITY

Do You Need Help To Get The End Product You Want?

After you have your design to meet your circuit performance requirements, ACC's Engineering Staff can assist you to package your circuit. We have a complete staff of electrical, mechanical, industrial, and chemical engineers to develop the most cost-effective assembly to compliment your product.

Custom Thick Film Hybrid?

If space is a problem, thick film hybrids are the answer to reduced manufacturing cost and component inventories. ACC can design and deliver a custom thick film hybrid to meet your performance, space, and cost requirements. For less stringent space requirements, formed discrete components or SOT packages are quite adequate. If space is tight or you have your own custom chip, a chip and wire hybrid may be the best approach.

The results to you are smaller size, improved reliability, and in most cases, better circuit performance due to the fact that thick film allows you to choose the exact resistor values and tolerances you want.

We have the capability to build your product to any stage of completion you desire. From a thick film print, fire, and trim, only, to a finished encased product, or any stage in between, by using custom thick film hybrids or printed circuit assemblies.

We will work with you during your development stage. We possess the capability to deliver into the millions, if necessary.

Automotive Controls Corporation (ACC) has over 200,000 square feet of production space. This facility, located in Southeast Kansas is staffed with a quality-conscious, dependable, rural and small-town work force. Our employees, to whom we owe our success, will build your product.

Printed Circuit Assembly?

If space is not a problem, then an automatically inserted printed circuit assembly is the most cost effective approach. ACC's printed circuit assembly area is equipped to insert components and wave solder boards up to 16 inches wide. Water washing is standard. Chlorinated cleaning solvents are available. The ACC facility is equipped and the personnel are trained to handle electrostatic sensitive components at all stages of production.

Packaging Support

In support of the electronic assembly, ACC can offer single-sided printed circuit boards, coil winding, transfer and injection molding, potting metal and lead frame stampings, metal plating, and painting, if required.

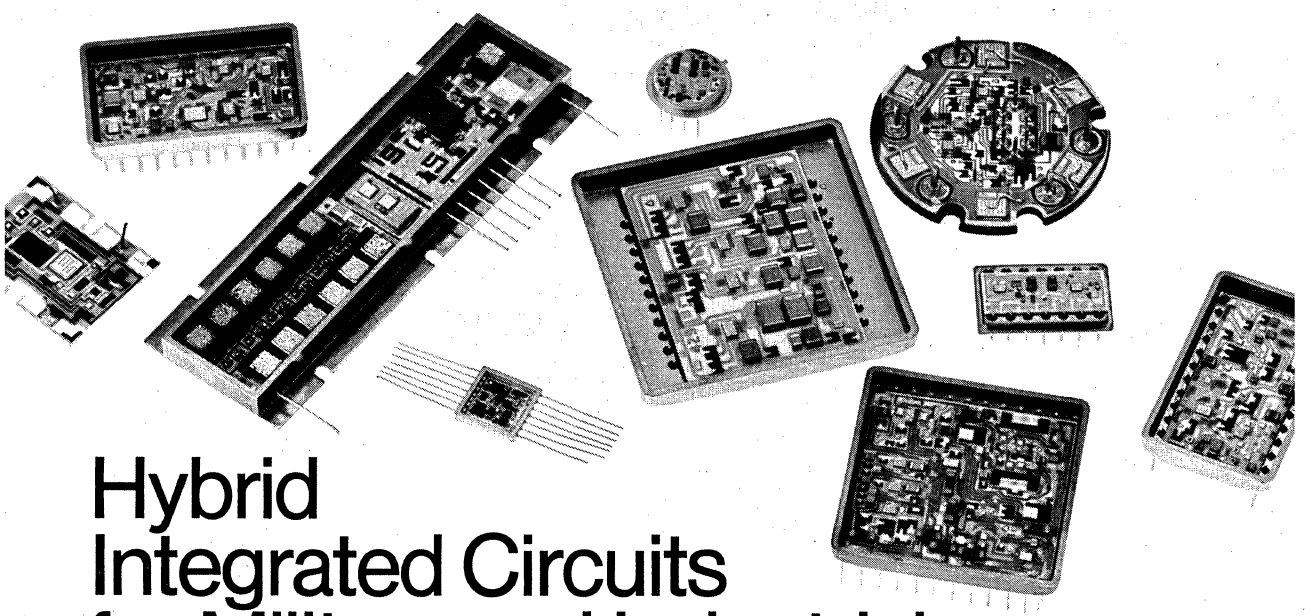
Total Design Capability through manufacture, test and delivery

ACC ELECTRONICS

AN ECHLIN COMPANY 1300 West Oak Independence, Kansas 67301 [316] 331-1000

Manufacturers of custom circuits for Industry.

Call us on our Inward Wats Line 800-835-0362 and ask for ACC Electronics Application Engineering, Extension 422.



Hybrid Integrated Circuits for Military and Industrial Applications

Aeroflex designs, develops and manufactures custom hybrids for both military and industrial customers. We are qualified for use on B1, B52, F15, F16 and LAMPS MK III, plus numerous other ground and airborne systems and medical and communications equipment.

Will a custom hybrid do your job? Hybrid technology combines the quick-response design and manufacturing economies of the printed circuit assembly with the reliability and small size of the monolithic IC. To help you determine when the method will be cost effective, Aeroflex's experienced engineers will consider the circuit itself, manufacturing lead time, and the quantities involved.

Once the decision has been made, Aeroflex has the technical and manufacturing support to meet your most exacting requirements. Our circuit designers will put your parameters together into the smallest, lightest package consistent with effective performance.

We excel in designing active filters, sample and hold networks, low noise pre-amps, voltage regulators, drivers and receivers and digital interface circuits to meet MIL-STD-1553. Electrical performance is guaranteed by our automatic test systems.

In our complete manufacturing facility, Aeroflex has the skilled personnel and production equipment to meet every hybrid design and manufacturing requirement. For most designs, we use thick film deposition for its great flexibility. On occasion, however, we will utilize thin film chip components in conjunction with thick film resistors and conductors. Gold conductors and various silver alloys are often employed, as well as a variety of resistor inks to cover the full range of resistor values. We have and use both laser, for active trimming, and airbrasive trimming systems.

Packaging for all environments. Aeroflex commercial hybrids are often epoxy sealed in ceramic for industrial applications. Heavy duty packaging options include welded hermetically sealed all-metal cases including flat packs, dips, plug-ins and "TO" cans for military requirements.

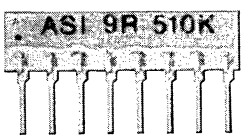
Product Assurance, in and out. Our Product Assurance Department meets the requirements of MIL-Q-9858A. Quality Assurance, Quality Control, Qualification Testing and Equipment Calibration are its responsibilities. Incoming inspection is performed on semiconductors in accordance with MIL-STD-883, Method 2010.1 Level B. Similar criteria are applied to hybrid inspection. Screening and qualification testing to MIL-STD-883B, Method 5008 and MIL-M-38510 are also available.

Microelectronics Division
AEROFLEX LABORATORIES INC.
35 South Service Road
Plainview, New York 11803
Tel. 516-694-6700 TWX 510-224-6417

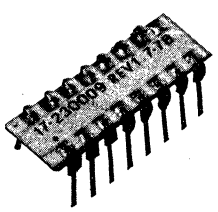
QUICK REACTION CAPABILITY

CUSTOM THICK FILM NETWORKS

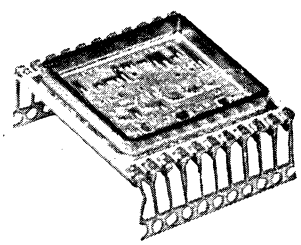
- Resistor Networks SIP & DIP
- Capacitor Networks
- Diode Networks
- RC Networks
- Resistor Chips
- Jumper DIPS
- High Volume Capacity



DESIGN GUIDELINES FOR A.S.I. CUSTOM THICK FILM PRODUCTS		
	STANDARD	PREMIUM
Resistance Range	5 ohms to 20M ohms	N/A
Tolerance 5 ohms to 30 ohms 30 ohms to 1M 1M to 20M	± 1 ohm ± 2% ± 5%	± .5 ohm ± .5%, ± 1% ± 1%, ± 2%
Ratio Match	± 1%	± .5%
TCR (-55° C to 125° C)	5 ohms to 30 ohms; 200 ppm 30 ohms to 1M; 100 ppm › 1M; 300 ppm	5 ohms to 30 ohms; N/A 30 ohms to 200K; 50 ppm 200K to 1M; 100 ppm › 1M; 200 ppm
TCR Tracking R's same geometry and inks R's same inks R's different inks	 10 ppm/°C 50 ppm/°C 100 ppm/°C	 N/A N/A N/A
Power Loading at 25° C	5 ohms to 250K; 100 W/in² 250K to 750K; 50 W/in² › 750K; 25W/in²	N/A N/A N/A



CUSTOM HYBRIDS



THICK FILM SCREENING & FIRING OF CONDUCTOR & RESISTOR MATERIALS
Down to 5 mil lines and 5 mil spaces, Ag and Au based conductors, 10 ohms/square to 1 Meg/square resistor inks, down to 50PPM/°C TCR
RESISTOR TRIMMING TO .5% TOLERANCES
Abrasive or laser; active or passive; negligible post-trim drift

DIE BONDING OF ICS, TRANSISTORS DIODES, CHIP CAPACITORS & INDUCTORS
Typical component density: 60 components/sq. inch of substrate

GOLD WIRE BONDING:
1 MIL WIRE DIAMETER TYP.

FUNCTIONAL AND QUALIFICATION TESTING, COMMERCIAL SPECIFICATIONS

HERMETIC OR EPOXY SEALING OR DIP COATING
Packaging Options:
- Sealed metal case
  - Glass-to-metal flat pac
  - Dual-in-line plug-in, 14 and 16 pin
- Coated substrate SIP or DIP
- Chip Carrier

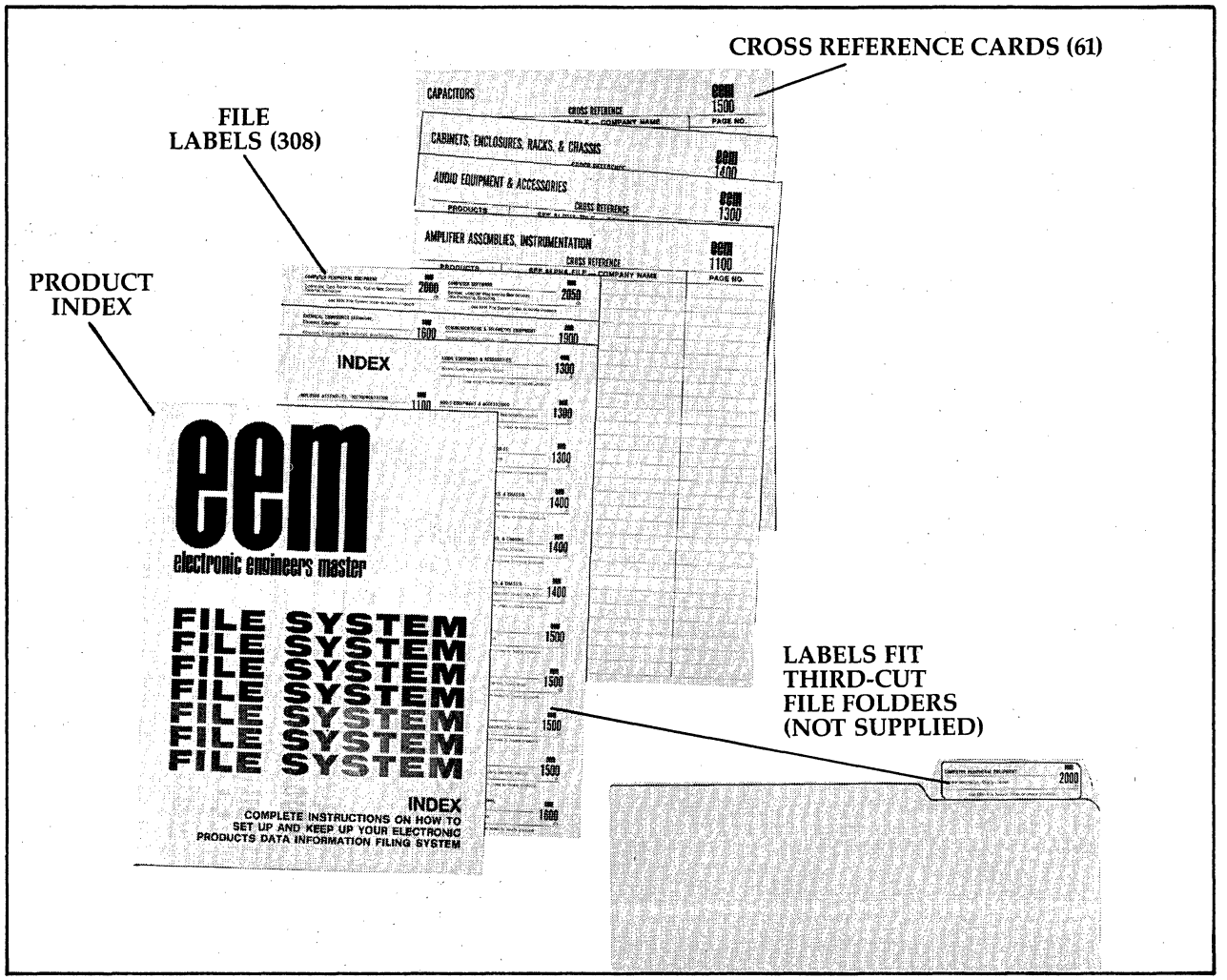
CONTRACT LASER TRIMMING

- E.S.I. Automatic System
- Step-and-Repeat Handling
- Prototype to High Volume Trimming
- Precision Trimming; Accuracy as high as .1%

ASSEMBLY SPECIALISTS INC.

DEPT. EM, BOX 965, ACTON, MASS. 01720 • (617) 263-9100

Other product areas include Machine Wire Wrapping, Printed Circuit Board Assembly and Electro-Mechanical Systems Assembly—Contact for further information & literature.



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

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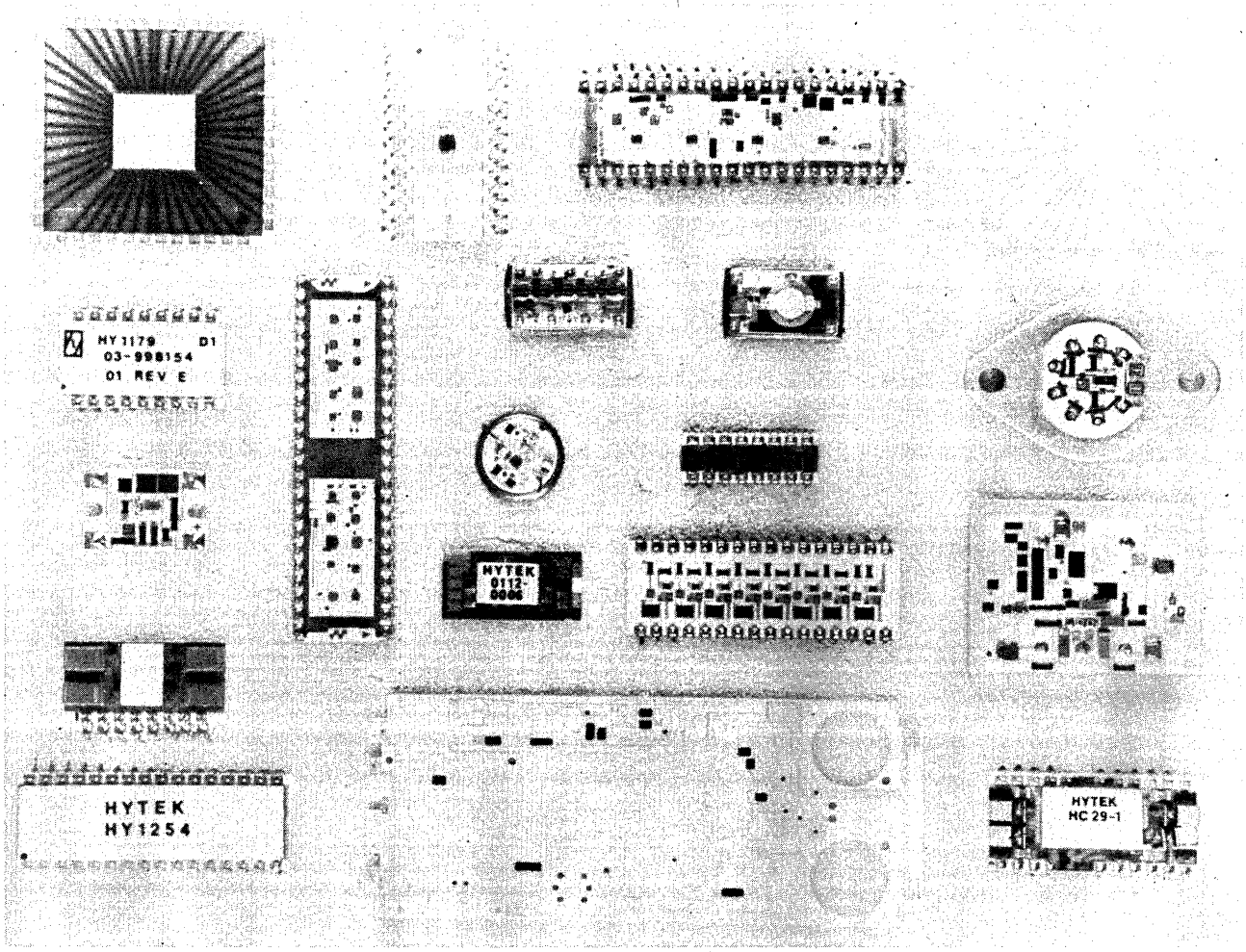
Mfrs. Of:
- Digital Delay Lines
- Crystal Clock Oscillators
- Custom Hybrid Circuits
- Thick Film Substrates
- Custom Resistor Networks

CUSTOM HYBRID CIRCUITS

MILITARY-COMMERCIAL-POWER-RF

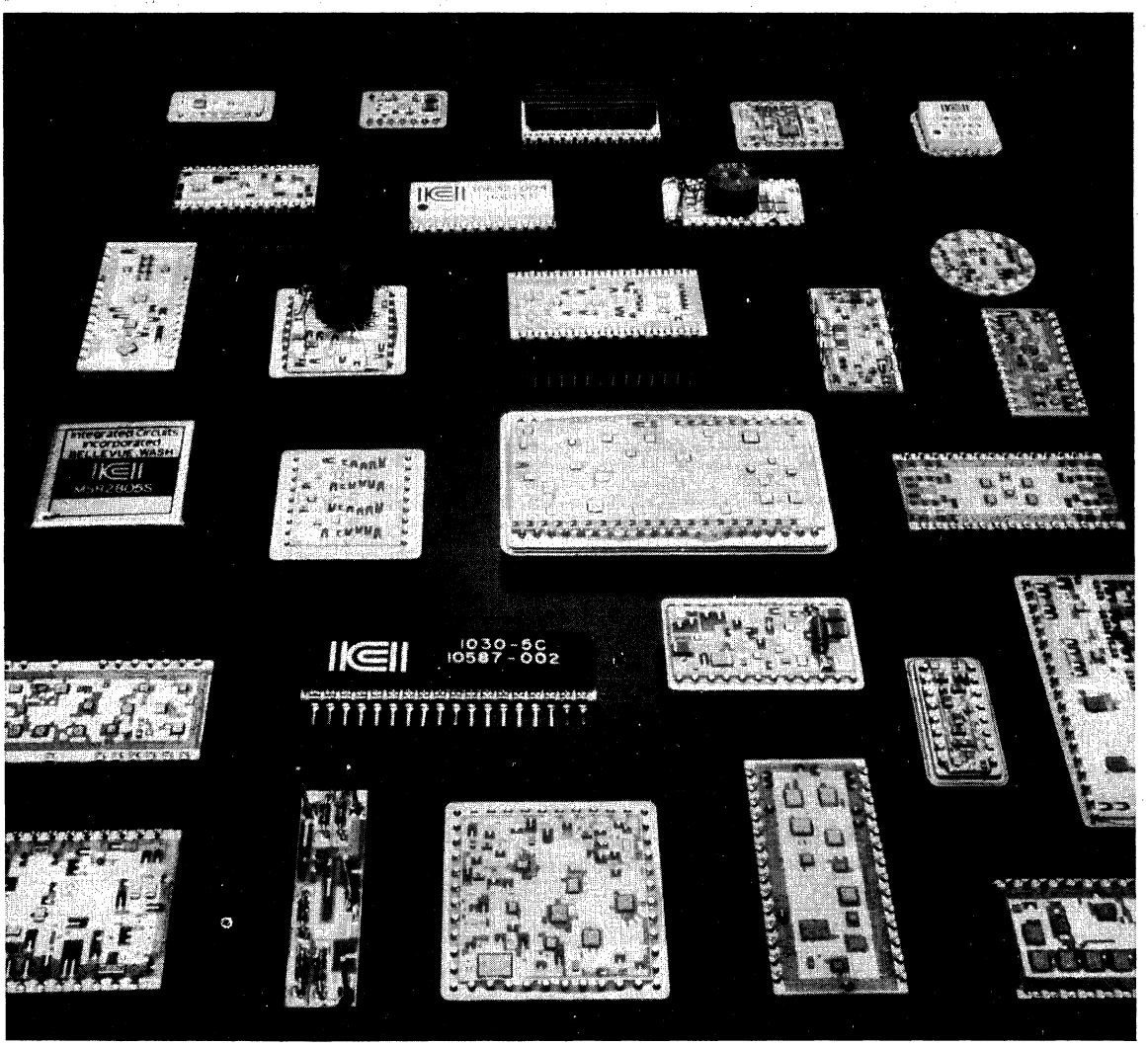
- Analog and Digital Circuit Design
- Laser Trimming-Active and Passive
- Welded and Epoxy Sealed Packages
- Automatic Wire Bonding
- Power Packaging and Assembly
- Chip Carrier Processing
- Computer Aided Design C.A.D.
- MIL Qualified Facility
- High Volume Capacity
- 883B Screening
- Computer Testing
- Molding Capability
- Multilayer Thick Film
- BeO Processing



hytek microsystems incorporated
16780 LARK AVENUE, LOS GATOS, CALIFORNIA 95030
PHONE (408) 358-1991 TWX 910-597-5393

Integrated Circuits Incorporated

CUSTOM HYBRID CIRCUITS



Producing high quality custom hybrid circuits is an art no one learns overnight. And producing circuitry consistently recognized as the finest in the industry takes years.

That's the secret behind the success of Integrated Circuits Incorporated. Building custom thick-film hybrid circuits has been our specialty since 1969. And we've used all of that experience to perfect our expertise in not only technical capabilities and quality, but also in program management and customer coordination.

We can design a circuit to your specification, or convert your circuit to a miniature hybrid design. Either way, it must pass the rigid quality assurance requirements basic at ICI - MIL-I-45208, MIL-STD-883, MIL-M-38510, and MIL-Q-9858 as applicable.

For military, airborne or industrial requirements, you'll find ICI to be responsive, capable and reliable.

Integrated Circuits Incorporated
13256 Northup Way
Bellevue, Washington 98005
(206) 747-8556
TWX: 910-443-2302

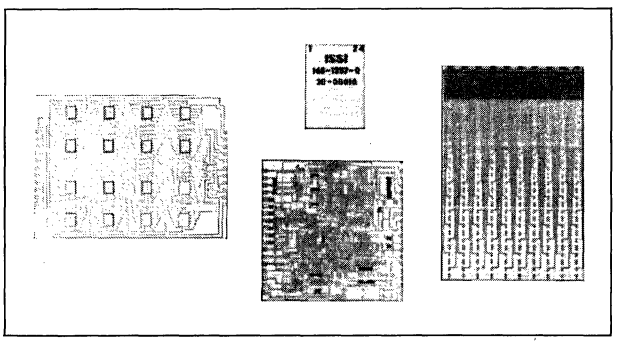
INTERNATIONAL SENSOR SYSTEMS INC.

P.O. Box 345 - Industrial Park - Aurora, NE 68818 - Telephone (402) 694-6111

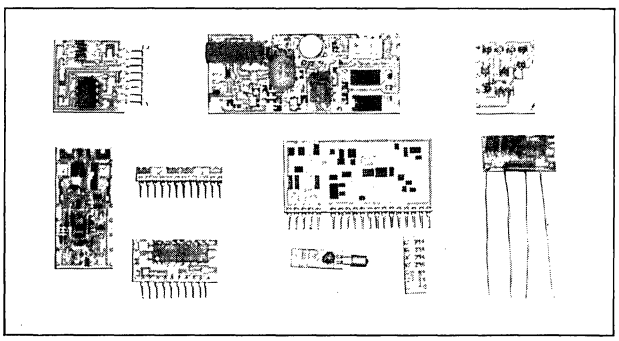
HYBRID THICK FILM TECHNOLOGY

FEATURES

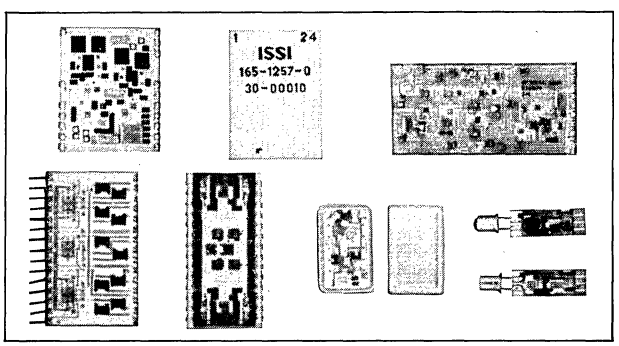
- one time insertion costs
- functional modularity
- high quality components
- compact
- low profile
- low mass
- high performance
- small
- extreme temperature operating range
- military specification capabilities



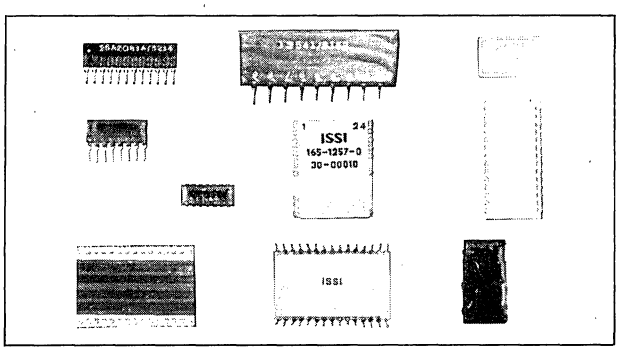
METALIZED SUBSTRATES — Simple or complex, single or multi-layer conductor patterns with Pd. Ag (Palladium Silver), Pt. Ag. (Platinum Silver), Au, (Gold), Pt. Au. (Platinum Gold) inks. Insulation with high temperature glass dielectric or low temperature glaze. Film Resistors from 1 ohm to 150 megohm, tolerances to ±0.1%, T.C.R. to 50 ppm, 1/10 w to 10 watt power dissipation, laser or abrasive trimming.



SOLDER REFLOW TECHNOLOGY — Compact networks with thick film resistors, IC packages, chip capacitors, inductors, discrete components, SOT package, diode bridge assembly, high and low temperature solder, standard or custom pinouts. Special devices with photo-transistors, LED's and functional sub-assemblies.



CHIP AND WIRE TECHNOLOGY — Microcircuit assembly of functional thin film integrated circuit or component chips into operational devices. All available IC & component chips assembled to a thick film circuit by solder or epoxy bonding. Chips wired into circuit with either gold or aluminum wire. (Thermocompression or thermosonic wire bonding). Special handling for static control. Components actively or passively trimmed to guarantee functional specifications.



CUSTOM PACKAGES — Single-in-line or Dual-in-line pinout packages, conformally coated, metal can, plastic or ceramic covered and sealed. Customer markings as well as manufacturer's identification for traceability. Leak tested, temperature cycling and burn-in before final test to insure reliability. Heat sink attached to either alumina or beryllium oxide to obtain maximum power dissipation.

TECHNICAL SERVICES

• Circuit design • layout (including conversion of existing circuitry to thick film technology) • material selection • rubylith production • screen fabrication • product tooling • product testing • and building to print. Testing includes functional electrical and mechanical parameters • burn-in • leak testing • and temperature cycling.

APPLICATIONS

• Memory • logic • linear circuits • A-D • D-A • timing • filters • isolation • pulse shaping • impedance matching • signal generation • switching • sequencing • and many other medium range energy dissipation functions or a combination thereof.

ISSI MILITARY SPECIFICATION CAPABILITIES

MIL-I-45208 Inspection System Requirements
MIL-C-45662 Calibration System Requirements
MIL-STD-883 Test Methods & Procedures for Microelectronics
Certificate of Compliance furnished upon request.

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

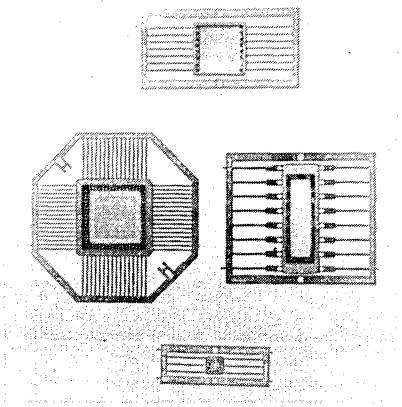
Y

YIG yttrium iron garnet

HERMETIC PACKAGES FOR HYBRID MICROCIRCUITS

MINI-SYSTEMS, INC.
Electronic Package Division, 168 East Bacon St., P.O. Box 1597, Plainville, MA 02762
Telephone: (617) 695-2000 • Telex: 710-348-0564

GLASS FLATPACKS



- Most economical means of hermetically enclosing small hybrids
- Easily and economically customized to your needs
- Meet MIL-M-38510 requirements
- Sealed by reflow soldering with combination lids

SELECTION GUIDE

Case Size: Flatpack — case sizes ⅛″ x ⅛″ to 1″ x 1″; Dual-In-Line — case size ¼″ x ¾″

Glass Free Area: Flatpack — .040″ x .070″ to .810″ x .810″

Number of Leads: 1 to 84, depending on case size

Lead Centers: .050″, .040″, .030″, or as specified

Configuration: Leads and pads on 2 sides; Leads on 2 sides; Pads on 4 sides; Leads and pads on 4 sides

Base Material: Metal, ceramic, or beryllia

Plating: Gold or Nickel, all over or selective

AVAILABILITY

Popular Packages — 2 weeks

Custom Packages — 8 weeks

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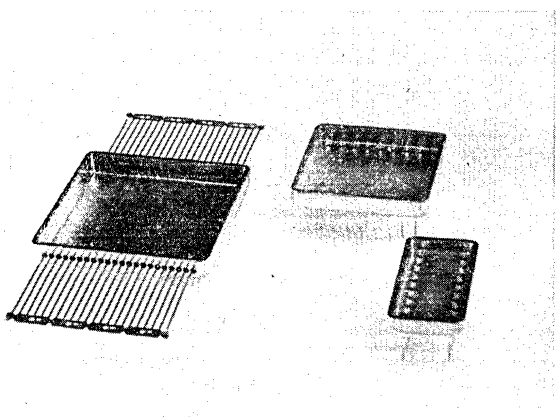
METAL PLUG-INS AND FLATPACKS



- Strongest and most reliable means of enclosing all size hybrids
- Package variations available built to your requirements
- Meet MIL-M-38510 Class S and all highest reliability requirements
- Sealed by seam welding with stepped lids or reflow combination lids

SELECTION GUIDE

Case Size: Plug-In and Flatpack case sizes ranging from .380″ x .625″ to 1.970″ x 2.970″

Number Pins/Leads: 1 to 188, depending on case size

Pin/Lead Centers: .100″ Plug-In; .050″ Flatpack

Configuration: Pins/Leads on 1, 2, 3, or 4 sides

Plating: Gold or Nickel, all over or selective

AVAILABILITY

Tooled Packages — 4 weeks

Custom Packages — 10 weeks

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MOS LOGIC AND SPECIAL FUNCTIONS

LOGIC FAMILIES

SERIES MC54/74HCxxx — The newest addition to Motorola's standard CMOS logic families, this family of SSI and MSI functions will offer over 100 device types to serve the high performance user. These devices incorporate the LSTTL features of wide fanout and high speed belonging with the present CMOS features of low power consumption and high noise immunity. These devices are pinout configurations identical with many of the popular 54/74 series LSTTL and MC14000 series CMOS devices. Devices are available in both −40 to 85°C and −55 to 125°C temperature ranges.

SERIES MC14000/MC14500 — These standard lines of MSI/SSI circuits contain a complement of nearly 200 device types with which to implement complete system designs. They feature the JEDEC B-Series specifications with low-power-Schottky compatible outputs. A faster nonbuffered line of devices is compatible with the B-Series, as well as with standard Schottky TTL, for mix-and-match versatility.

SPECIAL FUNCTIONS

SERIES MC14400 AND MC145000 SERIES — This series of higher complexity dedicated LSI devices consist of single-chip "subsystems" designed for specific applications. Most circuits utilize the latest wafer processing techniques in silicon-gate technology for higher performance. Included in the family of dedicated LSI functions are 7 groups or sub-families.

GENERAL PURPOSE FREQUENCY SYNTHESIZERS — Phase-locked loop and programmable divider variations are available in either single or dual modulus configurations. This group offers up to 25 MHz typical input frequency and a programmable reference divider. Parallel, serial, or 4-bit data bus input formats are available with the feature of an on-board reference oscillator.

TV/CATV PLL FREQUENCY SYNTHESIZERS — This family of specific purpose frequency synthesizers are designed for TV/CATV uses. They include circuitry for keyboard scan, both up and down. They operate from a 5 volt power supply in both UHF and VHF frequencies. All products have an on-board reference oscillator with full remote control capability. Included in the design is the capability of programming 100 channels in various signalling formats.

CMOS DATA CONVERSION CIRCUITS — A full line of A/D converter products are available in single slope, dual slope or successive approximation formats. Multiplexed channels accomodate up to 15 channels. Full MPU compatible (68xx format). Products are available that can offer a full 8 bits of resolution at 1 MHz with 32 μs conversion times.

OP AMPS AND COMPARATORS — This family is available with operational amplifier and comparator separately or both on the same chip. The devices are all internally compensated and also offer very low input current <1 nA. Bias currents are externally programmable.

CMOS DISPLAY DRIVERS — These devices can drive LED, LCD, or VF display segments. CMOS technology means very low power dissipation but each device can produce very high current drive. A master/slave combination can drive 48 segments (master) and 44 segments (slave). Segments or dot patterns can be driven up to 1 sq. centimeter in size.

REMOTE CONTROL ENCODER/DECODER PAIRS — This group pairs a transmitter and a receiver for full remote control applications. Decoder configurations can be 5 address/4 data, 4 address/5 data or all 9 address. The decoder can interpret up to 19,683 different codes.

CMOS SMOKE DETECTORS — Smoke detectors are popular for both residential or industrial uses. The package is a small 16-pin DIP with very low power consumption. They are ideal for battery applications. A smoke alarm is triggered via external transducer and internal "on-chip" drivers for lights, horns and other detector unit functions.

INTEGRATED CIRCUITS FOR TOMORROW'S TELECOMMUNICATION
(MOS AND BIPOLAR)

TELECOMMUNICATIONS

Motorola offers a comprehensive line of telecommunication products consisting of: Dialer chips; a broad family of Modems and Modem Filters; Crosspoint Switches; and Codecs and Filters. To service the newly emerging office automation market, there are: single-chip Codec/Filters (mono-circuits); Time Slot Assigner circuits; and advance Voice/Data parts.

MONO-CIRCUIT
MC14400
MC14401
MC14402
MC14403
MC14405

CODEC
MC14404
MC14406
MC14407

TSAC
MC14416
MC14417
MC14418

CROSSPOINT SWITCHES
MC142100
MC145100
MC3416

FILTERS
MC14413
MC14414
MC145414
MC145415
MC145431
MC145433
MC145440/41

VOICE/DATA
MC145420
MC145422
MC145423
MC145425
MC145426

SLIC
MC3419

MODEMS
MC14411
MC14412
MC145440/41
MC145445
MC145450
MC6860
MC6172
MC6173

DIALERS
MC14408
MC14409
MC14410
MC14419
MC34015
MC34011
MC34012

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8-Bit MPUs
8-Bit MCUs
8-Bit Peripherals

THE M6800 FAMILY

The MC6800 microprocessor was the first MPU of the M6800 Family and still remains a highly cost-effective processor for a great many process-control and data-communications applications. After years of field experience, the MC6800 has earned an enviable reputation as one of the easiest-to-use processors available.

The table to the right lists devices in the M6800 Family. The following microprocessor and microcomputer families are derivations and enhancements of the MC6800 architecture to provide easy migration within the M6800 Family as processing-power requirements change.

Device	Function	Device	Function
MC6800	MPU	MC6845	CRT Controller
MC6802	MPU (with Clock, RAM)	MC6846	ROM-I/O-Timer
MC6808	MPU (with Clock)	MC6847, Y	Video Display Generator
MCM6810	128 × 8 Static RAM	MC6850	Asynchronous Interface Adapter
MC6821	Peripheral Interface Adapter		
MC6822	Industrial Interface Adapter	MC6852	Synchronous Serial Data Adapter
MC6828[1]	Priority Interrupt Controller		
MC6829	Memory Management Unit	MC6854	Advanced Data Link Controller
MC6835	CRT Controller with ROM		
MCM6836	ROM/EEPROM Combination	MC6859	Data Security Device
MC6839	Floating Point ROM (IEEE Standard Draft 6.0)	MC6860[2]	Digital Modem
		MC6862[2]	Digital Modulation
MC6840	Programmable Timer	MC68488	General-Purpose Interface Adapter
MC6843	Floppy-Disk Controller		
MC6844	Direct Memory Access Controller		

[1]Motorola Digital Bipolar [2]Motorola Logic and Special Functions

THE M6801 FAMILY PROCESSORS: HIGH-PERFORMANCE MCUs

Frequency				Memory
1 MHz	1.25 MHz	1.5 MHz	2.0 MHz	
MC6801	MC6801-1	MC68A01	MC68B01	2K ROM, 128 Bytes RAM, Expansion Bus
MC68701	MC68701-1	–	–	2K EPROM, 128 Bytes RAM, Expansion Bus
MC6803	MC6803-1	MC68A03	MC68B03	No ROM, 128 Bytes RAM, Expansion Bus
MC6803E	MC6803E-1	–	–	No ROM, 128 Bytes RAM, External Clock, Expansion Bus
MC6801U4	MC6801U4-1	–	–	4K ROM, 192 Bytes RAM, Expansion Bus
MC6803U4	MC6803U4-1	–	–	No ROM, 192 Bytes RAM, Expansion Bus
MC68120	MC68120-1	–	–	2K ROM, 128 Bytes Dual-Port RAM, Expansion Bus
MC68121	MC68121-1	–	–	No ROM, 128 Bytes Dual-Port RAM, Expansion Bus

THE HMOS M6805 FAMILY PROCESSORS: MEDIUM-PERFORMANCE MCUs

Device	No. of Pins	Memory (Bytes)			I/O Lines	Special Features
		ROM	EPROM	RAM		
MC6804P2	28	1K	–	32	20 Programmable Bidirectional	Self-Check, Low Cost MCU
MC6805P2	28	1K	–	64	20 Programmable Bidirectional	Self-Check
MC6805P4	28	1K	–	112	20 Programmable Bidirectional	Self-Check, Standby RAM
MC6805P6	28	1.8K	–	64	20 Programmable Bidirectional	Self-Check
MC6805R2	40	2K	–	64	2 to 5 Inputs, 24 Programmable Bidirectional	1 to 4 Channel 8-Bit A/D, Self Check
MC6805R3	40	3.8K	–	112	2 to 5 Inputs, 24 Programmable Bidirectional	1 to 4 Channel 8-Bit A/D, Self Check
MC6805T2	28	2.5K	–	64	2 Special Function, 19 Programmable Bidirectional	PLL, Self-Check
MC6805U2	40	2K	–	64	8 Inputs, 24 Programmable Bidirectional	Self-Check
MC6805U3	40	3.8K	–	112	8 Inputs, 24 Programmable Bidirectional	Self-Check
MC68705P3	28	–	1.8K	112	20 Programmable Bidirectional	Self-Programming Bootstrap
MC68705R3	40	–	3.8K	112	2 to 5 Inputs, 24 Programmable Bidirectional	1 to 4 Channel 8-Bit A/D, Self-Programming Bootstrap
MC68705U3	40	–	3.8K	112	8 Inputs, 24 Programmable Bidirectional	Self-Programming Bootstrap

8-BIT MPUs/MCUs/PERIPHERALS (Continued)

THE CMOS M146805 FAMILY PROCESSORS: MEDIUM-PERFORMANCE MCUs

Device	No. of Pins	Memory (Bytes) ROM	RAM	EPROM	I/O Lines	Special Features
MC146805E2	40	—	112	—	16 Programmable Bidirectional	External Bus
MC146805F2	28	1K	64	—	16 Programmable Bidirectional	Self-Check
MC146805G2	40	2K	112	—	32 Programmable Bidirectional	Self-Check
MC1468705F2	28	—	64	1K	16 Programmable Bidirectional	Self-Prog. Bootstrap
MC1468705G2	40	—	112	2K	32 Programmable Bidirectional	Self-Prog. Bootstrap

SPECIAL PERIPHERALS

Device	Function
MC146818	CMOS Real-Time Clock
MC146823	CMOS Peripheral Interface Adapter (Similar to MC6821)

THE M6809 FAMILY PROCESSORS: HIGH-PERFORMANCE MPUs

PROCESSORS

Device	Features
MC6809	On-Chip Oscillator
MC6809E	External Clocking for Synchronization of Multiprocessor Systems

THE M68000 FAMILY — AN INVESTMENT IN THE FUTURE

16-Bit Microprocessor Family

Led by the MC68000 Microprocessing Unit (MPU) and followed by a host of peripherals, the M68000 Family offers the engineer a set of building blocks to construct cost-effective solutions to an ever-widening range of complex 16/32 bit applications. The tremendous popularity of the M68000 Family is not without warrant. HMOS technology, performance, and support are but a few of the many reasons why the M68000 Family continues to be the 16 bit industry leader.

It should be noted that the M68000 Family is a not-so-distant relative of the MC6800. All M6800 Family peripherals interface directly with the MC68000, so upward compatibility is built in. Where low cost and medium performance are required, they present a very attractive alternative. The plan for the M68000 Family is a simple one. Provide the marketplace with the best 16-bit family and back it up with support that is second to none. And it's happening now.

What about expandability? The M68000 Family is designed with this in mind. All the way from an internally microcoded 32-bit architecture to the third-generation EXORmacs development system. Efficient high level language support provided by Pascal allows upward compatibility of software from 8-bit to 16-bit to 32-bit machines.

The majority of today's 16-bit microprocessor applications are quite complex, with long design times. Clearly, the required investment in design resources requires finished products to have increased longevity. Motorola understands this, and is committed to offering a family which will allow these products to remain state-of-the-art for years to come. Thus, the M68000 Family is an investment in the future.

EXORmacs is a trademark of Motorola Inc.

68000 FAMILY DEVICES

68000	16-Bit MPU	Now
68008	8-Bit 68000	Now
68010	VM Processor	Now
68020	32-Bit 68000	1 Q 1984
68120	IPC	Now
68121	IPC-NR	Now
68200	MCU	3 Q 1983
68230	PI/T	Now
68440	DDMA	4 Q 1983
68450	DMAC	Now
68451	MMU	Now
68452	BAM	Now
68454	IMDC	3 Q 1983
68459	DPLL	3 Q 1983
68561	MPCC-II	3 Q 1983
68562	DUSCC	2 Q 1984
68564	SIO	Now
68590	LANCE	3 Q 1983
68652	MPCC	Now
68653	PGC	Now
68661	EPCI	Now
68681	DUART	Now
68881	FPCP	2 Q 1984
68901	MFP	Now

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MEMORIES Selector Guide RAMs

Motorola has developed a very broad range of reliable MOS and bipolar memories for virtually any digital data processing system application. And for those whose requirements go beyond individual components, Motorola also supplies Memory Systems and Micromodules.

New Motorola memories are being introduced continually. **This selector guide lists all those available as of April 1983.** For later releases, additional technical information or pricing, contact your nearest authorized Motorola distributor or Motorola sales office.

Data sheets may be obtained from your in-plant VSMF Data Center, distributors, Motorola sales office or by writing to:

Literature Distribution Center
Motorola Semiconductor Products Inc.
P.O. Box 20912
Phoenix, AZ 85036

RAMs

MOS DYNAMIC RAMs

Organization	Part Number	Access Time (ns Max)	Power Supplies	No. of Pins
16384 × 1	MCM4116BP15	150	+12, ±5 V	16
16384 × 1	MCM4116BP20	200	+12, ±5 V	16
16384 × 1	MCM4116BP25	250	+12, ±5 V	16
16384 × 1	MCM4517P10	100	+5 V	16
16384 × 1	MCM4517P12	120	+5 V	16
16384 × 1	MCM4517P15	150	+5 V	16
16384 × 1	MCM4517P20	200	+5 V	16
65536 × 1	MCM6664AP15[1]	150	+5 V	16
65536 × 1	MCM6664AP20[1]	200	+5 V	16
65536 × 1	MCM6665AP15	150	+5 V	16
65536 × 1	MCM6665AP20	200	+5 V	16

MOS STATIC RAMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
128 × 8	MCM6810	450	24
128 × 8	MCM68A10	360	24
128 × 8	MCM68B10	250	24
1024 × 4	MCM2114P20	200	18
1024 × 4	MCM2114P25	250	18
1024 × 4	MCM2114P30	300	18
1024 × 4	MCM2114P45	450	18
1024 × 4	MCM21L14P20	200	18
1024 × 4	MCM21L14P25	250	18
1024 × 4	MCM21L14P30	300	18
1024 × 4	MCM21L14P45	450	18
2048 × 8	MCM2016HP55*	55	24
2048 × 8	MCM2016HP70*	70	24

CMOS STATIC RAMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
2048 × 8	MCM65116P12*	120	24
2048 × 8	MCM65116P15*	150	24
2048 × 8	MCM65116P20*	200	24
4096 × 1	MCM65147P55	55	18
4096 × 1	MCM65147P70	70	18

ECL RAMs

Organization	Part Number	Access Time (ns max)	No. of Pins
8 × 2	MCM10143	15	24
16 × 4	MCM10145	15	27
16 × 4	MCM10H145	6	16
64 × 1	MCM10148	15	27
128 × 2	MCM10147	15	16
256 × 1	MCM10144	26	16
256 × 1	MCM10152	15	16
256 × 4	MCM10422A*	10	24
1024 × 1	MCM10146	29	16
1024 × 1	MCM10415	20	16
1024 × 1	MCM10415A	15	16
1024 × 1	MCM10415B	10	16
1024 × 4	MCM10474*	25	24
4096 × 1	MCM10470A*	15	18

TTL RAMs

Organization	Part Number	Access Time (ns max)	Output	No. of Pins
256 × 4	MCM93422	45	3-State	22
256 × 4	MCM93L422	60	3-State	22
1024 × 1	MCM93415	45	Open Collector	16
1024 × 1	MCM93425	45	3-State	16

*To be introduced.
(Not all speed selections shown)

[1]Motorola's innovative pin #1 refresh

Operating temperature ranges:
MOS — 0°C to 70°C
ECL — Consult individual data sheets
TTL — Military −55°C to +125°C, Commercial 0°C to 70°C

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MEMORIES
Selector Guide
ROMs PROMs EPROMs

ROMs

MOS STATIC ROMs (+5 Volts)

Character Generators[2]

Organization	Part Number	Access Time (ns max)	No. of Pins
128 × (7 × 5)	MCM6670P	350	18
128 × (7 × 5)	MCM6674P	350	18
128 × (9 × 7)	MCM66700P	350	24
128 × (9 × 7)	MCM66710P	350	24
128 × (9 × 7)	MCM66714P	350	24
128 × (9 × 7)	MCM66720P	350	24
128 × (9 × 7)	MCM66730P	350	24
128 × (9 × 7)	MCM66734P	350	24
128 × (9 × 7)	MCM66740P	350	24
128 × (9 × 7)	MCM66750P	350	24
128 × (9 × 7)	MCM66760P	350	24
128 × (9 × 7)	MCM66770P	350	24
128 × (9 × 7)	MCM66780P	350	24
128 × (9 × 7)	MCM66790P	350	24

Binary ROMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
2048 × 8	MCM68A316EP	350	24
2048 × 8	MCM68A316EP91[3]	350	24
4096 × 8	MCM68A332P	350	24
4096 × 8	MCM68A332P2[3]	350	24
8192 × 8	MCM68364P35	350	24
8192 × 8	MCM68364P35-3[3]	350	24
8192 × 8	MCM68364P25	250	24
8192 × 8	MCM68364P20	200	24
8192 × 8	MCM68365P25	250	24
8192 × 8	MCM68365P35	350	24
8192 × 8	MCM68366P25	250	24
8192 × 8	MCM68366P35	350	24
32768 × 8	MCM63256P15*	150	28
32768 × 8	MCM63256P20*	200	28

CMOS ROMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
256 × 4	MCM14524	1200	16
2048 × 8	MCM65516P43	430	18
2048 × 8	MCM65516P43M[3]	430	18
2048 × 8	MCM65516P55	550	18

Operating temperature ranges:
MOS — 0°C to 70°C
ECL — Consult individual data sheets
TTL — Military −55°C to +125°C, Commercial 0°C to 70°C

EPROMs

MOS EPROMs

Organization	Part Number	Access Time (ns max)	Power Supplies	No. of Pins
8192 × 8	MCM68764C	450	+5 V	24
8192 × 8	MCM68766C	450	+5 V	24
8192 × 8	MCM68766C35	350	+5 V	24

PROMs

ECL PROMs

Organization	Part Number	Access Time (ns max)	No. of Pins
32 × 8	MCM10139	20	16
256 × 4	MCM10149	25	16
256 × 4	MCM10149A*	15	16

TTL PROMs

Organization	Part Number	Access Time (ns max)	Output	No. of Pins
512 × 4	MCM7621	70	3-State	16
512 × 4	MCM7621A	60	3-State	16
512 × 8	MCM7641	70	3-State	24
512 × 8	MCM7641A	60	3-State	24
512 × 8	MCM7649*	70	3-State	20
512 × 8	MCM7649A*	50	3-State	20
1024 × 4	MCM7643	70	3-State	18
1024 × 4	MCM7643A	50	3-State	18
1024 × 8	MCM7681	70	3-State	24
1024 × 8	MCM7681A	60	3-State	24
2048 × 4	MCM7685	70	3-State	18
2048 × 4	MCM7685A	50	3-State	18
2048 × 8	MCM76161	70	3-State	24
2048 × 8	MCM76161A	60	3-State	24
4096 × 4	MCM76165*	35	3-State	20

*To be introduced.
(Not all speed selections shown)

[2]Character generators include shifted and unshifted characters, ASCII alphanumeric control, math, Japanese British, German, European and French symbols.

[3]Standard Patterns for MOS ROMs:
MCM68A316EP91 — Universal Code Converter and Character Generator
MCM68A332P2 — Sine/Cosine Look-Up Table
MCM68364P35-3 — Log/Antilog Look-Up Table
MCM65516P43M — MC146805 Monitor Program

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DIGITAL LOGIC FAMILIES

SCHOTTKY TTL • ECL • TTL
MDTL • MHTL • MCA • PLL

A "Supermarket" For Standard Logic

Motorola carries a comprehensive inventory of standard components encompassing almost all major digital logic families and technologies.

MECL (very high-speed) Logic Circuit

Motorola manufactures three lines of Emitter-Coupled-Logic (ECL). The new high-speed MECL10KH, the industry standard MECL10K and MECL III.

MECL10KH Series

Much of the MECL10KH Family of high-speed logic circuits will be pin-compatible with the existing MECL10K Family, but double the performance standards. System clock rates are increased as much as 40%, parasitic capacitance drops by 50%, and propagation delay is reduced by 50% with no corresponding increase in power dissipation. Pin compatibility permits upgrading of existing designs without major modifications. More complex logic functions will be available in the 10KH family than were possible in MECL10K. The MECL10KH Family is performance compatible with the MECL Macrocell Array.

MECL 10KH DC Specifications
V_{EE} = −5.2 V + −5.0%
R Load = 50 Ω to −2.0 Vdc

Parameter	0°C Min	0°C Max	25°C Min	25°C Max	75°C Min	75°C Max
V_{OH} Max	—	−0.840	—	−0.810	—	−0.735
V_{OH} Min	−1.020	—	−0.980	—	−0.920	—
V_{OL} Min	−1.950	—	−1.950	—	−1.950	—
V_{OL} Max	—	−1.630	—	−1.630	—	−1.600
V_{IHA}	—	−1.170	—	−1.130	—	−1.070
V_{ILA}	−1.480	—	−1.480	—	−1.450	—

MECL 10KH AC Specifications and Tracking

Parameter	0°C Min	0°C Typ	0°C Max	25°C Min	25°C Typ	25°C Max	75°C Min	75°C Typ	75°C Max	Units
t_{PD}	0.7	1.1	1.6	0.7	1.0	1.5	0.7	1.1	1.7	ns
	Min		Max	Min		Max	Min		Max	
t_r (20–80%)	0.8		2.2	0.7		2.0	0.8		2.2	ns
t_f (20–80%)	0.8		2.2	0.7		2.0	0.8		2.2	ns

V_{EE} = −5.2 V ±5.0%.

Parameter	Propagation delay (ns)* Typ	Propagation delay (ns)* Max	Delay variation vs temp (ps/°C) Typ	Delay variation vs temp (ps/°C) Max	Delay variation vs supply (ps/V) Typ	Delay variation vs supply (ps/V) Max
t_{PD} 10KH	1.0	1.5	0.5	4.0	0	0

*V_{EE} = 5.2 V, Temp = 25°C.

MECL/OKH and Macrocell are trademarks of Motorola Inc.

MECL 10KH Products Available

Function	Part No.	Sample Date
Binary Counter	MC10H016	NOW
Quad 2-Input Nor Gate w/Strobe	MC10H100	1Q83
Quad Or/Nor Gate	MC10H101	NOW
Quad Nor Gate	MC10H102	NOW
Quad 2-Input Or Gate	MC10H103	2Q82
Quad And Gate	MC10H104	NOW
Triple 2-3-2 Or/Nor Gate	MC10H105	NOW
Triple 4-3-3 Nor Gate	MC10H106	2Q82
Triple Exclusive Or/Nor Gate	MC10H107	NOW
Dual 4-5 Input Or/Nor Gate	MC10H109	NOW
Quad Exclusive Or Gate	MC10H113	3Q83
Quad Line Receiver	MC10H115	2Q83
Triple Line Receiver	MC10H116	NOW
Dual 2-Wide Or-And/Or-And/Invert Gate	MC10H117	NOW
Dual 2-Wide 3-Input Or-And	MC10H118	NOW
4 Wide 4-3-3-3 Input Or-And	MC10H119	NOW
4 Wide Or-And/Or-And-Invert Gate	MC10H121	NOW
Triple 4-3-3 Input Bus Driver (25 Ohm)	MC10H123	3Q83
Quad TTL-To-MECL Translator	MC10H124	2Q83
Quad MECL-To-TTL Translator	MC10H125	2Q83
Dual D Latch	MC10H130	NOW
Dual D Flip-Flop	MC10H131	NOW
Dual J-K Master-Slave Flip Flop	MC10H135	3Q83
Universal Binary Counter	MC10H136	2Q82
4-Bit Universal Shift Register	MC10H141	2Q82
16 x 4 Bit Register File	MC10H145	2Q82
8 x 2 Bit Content Addressable Memory	MC10H155	3Q83
Quad 2-Input MUX	MC10H158	NOW
Quad 2-Input MUX	MC10H159	NOW
12-Bit Parity Generator/Checker	MC10H160	1Q82
Binary To 1-8 Decoder (Low)	MC10H161	NOW
Binary To 1-8 Line Decoder (High)	MC10H162	NOW
8-line Multiplex	MC10H164	NOW
8-Input Priority Encoder	MC10H165	2Q83
5-Bit Magnitude Comparitor	MC10H166	2Q83
Dual 4-Line Decoder (Low)	MC10H171	3Q83
Dual 4-Line Decoder (High)	MC10H172	3Q83
Quad 2 Input Mux with Latch	MC10H173	NOW
Dual 4 to 1 Multiplexer	MC10H174	NOW
Quint Latch	MC10H175	NOW
Hex D Flip Flop	MC10H176	NOW
Look Ahead Carry Block	MC10H179	NOW
Dual High-Speed Adder/Subtracter	MC10H180	NOW
4-Bit ALU	MC10H181	2Q83
Hex D Flip Flop w/Common Reset	MC10H186A	2Q83
Hex Buffer w/Enable	MC10H188	2Q83
Hex Inverter w/Enable	MC10H189	2Q83
Dual 4-5-Input Or/Nor Gate	MC10H209	NOW
Dual 3-Input Or Gate	MC10H210	NOW
Dual 3-Input Nor Gate	MC10H211	NOW
Quad Bus Transceiver w/2-1 MUX	MC10H330	2Q83
Dual Bus Transceiver w/4-1 MUX	MC10H332	2Q83
Quad Transceiver w/Latches	MC10H334	2Q83
Quad MECL to TTL Translator (Single Power Supply +5.0 V or −5.2 V)	MC10H350	3Q83
Triple 3-Input Bus Driver w/Enable (25 Ohm)	MC10H423	3Q83
Quad TTL to MECL Translator (ECL Strobe)	MC10H424	1Q83

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DIGITAL LOGIC FAMILIES

MECL 10,000 Series — A complement of more than 80 circuits, ranging from simple gates to complex functions, such as arithmetic units and memories, populates this family of high-speed logic circuits. Devices are available in two temperature ranges −30 to 85°C and −55 to 125°C to meet the highest standards of performance.

Typical family characteristics for 10K and 10KH circuits

	10K	10KH
Speed (ns)	2.0	1.0
Power (mW)	25	22/25*
Power-speed product (pJ)	50	22/25
Rise/fall times (ns) (20–80%)	2.0	1.5
Temperature range (°C)	−30 to +85	0 to +75
Voltage regulated	No	Yes
Technology	Junction isolated	Oxide isolated

*V_{EE} = 4.5 V/5.2 V

MECL III series — Basic logic circuits designed for high-speed requirements, as in test and communications equipment, and in high-speed sections of larger systems. MECL III circuits are compatible with MECL 10,000/10KH devices.

MECL Family Comparisons

Feature	MECL 10,000		MECL III
	10,100 Series 10,500 Series	10,200 Series 10,600 Series	
1. Gate Propagation Delay	2.0 ns	1.5 ns	1.0 ns
2. Output Edge Speed	3.5 ns	2.5 ns	1.0 ns
3. Flip-Flop Toggle Speed	160 MHz	250 MHz	300–500 MHz
4. Gate Power	25 mW	25 mW	60 mW
5. Speed Power Product	50 pJ	37 pJ	60 pJ

*Average for Equivalent LSI Gate.

TTL Circuits

Motorola manufactures several different families of TTL circits:

The SN54LS/74LS, SN54ALS/74ALS, MC54F/MC74F Schottky Series

The MC4000/4300 Series

The newest families to be announced, 54/74ALS Advanced Low power Schottky and 54/74F FAST TTL, offer superior speed/power performance over their 54/74LS and 54/74S counterparts. Several design enhancements have also been incorporated in these new families to improve performance and minimize potential applications difficulties. Both families are fully specified over temperature as well as a 10% power supply voltage range. These families offer a wide selection of SSI, MSI, and LSI components to simplify system design.

Motorola's 54/74LS Low power Schottky TTL line offers a selection of over 180 devices and is 100% compatible with ALS and FAST TTL.

An impressive line of standard TTL complex functions in the MC4000/4300 series, provides significant reduction in package count over systems implemented with simpler families. Phase Locked Loop functions are also available in this series.

Macrocell Array

The Macrocell Array Concept combines a pre-diffused array of components with computer-aided design techniques to offer system designers a rapid, cost-effective means for implementing semi-custom, high-speed digital logic systems with VLSI circuitry.

Compared with equivalent systems developed with discrete logic (separately packed SSI/MSI logic functions) the high packing density of the Macrocell array chip offers up to 50-to-1 reduction in system component count, with a power dissipation improvement (reduction) of as much as 10 to 1.

	MCA 600 ECL	MCA 1200 ECL	MCA 2500 ECL	MCA 500 ALS	MCA 1300 ALS	MCA 2800 ALS
Technology	ECL			ALS		
Max. gate equiv.	652	1192	2472	533	1280	2800
Major Macrocells	24	48	110	24	60	130
Input ports	42	60	120 I/O	26	40	120 I/O
Output ports	18	26	68	27	40	
Max. gate delay (ns)	1.2	1.2	0.5	3.0	3.0	1.4
Max. toggle freq. (MHz)	160	160	300	50	50	125
Power diss. (w) max. @ 10 MHz	2.2	4.0	6.0	1.1	1.6	2.5

Other Logic Families

MHTL Seriis MC660 — for use in equipment designed for high-noise environments.

MDTL Series MC830/930 — An early logic family manufactured primarily for replacement purposes.

PLL Series — Motorola offers the designer an array of devices to perform phase-locked loop functions, such as phase detectors, dividers, and oscillators. These devices include both TTL and MECL (MC12000/12500) technologies.

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OPERATIONAL AMPLIFIERS

TRIMFET Family of JFET Input Operational Amplifiers

MC34001, MC35001
MC34002, MC35002
MC34004, MC35004

This new family of low-cost TRIMFET operational amplifiers combines two state-of-the-art linear technologies on a single monolithic integrated circuit. Each internally compensated operational amplifier has well matched high voltage JFET input devices with a laser trimmed input offset voltage. The BIFET technology provides wide bandwidths and fast slew rates with low input bias currents, input offset currents, and supply currents. The laser trimming technology provides input offset voltage specification options which range from 2.0 to 10 millivolts maximum.

The Motorola TRIMFET family offers single, dual and quad operational amplifiers which are pin-compatible with the industry standard MC1741, MC1458, and the MC3403/LM324 bipolar devices. The MC35001/35002/35004 series are specified over the military operating temperature range of −55°C to +125°C and the MC34001/34002/34004 series are specified from 0°C to +70°C.

TRIMFET is a trademark of Motorola Inc.

Features

- Laser Trimmed Input Offset Voltage Options of 2.0, 5.0, and 10 mV Maximum
- Low Input Bias Current — 40 pA
- Low Input Offset Current — 10 pA
- Low Input Noise Voltage — 16 nV/$\sqrt{Hz}$
- Wide Gain Bandwidth — 4 MHz
- High Slew Rate — 13 V/μs
- Low Supply Current — 1.8 mA per Amplifier
- High Input Impedance — 10^{12} Ω
- High Common-Mode and Supply Voltage Rejection Ratios — 100 dB
- Industry Standard Pinouts

GENERAL OP-AMP SELECTOR GUIDE

General Purpose Op-Amps

Single		Dual	Quad
Compensated	LF351 LF355 LF356 LF357 MC1741 MC34001 TL081	LF353 LM358 MC1458 MC1747 MC3458 MC4558 MC34002 TL082	LF347 LM324 MC3403 MC4741 MC34004 TL084
Uncompensated	LM301A MC1709 MC1748	MC1437	

JFET (BIFET) INPUT — High Impedance		
Single	Dual	Quad
LF351 LF355 LF356 LF357 MC34001 TL071 TL081	LF353 MC34002 TL072 TL082	LF347 MC34004 TL074 TL084

High Slew Rate

Slew Rate (V/μs)			
5.0	8.0 to 20		50
LF355	LF347 LF351 LF353 LF356 MC1458S MC1741S MC34074	MC34001 MC34002 MC34004 TL071 TL072 TL074 TL081 TL082 TL084	LF357

Programmable

Adjustable bias current varies noise bandwidth, power consumption, etc.

Single
MC1776 MC3476

Low Noise

Single	Dual	Quad
MC1741N OP-24 OP-27 TL071	MC1458N TL072	TL074

Wide Bandwidth

Bandwidth (MHz)				
3.0	4.0	5.0	20	100
MC4558S	MC34001 MC34002 MC34004	MC3401 LF356 MC34074	LF357	NE592 MC1733

Low Offset Voltage

V_{IO} Max (μV)			
≤ 200	500	2000	
OP-24 OP-27	LM11C LM308A	MC34001A MC34002A MC34074A	MC1709A LM301A LM308

Low Drift Over Temperature (TCV_{IO})

TCV_{IO} ≤ 5.0 μV/°C Max*	
LM11	LM308A OP-27

*Input offset voltage temperature coefficient

Single-Supply

Dual	Quad
LM358 LM2904 MC3458 MC3405	LM324 LM2902 MC3301 MC3401 MC3403 MC34074

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VOLTAGE REGULATORS

VOLTAGE REGULATOR SELECTOR GUIDE

Fixed Voltage, 3-Terminal Regulators for Positive or Negative Polarity Power Supplies

V_{out} Volts	Tol.† Volts	I_O mA Max	Device Type Positive Output	Device Type Negative Output
2	±0.1	1500	—	MC7902C
3	±0.15	100	—	MC79L03AC
	±0.3			MC79L03C
5	±0.5	100	MC78L05C	MC79L05C
	±0.25		MC78L05AC	MC79L05AC
		500	MC78M05C	—
	±0.4	1500	LM109*	—
			LM209	—
	±0.25		LM309	—
	±0.35		MC7805*	—
	±0.25		MC7805C	MC7905C
	±0.2		MC7805A*	—
			MC7805AC	MC7905AC
	±0.25		LM140-5*	—
			LM340-5	—
	±0.25	3000	MC78T05*	—
			MC78T05C	—
	±0.2		MC78T05A*	—
			MC78T05AC	—
	±0.6		LM123	—
			LM223	—
	±0.4		LM323	—
	±0.2		LM123A	—
			LM223A	—
			LM323A	—
5.2	±0.26	1500	—	MC7905.2C
6	±0.3	500	MC78M06C	—
	±0.35	1500	MC7806*	—
	±0.3		MC7806C	—
	±0.24		MC7806A*	MC7906C
			MC7806AC	—
	±0.3		LM140-6*	—
			LM340-6	—
				—
	±0.3	3000	MC78T06*	—
			MC78T06C	—
8	±0.8	100	MC78L08C	—
			MC78L08AC	—
	±0.4	500	MC78M08C	—
		1500	MC7808*	—
	±0.3		MC7808C	MC7908C
			MC7808A*	—
	±0.4		MC7808AC	—
			LM140-8*	—
			LM340-8	—
	±0.4	3000	MC78T08*	—
			MC78T08C	—

V_{out} Volts	Tol.† Volts	I_O mA Max	Device Type Positive Output	Device Type Negative Output
12	±1.2	100	MC78L12C	MC79L12C
	±0.6		MC78L12AC	MC79L12AC
		500	MC78M12C	—
		1500	MC7812*	—
			MC7812C	MC7912C
	±0.5		MC7812A*	—
			MC7812AC	MC7912AC
	±0.6		LM140-12*	—
			LM340-12	—
	±0.6	3000	MC78T12*	—
			MC78T12C	—
	±0.5		MC78T12A*	—
			MC78T12AC	—
15	±1.5	100	MC78L15C	MC79L15C
	±0.75		MC78L15AC	MC79L15A
		500	MC78M15C	—
		1500	MC7815*	—
			MC7815C	MC7915C
	±0.6		MC7815A*	—
			MC7815AC	MC7915AC
	±0.75		LM140-15*	—
			LM340-15	—
	±0.75	3000	MC78T15*	—
			MC78T15C	—
	±0.6		MC78T15A*	—
			MC78T15AC	—
18	±1.8	100	MC78L18C	MC79L18C
	±0.9		MC78L18AC	MC79L18AC
		500	MC78M18C	—
		1500	MC7818*	—
			MC7818C	MC7918C
	±0.7		MC7818A*	—
			MC7818AC	—
	±0.9		LM140-18*	—
			LM340-18	—
	±0.9	3000	MC78T18*	—
			MC78T18C	—
20	±1.0	500	MC78M20C	—
24	±2.4	100	MC78L24C	MC79L24C
	±1.2		MC78L24AC	MC79L24AC
		500	MC78M24C	—
		1500	MC7824*	—
			MC7824C	MC7924C
	±1.0		MC7824A*	—
			MC7824AC	—
	±1.2		LM140-24*	—
			LM340-24	—
	±1.2	3000	MC78T24*	—
			MC78T24C	—

*T_J = −55 to +150°C
†Output Voltage Tolerance for Worst Case

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VOLTAGE REGULATORS

Positive Output Regulators

I_O mA Max	Device Type	Suffix	V_{out} Volts Min	V_{out} Volts Max	V_{in} Volts Min	V_{in} Volts Max	$V_{in} - V_{out}$ Differential Volts Min	P_D Watts Max T_C = 25°C	P_D Watts Max T_C = 25°C	Regulation % V_{out} @ T_A = 25°C Typ Line	Regulation % V_{out} @ T_A = 25°C Typ Load	TC V_{out} Typ %/°C	T_J = °C Max	Case
100	LM317L	H,Z	1.2	37	5.0	40	3.0	Internally Limited		0.04	0.5	0.006	125	29,79
	LM217L									0.02	0.3	0.004	150	
	LM117L*											0.003		
150	MC1723	CP	2.0	37	9.5	40	3.0	0.65	—	0.1	0.3	0.003	150	646
		CG						0.8	2.1	0.1		0.003		603C
		G								0.2		0.002		
		CL						1.0	—	0.1		0.003	175	632
		L							—	0.2		0.002		
250	MC1469	G	2.5	32	9.0	35	3.0	0.68	1.8	0.03	0.13	0.002	150	603
	MC1569*			37	8.5	40	2.7			0.015				
500	LM317M	T	1.2	37	5.0	40	3.0	Internally Limited		0.02	0.1	0.0056	125	221A
	LM317M	R												080
	LM217M											0.004	150	
	LM117M*											0.0036		
600	MC1469	R	2.5	32	9.0	35	3.0	3.0	14.0	0.03	0.05	0.002	150	614
	MC1569*			37	8.5	40	2.7			0.015				
1500	LM317	T	1.2	37	5.0	40	3.0	Internally Limited		0.07	1.5	0.006	125	221A
	LM317	H,K												79,1
	LM217											0.004	150	
	LM117*									0.05	1.0	0.003		
3000	LM350	T	1.2	33	5.0	36	3.0	Internally Limited		0.02	0.1	0.008	125	221A
	LM350	K												
	LM250											0.0057	150	1
	LM150*											0.0051		

*T_J = −55°C to +150°C.

Negative Output Regulators

I_O mA Max	Device Type	Suffix	V_{out} Volts Min	V_{out} Volts Max	V_{in} Volts Min	V_{in} Volts Max	$V_{in} - V_{out}$ Differential Volts Min	P_D Watts Max T_C = 25°C	P_D Watts Max T_C = 25°C	Regulation % V_{out} @ T_A = 25°C Typ Line	Regulation % V_{out} @ T_A = 25°C Typ Load	TC V_{out} Typ %/°C	T_J = °C Max	Case
250	MC1463	G	−3.8	−32	−9.0	−35	3.0	0.68	1.8	0.03	0.05	0.002	150	603
	MC1563*		−3.6	−33	−8.5	−40	2.7			0.015	0.13			
500	LM337M	T	−1.2	−37	−4.25	−40	3.0	Internally Limited		0.01	0.3	0.0048	125	221A
600	MC1463	R	−3.8	−34	−9.0	−35	3.0	2.4	9.0	0.03	0.05	0.002	150	614
	MC1563*		−3.6	−37	−8.5	−40	2.7			0.015				
1500	LM337	T	−1.2	−37	−5.0	−40	3.0	Internally Limited		0.02	0.3	0.0048	125	221A
	LM337	H,K												79,1
	LM237											0.0034	150	
	LM137											0.0031		

*T_J = −55°C to +150°C.

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VOLTAGE REGULATORS

Switching Regulators

These cost-effective ICs are designed to improve reliability and performance by providing all necessary circuit functions to control various configurations of off-line and dc to dc switching regulators through pulse-width modulation (PWM).

I_O (mA)	V_{CC} (Volts)		f_o (kHz)		Device		T_A	
Max	Min	Max	Min	Max	Number	Suffix	(°C)	Case
40	10	30	2.0	100	MC3420	P	0 to +70	648
						L		620
					MC3520	L	−55 to +125	620
250*	7.0	40	1.0	300	MC34060	P	0 to +70	646
						L		632
					MC35060	L	−55 to +125	632
250	7.0	40	1.0	300	TL494	CN	0 to +70	648
						CJ		620
						IN	−25 to +85	648
						IJ		620
						MJ	−55 to +125	620
250	7.0	>40	1.0	300	TL495	CN	0 to +70	707
						CJ		726
						IN	−25 to +85	707
						IJ	−25 to +85	726
±400	8.0	40	0.1	400	SG3525A	N	0° to +70	648
					SG3525A	J	0° to +70	620
					SG2525A	N	−40 to +85	648
					SG2525A	J		620
					SG1525A	J	−55 to +125	620
±400	8.0	40	0.1	400	SG3527A	N	0 to +70	648
					SG3527A	J		620
					SG2527A	N	−40 to +85	648
					SG2527A	J		620
					SG1527A	J	−55 to +125	620
±200	8.0	40	0.001	400	SG3526	N	0 to +70	707
					SG3526	J		726
					SG2526	N	−40 to +85	707
					SG2526	J		726
					SG1526	J	−55 to +125	726
1500	5.0	40	1.0	40	μA78S40	PC	0 to +70	648
					μA78S40	DC		620
					μA78S40	DM	−55 to +125	
1500	2.5	40	1.0	40	MC34063	P1	0 to +70	626
					MC34063	U		693
					MC33063	P1	−40 to +85	626
					MC33063	U		693
					MC35063	U	−55 to +125	693

*Single output device
**Internal 39 V zener for <40 volt operation

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

Technology Leadership In Synchro Converters

Natel offers the widest selection of synchro-to-digital and digital-to-synchro converters...as well as synchro instrumentation.

And...Natel means more than technological superiority in standard products. It also stands for the best in Custom Hybrids. Our new, expanded, automated, class 10,000 hybrid facility is at your disposal...fully MIL qualified, and ready for volume production.

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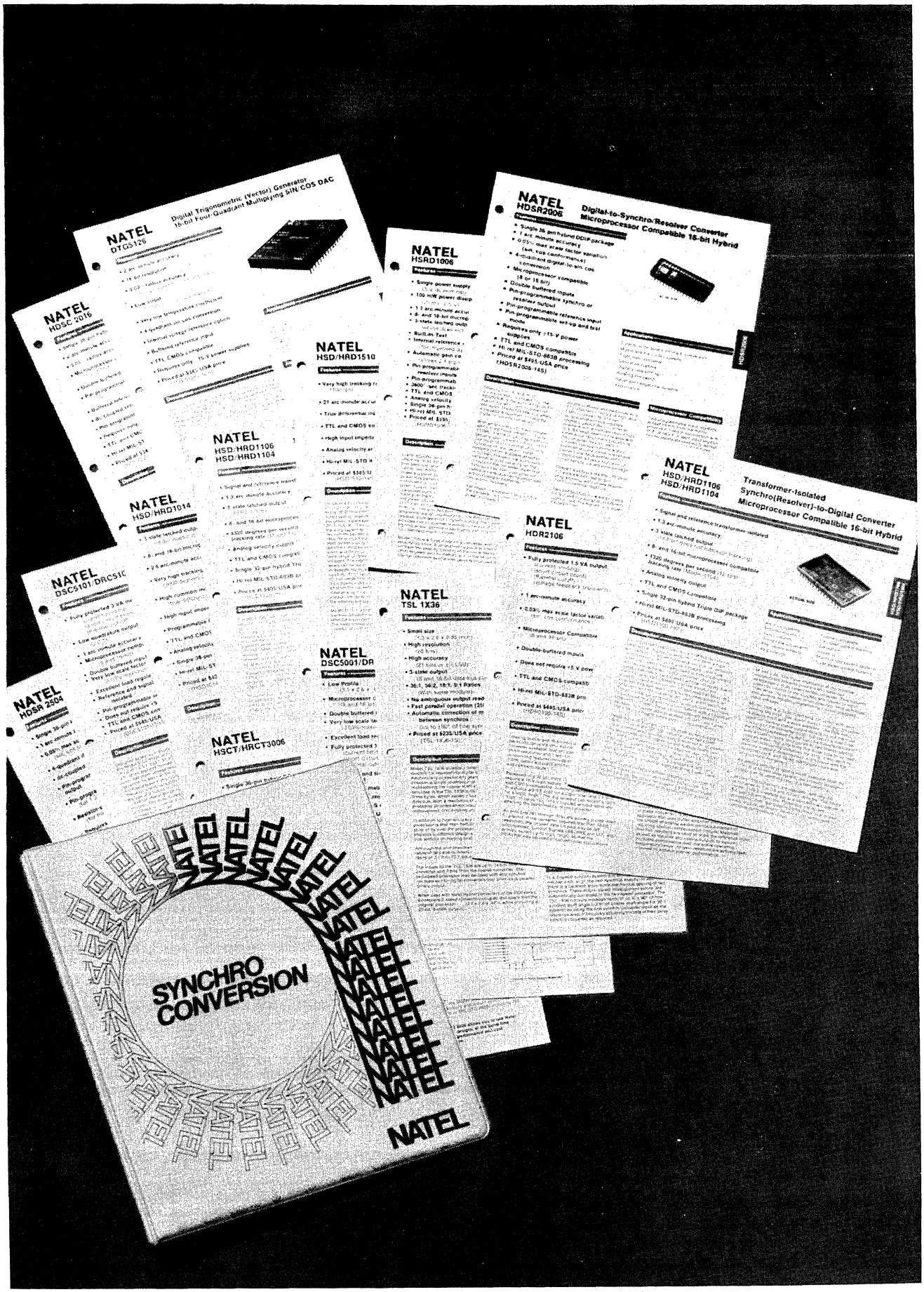
NATEL
DTGS126
Digital Trigonometric (Vector) Generator
16-bit Four-Quadrant Multiplying SIN-COS DAC
NATEL
HDSC 2016
NATEL
HSD/HRD1510
NATEL
HSD/HRD1106
HSD/HRD1104
NATEL
HSD/HRD1014
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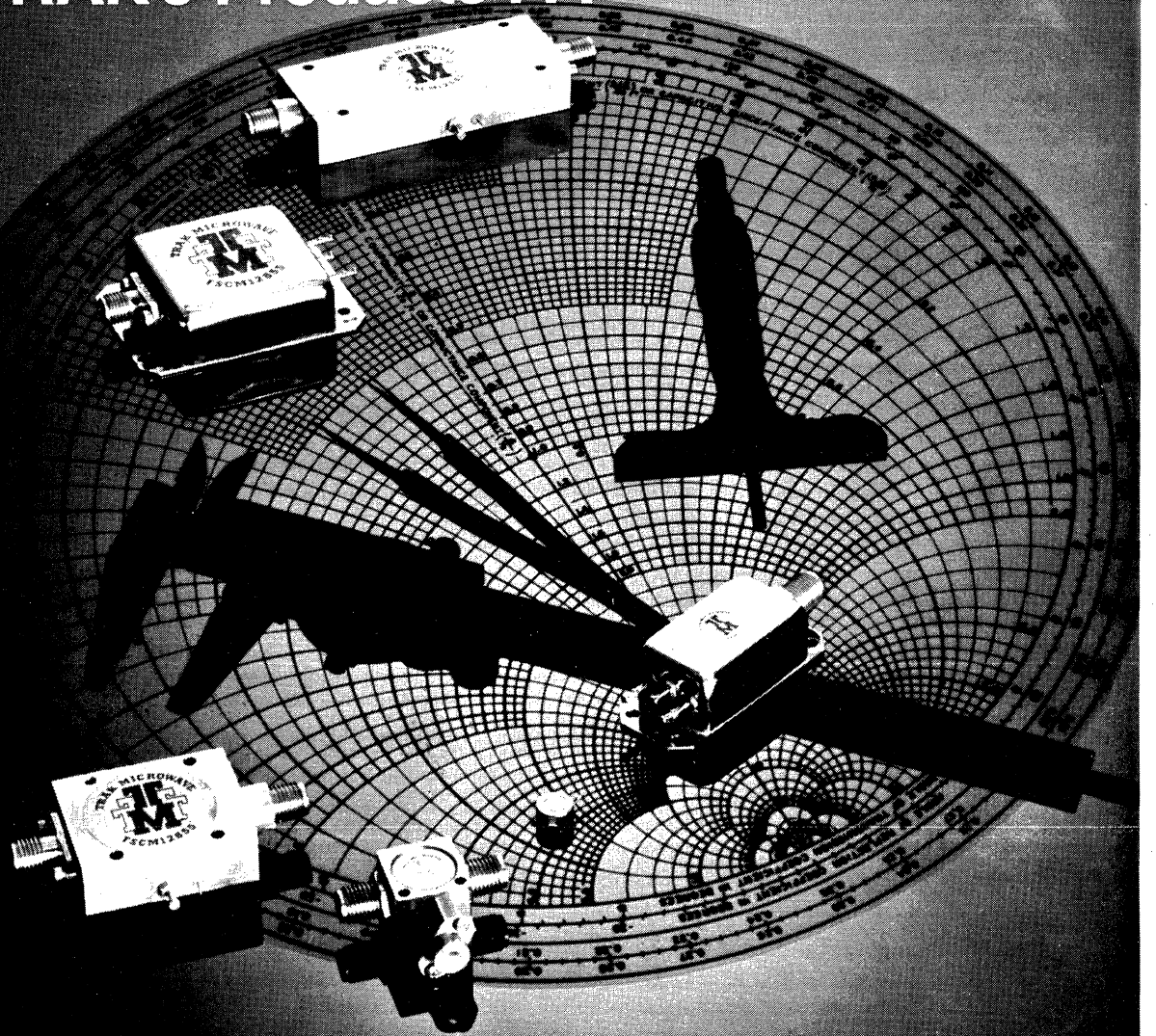
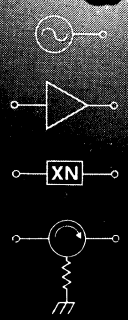
DSCS101/DRCS1C
NATEL
HDSR 2504
NATEL
HSCT/HRCT3006
NATEL
DSC5001/DR
NATEL
TSL 1X36
NATEL
HSRD1006
NATEL
HDSR2006
Digital-to-Synchro/Resolver Converter
Microprocessor Compatible 16-bit Hybrid
NATEL
HDR2106
NATEL
HSD/HRD1106
HSD/HRD1104
Transformer-Isolated
Synchro(Resolver)-to-Digital Converter
Microprocessor Compatible 16-bit Hybrid
SYNCHRO
CONVERSION
NATEL

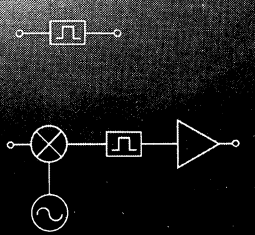
TRAK's Products . . .



Generate
Amplify
Multiply
Isolate



Filter
and
Convert



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TRAK MICROWAVE CORPORATION

4726 Eisenhower Boulevard • Tampa, Florida 33614-6391 • (813) 884-1411 • TLX: 52-827 • TWX: 810-876-9140
WESTERN DIVISION (YIG Components) 735 Palomar Avenue • Sunnyvale, California 94086 • (408) 735-9660 • TWX: 910-339-9309

Manufacturer	Attenuators					Couplers & Hybrids (Directional)	Dividers		Filters		
	Fixed	Variable	Step	Coaxial	Programmable		Power (Microwave)	Power (UHF/VHF)	Waveguide	Bandpass	Low Pass
Applied Research	1•1565			1•1565							
ARRA	1•1567	1•1567		1•1567		1•1567	1•1567	1•1567	1•1567		
Compac				1•1568							
Daico Induseries		1•1579	1•1578								
General Microwave	1•1583				1•1583						
Kay Elemetries		1•1585	1•1585		1•1585						
Matrix											
Mini Circuits	1•1590 1•1591 1•1644-1•1647					1•1591 1•1599 1•1618 1•1629	1•1591 1•1599 1•1618-1•1621 1•1624-1•1631	1•1591 1•1599 1•1618-1•1629			
North HillsElectronics				1•1590 1•1644		1•1653					
Telonic Berkley	1•1655		1•1655							1•1655	1•1655
Track											
Wavetek	1•1663				1•1663					1•1662	1•1662
Weinschel	1•1664	1•1664	1•1664				1•1664	1•1664			

Manufacturer	Coaxial	Terminations Feed-through	Power	Diode	RF Switches Transfer	MIC	Phase Shifters	Oscillators	Mixers	RF Relays	Waveguides	ICs MICs
Applied Research	1•1565							1•1564				
ARRA				1•1567			1•1567				1•1567	
Compac	1•1568	1•1568	1•1569		1•1569					1•1569		
Daico Induseries				1•1574, 1•1575	1•1575	1•1572, 1•1573, 1•1576	1•1579			1•1577		1•1570-1•1573, 1•1576-1•1580
General Microwave				1•1583								1•1583
Kay Elemetries												
Matrix												
Mini Circuits				1•1590					1•1596-1•1598 1•1600-1•1617 1•1650-1•1652			
North HillsElectronics												
Telonic Berkley												
Track												
Wavetek												
Weinschel	1•1664		1•1664							1•1586, 1•1587		

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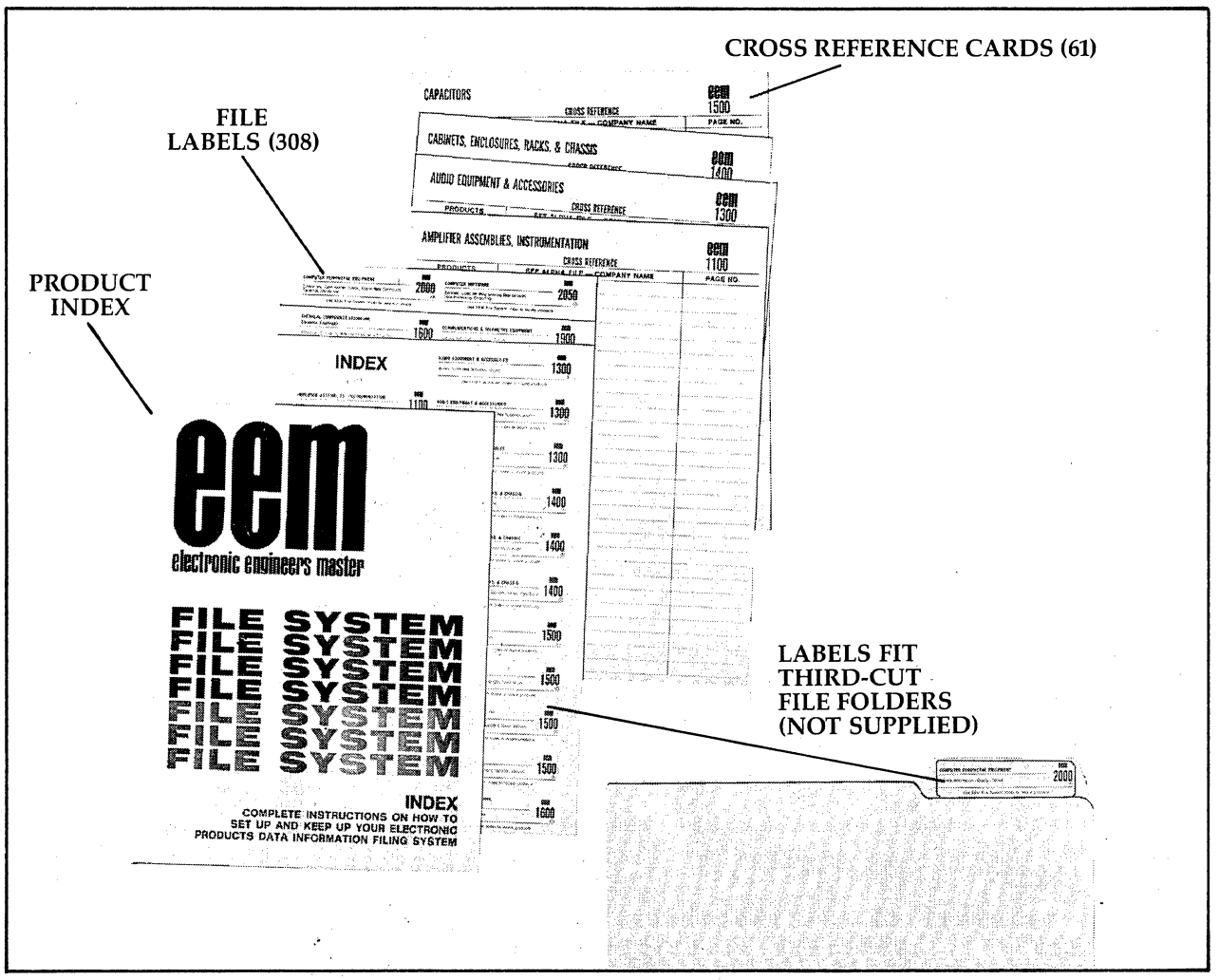


WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

APPLIED RESEARCH Inc.

DEPT. EM, 160 DUPONT STREET, PLAINVIEW, NEW YORK 11803, (516) 349-9200

Over 30 Years as a Supplier to the Military/Industrial RF Markets.

RF FILTERS, MULTIPLEXERS, CONVERTERS, POWER AMPLIFIERS, MULTIPLIERS, SIGNAL SOURCES, MULTICOUPLERS and COMPLETE RF SYSTEMS.

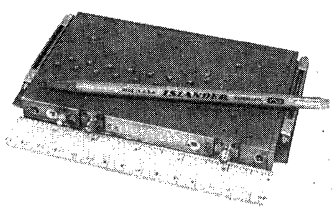
MULTIPLIERS

FREQUENCY GENERATION THROUGH MULTIPLICATION OR PHASE-LOCK TECHNIQUES/VHF to Ku-Band (10 MHz to 1.5 GHz)

Applied Research offers many proven designs using either technique or combinations. And we're capable of meeting your exact requirements, precisely.

Our Phase-lock loops, comprised of I.C. components, together with RF devices, yield outputs of up to 10 watts at microwave frequencies. And our multipliers are available as passive devices or in combination with amplifiers having multiplication factors of from 2 to 2000. In combination with varactor multiplier devices output in Ku-band can be obtained.

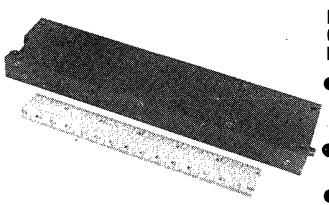
What's more, we can supply crystal oscillators or internal drivers to provide a self-contained source.



Frequency sources with mutiplication up to 29 and multiples thereof are available deriving signals in the L, S, and C-bands.

ELECTRICAL CHARACTERISTICS (TYPICAL)

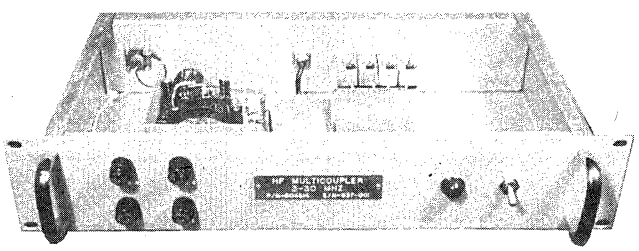
- Input Frequency: 100 MHz ±10 MHz
- Output Frequency:
  Type-1, 6400 MHz (X64)
  Type 2, 5800 MHz (X58)
- RF Power
  Input Power: +5 dBm, ±3 dB
  Output Power: +5 dBm, ±2 dBm over temperature
- Discrete spurious outputs: Harmonics below −60 dBc, others at a maximum of −60 dBc.
- Temperature: −54°C to +85°C



ELECTRICAL CHARACTERISTICS C-BAND PASSIVE BROADBAND HIGH POWER MULTIPLIERS

- Input Power: +40 dBm
  Output Power: +32.6 dBm ±0.5 dB
- Spurious Response: >−70 dBc inband
- Bandwidth: 5.9 to 6.4 GHz

MULTICOUPLERS



Multicoupler Model HFM-2 (TX)-230-8-40 is one of a series of multicouplers designed and manufactured by Applied Research Inc. This model, operating over a frequency range of 2 to 32 MHz, has 8 to 32 independent outputs for inputs of up to +20 dBm.

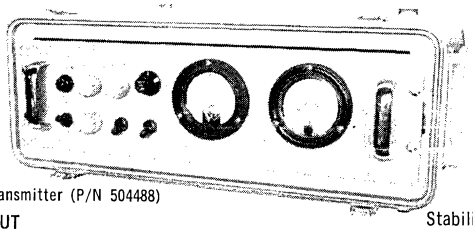
PERFORMANCE SPECIFICATIONS
Frequency Range: 0.5 to 32 MHz
Number of Outputs: Up to 32
Isolation Between Outputs: To be specified by customer — Up to 70 db.
Overall Gain (Input to Output): 0 dB
Connectors: To be specified by customer.

The HFM Series covers the frequency range of 0.5 MHz to the Telemetery Bands, and has been designed for applications where weight and space are critical such as submarine, shipboard, or mobile installations.

MODEL	NO. OF OUTPUTS	FREQUENCY RANGE
HFM-2(TX)0532 8/40	6 to 32	500 KHz-32 MHz
HFM-2(TX)232 8/40	6 to 32	2 MHz-32 MHz
HFM-2(TX)140 12/40	6 to 32	10 MHz-400 MHz
HFM-2(TX)2410 8/40	6 to 32	20 MHz-1100 MHz
HFM-2(TX)1415 6/50	6 to 32	1400 MHz-1600 MHz
HFM-2(TX)2223 8/50	6 to 32	2200 MHz-2300 MHz
HFM-2(TX)1423 8/50	6 to 32	1400 MHz-2300 MHz

SOLID STATE TRANSMITTERS and POWER AMPLIFIERS in P, L, S and C BANDS.

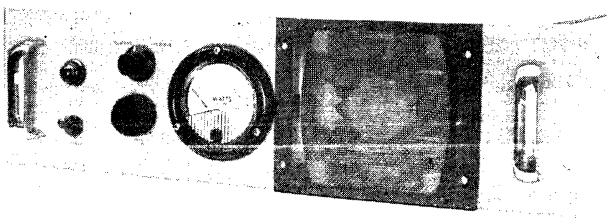
TRANSMITTERS



Transmitter (P/N 504488)

RF OUTPUT
Range: 400-550 MHz
Control: Field Tuneable in 0.5 MHz increments
DC/AC Power: 24-30 volts at 9 amperes/115/230 VAC 5/2 Amps
Stability: ±0.005%
Power: 30 watts, minimum
MODULATION: Frequency Modulation

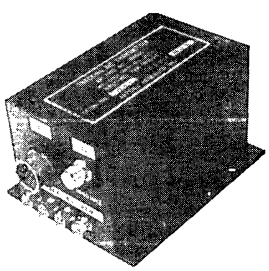
POWER AMPLIFIERS



200 Watt RF Power Amplifier (P/N 504495)

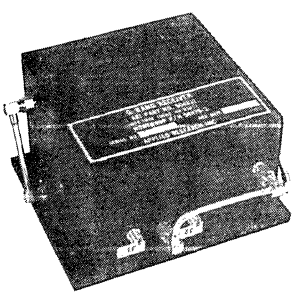
Frequency Range: 400 to 550 MHz

AEROSPACE COMPONENTS



L-BAND TRANSMITTER

Frequency: Tunable, 1650-1670 MHz
Power Output: +28 dBm min.
Modulation: FM; 1-35 KHz
Stability: ±3 MHz
Power Input: +22 to +34 VDC, .75A max.
Weight: 1 kg max.

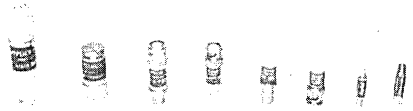


G-BAND RECEIVER

Frequency: 4.4 to 5.0 GHz*
Stability: ±.005%
Sensitivity: −90 dBm for 10 dB S/N and ±250 KHz deviation
IF Bandwidth: 1 MHz nominal
Power Input: +21 to 30 volts, .75A max.
Weight: 3.5 lbs. max.
* Factory set

FIXED PAD ATTENTUATORS & TERMINATIONS (DC-2GHz)

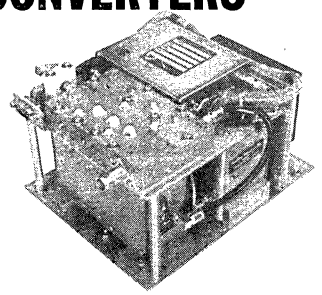
FOR TYPES BNC, TNC, C, N, AND OSM CONNECTORS



Integrated line of fixed pad attenuators, terminations, and impedance-matching transformers provides means for rapid and accurate division of voltages over the frequency range of DC-2 GHz, and for the matching of different impedances with minimum loss over a broad frequency band. The unit cost is within the practical price range of the large and small equipment user, as well as the research and experimental user.

GENERAL CHARACTERICTICS
Frequency Range: DC-2 GHz
VSWR: 1.25:1
Attenuation Accuracy:
−0.1 dB +0.3 dB for values of 1 to 12 dB
−0.2 dB +0.5 dB for values of 15 to 20 dB
Impedances (Nominal): 50, 75 90 ohms
Attenuation Values:
1, 2, 3, 4, 6, 10, 12, 15, 20 dB (standard).
Other values up to 30 dB Special

TELEMETRY CONVERTERS



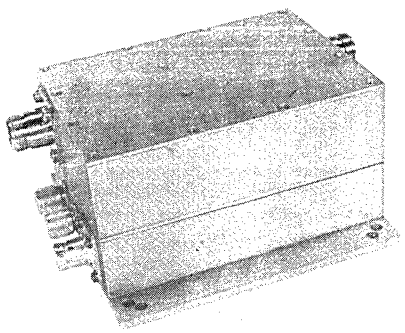
Down converters for military and commercial application are available throughout the frequency range from VHF to K-band. Applied Research manufacturers the filters, oscillator sources, the IF amplifiers, and complete packages that are associated with down converters.

These units permit the ready adapting of existing UHF telemetry receiving equipment for use in the 1435 to 1540 and 2200 to 2300 MHz telemetry band with high conversion gain.

GENERAL CHARACTERISTICS
Long Term Stability: Better than ±.1 PPM over temperature range
Image Rejection: >50 dB
Noise Figure: Better than 5 dB for 100 mc bandwidth (2.2 to 2.3 GHz)

Converters meeting special requirements which include group delay or phase and amplitude characteristics can be designed to meet special needs.

MULTIPLEXERS



State of the Art Multiplexers, applying Applied Research Inc.'s experience in the design and manufacture of NOTCH FILTERS, BANDPASS FILTERS, and BAND REJECT FILTERS allows for the ultimate in performance.

TYPICAL TRIPLEXER CHARACTERISTICS
Frequency Range: 5 kHz to 500 MHz
Frequency Breaks: 500 kHz and 32 MHz
Passband Attenuation: 1.5 dB maximum
Crossover Losses: 4.5 dB maximum
Reject Characteristics: 42 dB minimum, other bands
Ripple: 0.5 dB peak to peak maximum
Impedance: All ports shall be 50 ohms unbalanced
VSWR: 1.5:1 maximum, 2:1 through crossover

APPLIED RESEARCH Inc.

DEPT. EM, 160 DUPONT STREET, PLAINVIEW, NEW YORK 11803, (516) 349-9200

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

ARRA INC.
ANTENNA & RADOME RESEARCH ASSOCIATES

Coaxial • Waveguide • Solid State

microwave

Components • Assemblies • Sub-Systems

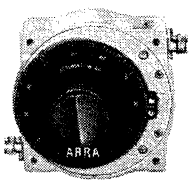
VARIABLE ATTENUATORS DC THRU 18000 MHz

Direct Reading

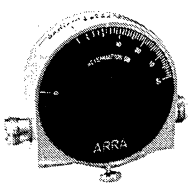
Low Ins. Loss • 1.5 Max. VSWR • 10 Watts Aver. Power

Freq. Range (GHz)	Atten. Range (dB)	Atten. vs. Freq. (±dB)	Form Type	Model No.
DC-0.1	30	0.5	4450	†0682-30F
DC-0.5	10	0.25	4450	†0682-10G
0.5-1.0	60	1.0	0-214	2952-60
0.5-1.0	100	1.5	0-214	2952-100
0.9-1.3	60	1.0	0-660	2-3952-60
0.9-1.3	100	1.5	0-660	2-3952-100
1.0-2.0	10	1.0	0-1014	3617-10F
1.0-2.0	60	1.0	0-660	3952-60X
1.0-2.0	100	1.5	0-660	3952-100X
1.4-2.4	80	1.25	0-660	3-4952-80
2.0-4.0	10	1.0	0-51	4674-10F
2.0-4.0	20	1.5	0-51	4674-20F
2.0-4.0	30	2.0	0-51	4674-30F
2.0-4.0	60	1.0	0-660	4952-60X
2.0-4.0	100	1.5	0-660	4952-100X
2.5-4.0	10	0.75	0-51	4674-10G
2.5-4.0	20	1.0	0-51	4674-20G
4.0-8.0	10	0.6	0-701-2	5684-10F
4.0-8.0	20	1.0	0-701-2	5684-20F
4.0-8.0**	60	1.0	0-660	5952-60X
4.0-8.0**	100	1.5	0-660	5952-100X
5.4-11.0	10	1.0	0-701-2	5-6684-10F
5.4-11.0	20	1.5	0-701-2	5-6684-20F
7.0-11.0	10	0.5	0-701-2	6684-10F
7.0-11.0	20	1.0	0-701-2	6684-20F
8.0-12.4	10	0.5	0-701-2	6684-10X
8.0-12.4	20	1.0	0-701-2	6684-20X
12.4-18.0	10	0.5	0-701-2	9684-10F
12.4-18.0	20	1.0	0-701-2	9684-20F
12.4-18.0	30	1.0	0-701-2	9684-30F

*See catalog for VSWR, Ins. Loss and Power.
**Only less than octave — consult factory.
†1 Watt Average Power.



Form 0-660: 5″ Dia.
Form 0-214: 6″ Dia.



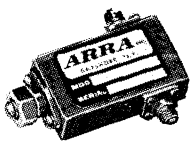
Form 0-701: 3″ Dia.
Form 0-51: 5″ Dia.

Miniature

0.5 dB Max. Ins. Loss • 5 Watts Aver. 3 KW Peak • 2 Ounces

Freq. Range (GHz)	Atten. Range (dB)	Atten. vs. Freq. (±dB)	Max. VSWR	Form Type	Model No.
DC-0.1	20	0.6	1.3	4242	**0682-20
DC-0.25	15	1.5	1.5	4242	**0682-15
DC-0.5	10	0.25	1.5	4449	**0682-10
1.0-2.0	10		1.8	3651	3814-10
1.5-2.0	15		1.7	3651	3814-15
2.0-4.0	10		1.8	2191	4804-10
2.0-4.0	20		1.5	3651	4814-20
2.5-4.0	10		1.5	2191	4804-10X
4.0-8.0	10		1.5	2191	5804-10
4.0-8.0	20		1.5	2191	5804-20
4.0-8.0	30		1.5	3651	5814-30
6.0-11.0	10		1.5	2191	5-6804-10
6.0-11.0	20		1.5	2191	5-6804-20
6.0-11.0	30		1.5	2191	5-6804-30
6.0-11.0	40		1.5	3651	5-6814-40
8.0-18.0	10	1.5	1.5*	2191	9803-10
8.0-12.4	10		1.5*	2191	6804-10
8.0-12.4	20		1.5*	2191	6804-20
8.0-12.4	30		1.5*	2191	6804-30
8.0-12.4	40		1.5*	3651	6814-40
8.5-10.5	10	0.5	1.5	2191	6803-10A
8.5-10.5	20	0.5	1.5	2191	6803-20A
10.5-12.4	10	0.5	1.6	2191	6803-10B
10.5-12.4	20	0.5	1.6	2191	6803-20B
12.0-18.0	10		1.5	2191	9804-10X
12.0-18.0	20		1.5	2191	9804-20X
12.0-18.0	30		1.7	2191	9804-30X
12.0-18.0	40		1.7	2191	9804-40X
12.0-18.0	10	1.0	1.5	2191	9803-10A
12.0-18.0	15	1.0	1.7	2191	9803-15A

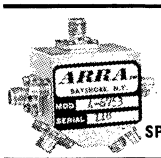
*1.7 VSWR above 11.0 GHz.
**1 Watt Average Power.



Form 2191: 1¾x1x½″
Form 3651: 2x1¼x½″

Form 4242: 2.2x1.37x1.2″

BROADBAND DIODE DEVICES



SPST & SPNT Switches

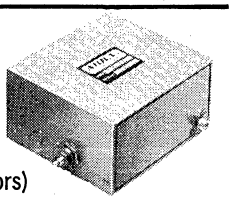
- High Isolation • Low Insertion Loss
- Integrated Drivers Available

SP4T

Configuration	Freq. Range (MHz)	Switching Time (nsec)	Average Power (Watts)	Model Number With Driver	Model Number Without Driver
SPST	100-18000	50	5	8753-40D	8753-40
SPST	500-18000	10	2	H8753-40D	H8753-40
SPST	200-18000	50	5	8753-80D	8753-80
SPST	500-18000	10	2	H8753-80D	H8753-80
SPDT	2000-18000	2000	2	2-9753R	2-9753
SP3T	2000-18000	2000	2	3-9753R	3-9753
SP4T	2000-18000	2000	2	4-9753R	4-9753

Attenuators & Modulators

- Absorptive for all Values
- Each Model 200-18000 MHz
- Low Insertion Loss
- Integrated Linearized Driver (Attenuators)
- TTL Compatible Driver (Modulators)

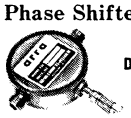


Model 8752-30D

Configuration	Attenuation (dB)	Switching Time	Model No.
Cont. Variable	35	50 μsec	8752-35D
Cont. Variable	65	50 μsec	8752-65D
On/Off	30	20 nsec	8752-30M
On/Off	65	20 nsec	8752-65M

COAXIAL COMPONENTS

Phase Shifters



DC-18GHz Models

Microwave Filters

.03-18GHz Bandpass & Reject

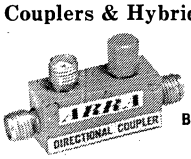
Broadband Fixed Attenuators

DC-18GHz High Power

Broadband Terminations

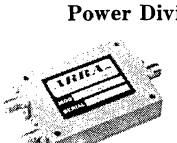
DC-18GHz High Power

Couplers & Hybrids



Bands from .5-18GHz

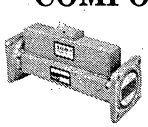
Power Dividers



Bands from .25-18GHz

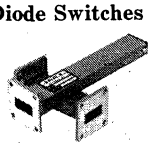
Motorized Variable Attenuators
500 Watt Variable Attenuators . . . Lots More

WAVEGUIDE COMPONENTS & ASSEMBLIES

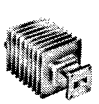


Broadband Diode Switches

Variable Attenuators

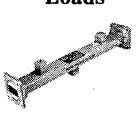


Cross Guide Couplers



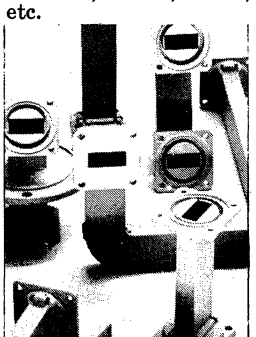
Dummy Loads

Fixed Attenuators



Filters

ARRA will fabricate your special waveguide assemblies in any material and finish...from the simplest straight section and single bend to complex combinations of bends, miters, twists, etc.



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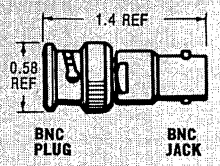
COAXIAL ATTENUATORS

Additional products which do not appear on this page can be designed to meet your requirements.

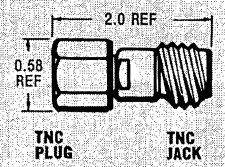
BNC / DC TO 2.0 GHz



PART NO.	ATTENUATION VALUE
130-1001	1 dB
130-1002	2 dB
130-1003	3 dB
130-1006	6 dB
130-1010	10 dB
130-1020	20 dB
130-1030	30 dB

Operating Temperature Range: −55 to +125°C
Total Input Power: 1 watt average
Impedance: 50 ohms
VSWR: DC to 1 GHz 1.2 to 1
1 GHz to 2 GHz 1.4 to 1
Accuracy: DC to 1 GHz ±.5 dB
1 GHz to 2 GHz ±.8 dB

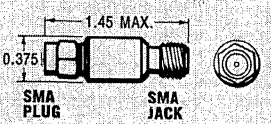
TNC / DC TO 2.0 GHz



PART NO.	ATTENUATION VALUE
130-2001	1 dB
130-2002	2 dB
130-2003	3 dB
130-2006	6 dB
130-2010	10 dB
130-2020	20 dB
130-2030	30 dB

Operating Temperature Range: −55 to +125°C
Total Input Power: 1 watt average
Impedance: 50 ohms
VSWR: DC to 1 GHz 1.2 to 1
1 GHz to 2 GHz 1.4 to 1

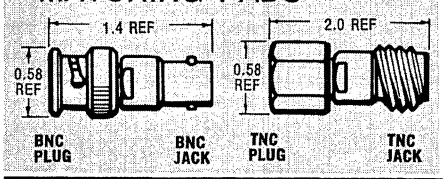
SMA / DC TO 2.5 GHz



PART NO.	ATTENUATION VALUE
130-3001	1 dB
130-3002	2 dB
130-3003	3 dB
130-3006	6 dB
130-3010	10 dB
130-3020	20 dB
130-3030	30 dB

Operating Temperature Range: −20 to +125°C
Total Input Power: 1 watt average
Finish: Passivated Stainless
Accuracy: DC to 1 GHz ±.5 dB
1 GHz to 2.5 GHz ±1 dB
Impedance: 50 ohms
VSWR: DC to 1 GHz 1.2 to 1 Max
1 GHz to 2.5 GHz 1.4 to 1 Max

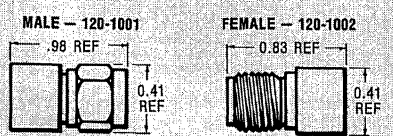
IMPEDANCE MATCHING PADS



SPECIFICATION	MODEL 130-1050	MODEL 130-2050	MODEL 130-1075	MODEL 130-2075
Frequency Range	DC to 1 GHz	DC to 1 GHz	DC to 1 GHz	DC to 1 GHz
Impedance	50 ohm male 75 ohm female	75 ohm male 50 ohm female	50 ohm male 75 ohm female	75 ohm male 50 ohm female
Attenuation (Loss)	5.7 dB	5.7 dB	5.7 dB	5.7 dB
VSWR (Max)	1.2 to 1	1.2 to 1	1.2 to 1	1.2 to 1
Connections	BNC	BNC	TNC	TNC
Accuracy	±.5 dB	±.5 dB	±.5 dB	±.5 dB

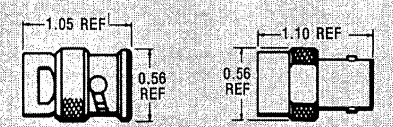
COAXIAL TERMINATIONS

SMA / DC TO 2.5 GHz



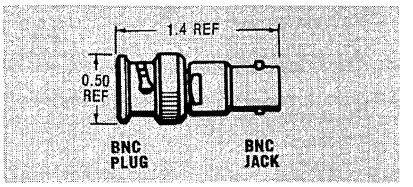
SPECIFICATIONS
120-1001 / 120-1002
Power: 1 watt average
Material: Passivated stainless steel
Impedance: 50 ohm nominal
Temperature Range: −20 to +125°C
VSWR: DC to 2.5 GHz 1.2 to 1 maximum

BNC



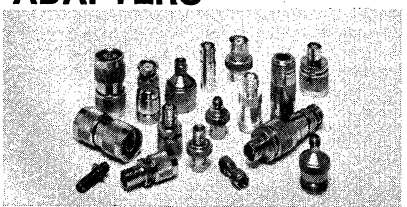
SPECIFICATIONS
Power: 1 watt average
VSWR: 1.1 to 1 maximum
DC to 2 GHz — 50 ohms
Male: 120-1003
Female: 120-1004
DC to 1 GHz — 75 ohms
Male: 120-1005
Female: 120-1006

FEED-THRU TERMINATIONS



	MODEL 120-1007	MODEL 120-1008
Power	1 watt average	1 watt average
Ohms	50	75
Frequency	DC to 1000 MHz	DC to 500 MHz
VSWR	DC to 500 MHz 1.1 to 1 500 to 1000 MHz 1.2 to 1	1.2 to 1

ADAPTERS



All Dimensions in Inches.

SIMPLIFIED ADAPTER PART NUMBERS
SELECT CONNECTOR TYPE

N = N	SMA = S	FEMALE = F
TNC = T	SMB = SMB	MALE = M
BNC = B	SMC = SMC	
BULKHEAD = Prefix with B		
RIGHT ANGLE = Prefix with R		
PANEL = Prefix with P		

EXAMPLES:	PART NO.
N (male) to SMA (female)	NM-SF
TNC (female) to SMA (female)	TF-SM
BNC (male) to BNC (female)	BM-BF
SMB (male) to SMC (female)	SMBM-SMCF

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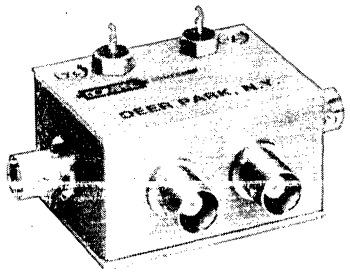
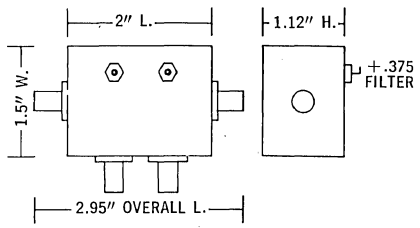
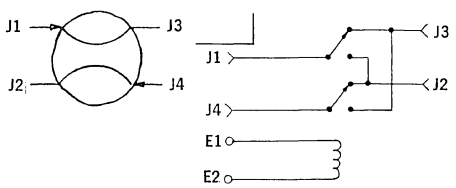
RF TRANSFER SWITCHES

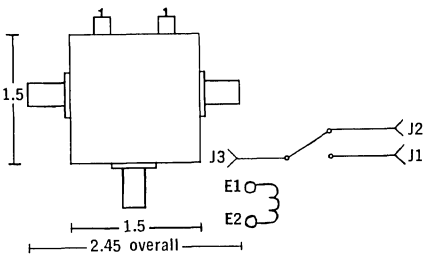


SCHEMATIC DPDT





SCHEMATIC SPDT



WARRANTY
This unit is warranteed fully against manufacturing defects for one year as long as case seals are not broken.

OPTIONS
Internal Protection Diode
Coil voltages
Extended flanges
Other connectors
Special switch circuit configurations on request.

GENERAL
These RF Switches for use in RF Communications equipment are a DPDT, SPDT type or Transfer with BNC standard connectors (other connectors optional). The relay coil is available in a latching or non-latching type with internal protection diodes as an option. Other configurations thru SP16T are currently available.

OPERATION
Hook up the terminals E1 (ground) and E2 to the appropriate voltage to cause the coil to pull in. Be sure to observe polarity if protection diodes are used. The low current of the coil can be driven by transistor or I.C. Logic.

SPECIFICATIONS
Non-Latching (standard), Latching (optional)
DPDT & SPDT
BNC Standard Connectors (others optional)
Frequency: DC-500 MHz
Impedance: 50 ohms
Isolation: Port-to-Port 40 dB typ. min.
Coil Voltage: 24/28V (others optional)
VSWR: 1.2
Insertion Loss: 0.3 dB

HOW TO ORDER:

TS D — 28 0 0 — __

SWITCH CONFIGURATION
D - DPDT
S - SPDT

COIL VOLTAGE
05
06
12
18
28

CONNECTOR TYPE
0 - BNC
1 - SMA
2 - TNC
3 - N

0-Flush
1-Extended Flange

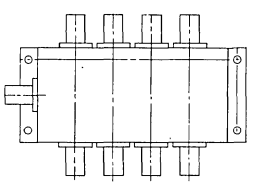
Suffix - PD = Protection Diode

Example — TSD-1211-PD is a DPDT Transfer Switch with SMA Connectors, Extended Flange and a Protection Diode in the 12 volt version.

RF POWER RELAYS

- 0 to 500 Mhz* Operation
- 200 Watts Power Handling
- 75 Watts Power Switching
- 2 to 16 Position
- 1.2:1 Max VSWR
- 50 dB Typ. Isolation
- .3 dB Typ. Insertion Loss

* Derated Characteristics to 1 GHz



TO ORDER:

PRF200 — XX — X

NO. POSITIONS — CONNECTOR TYPE

POWER ATTENUATORS

- 50W, 100W, 200W
- 1 through 30 dB Attenuation
- Flange Mounted
- DC to 500 MHz*

*50W to 1 GHz

TO ORDER:

ATN XX — XX — X

POWER — ATTENUATION — CONNECTOR TYPE

POWER TERMINATIONS

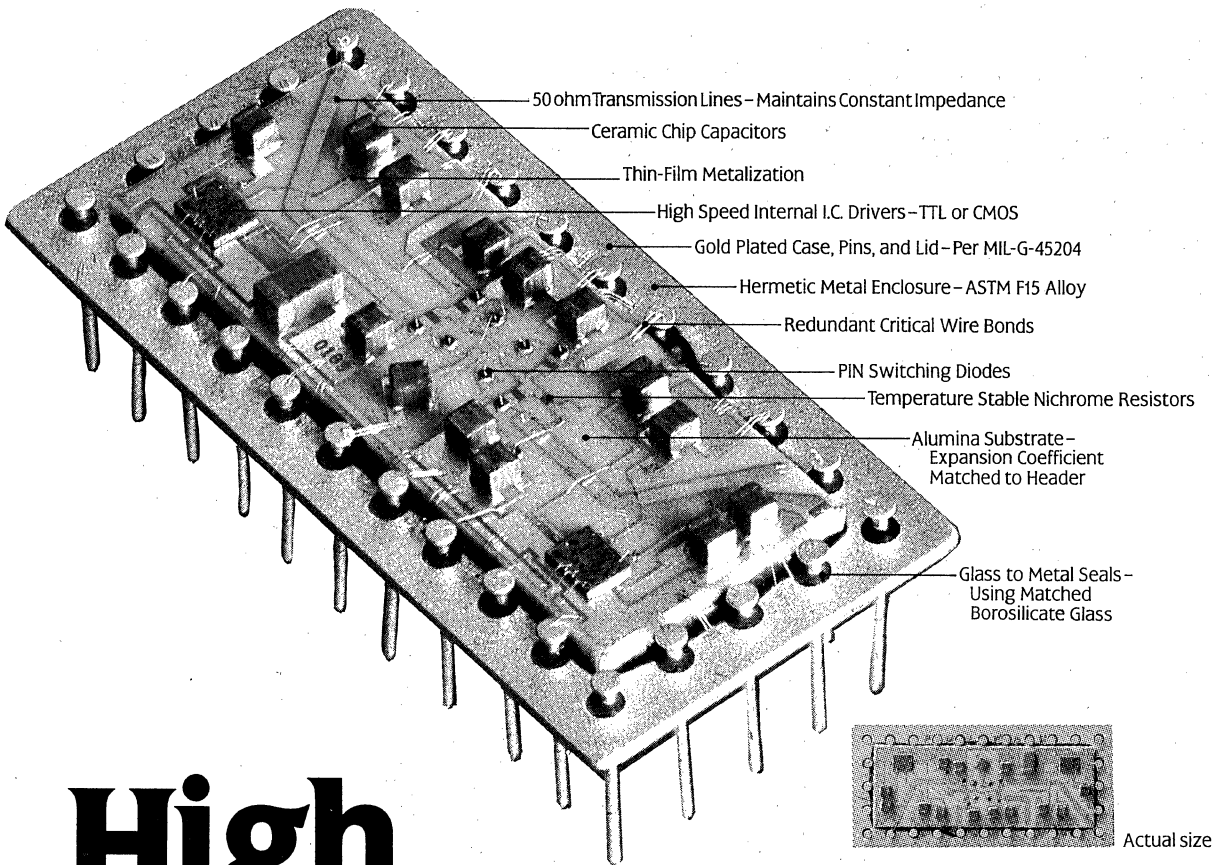
- 50W, 150W, 250W, 800W
- 50 Ohm Terminations
- Flange Mounted
- DC to 1 GHz*

* 800W to 500 MHz

TO ORDER:

TRM XX — X

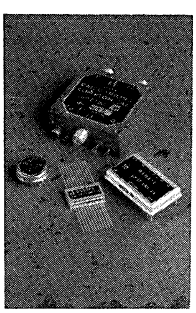
POWER — CONNECTOR TYPE



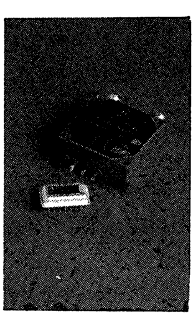
High Reliability RF MICs

DAICO High Reliability RF Microwave Integrated Circuit Components

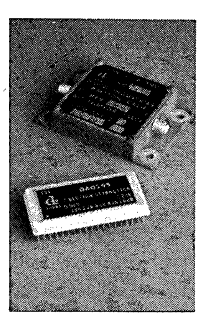
are products of state-of-the-art thin-film technology. Quality screened components, manufactured and tested to rigid Daico standards and numerous in-process quality tests, assures each device meets applicable MIL STD Specifications. Quantitative 100% final electrical tests are made with HP8505 Analyzers and HP9825 Computer controlled automatic systems. These data assure Daico High Reliability RF MIC components meet all critical design parameters, thus saving costly incoming testing.



MIC SWITCHES
- Thin-film MIC construction.
- DC – 4GHz
- SPST – SP24T
- Speeds < 5nS (10-90% RF)
- Internal TTL or CMOS drivers
- Internal 50 ohm terminations
- PC Board mount, Stripline or Connectorized



MIC VOLTAGE CONTROLLED ATTENUATORS
- Thin-film MIC construction
- Linear attenuation to 60dB
- Linearity to ±0.75dB
- Internal drivers
- Constant 50 ohm impedance
- PC Board mount, Stripline or Connectorized



MIC STEP ATTENUATORS
- Thin-film MIC construction
- Steps – 1 through 7
- Attenuation to 63.5dB
- Speeds < 5nS (10-90%RF)
- Internal TTL or CMOS drivers
- PC Board mount or Connectorized

DAICO INDUSTRIES, INC.
2351 East Del Amo Blvd., Compton, Calif. 90220
Telephone: (213) 631-1143 · TWX 910-346-6741

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DAICO QUALITY ASSURANCE

INTRODUCTION

Daico Industries, Inc., founded in 1967, is a leader in the DC-4GHz field of MIC's, Connectorized Solid State Switches, RF relays and both Digital and Voltage Controlled Attenuators.

Daico engineering, inspection, production, sales and service people are highly experienced and understand your requirements as well as the capabilities of Daico Industries. You can talk to us and get realistic answers. Our production and computer test equipment combined with our quality assurance procedures provide the necessary base to meet your most stringent requirements. We offer quality products at competitive prices. For a prompt response to your needs contact our local representative or the factory directly.

QUALITY ASSURANCE PROVISIONS

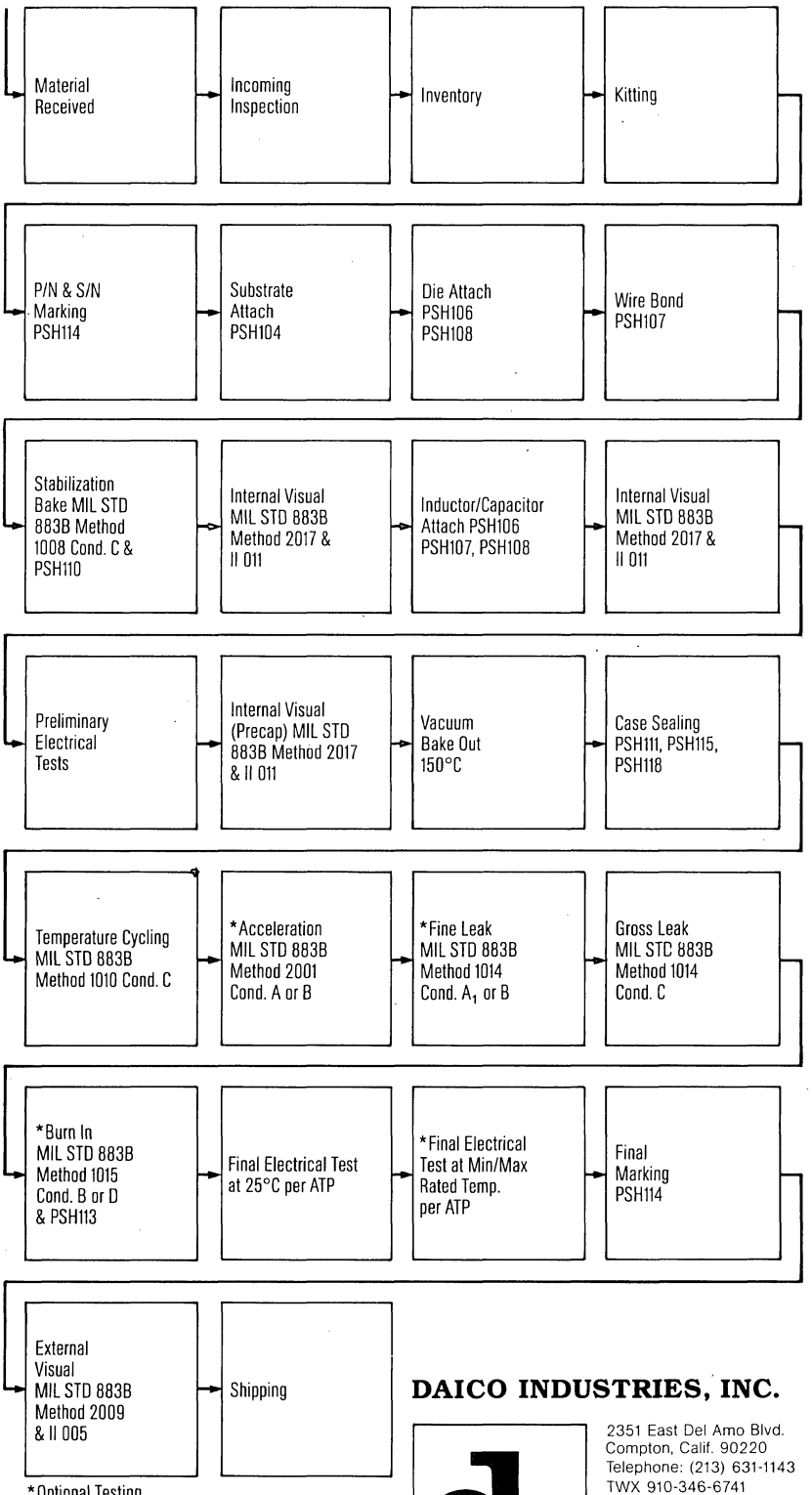
Daico quality is built into every unit through each manufacturing operation. Each new design is thoroughly tested in the engineering prototype state prior to being released to production. Only top quality components are used which must first go through extensive testing.

Workmanship Quality Manuals along with in-process inspection stations assure the product is built right, the first time.

The use of an Automatic Computer/Analyzer, complete with printer and plotter, provides a reliable, accurate and time-saving method for testing.

ADDITIONAL ENVIRONMENTAL TESTING AVAILABLE

Vibration:	MIL STD 202 Method 204 64g RMS, 1.5 hrs. each axis
Mechanical Shock:	MIL STD 883 Method 2002 Condition C, 3000g Y axis
Moisture Resistance:	MIL STD 883 Method 1004
Salt Atmosphere:	MIL STD 883 Method 1009
Thermal Shock:	MIL STD 883 Method 1011 Condition B, 15 cycles
Lead Integrity:	MIL STD 883, Method 2004 Condition B_2
Solderability:	MIL STD 883 Method 2003 260°C ±10°C
Resistance to Solvents:	MIL STD 883, Method 2015



*Optional Testing

PSH 104, 106, 107, 108, 110, 111, 113, 114, 115, 118, & II 005, 011 are approved DAICO in-process inspections and procedures.

DAICO INDUSTRIES, INC.

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DAICO MIC SWITCHES

The M.I.C. (Microwave Integrated Circuits) Switches are built utilizing Daico's inhouse Hi-Rel Thin Film Technology, which provides excellent stability over temperature extremes. All switches are encased in shielded hermetic enclosures providing maximum protection to the circuitry with minimum RF leakage. The switches include drivers compatible with TTL or CMOS. Frequency ranges from DC-2000 MHz with isolation over 75 dB are available.

Spec. Frequency MHz	Usable Frequency MHz	Part Number	Switching Speed Microsec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Package
SPST												
3-150	3-150	DS0111	.025	40	1.00	+6	1.25	+5	90	TTL	50	14 Pin DIP
10-200	5-400	DS0050	.025	50	1.5	+10	1.25	+5	100	TTL	50	14 Pin DIP
10-200	10-300	DS0235	.025	60	2.5	+16	1.25	+5	230	TTL	50 or 93	.750 Sq. 14 Pin
100-500	70-700	DS0141	.025	50	3.0	+17	1.4	+5	150	TTL	Open	14 Pin DIP
DUAL SPST												
45-75	10-1000	DS0343	1	60	1.5	+10	1.4	+5 −5.2	55 40	TTL	50	.800 Sq. 14 Pin
460-500	70-700	DS0321	1	60	1.5	+10	1.4	+5 −5	55 40	TTL	50	.800" SQ 14 Pin
3-SPST												
10-500	10-700	DS0031	2	50	1.0	+13	1.25	+5	90	TTL	Open	.380x.655 22 Lead Planar
SP2T												
1-100	1-150	DS0042-10	.04	60	1.0	+6	1.25	+5	100	TTL	Open	14 Pin DIP
3-300	1-500	DS0252	.015	45	1.5	+10	1.25	+5	170	TTL	50	14 Pin D DIP
5-500	5-500	DS0086	20	30	1.0	+15	1.25	+15	10	CMOS	50	14 Pin DIP
5-1500	5-1500	DS0074	5	35	1.5	+5	1.25	+12	4.5	CMOS	Open	14 Pin DIP
8-180	8-500	DS0175	100	45	1.4	+0	1.25	+15	5	CMOS	50	14 Pin DIP
10-150	10-500	DS0082	.3	50	1.0	+0	1.3	+5	70	TTL	50	14 Pin DIP
10-200	10-300	DS0042-100	.04	60	1.5	+6	1.4	+5	100	TTL	Open	14 Pin DIP
10-350	10-500	DS0108	.03	25	1.5	+15	1.25	+5	180	TTL	50 or Ground	14 Pin DIP
20-500	10-500	DS0047	1	40	1.0	+10	1.18	+5 −5	40 30	TTL	50	14 Pin DIP
20-500	10-500	DS0062	1	40	1.0	+10	1.18	+5 −5	40 30	TTL	50	.380x.655 22 Lead Planar
20-80	10-500	DS0112	5	55	.8	+20	1.25	+15	30	TTL	50	14 Pin DIP
20-180	10-500	DS0152	100	40	.7	+15	1.25	+15	8	CMOS	Open	TO-8
20-200	15-300	DS0049	1	40	1.0	+10	1.25	+5	120	TTL	Open	16 Pin DIP
20-300	20-500	DS0158	.03	25	1.25	+15	1.25	+5	130	TTL	50 or Ground	14 Pin DIP
20-1000	10-1000	DS0052	1	30	2.0	+10	1.25	+5 −5	25 15	TTL	50	14 Pin DIP
20-2000	20-2000	DS0352	1	20	2.5	+10	1.5	+5 −5	25 15	TTL	50	14 Pin DIP
30-85	30-85	DS0024	15	75	1.5	+10	1.2	+12	4	CMOS	Open	14 Pin DIP
40-80	30-300	DS0114	5	30	1.1	+10	1.3	+5	3	TTL	Open	.375 Sq. 14 Lead Planar
40-200	30-300	DS0022	.2	45	1.0	+10	1.2	+5	40	TTL	Open	14 Pin DIP
50-90	10-100	DS0083	5	60	1.2	+15	1.25	+15	5	CMOS	75	14 Pin DIP
50-140	10-500	DS0164	15	45	.7	+16	1.2	+15 −15	15 15	TTL	50	.375x.655 22 Lead Planar
50-300	50-500	DS0075	5	50	1.2	+20	1.25	+15	5	CMOS	50	14 Pin DIP
60-1500	40-1500	DS0068	20	40	1.3	+10	1.25	+12	8	CMOS	Open	14 Pin DIP
70-1000	10-1000	DS0320	.2	40	3	+10	1.5	+5	225	TTL	Ground	18 Pin D Dip
100-500	70-700	DS0142	.025	45	2.5	+17	1.5	+5	200	TTL	Open	16 Pin D DIP
160-500	160-500	DS0271	1	50	1.2	+10	1.25	+5 −5	11 6	TTL	50	14 Pin DIP .400 Pin Row
225-400	225-400	DS0332	.1	40	1.5	+10	1.3	+5	100	TTL	50	14 Pin DIP .400 Pin Row
225-590	225-400	DS0342	10	60	.5	+10	1.25	+5 −10	100 15	TTL	Ground	14 Pin DIP
250-450	10-500	DS0229	2	60	1.0	+10	1.25	+5 −5	— —	TTL	Open	14 Pin DIP .400 Pin Row
345-425	300-700	DS0189	10	40	1.0	+15	1.2	+15	8	CMOS	Open	TO-8
490-590	70-700	DS0322	1	60	1.5	+15	1.4	+5 −5	35 20	TTL	50	.800" SQ 14 Pin
500-2000	400-2000	DS0257	.4	35	1.5	+10	1.4	+5 −5	25 25	TTL	50	14 Pin DIP .400 Pin Rows
1197-1605	600-3000	DS0292	2	60	2	+10	1.4	+5 −5	10 10	TTL	50	18 Pin D DIP
2580-3700	2000-4000		.4	35	1.6	+22	1.5	+5 −5.2	18 8	TTL	Ground	.65 x 1.06 Planar

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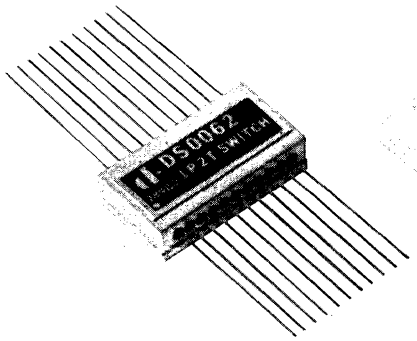
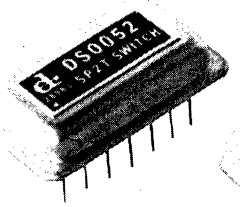
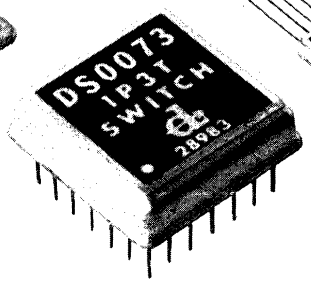
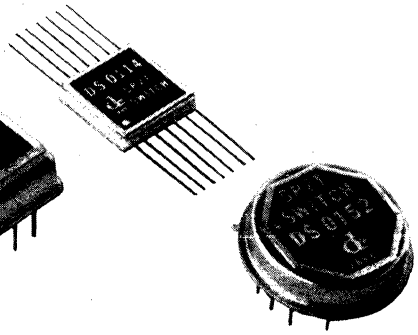
MIC SWITCHES DAICO









Spec. Frequency MHz	Usable Frequency MHz	Part Number	Switching Speed Microsec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Package
DUAL SP2T												
10-100	10-200	DS0241	.05	40	.8	+10	1.15	+5	200	TTL	50 or Ground	16 Pin D DIP
20-60	10-500	DS0020	100	50	1.0	+10	1.25	+15	4	CMOS	Open	16 Pin DIP
20-300	10-500	DS0043	50	30	1.0	+10	1.25	+15	8	CMOS	Open	16 Pin DIP
20-750	20-750	DS0017	1	30	1.3	+10	1.5	+5	120	TTL	Open	16 Pin DIP
SP3T												
20-80	20-250	DS0113	5	55	.8	+20	1.25	+15	40	TTL	Open	14 Pin DIP .400 Pin Row
50-500	30-700	DS0073	2	40	1.0	+10	1.25	+15	5	CMOS	50	.8 Sq. 24 Pin Plug In
250-460	100-600	DS0233	1	35	1.2	+20	1.25	+15	5	CMOS	50	.8 Sq. 24 Lead Plug In
250-500	250-500	DS0270	2.5	45	.8	+10	1.25	+15	5	CMOS	50	.8 Sq. 24 Lead Plug In
3500-4700	3500-4700	DS0311	.6	55	1.5	+10	1.3	+5 −5	40 30	TTL	Ground	.625 x .750 Planar
SP4T												
DC-12	DC-20	DS0294	10	50	1.2	+20	1.4	+10 −5	7 5	TTL	Open	18 Pin D DIP
10-500	10-500	DS0085	35	25	.8	+10	1.2	+15	6	CMOS	50	14 Pin DIP .400 Pin Row
10-100	10-150	DS0033	.2	50	.6	+10	1.25	+5	160	TTL	50	.8 Sq. 24 Lead Plug In
10-100	10-500	DS0221	20	35	1.0	+27	1.2	+5 −15	60 50	TTL	Open	16 Pin D DIP
10-100	10-500	DS0222	20	35	1.0	+27	1.2	+5 −15	60 50	TTL	Open	16 Pin D DIP
10-1000	10-1000	DS0238	10	45	1.5	+15	1.2	—	—	—	50	24 Pin D DIP
50-70	20-500	DS0078	1	60	1.0	+23	1.2	+5 −12	10 10	TTL	50	.8 Sq. 24 Lead Plug In
159-209	30-400	DS0014	.5	45	1.0	+10	1.25	+5 −5	35 30	TTL	50	1″ Sq. 13 Lead Planar
225-400	225-400	DS0304	.1	40	1.5	+10	1.3	+5	135	TTL	50	24 Pin D DIP
200-1500	200-1500	DS0069	20	20	1.1	+10	1.25	+12	5	CMOS	Open	.8 Sq. 24 Lead Plug In
510-570	50-600	DS0324	1	60	1.5	+15	1.4	+5 −5	75 45	TTL	50	24 Pin D DIP
500-2000	500-2000	DS0259	.4	35	1.5	+10	1.4	—	—	TTL	50	24 Pin D DIP
1900-4100	1900-4100	DS0298	3	50	1.1	+10	1.6	+5.1 −5	35 25	TTL	Ground	.625 x .750 Planar
SP5T												
645-795	10-800	DS0347	1	40	1.5	+10	1.3	+5 −5.2	65 40	TTL	50	38 Pin DIP .800 Pin Row
20-300	10-700	DS0028	1	40	1.0	+10	1.3	+5 −5	20 80	TTL	50	24 Pin D DIP
130-180	30-300	DS0018	100	40	1.0	+10	1.25	+5	10	CMOS	50	24 Pin D DIP
SP6T												
400-450	200-500	DS0208	1	36	2.5	+15	1.5	+5	400	TTL	Ground	38 Pin DIP .800 Pin Row
SP7T												
100-400	30-500	DS0137	100	40	1.5	+10	1.5	—	—	—	Open	16 Pin D DIP
SP8T												
20-1200	20-1200	DS0328	20	40	1.5	+10	1.35	+5 −15	40 15	CMOS	Ground	38 Pin DIP .800 Pin Row
25-520	10-700	DS0338	10	40	1.5	+10	1.35	+12	6	CMOS	50	38 Pin DIP .800 Pin Row
DUAL BY PASS												
450-550	30-700	DS0079	5	25	1.7	+10	1.25	+15	6	CMOS	N/A	14 Pin DIP
TRANSFER												
15-45	10-500	DS0097	10	50	1.0	+10	1.25	+5	20	CMOS	N/A	.8 Sq. 24 Lead Plug In
50-100	10-500	DS0110	10	50	1.0	+5	1.15	+12	30	CMOS	N/A	.8 Sq. 24 Lead Plug In
70-1000	50-1000	DS0319	10	40	1.5	+10	1.3	+15	15	CMOS	N/A	18 Pin D DIP

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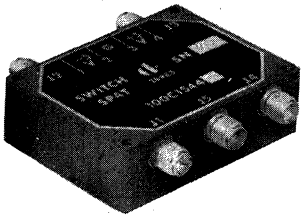
DAICO CONNECTORIZED SOLID STATE RF SWITCHES



The Solid State Connectorized Switches are available with SMA connectors. Units with BNC, TNC or N type connectors are offered on special order. Frequency ranges from DC-2000 MHz with switching speeds from 15 nanoseconds are obtainable. Switches with RF peak power to 3000 watts with reduced switching speed are also available. See page 1•1576 for High Speed and High Power Switches.

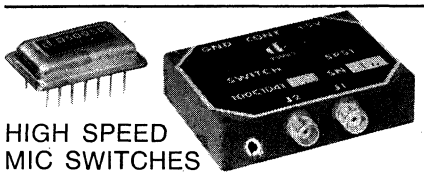
Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Connector	Size
SPST													
30-300	5-400	100D0581	2	50	.5	+10	1.25	+5 −5	45 15	TTL	50	SMA	1x1.5x.675
10-200	5-300	100C1041	.025	50	1.5	+10	1.25	+5	100	TTL	50	SMA	2x1.5x.5
10-500	10-500	100D0801	.8	60	1.2	+10	1.5	+5 −5	75 45	TTL	50 or open	SMA	1.5x1.5x.69
15-1000	15-1000	100C1291	20	60	1.5	+22	1.5	+10	3	CMOS	50	SMA	1x1.5x.9
20-300	20-800	100D0591	4	50	.7	+27	1.25	+15 −15	60 50	TTL	50	SMA	1x1.5x.675
20-300	10-200	100C1051	.035	55	2.0	+10	1.4	+5	200	TTL	50	SMA	2x2x.48
20-600	10-600	100C1281	.5	70	1.3	+13	1.25	+5	75	TTL	50	SMA	1x1.5x.72
SP2T													
DC-50	DC-50	100C1562	2	65	2.5	+25	1.35	+15 −15	10 20	TTL	50	SMA	2x3x1
1-100	1-100	100C1042	.015	60	.8	+8	1.2	+5	130	TTL	Open	SMA	1.5x1.5
1-100	1-200	100C1273	.03	60	1	+10	1.2	+5	100	TTL	Open	SMA	1.5x1.5x.5
2-500	2-600	100C1052	.04	40	1.5	+10	1.4	+5	160	TTL	50	SMA	2x2x.48
30-300	10-300	100D0582	2	50	1.0	+10	1.25	+5 −5	45 15	TTL	50	SMA	1x1.5x.675
10-300	10-700	100C1471	10	40	1.0	+10	1.2	+5	100	TTL	Open	SMA	1.5x1.69x.75
10-500	5-600	100D0802	.8	70	1.0	+10	1.2	+5 −5	40 25	TTL	50	SMA	2x1.5x.68
10-700	10-1000	100C1172	5	50	1.2	+20 Over 100 MHz	1.25	+15	20	CMOS	50	SMA	2x2x.48
20-2000	20-2000	100C1558	2	20	2.5	+10	1.5	+5 −5	25 15	TTL	50	SMA	1.5x2x.44
10-1000	10-1000	100C1182	10	35	1.0	+15	1.25	+15	5	CMOS	50	SMA	2x2x.48
15-1000	15-1000	100C1292	20	60	1.5	+22 Over 80 MHz	1.5	+15	3	CMOS	50	SMA	1.5x1.5x.6
20-300	20-800	100D0592	4	55	.7	+27	1.25	+15 −15	60 50	TTL	50	SMA	1.5x1.5x.78
20-600	10-700	100C1282	.5	70	1.2	+10	1.25	+5	50	TTL	50	SMA	1.5x1.5x.6
40-1000	30-1000	100C1102-HF	5	35	1.2	+10	1.25	+12	10	CMOS	50	SMA	2x2x.48
10-500	10-700	100C1102-LF	10	50	1.0	+10	1.25	+12	10	CMOS	50	SMA	2x2x.48
100-1400	100-1500	100C1032	10	40	.5	+43	1.3	+5 −5	160 160	TTL	Open	SMA, BNC, TNC	2.75x1.75x1
150-1500	100-2000	100C1244	1	45	.5	+30	1.3	+5 +15 −15	60 25 25	TTL	Ground	SMA	2.75x1.75x1
500-2000	300-2000	100C1515	.4	35	1.5	+10	1.4	+5 −5	25 25	TTL	50	SMA	1.5x1.5x.625
SP3T													
1-30	1-30	100C0624	5	65	.5	+10	1.25	+5 −15	60 30	TTL	50	SMA	1.5x1.5x.675
30-300	5-800	100D0583	2	50	.5	+10	1.25	+5 −5	65 40	TTL	50	SMA	1.5x1.5x.675
10-500	10-700	100D0803	.8	70	1.2	+10	1.5	+5 −5	100 100	TTL	50	SMA	2.5x1.3x.67
10-1000	10-1000	100C1293	20	60	1.5	+22 Over 80 MHz	1.5	+15	3	CMOS	50	SMA	2x1.5x.72
20-300	20-800	100D0593	4	55	.7	+27	1.25	+15 −15	75 50	TTL	50	SMA	2x1.5x.68
20-600	10-700	100C1283	.5	70	1.3	+10	1.25	+5	100	TTL	50	SMA	2x1.5x.72
250-1150	200-1500	100C1204	10	65	1.0	+10	1.25	+5 −5	40 45	TTL	50	SMA	3x3x1
SP4T													
.1-32	.1-32	100C1684	50	75	2.5	+27	1.2	+15 −15 +5	20 20 350	TTL	50	SMA	3.75 x 2 x 1.34
1-10	1-10	100C0794	30	95	1.0	+25	1.25	+12 −12	150 60	TTL	50	SMA with COM N	6x3x1
1-100	1-200	100C1021	10	80	.6	+5	1.2	+5 −5	200 50	TTL	50	SMA	3x3x1.03
30-300	5-500	100D0584	2	50	.5	+10	1.3	+5 −5	75 75	TTL	50	SMA	2x1.5x.68

DAICO INDUSTRIES, INC. / 2351 E. DEL AMO BLVD. / COMPTON, CA 90220 / (213) 631-1143 / TWX 910-346-6741

CONNECTORIZED SOLID STATE RF SWITCHES DAICO

Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Connector	Size
SP4T (Continued)													
10-300	10-700	100C1451	10	60	1.2	+15	1.2	+5 −5	100 100	TTL	50	SMA	3x3x1.125
10-500	10-700	100D0804	.8	70	1.6	+10	1.2	+5 −5	80 150	TTL	50	SMA	3x1.75x.67
10-1000	10-1000	100C1449	10	50	1.5	+15	1.3	+5 −5	100 100	TTL	50	SMA	3x3x1.125
10-1000	10-1000	100C1294	20	55	1.5	+22 Over 80 MHz	1.5	+10	3	CMOS	50	SMA	3x1.75x.6
20-80	10-700	100D1304	4	90	1.5	+20	1.3	+5 +15	25 30	TTL	50	SMA	3x1.79x.95
20-600	10-600	100C1284	.5	70	1.4	+10	1.25	+5	130	TTL	50	SMA	3x1.75x.6
20-300	20-300	100D0594	4	60	.7	+27	1.25	+12 −12	130 100	TTL	50	SMA	2.5x1.5x.69
30-1000	30-1000	100C1413	5	60	1.6	+10	1.3	+15	20	CMOS	50	SMA	3 x 1.75 x .6
500-2000	300-2000	100C1514	.4	35	1.5	+10	1.4	+5 −5	45 25	TTL	50	SMA	2x1.5x.625
DP4T													
20-200	10-200	100C1024	.05	55	.5	+10	1.25	+5	150	TTL	Open	SMA	3x1.5x.67
SP5T													
2-32	1-200	100C1215	110	45	.7	+17	1.5	+12 +5	220 20	TTL	50	BNC	5x3x1.375
30-300	5-400	100D0585	2	50	.5	+10	1.3	+5 −5	125 75	TTL	50	SMA	2.5x1.5x.675
10-1000	10-1500	100C1295	20	50	1.5	+22 Over 80 MHz	1.5	+15	3	CMOS	50	SMA	3.5x1.75x.6
20-500	15-500	100D0805	1	80	1.3	+10	1.3	+5 −5	40 30	TTL	50	SMA	3.5x1.75x.67
20-500	20-500	100D0970	2	40	1.0	+20	1.5	+5 −5	150 20	TTL	50	SMA	2.5x1.5x.675
20-600	10-700	100C1285	.5	60	1.8	+10	1.35	+5	175	TTL	50	SMA	3.5x1.75x.6
SP6T													
30-300	5-500	100D0586	2	50	.8	+10	1.4	+5 −5	150 90	TTL	50	SMA	3x1.5x.675
10-500	10-500	100D0826	4	70	2.0	+30	1.5	+15 −15	85 260	TTL	50	SMA	4.5x2.5x.95
10-1000	10-1000	100C1448	10	45	2.5	+15	1.3	+5 −5	200 150	TTL	50	SMA	5x4x1.3
15-1000	10-1000	100C1296	20	50	1.8	+22 Over 100 MHz	1.4	+15	20	CMOS	50	SMA	4x1.75x.6
20-600	20-600	100C1286	.5	70	2	+10	1.25	+5	175	TTL	50	SMA	4x1.75x.6
SP7T													
1500-2700	1500-2700	100D0696	10	40	2.5	+10	1.6	+5 −5	900 300	TTL	50	N	6x3.5x2.16
SP8T													
4-6	1-40	100C1348	.9	60	1.5	+3	1.25	+5	400	TTL	50	SMA	5x2.5x1
10-350	10-500	100C1188	5	70	1.3	0	1.5	+5 −5	200 300	TTL	50	SMA	6x3x.63
SP12T													
15-500	10-700	100D1450	10	55	2.0	+15	1.3	+5 −5	300 150	TTL	50	SMA	5x3x3.75
SP14T													
2-32	1-40	100D1247	20	40	1.2	+10	1.35	+5	1.5A	TTL	50	BNC	12x6x1.12
SP16T													
10-1000	10-1000	100D1447	10	45	3.0	+15	1.3	+8 −8	300 150	TTL	50	SMA	5x3x3.75
TRANSFER													
30-300	1-600	100C0587	2	50	.8	+10	1.3	+5 −5	90 90	TTL	N/A	SMA	2x1.5x.94
15-1000	10-1000	100C1297	20	70	1.2	+15 Over 70 MHz	1.25	+15	20	CMOS	N/A	SMA	2x1.5x.69
20-600	20-1000	100C1287	1	70	.8	+10	1.25	+5	80	TTL	N/A	SMA	2x1.5x.69

DAICO HIGH SPEED RF SWITCHES



HIGH SPEED MIC SWITCHES

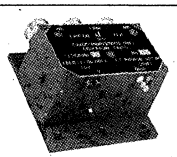
Diaco's High Speed Switches are available in both M.I.C. (Microwave Integrated Circuit) as well as connectorized form. Switching speeds as low as 15 nanoseconds are available. The M.I.C. units are packaged in hermetic DIP configurations, while the connectorized units have SMA connectors for convenient cable attachment.

Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Nanosec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Package
SPST												
3-150	3-150	DS0111	25	40	1.0	+6	1.25	+5	90	TTL	50	14 Pin DIP
10-200	5-400	DS0050	25	50	1.5	+10	1.25	+5	100	TTL	50	14 Pin DIP
10-200	10-300	DS0235	25	60	2.5	+16	1.25	+5	230	TTL	50	.750 Sq. 14 Pin Plug In
100-500	70-700	DS0141	25	50	3.0	+17	1.4	+5	150	TTL	Open	14 Pin DIP
SP2T												
1-100	1-150	DS0042-10	40	60	1.0	+6	1.25	+5	100	TTL	Open	14 Pin DIP
3-300	1-500	DS0252	15	45	1.5	+10	1.25	+5	170	TTL	50	14 Pin D DIP
10-200	10-300	DS0042-100	40	60	1.5	+6	1.4	+5	100	TTL	Open	14 Pin DIP
10-350	10-500	DS0108	30	25	1.5	+15	1.25	+5	180	TTL	50	14 Pin DIP
20-300	20-500	DS0158	30	25	1.25	+15	1.25	+5	130	TTL	50 or Ground	14 Pin DIP
100-500	70-700	DS0142	25	45	2.5	+17	1.5	+5	200	TTL	Open	16 Pin D DIP
DUAL SP2T												
10-100	10-200	DS0241	50	40	.8	+10	1.15	+5	200	TTL	50	16 Pin D DIP

CONNECTORIZED HIGH SPEED SWITCHES

Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Nanosec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Connectors	Size
SPST													
10-200	5-300	100C1041	25	50	1.5	+10	1.25	+5	100	TTL	50	SMA	2x1.5x.5
20-300	10-300	100C1051	35	55	2.0	+10	1.4	+5	200	TTL	50	SMA	2x2x.48
SP2T													
1-100	1-100	100C1042	15	60	.8	+8	1.2	+5	130	TTL	Open	SMA	1.5x1.5x.5
1-100	1-200	100C1273	30	60	1.0	+10	1.2	+5	100	TTL	Open	SMA	1.5x1.5x.5
2-500	2-600	100C1052	40	40	1.5	+10	1.4	+5	160	TTL	50	SMA	2x2x.48
DP4T													
20-200	10-200	100C1024	50	55	.5	+10	1.25	+5	150	TTL	Open	SMA	3x1.5x.67

DAICO HIGH POWER RF SWITCHES



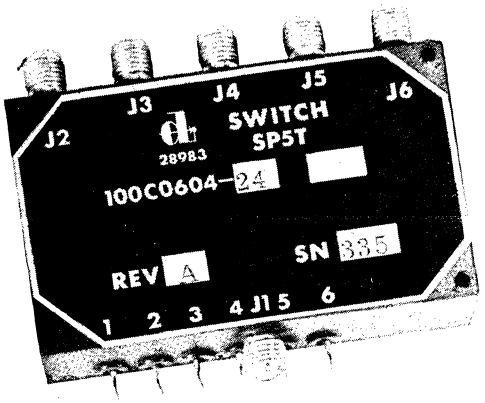
The Daico High Power RF Switches handle peak power to 3000 watts with CW power to 1000 watts. Frequency ranges from 1-2000 MHz are available. These High Power Diode Switches have been used successfully in numerous CW and pulse systems.

CONNECTORIZED HIGH POWER SWITCHES

Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Isolation dB Min.	Insertion Loss dB Max.	RF Power Watts CW	RF Power Watts Peak	VSWR Max.	DC Power Volts	DC Power mA	Control	Termination Ohms	Connectors	Size
SP2T														
20-80	15-150	100C1142	20	60	.25	1000	3000	1.15	+5 −300	250 15	TTL	Ground	N	4x5x2.75
20-100	10-200	100D1078	20	70	.5	250	500	1.15	+5 −15	350 15	TTL	Open	N	6x3x2.5
20-500	20-500	100C1592	10	55	.75	20	100	1.25	+5 −15	220 20	TTL	Ground	SMA	2.75x3x1.4
100-500	50-500	100C1492	30	45	.4	100	500	1.25	+5 −50	300 10	TTL	Ground	N	4x4.75x1.3
100-1400	70-1500	100C1032	10	40	.5	20	250	1.3	+5 −5	160 160	TTL	Open	SMA, NC, TNC	2.75x1.75x1
950-1225	925-1250	100C0932	10	23	.5	20	2000	1.25	+5 −15	65 25	TTL	Ground	N	3x4x1.38
1060-1100	1060-1100	100C1246	10	35	1.0	10	2000	1.4	+5 −70	300 5	TTL	50	SMA	3x3x1.12
SP4T														
1700-2000	1700-2000	100D1004	30	30	1.0	220	2000	1.4	+5 −150	700 4	TTL	Open	TNC	6x3.5x2.13
TRANSMIT/BY PASS														
225-400	225-400	100C1545	50	30	.15	600	2000	1.25	+5 −200	800 25	TTL	Open	TNC	7x5.25x2.5
TRANSMIT/RECEIVE														
Xmtr. 100-400 Rcvr.	100-400	100D1569	15	30 80	.2 .8	1000 .02	1500 10	1.25	125 VAC 400 Hz	100	Line Rcvr	Ground	SC TNC	5x6x3.16

RF RELAYS

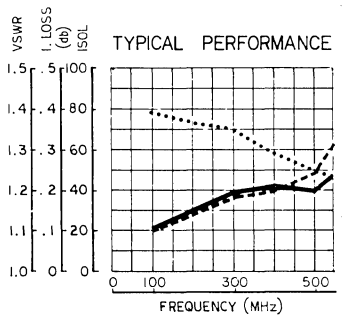
DAICO



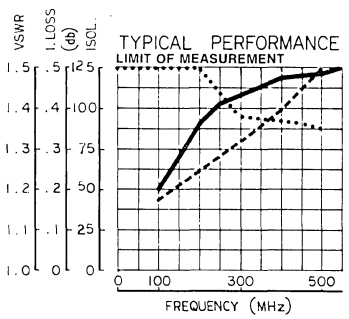
Daico Industries RF relays employ hermetically sealed switching elements which provide extreme resistance to the severe environments encountered in military aircraft and communications systems, including 20 g's vibration to 3 kHz, 80 g's shock and altitude in excess of 100,000 ft. A continual test and evaluation program assures switch performance in excess of 20 million operations. These units are operable at extremely low current levels and may be ordered with 6-, 12-, 18- or 24-volt coils.

LEGEND
..... Isolation
— — — — Insertion Loss
———— VSWR

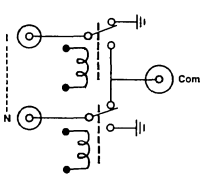
STANDARD



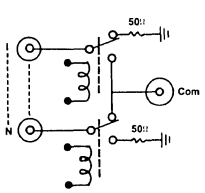
HIGH ISOLATION



RF RELAYS DC-500 MHz 50 watts cw SMA Connections SIZE MATRIX	SPST	SP2T	SP3T	SP4T	SP5T	SP6T	TRANS.
STANDARD		100C0073 1x1½x.56	100C0254 1½x1½x.63	100C0259 2x1½x.63	100C0604 2½x1½x.69	100C0605 3x1½x.69	100C0347 2x1½x.87
HIGH ISOLATION		100C0109 1½x1½x.63	100C0630 1½x1¾x1.5	100C0104 1½x1¾x1.5			100C0608 1¼x1¼x1.3
STANDARD 50 OHM TERMINATION	100C0610 1x1½x.55	100C0611 1½x1½x.63	100C0612 2x1½x.63	100C0613 2½x1½x.63	100C0614 3x1½x.63	100C0615 3½x1¾x.63	
HIGH ISOLATON & 50 OHM TERMINATION	100C0609 1x1½x.50	100C0350 1½x1½x.75	100C0285 2x1½x.75	100C0485 2½x1½x.75			



Switching Speed: 5 millisec. max
RF Power: 50W CW, 50W Peak
Drive Current: 24 mills nom. at 24 VDC. Other coils available include 6, 12, 18 VDC.



Units can be provided with Fail Safe (no power) to a through path.

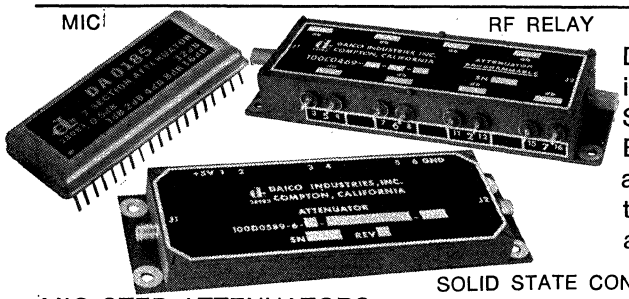
Can be operated directly from TTL with integrated circuit 75450 Dual Driver, 54 45 Decoder or equivalent.

ALSO AVAILABLE

Type	Part Number	Frequency	Isolation	Connector
SP2T	100C0878	DC-1250 MHz	45 dB	SMA
SP2T	100C0076	DC-400 MHz	45 dB	BNC or TNC
SP2T	100C0942	DC-100 MHz	70 dB	75 Ohm SMC
SP2T	100C1003	DC-1250 MHz	45 dB	SMA or BNC or TNC
SP3T	100C1015	DC-450 MHz	50 dB	BNC or TNC
SP4T	100C0954	DC-100 MHz	55 dB	75 Ohm TNC
SP4T	100C1423	DC-500 MHz	45 dB	BNC or TNC
SP6T	100C1026	DC-450 MHz	45 dB	BNC or TNC or SMA
SP7T	100C1094	DC-200 MHz	50 dB	SMA
SP8T	100C1159	DC-200 MHz	50 dB	SMA
2P4T	100C0368	DC-250 MHz	100 dB	SMA
14P2T	100D0872	DC-200 MHz	60 dB	SMA
14P4T	100D0873	DC-500 MHz	40 dB	SMA

DAICO INDUSTRIES, INC. / 2351 E. DEL AMO BLVD. / COMPTON, CA 90220 / (213) 631-1143 / TWX 910-346-6741

DAICO STEP ATTENUATORS



Daico's complete line of Programmable Step Attenuators include Thin Film M.I.C. (Microwave Integrated Circuits), Solid State Connectorized, as well as RF Relay Control. Binary steps from 1 through 10 are available with total attenuation values to 127 dB. Frequency ranges from DC to 2350 MHz are covered with switching speeds as low as 25 nanoseconds.

MIC STEP ATTENUATORS

Number of Steps	Available Range dB	Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Package
1	24	25-35	7-200	DA0130	.04	2	+10	1.2	+5	75	TTL	14 Pin DIP
1	24	25-35	10-100	DA0188	.05	3	+17	1.2	+5	100	TTL	14 Pin D DIP
1	4 or 8 or 16	50-500	50-500	DA0240	10	1.2	+10	1.15	+15	12	CMOS	TO-8
1	20	140-160	10-700	DA0091	5	1.2	+10	1.5	+15	5	CMOS	14 Pin DIP
1	20	200-240	50-500	DA0236	4	1.2	+10	1.2	+5	8	CMOS	TO-8
2	.25/40	20-250	20-250	DA0051	1	1.8	+10	1.25	+15	6.5	CMOS	14 Pin DIP
2	8-16	20-200	10-300	DA0147	.035	4	+17	1.25	+5	100	TTL	14 Pin D DIP
2	8-24	250-460	250-460	DA0230	25	2	+10	1.3	+15	10	CMOS	16 Pin DIP
4	2-30	10-100	10-100	DA0104	.05	5	+10	1.35	+5	240	TTL	38 Pin Plug In 1.998x.988
4	.1-1.5	20-40	20-300	DA0264	.05	5	+10	1.3	+5	175	TTL	24 Pin D DIP
4	1.6-24	20-40	20-300	DA0265	.05	5	+10	1.3	+5	165	TTL	24 Pin D DIP
4	.5-32.6	20-200	10-300	DA0146	.035	5	+17	1.25	+5	200	TTL	24 Pin D DIP
4	1-15	20-200	10-300	DA0145	.035	5	+17	1.25	+5	200	TTL	24 Pin D DIP
4	1.5-22.5	20-200	10-300	DA0129	.035	4	+20	1.3	+5	200	TTL	24 Pin D DIP
4	2-24	25-35	10-300	DA0181	.050	6	+17	1.2	+5	200	TTL	24 Pin D DIP
4	.5-7.5	25-35	10-300	DA0186	.050	6	+17	1.2	+5	200	TTL	24 Pin D DIP
4	8-32	25-35	10-300	DA0187	.050	6	+17	1.2	+5	200	TTL	24 Pin D DIP
5	.5-15.5	40-80	20-500	DA0245	20	5	+10	1.5	+5	10	CMOS	24 Pin D DIP
5	1-31	345-425	50-500	DA0178	15	6	+10	1.3	+5	6	CMOS	24 Pin D DIP
6	1-63	30-300	30-300	DA0204	1	4	+10	1.5	+5	250	TTL	38 Pin Plug In .998x1.988
6	1-63	40-150	10-700	DA0296	.050	8	+10	1.35	+5	500	TTL	38 Pin Plug in .998 x 1.988
7	.5-63.5	30-500	30-500	DA0285	20	6	+10	1.25	+5 to +15	30	CMOS	38 Pin Plug In .998x1.988
7	.5-63.5	30-500	30-500	DA0295	20	6	+10	1.25	+5	50	TTL	38 Pin Plug In .988x1.988

RF RELAY STEP ATTENUATORS

Number of Steps	Standard Range* dB	Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Millisec.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.		Connector	Size
2	16-48	DC-500	DC-500	100C1428	5	1	+20	1.2		SMA	1.5x1.5x.63
3	10-30	DC-1000	DC-1000	100C0994	5	.5	+33	1.4		SMA	2.75x2x.88
3	10-30	DC-1000	DC-1000	100C1511	5	.5	+33	1.4		SMA	2.75x2x.88
4	2-30	DC-500	DC-500	100D0809-4	5	3.5	+20	1.2		SMA, BNC, TNC	1.5x3.5x.88
5	1-31	DC-500	DC-500	100C1427	5	2	+20	1.2	RF Relay Attenuators Available With 6, 12, 18, or 24 Volt Coils	SMA	3x1.5x.63
6	1-63	DC-200	DC-400	100C0469 6 Bit	5	2.5	+20	1.3		SMA	1.75x5.75x.88
7	.5-63.5	DC-200	DC-400	100C0469 7 Bit	5	2.5	+20	1.3		SMA	1.75x5.75x.88
7	1-63	DC-400	DC-400	100C0712	5	3.5	+20	1.25		SMA	1.75x5.75x.88
8	1-127	DC-200	DC-400	100C0469 8 Bit	5	2.5	+20	1.3		SMA	1.75x5.75x.88
9	1-106	DC-15	DC-15	100C1403 TTL Control	5	.8	+33	1.2		BNC	5.75x1.75x1.25
10	1-111	DC-500	DC-500	100C1426	5	3.5	+20	1.3		SMA	4.25x1.5x2.25

SOLID STATE CONNECTORIZED STEP ATTENUATORS

Number of Steps	Standard Range* dB	Spec. Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Connector	Size
2	3-9	20-300	20-500	100D0589-2	1	1	+13	1.35	+5	70	TTL	SMA	1.75x2.5x.5
4	2-24	25-35	10-300	100C1418	.05	6	+17	1.2	+5	250	TTL	SMA	2x1.5x.53
4	1-15	20-300	20-500	100D0589-4	1	2	+13	1.35	+5	140	TTL	SMA	1.75x3.75x.5
6	1-63	20-300	20-500	100D0589-6	1	3	+13	1.35	+5	210	TTL	SMA	1.75x5.25x.5
6	1-63	200-400	200-400	100C1513	1	10	+20	1.35	+5	60	TTL	SMA	10x3.25x1.06
6	1-63	1128-2350	1128-2350	100D1071	.5	10	+10	1.5	+5	1 Amp	TTL	SMA	7x6.5x2.19
7	.5-63.5	30	10-300	100D1350	.025	12	+16	1.2	+5	500	TTL	SMA	1.75x3.5x.4
7	.5-63.5	30-500	20-1000	100C1585	20	6	+13	1.35	+5 to +15	25	CMOS	SMA	1.75x3x.54
7	.5-63.5	30-500	20-1000	100C1595	20	6	+13	1.35	+5	50	TTL	SMA	1.75x3x.54
8	.5-63.5	20-300	20-300	100D1438	1	3.5	+13	1.3	+5	300	TTL	SMA, BNC, TNC, N	6x3x1.18

* In addition to the standard ranges listed, most attenuators available with the following pad values: .1, .2, .4, .5, .8, 1, 1.6, 2, 3.2, 4, 6.4, 8, 12.8, 16, 32.

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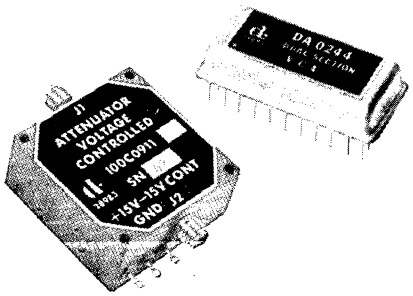
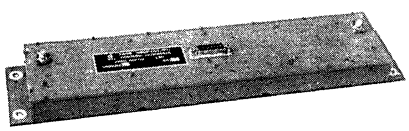
VOLTAGE CONTROLLED ATTENUATORS DAICO



The Daico Voltage Controlled Attenuators are available both as M.I.C. (Microwave Integrated Circuits) as well as in Solid State Connectorized form. Linearity of ±.75 dB from best straight line is achieved with frequency ranging from 10 to 1300 MHz. Constant impedance of 50 ohms is maintained at input and output ports over full attenuation range. VSWR over band is 1.25 typical.

Atten. Range dB	Spec. Freq. MHz	Usable Freq. MHz	Part Number	Control Volts DC	Atten. Slope dB/Volt	Slew Rate dB/ Microsec.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	Linearity dB	DC Power Volts	DC Power mA	Connector	Size
MIC VOLTAGE CONTROLLED ATTENUATORS														
20	20-700	20-700	DA0035	0 to +5	6.5	6	1.5	+10	1.25	±.8	+15 −15	25 25	—	14 Pin DIP
30	558-568	30-1300	DA0260	0 to +5	7	3	5	+10	1.7	±2	+15 −15	60 80	—	1x1 Planar 13 Leads
35	25-37	20-300	DA0308	0 to +5	15	4.5	9	+10	1.25	±.5	+15 −15	40 50	—	14 Pin DIP .400 Pin Rows
40	20-300	20-500	DA0098	0 to +5	15	6	2	+10	1.35	±2	+15 −15	40 50	—	14 Pin DIP .400 Pin Rows
40	50-1300	50-1300	DA0243	0 to +5	13	3	3.5	+10	1.5	±2	+15 −15	60 80	—	1x1 Planar 13 Leads
Dual Section 20/Section	80-120	80-120	DA0138	0 to +5	6.5	6	1	+10	1.25	±1	+15 −15	40 60	—	28 Pin Plug In .58x1.18
Dual Section 20/Section	80-120	80-120	DA0244	0 to +5	6.8	6	1	+10	1.25	±.75	+15 −15	60 80	—	28 Pin Plug In .58x1.18
SOLID STATE CONNECTORIZED VOLTAGE CONTROLLED ATTENUATORS														
20	20-700	20-700	100C0911	0 to +5	6.5	6	1.5	+10	1.25	±1	+15 −15	25 25	SMA	1.5x1.5x.69
40	20-300	20-700	100C0912	0 to +5	15	6	2	+10	1.35	±2	+15 −15	40 50	SMA	2x1.5x.75
40	50-1300	50-1300	100C1521	0 to +5	13	3	3.5	+10	1.5	±2	+15 −15	60 80	SMA	1.5x2x.43
Dual Section 20/Section	80-120	80-120	100C1522	0 to +5	6.5	6	1	+10	1.25	±.75	+15 −15	60 80	SMA	1.5x2x.54
60	60	10-200	100C1463	0 to +5	19.5	6	3	+20	1.5	±4	+15 −15	75 85	SMA	3x2.38x.75

DAICO PHASE SHIFTERS



Daico's Phase Shifters utilize either solid state or RF relay switching. Steps from 1 through 9 are available, allowing from 1.41° to a full 360° phase shift. Switching speed as low as 50 nanoseconds are obtainable.

Number of Steps	Available Range	Center Freq. MHz	Usable Freq. MHz	Part Number	Switching Speed Microsec.	Insertion Loss dB Max.	RF Power dBm	VSWR Max.	DC Power Volts	DC Power mA	Control	Connector	Size
SOLID STATE CONNECTORIZED													
1	180°	60	40-80	100C1146	5	1.3	+7	1.2	+5	40	TTL	SMA	2x1.5x.94
1	180°	350	100-500	100C1157	10	.8	+37	1.3	+5 −15	200 5	TTL	SMA	2.5x2.5x1
6	5.63-354.8	660	640-680	100C0792	5	4	+12	1.2	+5	250	TTL	SMA	3x3x.72
6	5.63-354.8	fo	20-300	100D0896	4	4	+10	1.5	+5	375	TTL	SMA, TNC, BNC	11.5x3x1.13
7	2.81-357.2	1080	960-1215	100C1140	.5	4	+10	1.7	+5 −5	90 90	TTL	SMA	9x6x1.5
8	1.41-358.61	fo	20-300	100D0898	4	5	+10	1.5	+5	375	TTL	SMA	3x14.5x1.13
8	1.41-358.61	60	55-65	100D1187	.05	14.4	+10	1.5	+5	1.45A	TTL	SMA	3x14.5x1.13
RF RELAY					**Millisec**								
8	1.41-358.61	fo	30-300	100D0888	5	3	+20	1.3	RF Relay Phase Shifters Available With 6, 12, 18, or 24 Volt Coils			SMA	14.5x3x1.13
9	1.41-360	70	65-75	100D1433	5	3	+20	1.2				SMA	14.5x3x1.13

DAICO INDUSTRIES, INC. / 2351 E. DEL AMO BLVD. / COMPTON, CA 90220 / (213) 631-1143 / TWX 910-346-6741

DAICO QUALITY ASSURANCE

INTRODUCTION

Daico Industries, Inc., founded in 1967, is a leader in the DC-2 GHz field of M.I.C.'s, Connectorized Solid State Switches, RF relays and both Digital and Voltage Controlled Attenuators.

Daico engineers, inspection, production, sales and service people are highly experienced and understand your requirements as well as the capabilities of Daico Industries. You can talk to us and get realistic answers. Our production and computer test equipment combined with our quality assurance procedures provide the necessary base to meet your most stringent requirements. We offer quality products at competitive prices. For a prompt response to your needs contact our local representative or the factory directly.

ENGINEERING

Daico Industries, Inc. places major emphasis on our engineering department. The talents of our RF design engineers are not only supported by qualified technicians with the full-time use of a Hewlett Packard Automatic Test and Evaluation System, but desk top computers as well.

Our three Hewlett Packard desk top computers allow the optimum design to be realized at a fraction of the time it would take to obtain the same results manually. The ATE (Automatic Test and Evaluation System) combined with Daico software allows the production tests to be run accurately and quickly, with minimal chance of operator error.

Prior to any job going into production, breadboard units are built and evaluated by engineering. All changes are thoroughly evaluated before being released to production.

The emphasis and care Daico Industries, Inc. places on the engineering aspects of your job results in the best and most economical approach to meet your requirements.

ELECTRICAL PRECAUTIONS

For a device to operate properly, the body must be connected to RF ground and with a M.I.C. device, the body and unused pins must both be grounded.

All unused ports of a switch should be terminated in 50 ohms to obtain optimum characteristics of the unit.

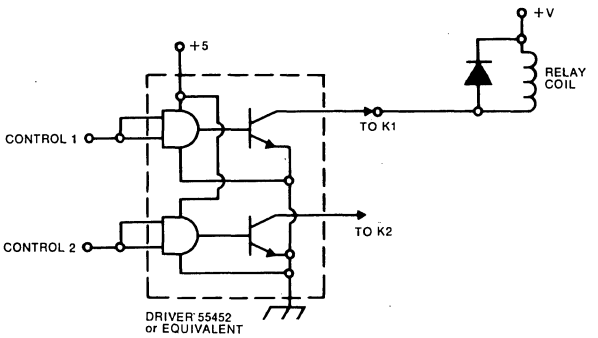
If a control line is to be at logic "0", it must be grounded.

The low current CMOS device drivers are static sensitive and precautions must be exercised to prevent driver damage.

Excess voltage, wrong polarity, or spikes on the DC supply or control lines may damage the device.

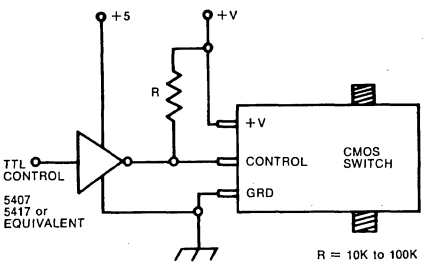
Only devices specified as having an all OFF or center position off condition may have all ports OFF. Most devices require one port to be ON at all times for proper operation.

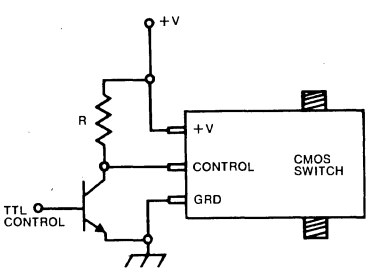
Specifications are applicable from 0°C to +71°C. Some derating of performance may occur when operated over the MIL temperature range of −55°C to +125°C.



RF RELAY DRIVERS

To drive Daico's RF relay switches, attenuators, or phase shifters, using TTL logic, the above is suggested. The driver is a dual section which allows one device to control two relays.





TTL TO CMOS INTERFACE

To switch CMOS Switch control lines with open collector TTL, the above is suggested to avoid damaging the CMOS Driver.

PERFORMANCE NOTES DAICO

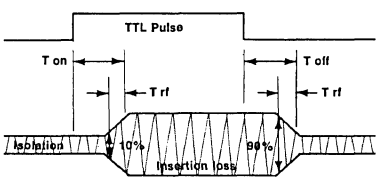
SPECIFICATION FREQUENCY vs. USABLE FREQUENCY

Although a device is designed for optimum characteristics over a specified frequency, the part is functional with slight performance reduction over a broader frequency range. This broader band is the Usable Frequency.

SWITCHING SPEED

A review of the adjacent figure will reveal that the switching time T_{on} is measured from the 50% point of the leading edge of the square wave control (TTL, CMOS or ECL) to the 90% point of the leading edge of the resultant RF envelope. Similarly, T_{off} is measured from the 50% point of the trailing edge of the square wave control pulse to the 10% point of the trailing edge of the resultant RF envelope. Switching speed is defined as the greater of these two values.

Of specific interest is the RF switching envelope which is defined as T_{rf} from 10-90% of the RF envelope. Systems requiring excessively high speed operation occasionally program the switch operation with a delay or anticipatory circuit to be able to accommodate only the T_{rf}. Values of five nanoseconds are readily available.



TRANSIENTS

During the switching of one part to another, video transients are incurred with characteristics that are occasionally disturbing to RF components following the switch. Daico Industries has over the years developed balanced designs which will provide less than 10-15 millivolts of in-band transients at switching speeds (T_{rf}) of 5-10 nanoseconds. Where lower transients are required during the switching period, it is recommended that slow switching speeds be tolerated or discussed with the manufacturer.

ISOLATION

The minimum isolation in dB is the worst case condition over the specification frequency between any two ports, with all other ports terminated in 50 ohms.

INSERTION LOSS

Insertion loss is defined as the worst case path loss between the input port and any output port in the "ON" state with all other ports "OFF" and terminated in 50 ohms. Insertion loss for attenuators is measured with zero or minimum attenuation level from the input to output and is as the reference level for all attenuation values.

NOISE FIGURE

Experience has shown that the Noise Figure (N.F.) of a switch may be assumed to be equal to the Insertion Loss. This assumption can be made without introducing substantial error.

RF Power

The RF power level (measured in dBm) is the level of CW input power that results in not more than 0.1 dB compression at the output. The maximum RF power level is also the maximum signal level at which the device will meet all RF specifications.

VSWR

The maximum VSWR in a 50 ohm system applies only to the thru condition, unless otherwise specified. Devices with open or short to ground terminations exhibit total refection.

DC POWER

The typical current for the maximum regulated DC supply voltage is listed. Exceeding the DC voltage may damage the device.

CONTROL

The driver control circuitry is listed as either TTL or CMOS. TTL devices may be driven directly from system TTL outputs. 5 volt CMOS devices may be driven directly from system TTL outputs with a pull up resistor to +5 volts. Hi-voltage CMOS devices (8 to 15 volts) may be driven with TTL using a pull up resistor to VCC with an open collector transistor, or the 5400 series of Hi-voltage TTL compatible buffers. CMOS control lines should be pulled up to VCC to prevent possible damage to internal drivers.

RF relays may be made TTL compatible using the SN55450 series of relay drivers.

TERMINATION

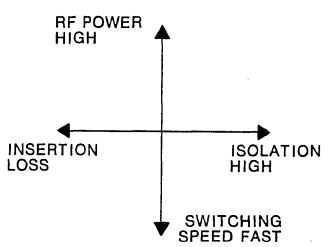
Internally terminated switches are so defined.

PACKAGE OR SIZE

The outline configuration is given in inches or standard DIP configurations. The DIP package has .100″ pin spacings with .300″ pin rows. A DDIP has .600″ pin rows.

CUSTOM/OPTIMIZED DESIGNS

Daico Industries' engineering department welcomes your inquiry regarding special applications or optimized designs. An approximate guide regarding trade-offs are presented in the attached figure, i.e., high power means lower switching speed: high isolation suggests higher insertion loss.

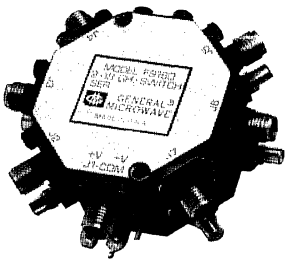


EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

PIN DIODE CONTROL DEVICES FROM GENERAL MICROWAVE

PIN Diode Switches

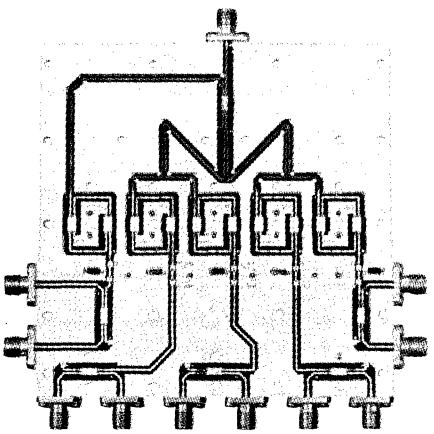


General Microwave's complete line of high performance broadband switches, with and without integral drivers, are available in three basic series.

- Ultra Broadband Series: 0.2 to 18 GHz, SPST to SP5T
- Multi Octave Band - Miniature Series: 0.2 to 4 GHz (Series 92) 2-18 GHz (Series 91); SPST TO SP7T
- Octave Band - High Speed Series: 10 nsec switching speed, 2-18 GHz; SP2T

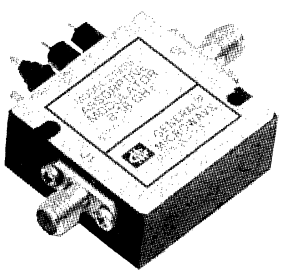
Many models of each type are available to satisfy most requirements. Non-reflective switches, space qualified units and other special designs are also available.

MIC Assemblies



General Microwave MIC assemblies can combine: • Frequency Translators • High Speed Digitally Controlled Attenuators • Power Combiners and Dividers • High Speed Switches • Mixers • Amplifiers • Isolators • Directional Couplers • Phase Modulators • Filters and other signal conditioning and processing devices.

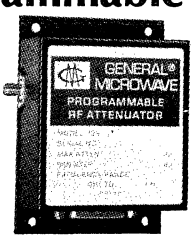
PIN Diode Modulators/ Attenuators



General Microwave's Series of PIN diode modulators/attenuators provide octave-band and greater than octave-band performance from 0.5 to 18 GHz. All at low cost.

Series	Bandwidth	Atten. Range (dB)	Control
D195	Octave	60	Linear Voltage
D196	Multi-octave	60	Linear Voltage
195	Octave	60	Current
M180	Ultra-broadband	60	Linear Voltage

Digitally Programmable PIN Diode Attenuators

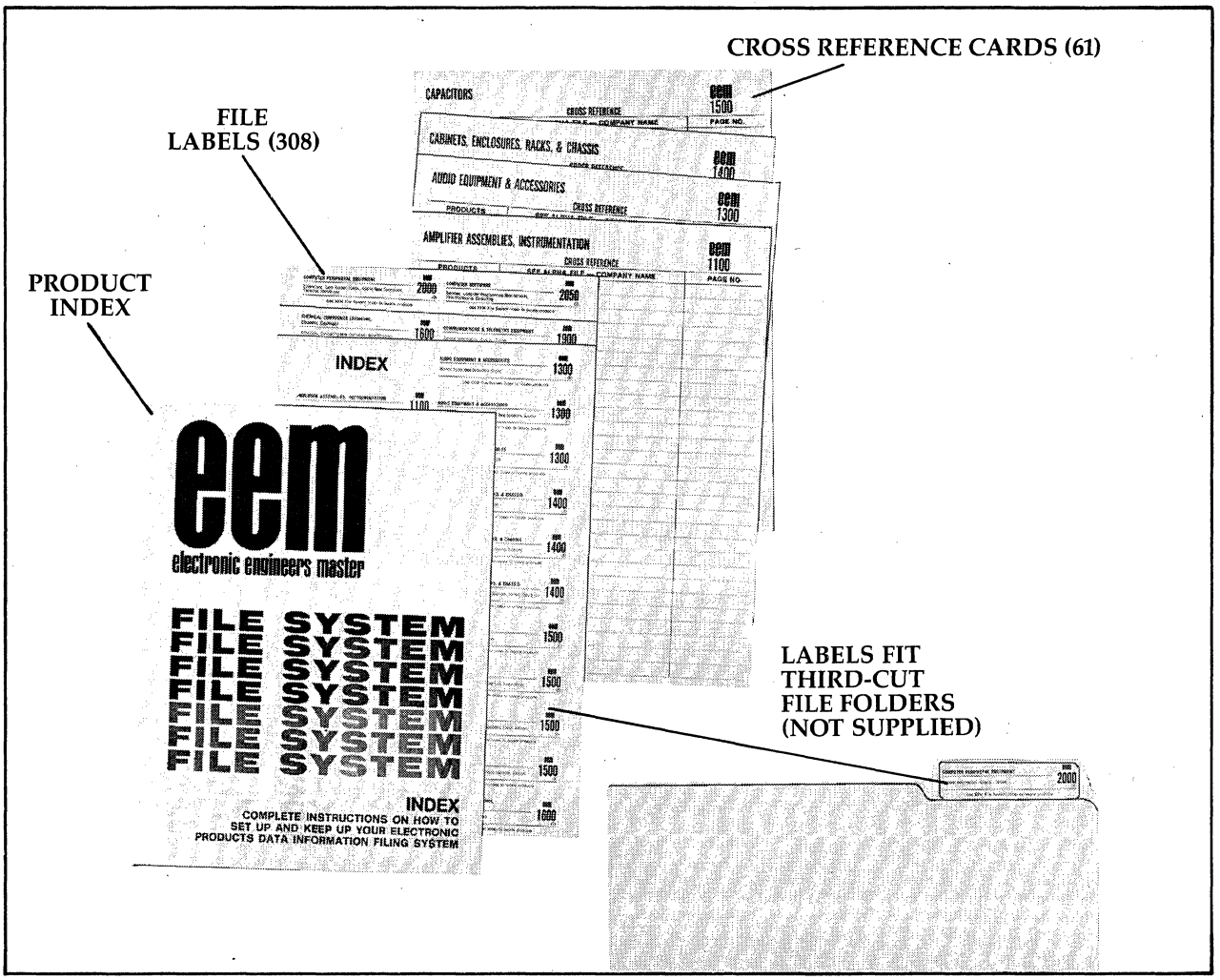


General Microwave's Series of Digitally Programmable PIN Diode Attenuators provide octave-band and greater than octave-band performance from 0.2 to 18 GHz with wide programming flexibility. All at low cost. Their compact, rugged packages are well suited to military applications. They are available in drop-in module type configurations and hermetically sealed packages. Nanosecond switching speed modules are also available.

Series	Bandwidth	Atten. Range (dB)	LSB (dB)
329	Octave	80&120	0.1
345	Octave	60	0.25
346	Multi-octave	60	0.25
325	Ultra-broadband	120	1.0

GENERAL MICROWAVE

155 Marine Street, Farmingdale, L.I., New York 11735, Tel: 516-694-3600



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

HIGH QUALITY ATTENUATORS!

Kay switch attenuators are constructed with patended switches using teflon housings and gold plated silver contacts. These high quality switches have been field proven for over 10 years. All Kay attenuators are equipped with precision resistors.

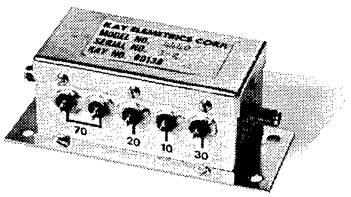
Kay rotary switch attenuators are gold plated printed circuit contact with dual contacts at each connector. This design provides superior electrical contact.

Kay has designed over 200 special attenuators for OEM applications using our extensive design capabilities. We can adapt our current line to fit specific requirements.

Please call or write for our complete attenuator catalog.

OEM PROGRAMMABLE ATTENUATORS

- LOGIC ADAPTORS AVAILABLE



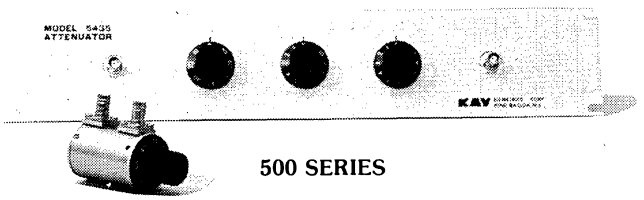
4000 SERIES

IMP. Ω	MODEL	FREQ. RANGE	ATTEN. RANGE
50	4440	DC-1.5GHz	0-130dB in 10dB steps
75	4447	DC- 1GHz	0-130dB in 10dB steps
50	4450	DC-1.5GHz	0-127dB in 1dB steps
75	4457	DC- 1GHz	0-127dB in 1dB steps
50	4460	DC-1.5GHz	0- 31dB in 1dB steps
75	4467	DC- 1GHz	0- 31dB in 1dB steps
50	1/4450	DC- 1GHz	0-16.5dB in .1dB steps
75	1/4457	DC-750MHz	0-16.5dB in .1dB steps

OEM STEP ATTENUATORS

- HIGH RELIABILITY
- DUAL CONTACT

5400 SERIES



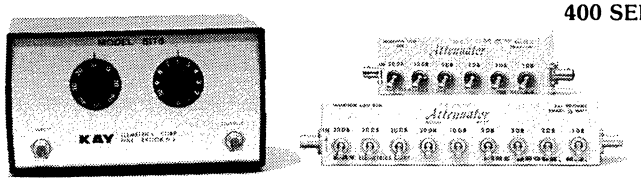
500 SERIES

IMP. Ω	MODEL	FREQ. RANGE	ATTEN. RANGE
50	500	DC- 2GHz	0-10dB in 1dB steps
50	1/500	DC- 1GHz	0- 1dB in .1dB steps
75	510	DC-1.5GHz	0-10dB in 1dB steps
75	1/510	DC-500MHz	0- 1dB in .1dB steps
50	520	DC- 2GHz	0-70dB in 10dB steps
75	530	DC-1.5GHz	0-70dB in 10dB steps
50	5435	DC- 1GHz	0-81dB in .1dB steps
75	5445	DC- 1GHz	0-81dB in .1dB steps
50	5436	DC- 2GHz	0-80dB in 1dB steps
75	5446	DC-1.5GHz	0-80dB in 1dB steps

BENCH STEP ATTENUATORS

- HIGH ACCURACY
- POSITIVE REPEATABILITY
- COMPACT DESIGN

400 SERIES

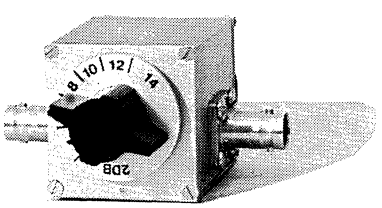


5000, 5100 SERIES

IMP. Ω	MODEL	FREQ. RANGE	ATTEN. RANGE
50	5050	DC- 1GHz	0- 81dB in .1dB steps
75	5075	DC- 1GHz	0- 81dB in .1dB steps
50	5150	DC- 2GHz	0- 80dB in 1dB steps
75	5175	DC-1.5GHz	0- 80dB in 1dB steps
50	430	DC- 1GHz	10- 51dB in 1dB steps
50	431	DC- 1GHz	0- 41dB in 1dB steps
50	432	DC- 1GHz	0-101dB in 1dB steps
50	1/432	DC-500MHz	0-22.1dB in .1dB steps
50	437M	DC- 1GHz	0-102.5dB in .5dB steps
50	438M	DC- 1GHz	0- 41dB in 1dB steps
50	439M	DC- 1GHz	0-101dB in 1dB steps
50	1/439M	DC- 1GHz	0-22.1dB in .1dB steps
75	441	DC- 1GHz	0- 41dB in 1dB steps
75	442	DC- 1GHz	0-101dB in 1dB steps
75	1/442	DC-500MHz	0-22.1dB in .1dB steps
75	447	DC- 1GHz	0-102.5dB in .5dB steps
75	449M	DC- 1GHz	0-101dB in 1dB steps
75	1/449M	DC-500MHz	0-22.1dB in .1dB steps
50	460M	DC- 1GHz	0-132dB in 1dB steps
75	470M	DC- 1GHz	0-132dB in 1dB steps

90 Ω ALSO AVAILABLE *M - MINIATURE

CONTINUOUSLY VARIABLE ATTENUATORS

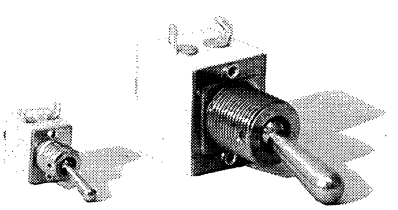


0/400, 0/410 SERIES

0/400 DC-500MHz 1-13dB
0/410 DC-400MHz 2-14dB

R.F. MEGA SWITCHES

- DC-1000 MHz
- LOW INDUCTANCE, CAPACITANCE & RESISTANCE



254 SERIES

0.15pf Between switch arms
0.1pf Between open contacts and switch arm

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13 Maple Avenue
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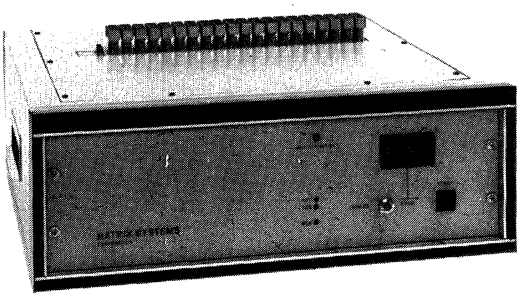
COAXIAL SWITCHING SYSTEMS

PORTABLE PROGRAMMABLE COAXIAL SWITCHING SYSTEM



Model 2450 is a unique switching system incorporating provisions for controlling up to ten 7000 Series Coaxial/Twinaxial relays from the IEEE-488 Bus, or from RS-232C Serial, or from 8 and 16 bit parallel inputs. Front panel manual control is standard.

Up to 200 coaxial switchpoints located on the top of the unit offer the user easy accessibility. These can be configured into a 10 x 20 matrix, for instance, using ten matrix model 9410 push-on cross straps.

See relay module specifications on adjacent page.

Switchpoints can also be configured as a 1 x 200 scanner/multipler or a variety of multiple multithrow configurations by merely changing the positions of the push-on cross straps.

The user may purchase a few relay modules to start with and easily add additional modules in the field any time in the future.

The 2450 will accept all eight 7000 series relay styles and all options listed shown on the matrix 7000 series data sheet. Note that the number of matrix positions is standardized at twenty. On special order the 20 positions can be electrically divided into several sub-sections (ie: three separate six throw relays, etc.)

The front panel manual thumbwheel controll allows the operator to switch from remote to local control and set or reset any switchpoint manually without disturbing any other point settings. The "SWITCHPOINT SET" indicator on the front panel verifies that the unit is receiving commands and that one or more points is set.

If more that two hundred switchpoints are required, the system can be expanded by adding another Model 2450 and specifying expander option on the relays, cross straps, or both. For instance, two Model 2150's, each configured as a 10 x 20 matrix can be expanded to either a 20 x 40 or a 10 x 40 configuration.

When ordering a system, specify the quantity and model number of the relays and cross straps desired. One Model 2194 control card and cable assembly is required for each relay. Choose the 2450 for your portable and test switching needs.

SPECIFICATIONS

CAPACITY:	One to ten 7000 Series 20-Throw Coaxial relays. (User must specify type and quantity.)
REMOTE CONTROL:	IEEE-488 GP-IB is standard. Specify -R for RS-323C or -M for 8/16 bit microprocessor control.
MANUAL CONTROL:	Front panel BCD Thumbwheel switches are standard.
OPERATING TEMPERATURE:	0°-70°C
LINE VOLTAGE:	105-125 VAC
LINE FREQUENCY:	47 to 63 Hz
SIZE:	7"H x 19.2"W x 18.6"D

Matrix Systems Corporation manufactures a variety of Switching Devices. Whether you are Switching VHF, Video, Pulse or Audio or your control requirements are programmable or manual. Give us a call. We specialize in specials. (213) 992-6776

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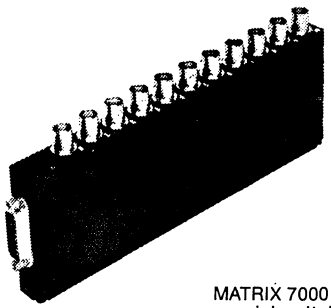
COAXIAL RELAY MODULE



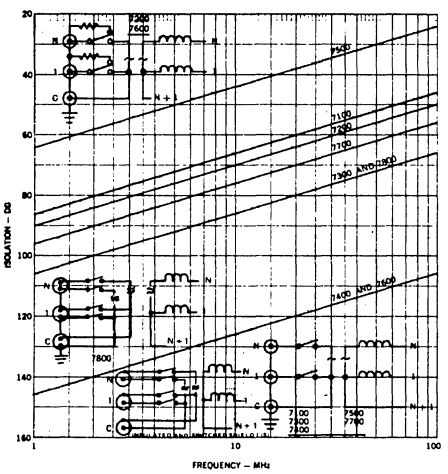
FEATURES

- Two to twenty throws
- Continuous shield continuity
- Rugged machined aluminum housing
- Crosstalk always less than isolation
- Switchpoints individually field replaceable
- Extremely low EMI
- Low VSWR
- Maitrix configuration easily assembled using 9000 series cross straps
- Signal circuits isolated from control circuitry

MATRIX 7000 Series Switch Modules are designed to maintain coaxial switching continuity over a wide range of critical and high environmental applications. The switch housings are constructed on precision machined aluminum alloy for structural integrity and hard anodized for durability. All signal shield paths are silver plated with covers gasketed for maximum EMI protection. The basic reed switch elements are hermetically sealed in nitrogen filled gas envelopes and employ rhodium plated contacts to insure non-stick operation. Applications for MATRIX 7000 Series include:

— R.F. and I.F. switching where a low VSWR is required .
— CCTV, base band video and pulse switching where low phase distortion and high pulse fidelity are required.
— Applications requiring a high degree of shielding integrity and low contact and induced noise such as pre amp input switching or the switching of high impedance operational amplifier inputs.

Matrix and hybrid switching systems are easily constructed by using Series 9000 (no output), 9100 (one output) or 9200 (two output) push-on cross straps which mate with the BNC connectors on the switch modules. The cross strap output connectors are BNC female type UG 1094/U. The model number of the cross strap is assigned by replacing the two zeros of the series number with the number of inputs desired. For example, a Model 9108 has eight inputs and one output.



SERIES 7000

7100— Standard
7200— Self-terminating
7300— High isolation
7400— Highest isolation
7500— High power
7600— Highest isolation self-terminating
7700— Mercury wetted contacts
7800— Twinax

MODEL NUMBER ASSIGNMENT

7 X XX -X

Series

Number of throws

Coil suppression diodes — D
TNC connectors — T
Self-terminating resistance — ohms
Insulated shield — I
Insulated and switched shield — IS
Expander output — E

Many of the above options may be combined

SPECIFICATIONS

FREQUENCY RANGE:	0 - 300MHz
CHARACTERISTIC IMPEDANCE:	50 ohms - 75 ohm optional
SWITCHING CONFIGURATION:	Single or double pole, two thru twenty throws
SWITCHING SPEED:	Less than one millisecond
ISOLATION:	See graph
CONTROL - CONNECTOR:	28 VDC,30 MA D type - subminiature connector
SIGNAL CONNECTOR:	BNC - UG1094/U, TNC and SMA optional
OPERATING TEMPERATURE AND HUMIDITY RANGE: −30°F to + 150°F, 0 to 98 percent R.H.	
OPERATING SHOCK AND VIBRATION:	50 G's -1MS,2G's p-p 20-2000 Hz
DIMENSIONS:	.625" W × 3.25" H × 1.44" + .625" × Number of throws
MOUNTING:	Three 6-32 tapped holes in base

	7100	7200	7300	7400	7500	7600	7700	7800
CONTACT RATING:	100 vdc .250 amp 10 W	28 vdc .250 amp 3 W	100 vdc .250 amp 10 W	28 vdc .250 amp 3 W	400 vdc 1 amp 15 W	28 vdc .250 amp 3 W	100 vdc 20 amp 50 W	100 vdc .250 amp 10 W
CONTACT RESISTANCE:	.150ohm	.300ohm	.300ohm	.300ohm	.060ohm	.300ohm	.050ohm	.300ohm

Matrix Systems Corporation manufactures a variety of Switching Devices. Whether you are Switching VHF, Video, Pulse or Audio or your control requirements are programmable or manual. Give us a call. We specialize in specials. (213) 992-6776

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

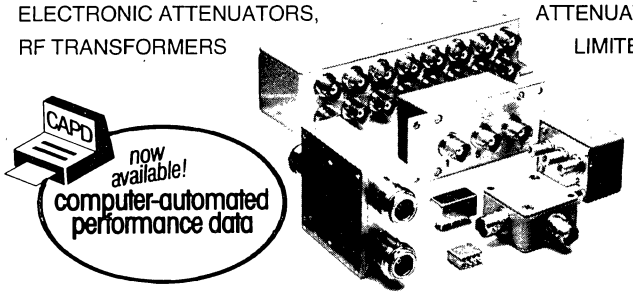
Y

YIG yttrium iron garnet

IMMEDIATE DELIVERY

RF signal processing components

DOUBLE BALANCED MIXERS, MICROWAVE MIXERS, MICROWAVE POWER DIVIDERS, POWER SPLITTER/COMBINERS, ELECTRONIC ATTENUATORS, ATTENUATORS, BROADBAND AMPLIFIERS, FREQUENCY DOUBLERS RF TRANSFORMERS LIMITERS, DIRECTIONAL COUPLERS, ELECTRONIC SWITCHES



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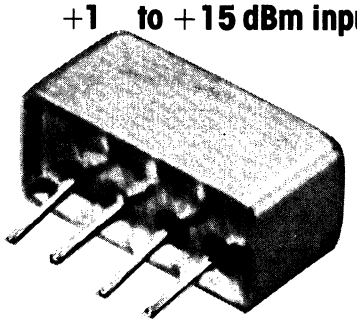
C-75 REV C

frequency doublers

+1 to +15 dBm input



1 to 1000 MHz

only $21.95 (5-24)

AVAILABLE IN STOCK FOR IMMEDIATE DELIVERY

- micro-miniature, 0.5 x 0.23 in. pc board area
- flat pack or plug-in mounting
- high rejection of odd order harmonics, 40 dB
- low conversion loss, 13 dB
- hermetically sealed
- **ruggedly constructed MIL-M-28837 performance***

*Units are not QPL listed

SK-2 SPECIFICATIONS

FREQUENCY RANGE, (MHz)		
INPUT	1-500	
OUTPUT	2-1000	
CONVERSION LOSS, dB	TYP.	MAX.
1-100 MHZ	13	15
100-300 MHz	13.5	15.5
300-500 MHz	14.0	16.5
Spurious Harmonic Output, dB	TYP.	MIN.
2-200 MHz F1	−40	−30
F3	−50	−40
200-600 MHz F1	−25	−20
F3	−40	−30
600-1000 MHz F1	−20	−15
F3	−30	−25

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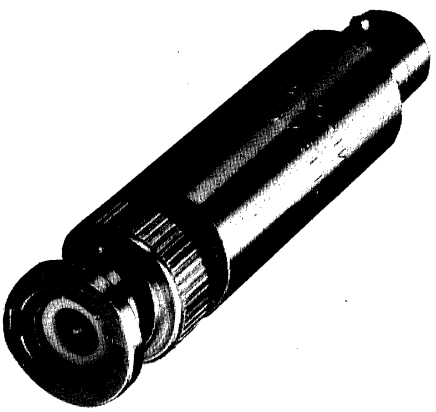
78-3 REV. A

tough attenuators



DC to 1500 MHz

only $11.95 (1-49)

IN STOCK...IMMEDIATE DELIVERY

- **rugged one-piece construction**
- available with BNC, N, SMA, TNC
- male/female connectors standard
- available with connector series intermixed
- 2W maximum power (0.5W for SMA)
- VSWR DC to1000 MHz <1.3:1
  VSWR 1000 to 1500 MHz <1.5:1
- excellent temperature stability (0.002dB/°C)
- exclusive 1 year guarantee

SPECIFICATIONS

MODEL	ATTEN.	ATTEN. TOL.
–AT–3	3 dB	±0.2 dB
–AT–6	6 dB	±0.3 dB
–AT–10	10 dB	±0.2 dB
–AT–20	20 dB	±0.3 dB

Add prefix **C** for BNC ($11.95)
T for TNC ($12.95)
N for Type N ($15.95)
S for SMA ($14.95)

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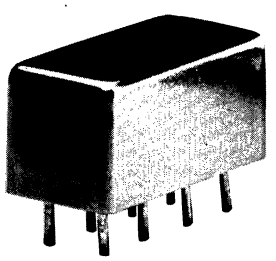
C92-3 REV. ORIG.

electronic attenuator/ switches



1 to 200 MHz

only $28.95 (5-24)

AVAILABLE IN STOCK FOR IMMEDIATE DELIVERY

- miniature 0.4 x 0.8 x 0.4 in.
- hi on/off ratio, 50 dB
- low insertion loss, 1.5 dB
- hi-reliability, HTRB diodes
- low distortion, +40 dBm intercept point
- **NSN 5985-01-067-3035**

PAS-3 SPECIFICATIONS

FREQUENCY RANGE, (MHz)		
INPUT	1-200	
CONTROL	DC-0.05	
INSERTION LOSS, dB	TYP.	MAX.
one octave from band edge	1.4	2.0
total range	1.6	2.5
ISOLATION, dB	TYP.	MIN.
1-10 MHz IN-OUT	65	50
IN-CON	35	25
10-100 MHz IN-OUT	45	35
IN-CON	25	15
100-200 MHz IN-OUT	35	25
IN-CON	20	10
IMPEDANCE	50 ohms	

For complete specifications and performance curves refer to the 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM.

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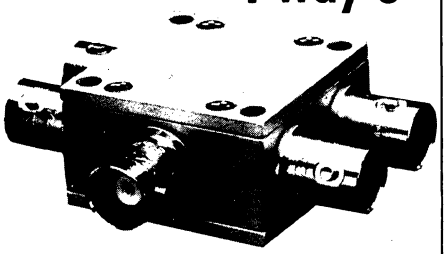
76-3 REV. ORIG.

power splitter/ combiners

4 way 0°



10 to 500 MHz

only $74.95 (1-4)

AVAILABLE IN STOCK FOR IMMEDIATE DELIVERY

- rugged 1¼ in. sq. case
- BNC, TNC, or SMA connectors
- low insertion loss, 0.6 dB
- hi isolation, 23 dB

ZFSC 4-1W SPECIFICATIONS

FREQUENCY (MHz) 10-500		
INSERTION LOSS, dB (above 6 dB) 10-500 MHz	TYP. 0.6	MAX. 1.5
AMPLITUDE UNBAL., dB	0.1	0.2
PHASE UNBAL. (degrees)	1.0	4.0
ISOLATION, dB (adjacent ports)	TYP. 23	MIN. 20
ISOLATION, db (opposite ports)	23	20
IMPEDANCE	50 ohms.	

For complete specifications and performance curves refer to tne 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM.

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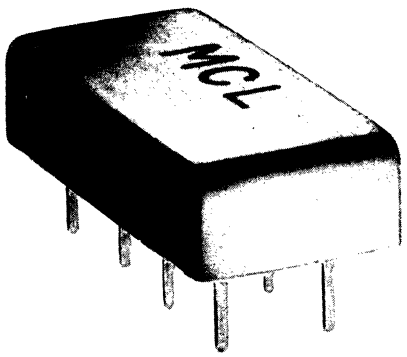
83-3 REV. ORIG.

plug-in attenuators



DC to 1500 MHz

only $1.95 (1,000 qty.)
$3.95 (10-49)

IN STOCK... IMMEDIATE DELIVERY

- **rugged...meets MIL-STD-202**
- hi-stability, thick-film construction
- miniature 0.4 x 0.8 x 0.4 in.
- flat frequency response... ±0.3dB (typ.)
- VSWR less than 1.2:1 (typ.)
- 1W maximum power
- designer's kit available, 4 of each type (12 units) $39.95

SPECIFICATIONS

MODEL	ATTEN.	ATTEN. TOL.
AT–3	3 dB	±0.2 dB
AT–6	6 dB	±0.3 dB
AT–10	10 dB	±0.3 dB
AT–20	20 dB	±0.3 dB

For complete specifications and performance curves refer to the Microwaves Product Data Director, the Goldbook, EEM, or Mini-Circuits catalog

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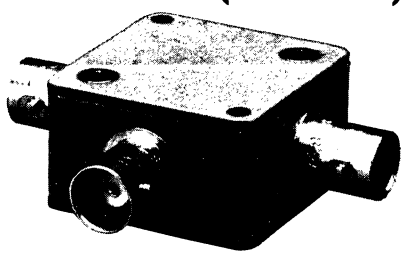
C94-3 REV. ORIG.

high performance mixers

standard level (+7 dBm LO)



1 to 1000 MHz

only $43.95 (1-24)

IN STOCK... IMMEDIATE DELIVERY

- **low conversion loss, 6dB**
- hi-isolation, 40dB
- flat frequency response
- rugged 1¼ in. sq. case
- 3 Mounting Options—thru hole, tapped hole or flange
- 4 Connector Choices BNC, TNC, SMA and Type N intermixing available
- male BNC, SMA, and Type N available
- 1 year guarantee

ZFM-2 SPECIFICATIONS

FREQUENCY RANGE, (MHz)			
LO, RF		1-1000	
IF		DC-1000	
CONVERSION LOSS, dB		TYP.	MAX.
One octave band edge		6.0	7.5
Total range		7.0	8.5
ISOLATION, dB		TYP.	MIN.
1-10 MHz	LO-RF	50	45
	LO-IF	45	40
10-500 MHz	LO-RF	40	25
	LO-IF	35	25
500-1000 MHz	LO-RF	30	25
	LO-IF	25	20

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C 71-3 REV. A

reliability and

All Mini-Circuits' RF signal-processing components are subjected to rigid quality control procedures starting from raw material procurement through product production and final inspection; the objective—to supply our customers with the finest RF signal-processing components available. Here's a list of some of the procedures taken to insure high-quality performance and product reliability:

A. 100% testing of each diode.

B. 100% testing of each unit.

C. 100% inspection of every solder connection.

D. All transformers bonded to the header for protection against severe shock and vibration.

E. All diodes, resistors and capacitors bonded to the header for protection against severe shock and vibration conditions.

F. Diode and resistor power dissipation derated greater than 50%.

G. All components rated for greater than + 125°C.

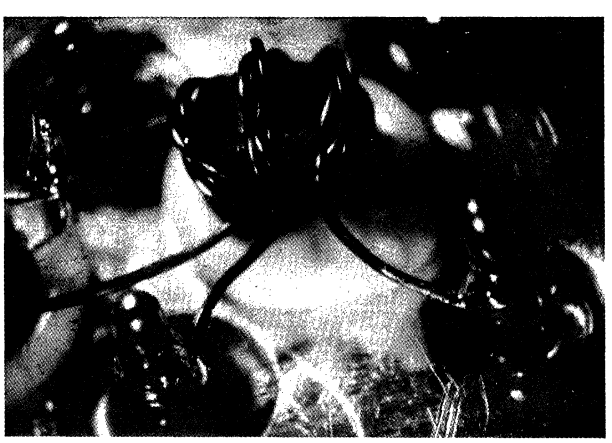
H. All transformer leads double wrapped.

I. Heavy coated wire insulation for HiPot/altitude.

J. Completely encapsulated for protection against mechanical shock and vibration as well as temperature shock.

K. Permanent case marking of model number cannot be removed by cleaning agents.

L. Cupro-Nickel case for long-lasting finish especially under salt atmosphere conditions.



Every unit shipped from Mini-Circuits carries a full-year guarantee; in fact, our industry-standard SRA-1 mixer offers an exclusive three-year guarantee.

hi-rel components

High-temperature, Reverse-bias (HTRB) testing is an accelerated-life screening test generally reserved for space applications. Here the Schottky and PIN diodes are subjected to a one-volt negative bias at 150°C for 168 hours. The objective of this accelerated aging stress is to force time/temperature-related failures and thus screen out potentially unreliable devices; in conventional "baking" processes, the diode does not experience anywhere near the stress imposed by the HTRB program. The result: highly-reliable Schottky and PIN diodes ready for wiring into assemblies.

Next, the assembled units are subjected to additional testing procedures including
(1) burn-in for 96 hours at 100°C with 8 ma at 1 KHz
(2) thermal shock per MIL-STD 202, Method 107
(3) Gross and fine leak tests according to MIL-STD 202, Test Method 112B, Conditions A and C

As a consequence of the above HTRB, final seal, and burn-in testing, Mini-Circuits components offer an unprecedented high level of reliability. In fact, Mini-Circuits' industry-standard SRA-1 is the only double-balanced mixer in the world to be offered with an exclusive *three-year* guarantee.

TX mixers

For the most critical space, military or industrial applications in hostile environments, Mini-Circuits offers TX mixers. Stringent screening and stressing are applied to the TX mixers which employ TX hermetically-sealed diodes that have passed the following tests per MIL-STD-750:
(1) high-temperature storage for 340 hours at 150°C, Method 1032; (2) thermal shock, Method 1051, Test Condition C (−65°C to +150°C, 10 cycles); (3) constant acceleration, Method 2006, Y1 orientation, 20,000 G's; (4) fine leak, Method 1071, Condition H; (5) gross leak, Method 1071, Condition C; (6) burn-in for 96 hours at 25°C, 75mW/junction at 60 Hz, Method 1038, Condition B.
Those diodes that pass these rigid tests are then electrically tested to ensure that they meet specifications. They are then assembled into TX mixers which are then further exposed to these stress tests: (1)thermal shock, MIL-STD 202, Method 107; (2) burn-in for 96 hours at 100°C, with 8 ma at 1 KHz; (3) gross and fine leak, MIL-STD 202, Method 112B, Conditions A and C
The SRA-1TX is the first off-the-shelf TX mixer in the industry available for immediate delivery. All other Mini-Circuits' mixers are available with TX screening and testing.

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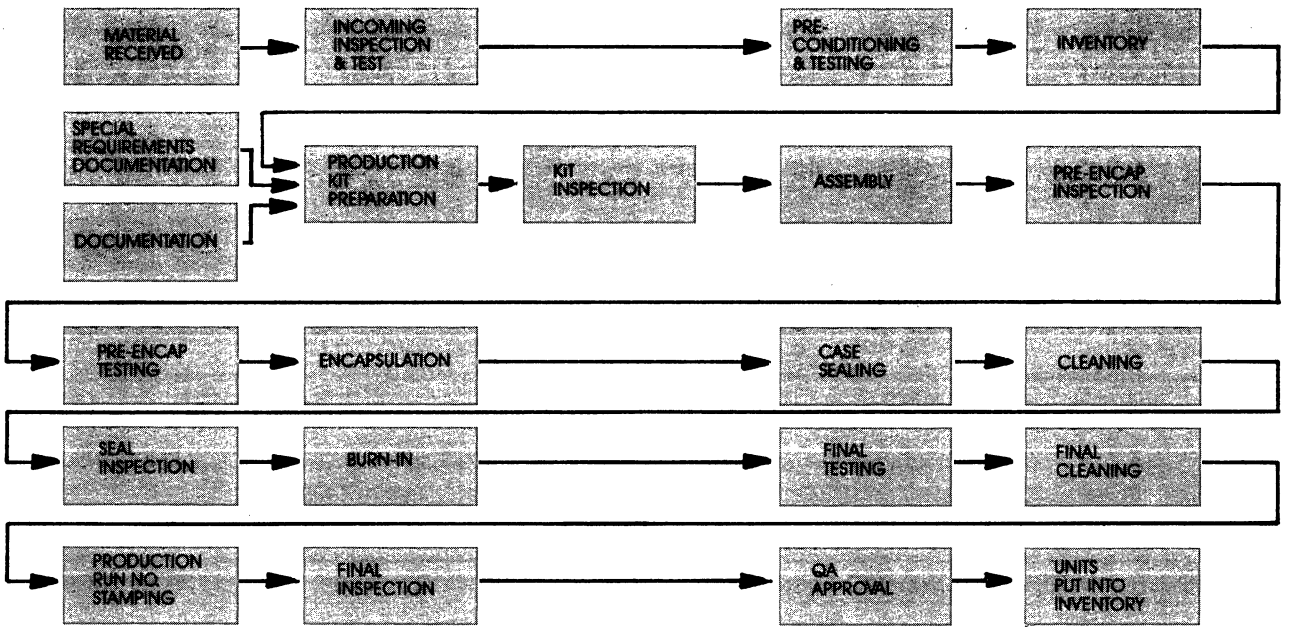
quality control

how Mini-Circuits achieves high reliability



environmental specifications

All MCL components are manufactured under exacting quality assurance and control standards. They will meet or exceed published specifications over the operating temperature range of −54° to +100°C, and after being subjected to any or all of the following physical or environmental tests of MIL-STD 202E which are applicable.

	TEMPERATURE CYCLING: −65° to +125°C	102 C
	ALTITUDE: 656,000 feet	105 G
(2)	HUMIDITY: 90% RH, 65°C	106
	THERMAL SHOCK: −65°C to +125°C	107 B
(1) (2)	SEAL: Less than 10^5 Atm. cc/sec	112 A
	DROP: Random, 45 min.	203
	VIBRATION: 2 to 2,000 cps, 20g, 12 hrs.	204 D
	SOLDER HEAT: 260°C, 10 sec.	210 B
(1)	SOLDERABILITY: 95% coverage	208
	TERMINAL TENSILE STRENGTH: 4½ lbs., 10 sec.	211 A
(1)	TERMINAL FATIGUE: 2 lbs., 3 cycles	211 C
	MECHANICAL SHOCK: 100g, 6ms	213 I
	SOLVENT RESISTANCE: Alcohol, Trichloroethan, Freon	215

NOTE:

(1) These specifications do not apply to coaxial connector models.

(2) Exceptions are non-hermetic case styles 6, 38, 46.

absolute maximum ratings

OPERATING AND STORAGE TEMPERATURE	−55°C to +100°C
PIN TEMPERATURE (10 sec)	+260°C

eliminating guesswork in systems design

CAPD (computer-automated performance data)

Today, RF and Microwave subsystem and system designs must be more precisely detailed as performance demands become more stringent. Radars must be more accurate, communications systems must be more noise-free, and guidance systems must be more rigorous, and all are required to meet quality and reliability levels considered unattainable a decade ago. These new demands place a heavy burden on the design engineer, the project manager, the quality assurance group...and the suppliers of the components to be assembled into these systems. In addition to the stricter performance and reliability specs, the designer faces escalating costs if, at the last stages before system delivery, unexpected surprises occur in the form of spurious signals, high VSWR or other pitfalls not anticipated.

Until now, the designer selected his RF/Microwave components, such as mixers, power splitters, and amplifiers, using manufacturers' data sheets to provide detailed specs, performance curves, and environmental ratings. Indeed, the design engineer did receive a workable package of information to see how his design might proceed...but it was not a detailed, close-up look. The reason is simple—it has just been too expensive to take an enormous number of test points, at a considerable number of specific frequencies, tabulate the results and then repeat at other input levels.

As an example, a two-tone intermodulation distortion chart for mixer performance would require at least 100 measurement points plus 10 additional calibration points and would take an experienced technician at least a half-day to complete.

For those customers who required their data at specific frequencies or under conditions other than is offered on the manufacturers' data sheets, extra charges were justifiably added to offset the additional labor costs.

Now, a new computer-automated performance data (CAPD) service offered exclusively by Mini-Circuits to its customers at no additional charge. Based on over 20 years of RF test experience and six years of engineering manpower-hours, the CAPD service provides detailed specs never available previously on mixer conversion loss, isolation, VSWR and intermod; for directional couplers and power splitters, details on insertion loss, isolation, phase unbalance and VSWR vs. frequency; for amplifiers, VSWR, gain changes and compression point vs frequency. In fact, all Mini-Circuits' products are available with CAPD specs.

test setup is self checking

The heavy investment in CAPD, using a Hewlett-Packard Model 85 computer and HP8566A spectrum analyzer as key elements, allows the previously-mentioned, two-tone IM test to be completed in less than ten minutes compared with the manually performed sequence requiring 4-5 hours. Here's how stringent the computer-automated set up dictates each measurement: each point is measured three times, with a maximum allowable deviation of less than 0.05 dB between the three; otherwise the test is repeated. Before each measurement is taken, the computer checks the reference voltage level for any variation due to line voltage, temperature, etc., changes and compensates as required. Similarly, frequency is monitored before each test and any drift is automatically corrected. Such continuous and rapid inspection and correction ensure highly-reliable CAPD data. And, by using a large number of closely-spaced frequency points for component measurement, effects of narrow-band suck-outs or resonances (often missed with manual test procedures) are immediately identified.

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Mini-Circuits

a close-up view of performance

What's the significance of CAPD to the designer? Is it a sales "gimmick" or is it truly a design tool? Review these points and judge for yourself.

A competent RF/Microwave design engineer, drawing on his experience and expertise over years of varied projects, still must be concerned with unforeseen problems when the prototype is first turned on. Generation of spurious signals, changes in dc offset level, affects of LO drive variations and other vexing problems often become evident to extend delivery time and escalate costs. In many instance, a more precise definition of the component specs could have pinpointed the potential problem areas; with CAPD, it's now possible.

Let's assume you are specifying a double-balanced mixer for a wideband front-end design. Here are a number of profound questions you face:

- In a wideband design, the local oscillator (LO) output might vary over the band and could fall below the level requried by the mixer spec. Should you spend additional money to flatten LO output or do you boost LO output if it is not sufficient?... Wouldn't it be valuable to know exactly how performance will be affected since you might find performance acceptable without any additional investment? with CAPD, a close point-by-point printout of key parameters as a function of LO level is available (fig. 1) — now you can make your decision based on a close-up, view of LO drive effects on mixer performance.
- How about VSWR over the full range of receiver specs? Generally, mixer VSWR specs are given at one particular frequency. With manual-test procedures, it's a time-consuming task for the components manufacturer or systems house; with CAPD it's available at no extra charge (fig. 2).
- How does the filter in the design match the mixer IF output and what is the impedance match in-band as well as out-of-band where spurious responses become a threat? CAPD VSWR data tells it all. How will the mixer conversion loss affect receiver sensitivity over the full frequency range? And, how will flatness of conversion loss affect the degree of image rejection in an image-reject mixer? CAPD data (fig. 1) will pinpoint these details.

If the mixer is being used as a phase detector, it may be critical to know how dc offset voltage varies with frequency. Most mixer specs list dc offset at only one frequency; with CAPD, this parameter is given over the full range of frequency (fig 4).

- Harmonic and intermod signals invariably plague your final design. The effects of, for example, a 4th harmonic of the LO mixing with the 5th harmonic of the RF is given on many spec sheets, but at a specific LO and RF level. The effects of LO level changes might be crucial to your design; with manual point-by-point testing, extensive and costly technician test time would be demanded or, more likely, such tests just won't be performed. With CAPD capabilities, such intricate interactions are quickly run, and made available to the designer (fig. 3).

If you are specifying directional couplers and/or power splitter/combiners in your systems, you can now closely examine how VSWR, insertion loss, isolation and amplitude/phase unbalance vary at closely-spaced points over the frequency range of interest, (fig. 5). You can now evaluate the effects of the VSWR of the termination at the S-port and, another industry-first, inspect intermod data of a power splitter caused by saturation of the cores within the unit.

Amplifier performance is clearly shown with CAPD data as a function of dc power supply changes, (fig. 6). You'll be able to closely examine how VSWR, compression point and gain are influenced by dc supply fluctuations; this could reduce your power-supply costs, since it will conveniently point to the degree of voltage regulation required to meet the amplifier performance needed. Also, it's common to furnish amplifier specs over the frequency band of interest, but CAPD testing offers an opportunity to examine the amplifier characteristics, outside the band to foresee the effects of harmonic and spurious signals; for example, an amplifier that is flat to 1200 MHz offers what gain and what VSWR for second-harmonic 2400 MHz signals? Knowing these details can thwart potential systems problems.

Even a relatively common component such as an RF transformer is now available with CAPD data, (fig. 7). The significance...previously insertion loss vs frequency was considered flat over a specified frequency range. With closely spaced CAPD test prints, even slight variations which could affect systems performance become apparent.

CAPD is your microscope

Look at CAPD as a microscope, revealing the "real world" details affecting your design decisions. Most important, CAPD was involved with one uppermost objective—to assist you, the design engineer, in producing a more effective end product. To accomplish this, you may require CAPD data at very specific frequency points not provided by our programmed steps. Not to worry...just furnish us with precise needs for your specific application. Be assured we'll do our best to comply.

eliminating guesswork in systems design

CAPD (computer-automated performance data)

mixer conversion loss and isolation

RF (MHz)	RF-Level (dBm)	LO (MHz)	C-LOSS(dB) LO +1dBm	LO +4dBm	LO +7dBm	LO +10dBm	L-R (dB) LO +1dBm	LO +4dBm	LO +7dBm	LO +10dBm	L-I (dB) LO +1dBm	LO +4dBm	LO +7dBm	LO +10dBm
10.00	−14.97	40.00	6.84	6.21	5.48	5.73	48.83	51.66	56.57	56.14	48.48	51.72	56.14	55.84
35.78	−14.92	65.78	7.32	6.68	5.71	5.91	49.28	51.47	54.93	54.83	48.04	50.90	54.75	53.93
61.56	−14.97	91.56	6.96	6.30	5.82	5.76	49.31	50.86	53.42	51.81	48.16	49.62	52.86	51.92
87.34	−14.96	57.34	6.99	6.38	5.77	5.86	49.40	51.62	54.58	55.74	48.70	50.97	54.02	54.69
113.12	−14.96	83.12	6.65	6.73	5.66	6.01	49.23	51.39	54.09	52.15	48.11	50.40	53.81	52.37
138.90	−14.95	108.90	6.10	5.52	5.81	5.05	49.03	50.58	52.04	50.35	48.10	48.84	51.56	50.73
164.68	−14.96	134.68	6.49	5.56	5.77	5.16	48.24	49.50	48.19	48.13	47.47	48.08	48.20	48.64
190.46	−15.02	160.46	6.14	5.41	5.62	5.01	47.61	48.20	46.85	46.44	46.51	47.18	46.27	46.53
216.24	−14.96	186.24	6.03	5.49	5.85	5.11	47.27	45.80	44.88	45.34	44.96	46.25	44.72	45.78
242.02	−14.99	212.02	7.11	6.53	5.91	6.05	46.49	44.25	43.74	43.47	44.64	44.80	43.20	43.56
267.80	−14.92	237.80	6.88	6.33	5.79	5.87	45.17	43.44	42.49	42.93	44.18	44.21	42.27	43.21
293.58	−14.96	263.58	7.08	6.61	6.01	6.17	42.69	42.29	40.93	40.87	42.63	42.74	40.33	40.79
319.36	−15.00	289.36	6.97	6.41	6.03	6.04	41.59	40.77	38.59	39.64	41.75	41.10	39.70	39.51
345.14	−14.97	315.14	7.41	6.71	5.99	6.26	39.60	39.02	37.93	37.84	41.39	40.74	38.97	38.82
370.92	−14.95	340.92	7.58	6.91	6.62	6.17	40.15	38.78	37.22	37.21	41.67	39.80	39.26	37.44
396.70	−15.00	366.70	8.22	7.42	6.93	6.39	39.81	38.10	36.79	35.84	40.85	38.81	37.86	37.46
422.48	−14.97	392.48	8.46	6.99	7.27	5.57	39.50	38.16	36.76	35.79	38.93	36.27	34.74	36.69
448.26	−14.96	418.26	9.44	7.80	7.76	6.22	39.02	37.60	36.14	36.29	38.29	36.00	34.76	33.54
474.04	−15.02	444.04	10.04	8.03	8.13	6.49	39.39	38.03	37.53	36.73	36.78	34.93	35.30	33.84
500.00	−14.92	470.00	10.31	8.43	8.10	6.84	41.24	40.71	40.19	40.14	36.15	34.30	33.89	33.63

FIG. 1

mixer VSWR

Freq. (MHz)	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
.500	2.57		2.52	3.57		3.82	1.37		1.07
5.000	1.16			2.28			1.16		
26.789	1.06	1.08	1.25	1.41	2.28	3.09	1.43	1.19	1.09
53.079	1.12	1.13	1.24	1.33	2.10	2.99	1.41	1.24	1.14
79.368	1.18	1.18	1.27	1.37	2.08	3.24	1.46	1.29	1.21
105.658	1.30	1.23	1.43	1.37	2.13	2.82	1.73	1.37	1.37
131.947	1.35	1.29	1.46	1.42	2.16	3.01	1.77	1.47	1.45
158.237	1.41	1.35	1.49	1.47	2.12	3.07	1.82	1.54	1.47
184.526	1.48	1.42	1.53	1.46	2.12	2.73	1.96	1.67	1.59
210.816	1.53	1.47	1.57	1.53	2.16	2.83	2.09	1.74	1.67
237.105	1.78	1.53	1.80	1.53	2.19	2.77	2.67	1.82	1.99
263.395	1.81	1.62	1.84	1.57	2.19	2.61	2.60	1.95	2.00
289.684	1.65	1.70	1.66	1.64	2.19	2.72	2.23	2.07	1.83
315.974	1.82	1.76	1.78	1.67	2.22	2.52	2.74	2.16	2.08
342.263	1.88	1.83	1.84	1.79	2.32	2.55	2.94	2.25	2.21
368.553	1.96	1.87	1.90	1.77	2.40	2.56	3.15	2.29	2.35
394.842	2.00	1.92	1.91	1.70	2.43	2.44	3.11	2.36	2.31
421.132	1.75	2.02	1.71	1.66	2.43	2.54	2.47	2.48	2.00
447.421	1.91	2.04	1.85	1.61	2.40	2.44	3.15	2.41	2.35
473.710	2.06	2.03	1.94	1.57	2.35	2.39	3.56	2.35	2.47
500.000	1.94	2.07	1.85	1.47	2.32	2.37	3.12	2.37	2.30

FIG. 2

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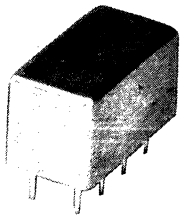
SRA-1 mixer



Mini-Circuits

mixer harmonic intermodulation

(Relative to desired IF Output)

LO at +4dBm

Harmonic RF Order	RF CAL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	—	36	17	24	24	29	33	45	49	49	65	57	59	60	65	58
1	0	18	—	33	18	35	31	45	40	52	50	55	58	49	63	54	65
2	74	42	49	41	63	45	57	57	58	55	67	69	72	72	71	70	70
3	78	66	40	51	35	54	38	57	57	69	63	70	70	72	72	71	71
4	79	68	72	66	69	63	69	63	69	71	72	67	71	70	70	71	72
5	78	72	71	72	65	68	59	60	59	71	70	70	70	71	71	72	72
6	77	70	71	71	72	73	72	73	72	71	71	72	71	70	71	70	72
7	78	71	69	71	71	71	72	71	71	71	71	71	72	71	72	70	70
8	78	72	71	71	70	71	71	70	71	72	71	72	71	71	70	72	70
9	80	72	72	68	70	71	71	72	72	71	71	72	71	71	71	72	70
10	80	71	72	71	70	72	71	71	72	73	71	70	72	72	71	72	72
11	79	71	72	72	72	71	70	70	71	72	72	71	73	72	72	72	71
12	79	71	71	72	71	72	71	71	71	71	71	72	71	71	71	70	72
13	78	71	71	71	70	72	71	71	71	70	71	70	72	71	71	71	72
14	80	72	71	72	71	71	71	71	71	70	71	71	71	72	71	72	72
15	73	66	73	71	71	71	71	72	72	72	72	70	70	71	71	73	71

Harmonic LO Order

LO at +7dBm

Harmonic RF Order	RF CAL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	—	31	17	27	22	28	30	39	49	46	58	57	58	59	66	53
1	0	17	—	37	11	33	37	47	36	50	53	60	58	59	62	61	67
2	74	48	47	50	52	49	60	56	58	50	69	65	72	73	72	73	71
3	78	66	56	58	46	57	44	68	60	64	58	72	69	72	74	72	74
4	79	71	71	72	70	73	69	70	72	73	73	71	72	71	73	72	73
5	78	73	73	72	73	73	71	72	68	72	73	72	72	71	73	72	73
6	77	73	71	72	71	73	73	73	73	72	73	72	74	73	73	71	72
7	78	73	71	72	71	73	73	73	73	72	73	72	74	73	73	71	72
8	78	74	72	72	71	74	74	73	71	72	73	72	72	73	73	72	72
9	80	74	72	73	72	72	72	73	73	73	72	73	72	74	73	72	73
10	80	73	74	73	71	73	73	73	73	72	73	73	74	72	73	74	72
11	79	71	73	73	72	72	72	71	73	72	74	73	73	73	75	72	73
12	79	73	73	72	74	72	73	72	72	73	74	72	71	72	73	73	71
13	78	73	73	73	73	72	73	73	71	72	72	72	73	72	73	73	71
14	80	73	72	73	73	73	73	73	71	72	72	71	72	73	73	72	73
15	73	66	73	72	73	73	73	73	73	73	72	71	71	73	73	72	73

Harmonic LO Order

LO at +10dBm

Harmonic RF Order	RF CAL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	—	26	13	25	16	21	21	34	43	38	61	48	54	50	54	47
1	0	19	—	42	10	30	30	39	34	49	50	52	58	57	59	60	64
2	74	63	53	71	59	58	62	58	59	54	71	66	71	73	73	73	74
3	78	69	63	70	69	73	64	72	72	70	63	71	71	73	74	74	73
4	79	72	73	74	72	73	73	74	73	72	72	71	72	73	72	73	73
5	78	72	72	74	74	74	72	73	73	72	72	72	73	73	73	72	73
6	77	71	72	73	72	73	73	72	73	74	73	72	72	72	72	73	72
7	78	72	72	71	73	72	73	73	74	73	73	74	72	71	73	72	72
8	78	72	71	72	72	72	74	73	73	73	73	73	71	72	73	73	73
9	80	74	71	71	71	72	73	73	71	73	73	71	73	73	72	73	73
10	80	73	73	72	72	74	72	73	71	74	74	73	74	71	74	73	71
11	79	73	73	72	73	73	73	71	70	74	73	72	72	74	74	73	72
12	79	73	73	73	73	73	73	72	71	73	74	73	73	72	72	71	73
13	78	73	73	74	72	73	72	73	72	72	71	73	74	72	73	73	73
14	80	72	73	72	74	74	74	73	71	72	73	71	72	72	74	73	72
15	73	66	73	73	73	72	73	73	73	72	73	73	72	72	73	72	73

Harmonic LO Order

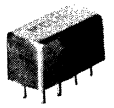
test conditions

RF = 400.1 MHz at −10dBm
LO = 370.01 MHz at + 7dBm
For other test frequencies, contact factory.

FIG. 3

eliminating guesswork in systems design

CAPD (computer-automated performance data)



mixer phase detection (+7 dBm)

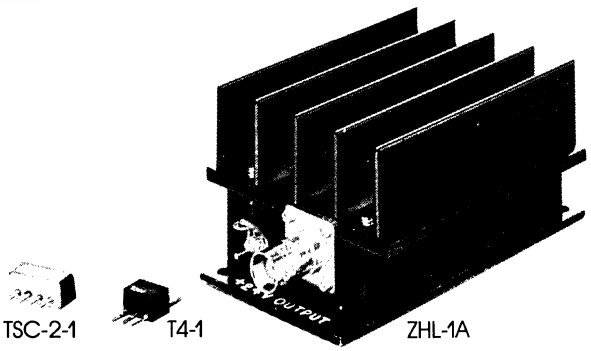
max. output/DC offset Vs. freq.

Freq. (MHz)	max. DC output mV	DC offset mV
10.00	−262.53	− .57
30.42	−263.46	− .54
50.83	−260.71	− .54
71.25	−260.38	− .51
91.67	−264.70	− .46
112.08	−265.05	− .42
132.50	−266.23	− .38
152.92	−263.79	− .34
173.33	−263.92	− .34
193.75	−268.92	− .37
214.17	−274.08	− .32
234.58	−276.75	− .33
255.00	−275.81	− .53
275.42	−270.65	− .63
295.83	−266.67	− .35
316.25	−256.71	− .52
336.67	−251.84	− .82
357.08	−236.17	− .63
377.50	−228.06	−1.01
397.92	−217.55	−1.38
418.33	−214.55	−1.88
438.75	−214.43	−1.58
459.17	−210.65	−1.86
479.58	−206.27	−2.74
500.00	−204.64	−2.69

output voltage Vs. phase, 10 MHz

Phase, degrees	output, mV
0 deg.	−262 mVOLT
10 deg.	−258 mVOLT
20 deg.	−246 mVOLT
30 deg.	−227 mVOLT
40 deg.	−200 mVOLT
50 deg.	−168 mVOLT
60 deg.	−131 mVOLT
70 deg.	−89 mVOLT
80 deg.	−45 mVOLT
90 deg.	0.6 mVOLT
100 deg.	46 mVOLT
110 deg.	90 mVOLT
120 deg.	132 mVOLT
130 deg.	169 mVOLT
140 deg.	202 mVOLT
150 deg.	228 mVOLT
160 deg.	247 mVOLT
170 deg.	259 mVOLT
180 deg.	263 mVOLT
190 deg.	259 mVOLT
200 deg.	247 mVOLT
210 deg.	228 mVOLT
220 deg.	292 mVOLT
230 deg.	169 mVOLT
240 deg.	132 mVOLT
250 deg.	90 mVOLT
260 deg.	46 mVOLT
270 deg.	0.6 mVOLT
280 deg.	−45 mVOLT
290 deg.	−89 mVOLT
300 deg.	−131 mVOLT
310 deg.	−168 mVOLT
320 deg.	−200 mVOLT
330 deg.	−227 mVOLT
340 deg.	−246 mVOLT
350 deg.	−258 mVOLT
360 deg.	−262 mVOLT

FIG. 4



TSC-2-1 T4-1 ZHL-1A

Mini-Circuits

power splitter/combiners

model TSC-2-1

MHz	REF. (dBm)	S-1 (dB)	S-2 (dB)	Unbal. (dB)	ISO (dB)
1.00	−4.99	3.25	3.21	−.04	36.02
22.00	−4.95	3.20	3.20	0.00	46.30
43.00	−4.97	3.24	3.21	−.03	40.42
64.00	−4.99	3.25	3.25	0.00	36.77
85.00	−4.92	3.30	3.29	−.01	34.79
106.00	−4.99	3.28	3.28	0.00	33.30
127.00	−5.06	3.29	3.32	.03	32.27
148.00	−5.02	3.31	3.33	.02	31.51
169.00	−5.02	3.31	3.36	.05	30.95
190.00	−5.08	3.30	3.40	.10	30.64
211.00	−4.91	3.30	3.44	.14	30.51
232.00	−4.91	3.30	3.47	.17	30.62
253.00	−4.99	3.33	3.49	.16	31.06
274.00	−4.96	3.34	3.52	.18	31.94
295.00	−5.03	3.32	3.57	.25	33.35
316.00	−4.95	3.39	3.62	.23	35.36
337.00	−5.02	3.39	3.67	.28	39.90
358.00	−4.95	3.40	3.78	.38	45.13
379.00	−5.00	3.44	3.83	.39	40.23
400.00	−4.00	3.49	3.97	.48	32.15

Insertion loss, Amplitude Unbalance, Islolation

MHz	S	1	2
5.00	1.12	1.12	1.12
25.78	1.13	1.11	1.11
46.56	1.13	1.10	1.10
67.34	1.12	1.09	1.09
88.12	1.12	1.09	1.09
108.90	1.12	1.09	1.09
129.68	1.11	1.08	1.10
150.46	1.11	1.08	1.10
171.24	1.10	1.08	1.11
192.02	1.10	1.08	1.12
212.80	1.09	1.08	1.14
233.58	1.10	1.09	1.16
254.36	1.11	1.11	1.16
275.14	1.12	1.13	1.18
295.92	1.15	1.15	1.21
316.70	1.18	1.18	1.24
337.48	1.22	1.21	1.28
358.26	1.27	1.24	1.31
379.04	1.32	1.28	1.35
400.00	1.39	1.33	1.40

VSWR

FIG. 5

RF transformers

model T4-1

MHz	REF. (dBm)	I.L. (dB)
.200	−14.95	3.29
.350	−14.92	2.34
2.001	−15.03	1.58
18.612	−14.97	1.21
37.021	−14.99	1.30
55.433	−15.03	1.37
73.843	−14.99	1.39
92.253	−15.02	1.49
100.001	−14.99	1.50
110.661	−14.96	1.67
129.070	−15.06	1.71
147.480	−14.98	1.73
165.890	−15.09	1.85
184.310	−14.93	2.04
202.720	−15.00	2.07
221.131	−15.09	2.12
239.540	−14.94	2.29
257.850	−15.06	2.43
276.359	−14.93	2.49
294.770	−15.03	2.54
299.999	−15.03	2.59
313.180	−15.03	2.71
331.590	−15.09	2.79
350.000	−14.96	2.81

Insertion loss

REMARK: 2 units connected back to back

FIG. 7

power amplifiers

model ZHL-1A

FREQ. (MHz)	GAIN (dB) 12V	15V	20V	24V	REVERSE GAIN (dB) 12V	15V	20V	24V	VSWR (IN) 12V	15V	20V	24V	VSWR (OUT) 12V	15V	20V	24V
2.00	17.90	18.27	18.46	18.52	29.03	29.07	28.96	28.88	1.09	1.13	1.14	1.14	1.10	1.16	1.15	1.15
28.21	17.88	18.27	18.48	18.52	29.53	29.72	29.54	29.24	1.09	1.11	1.13	1.14	1.20	1.19	1.19	1.18
54.42	17.88	18.33	18.54	18.59	29.57	29.62	29.58	29.39	1.12	1.12	1.13	1.14	1.24	1.24	1.24	1.24
80.63	17.94	18.41	18.65	18.70	29.91	29.78	29.64	29.56	1.19	1.17	1.16	1.16	1.30	1.29	1.30	1.30
106.84	17.90	18.41	18.69	18.78	29.85	30.12	29.97	29.75	1.31	1.24	1.21	1.21	1.36	1.36	1.37	1.37
133.05	17.91	18.42	18.75	18.83	30.02	30.06	30.15	29.87	1.42	1.32	1.28	1.27	1.41	1.41	1.42	1.44
159.26	17.68	18.34	18.71	18.81	30.25	30.32	30.03	30.00	1.56	1.42	1.36	1.34	1.46	1.48	1.50	1.52
185.47	17.64	18.34	18.78	18.84	30.50	30.36	30.12	29.99	1.71	1.553	1.45	1.43	1.50	1.53	1.57	1.60
211.68	17.52	18.25	18.74	18.82	30.50	30.64	30.19	30.05	1.83	1.63	1.52	1.50	1.51	1.56	1.63	1.67
237.89	17.46	18.20	18.73	18.81	30.85	30.64	30.35	30.32	1.96	1.72	1.59	1.57	1.52	1.58	1.67	1.73
264.10	17.34	18.09	18.66	18.74	30.99	30.75	30.40	30.43	2.04	1.79	1.64	1.62	1.48	1.56	1.66	1.75
290.31	17.28	18.03	18.58	18.69	31.08	30.89	30.66	30.58	2.14	1.86	1.69	1.66	1.44	1.53	1.66	1.76
316.52	17.33	18.08	18.69	18.79	30.64	30.77	30.51	30.49	2.16	1.88	1.70	1.67	1.40	1.50	1.64	1.75
342.73	17.32	18.06	18.69	18.79	30.50	30.44	30.41	30.44	2.17	1.87	1.69	1.65	1.33	1.43	1.59	1.71
368.94	17.30	18.04	18.71	18.79	30.09	30.23	30.24	30.27	2.09	1.81	1.63	1.59	1.27	1.35	1.49	1.62
395.15	17.23	18.02	18.67	18.82	29.81	29.95	29.91	30.18	2.03	1.75	1.57	1.53	1.24	1.28	1.41	1.55
421.36	17.32	18.13	18.83	18.98	29.19	29.36	29.52	29.85	1.96	1.68	1.49	1.44	1.32	1.29	1.36	1.50
447.57	17.37	18.23	18.96	19.08	28.50	28.79	29.05	29.22	1.90	1.61	1.41	1.36	1.47	1.36	1.34	1.43
473.78	17.17	18.10	18.90	19.08	27.94	28.28	28.64	28.82	1.93	1.64	1.42	1.37	1.68	1.51	1.39	1.42
500.00	17.07	18.14	19.06	19.26	27.68	27.17	28.22	28.50	2.07	1.79	1.57	1.54	1.01	1.79	1.61	1.58

FIG. 6

CAPD now available! computer-automated performance data

the World's No.1 Mixer

SRA-1, the world's only mixer 3-year guaranteed and screened for HTRB, thermal shock, burn-in, and hermeticity. MIL-M-28837 performance* at only $11.95 (1-49)

Our 3-year guarantee is still unique today... even though we have been offering it for the past five years.

Here is how we achieve it. The diodes are the most critical component in the mixer. So to start, we use an accelerated life screening test generally reserved only for space applications. The HTRB-screened Schottky diodes are subjected to a one-volt negative bias at 150° C for 168 hours, a stress designed to accelerate ageing and force time-related failures—thus screening out potentially unreliable diodes.

In addition, further stressing and testing are performed on the assembled unit. Each completed SRA-1 experiences:
1. Burn-in for 96 hours at 100° C with 8 mA at 1 KHz.
2. Thermal shock. 3. Gross and fine leak tests (per MIL-STD 202).

Don't settle for an imitation. Specify Mini-Circuits' SRA-1, the only double-balanced mixers with a three-year guarantee. Immediate delivery, of course.

SRA-1 SPECIFICATIONS

FREQUENCY RANGE (MHz)

LO 0.5-500
RF 0.5-500
IF DC-500

CONVERSION LOSS (dB)		TYP.	MAX.
1-250 MHz		5.5	7.0
0.5-500 MHz		6.5	8.5
ISOLATION (dB)		TYP.	MIN.
0.5-5 MHz	LO-RF	50	45
	LO-IF	45	35
5-250 MHz	LO-RF	45	30
	LO-IF	40	25
250-500 MHz	LO-RF	35	25
	LO-IF	30	20

MIN. ELECTRONIC ATTENUATION (20 mA) 3 dB Typ.
SIGNAL 1 dB COMPRESSION LEVEL +1 dBm
IMPEDANCE All Ports, 50 Ohms
LO POWER +7 dBm

*Units are not QPL listed

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 East 14th Street, Brooklyn, New York 11235 (212)769-0200
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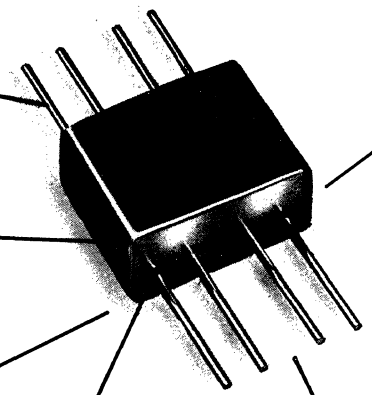
tough flatpack mixers

...innovated by Mini-Circuits for rugged applications

Rugged Pins heavier 25 mil. dia. leads resists wire breakage

Guaranteed for hermeticity every unit must pass MIL-STD 202 test method 112B condition A and C

withstands wave soldering punishment reliable pc board assembly eliminates open circuits common with conventional flatpacks. Every unit subjected to thermal shock testing MIL-STD 202 method 107



stronger glass seals prevents cracking when leads are bent and handled.

tough competitive pricing only **$14.95**(6-24) ½ to ⅕ the cost of conventional flatpacks

Model LMX-113 Superior Electrical Characteristics

FREQUENCY RANGE, (MHz)

LO, RF	5-1000
IF	DC-1000

CONVERSION LOSS, dB		TYP.	MAX.
one octave from band edge		6.2	7.0
total range		7.0	8.0
ISOLATION, dB		TYP.	MIN.
5-50 MHz	LO-RF	50	45
	LO-IF	45	40
50-500 MHz	LO-RF	40	30
	LO-IF	35	25
500-1000 MHz	LO-RF	30	20
	LO-IF	25	17

SIGNAL 1dB Compression Level 0dBm min

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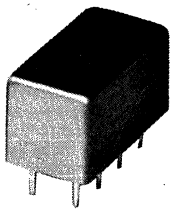


mastering the mixer maze...

or selecting the right model for your application.

Mixers are abundant in electronic systems ranging from inexpensive consumer products to sophisticated military hardware. You'll find them in video games, TV sets and video cassette recorders as well as communications gear, test instruments, radar units and countermeasure systems. Mini-circuits offers well over a hundred different off-the-shelf models with thousands of variations. Different connector configurations, tighter specs, Hi-Rel options are available on request. Improper mixer selection bears a penalty—underspecify and face marginal performance; overspecify and pay extra for unnecessary performance characteristics.

making the right choice

Simply stated, there are three basic steps—
(1) deciding on a printed-circuit (PC) or connector version, (2) selecting the mixer level required in the applications, and (3) picking a model that extends over the frequency range involved. Sounds simple enough so let's examine some of the details.
The first step involves the decision on whether the mixer will be mounted to a PC board or be connected by cable to other subsystem components. The next two steps require understanding your specific needs; so it is strongly recommended that you organize the requirements for your application and put it in writing. Decide what frequency range is involved, the LO drive available, the level of harmonic and two-tone, third-order intermodulation (IM) distortion you can tolerate and other dynamic range factors, see Fig. 1.

1 dB compression point key to mixer level

What does the 1 dB compression point signify? As RF input level is increased, IF output should follow in a linear manner. However, after a certain point, IF output increases at a lower rate until mixer output becomes fairly constant. The point at which IF output deviates from linearity with RF input 1 dB is termed the 1 dB compression point. This figure is useful in comparing dynamic range, maximum output and two-tone performance of various mixers. It is a basis on which mixer level is established.

The 1 dB compression point, which defines the linearity of a mixer at high RF input levels, is relatively simple to test and thus this parameter is included on data sheets supplied by all mixer manufacturers. But, in real life, mixer linearity may be specified in accordance with the intended application. For example, in a receiver application, two-tone, third-order intermod may be the critical parameter; for TV applications, percent distortion or intercept point may be specified; and in an attenuator measurement system, compression point may be important for a given RF input level. With this in mind, the engineer needs a convenient means to relate the particular parameter for his application with the published spec, the 1 dB compression point.

Fig. 1 lists the various ways mixer linearity might be specified.

FIG. 1
Dynamic range parameters affecting mixer selection

1. maximum RF input level anticipated
2. percent distortion acceptable
3. intercept point
4. Two-ton, 3rd order IM_____dB at _____dBm, RF input
5. 1 dB RF input compression level
6. LO power available
7. none of the above specified

Let's convert every parameter with the published 1 dB compression point and then show how simple it is to select the proper mixer level, *see Fig. 2 for Mini-Circuits' mixer level/1 dB compression point chart.*

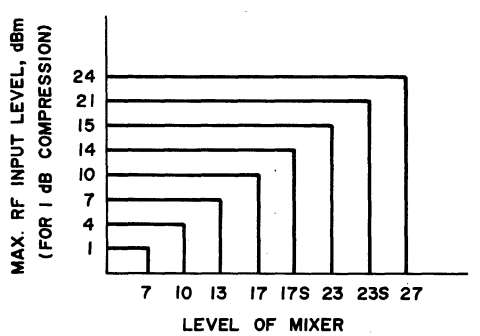


FIG. 2 THE 1 dB COMPRESSION POINT AS A FUNCTION OF THE LEVEL OF MIXER.

Mini-Circuits P.O. BOX 166, Brooklyn, New York 11235 (212) 934-4500

1. Maximum RF input level anticipated. If you know this parameter, simply select the lowest level mixer whose maximum RF input level exceeds your requirement. For example, if the maximum encountered RF level is +5 dBm, select a Level 13 mixer, rated at +7 dBm maximum RF input for 1 dB compression point.

2. Percent distortion. The percent distortion is usually specified in voltage. Thus, a 0.1% distortion figure means 0.999 of the input voltage appears at the mixer output. Next, convert this voltage ratio to a power ratio in dB by squaring and taking ten times the log. The resultant figure is the amount cf compression for the specified RF input level. Now this must be extrapolated to 1 dB compression for a corresponding RF input level. As a rule of thumb, extrapolation may be achieved by assuming a linear relationship, in dB, between compression and RF input level. So a ten-times increase in compression corresponds to a ten-times increase in RF input level.

Let's illustrate with an example using a 0.1 percent distortion spec at −10 dBm RF input level. The 0.1 percent corresponds to a 0.999 voltage output; squaring this yields 0.998 power ratio or 0.009 dB. We, therefore, know that 0.1% distortion at −10 dBm input means the maximum allowable compression is 0.009 dB. Extrapolating, using the rule-of-thumb relationship, states that 0.09 dB compression corresponds to an allowable RF of 0 dBm, and further extrapolating results in 0.9 dB compression at a maximum allowable RF input level of 10 dBm. So which mixer level is appropriate? A Level 17S, with +13 dBm RF Input level at the 1 dB compression point, see Fig. 2.

3. Intercept point.

This parameter is a figure of merit corresponding to the amount of intermodulation products generated relative to the desired IF output. An intercept point can be defined for a second order, third order, fifth order, product, etc. As a rule-of-thumb, two-tone third order intercept point is approximately 15 dB above the 1 dB compression point. So, if the intercept point figure is given, merely subtract 15 dB from this figure and pick a mixer which meets the 1 dB compression point spec, see Fig. 2.

4. Two-tone, third-order intermodulation (IM).

When a two-tone, third-order IM spec is given, the intercept point can be calculated. Remember that for each 10 dB increase in signal level, there is a 20 dB degradation in two-tone, third-order product. Once the intercept point is calculated, simply subtract 15 dB from the figure to find the 1 dB compression point and select the appropriate mixer.

5. 1dB Rf input compression level.

This key parameter is listed on mixer spec sheets so merely choose the lowest level mixer that will meet the requirement.

6. LO drive.

The LO dirve is critical since the function of the LO drive is to switch the mixer diodes fully on and off for lowest distortion. So, for optimum performance, select the mixer level to match the LO drive. Mini-Circuits conveniently identifies its mixer levels by the LO drive requirement; thus a Level 7 mixer refers to a LO drive level of +7 dBm. If there are constraints on the LO power available, select the lowest level mixer closest to the available LO power. For example, if +12 dBm LO drive is available, select a Level 10 mixer.

7. No particular spec to meet.

Choose a Level 7 mixer. Why? Because it is the most popular and it offers the widest choice of models at lowest cost.

Freq. range last deciding factor

Once the mixer level has been decided, you may find a wide variety of models to exercise your decision making. You may notice models within a series with overlapping frequency ranges. Why? So you can choose the optimum mixer for your requirement. Each model within a series has a different low-frequency limit. Select a mixer with the highest low frequency limit and whose mid-band range best covers your application.

Specs on the data sheets are given in three ranges. The lower frequency range, L, covers the lowest specified frequency to one decade higher; the upper frequency range, U, covers the highest frequency to one octave lower and mid-range, M, covers the frequency between L and U. Thus, a mixer specified from 0.5 to 500 MHz could offer a low-frequency range of 0.5 to 5 MHz, an upper frequency range of 250 to 500 MHz, and a mid-range of 5 MHz to 250 MHz.

What about "Specials"?

Although most Mini-Circuits mixers are 50 ohm devices, models are available in 75 ohms. Need connector types different than those listed for standard models? No problem. Some applications require matched mixer pairs that must be amplitude (conversion loss) and phase matched. Most Mini-Circuits mixers are tested to within 0.2 dB for the entire production run. Not tight enough? Let us know your exact requirement and we'll screen and test to meet it.

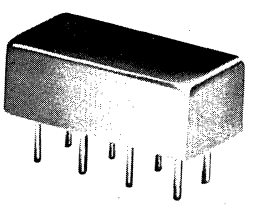
In summary, contact us about "specials" and we'll do our best to satisfy your needs without excessive cost or delivery date extensions. Sometimes, "special" means shipping a quantity of mixers within a very short time span; since Mini-Circuits is the largest manufacturer of mixers in the world, this may hardly be considered "special" and you may be pleasantly surprised. Try us.

order Mini-Circuits Q&A No. 4 Now...

There's lots more to mixer specs, applications and testing. Phone or write for Mini-Circuits' Q&A #4 for a provocative question-and-answer exchange on these topics.

CAPD now available! computer-automated performance data

the miser mixers



$3.95
100 PIECES
$4.50 (10-49)

the lowest priced mixers in the world **for demanding industrial applications**

the SBL-1 from Mini-Circuits only $3.95

Don't let the low price mislead you. As the world's number one manufacturer of double-balanced mixers, Mini-Circuits has accumulated extensive experience in high-volume production and testing, a key factor in achieving a successful low cost/high performance line of products.

The tough SBL-1 covers the broad frequency range of 1-500 MHz with 6 dB conversion loss and isolation greater than 40 dB. The SBL-1X covers 10-1000 MHz. Only well-matched, hot-carrier diodes and ruggedly constructed transmission-line transformers are used. Internally, every component is bonded to the header for excellent protection against shock, vibration and acceleration.

Here are some of the steps taken to ensure quality: Every SBL is RF tested two times, every solder connection is 100 per cent inspected under a high power microscope, all transformer leads are double-wrapped, and all components are rated for more than +100° C operation.

Of course, our one-year guarantee applies to these units.

finding new ways...
setting higher standards

SPECIFICATIONS		SBL-1		SBL-1X	
FREQUENCY, MHz					
LO, RF		1-500		10-1000	
IF		DC-500		0.5-500	
CONVERSION LOSS, dB		*Typ.*	*Max.*	*Typ.*	*Max.*
One Octave from Band Edge		5.5	7.5	6.0	7.0
Total Range		6.5	8.5	7.0	9.0
ISOLATION, dB		*Typ.*	*Min.*	*Typ.*	*Min.*
Lower Band Edge to	LO-RF	50	40	50	35
One Decade Higher	LO-IF	45	35	45	30
Mid Range	LO-RF	45	30	40	25
	LO-IF	40	25	35	20
Upper Band Edge to	LO-RF	35	25	30	20
One Octave Lower	LO-IF	30	20	25	20
PRICE					
10-49		**4.50**		**5.95**	
100		**3.95**		**5.50**	

SIGNAL 1dB COMPRESSION LEVEL +1dBM
IMPEDANCE, ALL PORTS 50 ohms
ELECTRONIC ATTENUATION (20mA) 3dB
METAL CASE Non hermetic-seal

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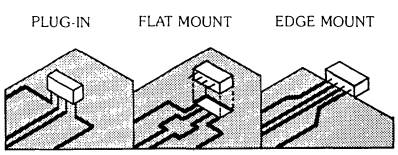
the world's smallest hermetically-sealed mixers
40 KHz to 3 GHz, MIL-M-28837 performance*
The TFM Series from Mini-Circuits from $11.95

Increase your packaging density, and lower your costs... specify Mini-Circuits miniature TFM Series. These tiny units 0.5" x 0.21" x 0.25" are the smallest, off-the-shelf Double Balanced Mixers available today.

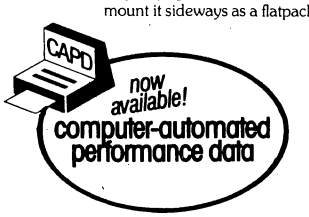
Requiring less PC board area than a flat-pack or TO-5 case, the TFM Series offer greater than 45 dB isolation, and only 6 dB conversion loss.

Manufactured to meet the requirements of MIL-M-28837*, the tiny but rugged TFM units have become the preferred unit in new designs for military equipment.



E-Z Mounting for circuit layouts
Use the TFM series to solve your tight space problems. Take advantage of the mounting versatility—plug it upright on a PC board or mount it sideways as a flatpack.

MODEL	FREQUENCY, MHz		CONVERSION LOSS dB, TYPICAL		ISOLATION dB, TYPICAL						PRICE	
			1 Octave from Band Edge	Total Range	Lower Band Edge		Mid Range		Upper Band Edge		$	
	LO/RF	IF			LO-RF	LO-IF	LO-RF	LO-IF	LO-RF	LO-IF	EA.	QTY.
TFM-2	1-1000	DC-1000	6.0	7.0	50	45	40	35	30	25	11.95	(1-49)
TFM-3	04-400	DC-400	5.3	6.0	60	55	50	45	35	35	19.95	(5-49)
TFM-4	5-1250	DC-1250	6.0	7.5	50	45	40	35	30	25	21.95	(5-49)
•••TFM-11	1-2000	5-600	7.0	7.5	50	45	35	27	25	25	39.95	(1-24)
•••TFM-12	800-1250	50-90	—	6.0	35	30	35	30	35	30	39. 95	(1-24)
▪▪TFM-15	10-3000	10-800	6.3	6.5	35	30	35	30	35	30	49.95	(1-9)
▪▪TFM-150	10-2000	DC-1000	6.0	6.5	32	33	35	30	35	30	39.95	(1-9)



•••If Port is not DC coupled
▪▪+10 dBm LO, +5 dBm RF at 1dB compression
*Units are not QPL listed

For complete specifications and performance curves refer to the Microwaves Product Data Directory, the Goldbook, EEM or Mini-Circuits catalog

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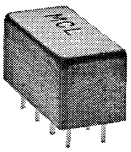
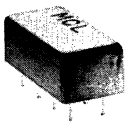
68 REV B

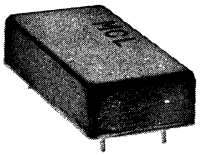
Double Balanced Mixers

LEVEL 1 Standard Level (+7 dBm LO) PC Board Mounting


SRA SERIES


SBL SERIES

TAK SERIES


GRA SERIES

SAM SERIES

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin. Layout Fig.	PRICE $ Ea.	Qty.
SRA SERIES case outline Fig. 1 (SRA-5, -11, -12 — Fig. 6)	SRA-1	.5-500	DC-500	5.5	7.0	6.5	8.5	50	45	45	35	45	30	40	25	35	25	30	20	A		11.95	(1-49)
	SRA-1TX	.5-500	DC-500	5.5	7.0	6.5	8.5	50	45	45	35	45	30	40	25	35	25	30	20	A		39.95	(1-49)
	SRA-1W	1-750	DC-750	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	B		14.95	(5-24)
	SRA-1-1	.1-500	DC-500	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	C		13.95	(5-24)
	•SRA-2	1-1000	.5-500	5.5	7.5	6.5	8.5	45	30	45	30	35	20	35	20	30	20	30	20	D		14.95	(5-24)
	SRA-2CM	5-1000	DC-1000	6.0	7.0	6.5	8.5	60	50	50	45	35	30	30	25	30	25	25	20	E		14.95	(1-49)
	SRA-3	.025-200	DC-200	5.5	7.5	6.5	8.5	60	50	45	35	45	35	40	30	35	25	30	20	F		14.95	(5-24)
	•SRA-4	5-1250	.5-500	5.5	7.5	6.5	8.5	50	40	50	40	40	20	40	20	30	20	30	20	D		16.95	(5-24)
	•SRA-5	5-1500	10-600	7.0	8.0	7.5	8.5	50	45	45	40	35	30	30	25	30	20	25	15	D		21.95	(5-24)
	SRA-6	.003-100	DC-100	5.5	7.5	6.5	8.5	60	50	60	45	45	30	40	25	35	25	30	20	G		21.95	(5-24)
	SRA-8	.0005-10	DC-10	6.5	7.5	7.0	8.5	60	50	60	50	50	40	50	40	45	35	45	35	G		26.95	(5-24)
	•SRA-11	5-2000	10-600	7.0	8.5	7.5	9.0	50	45	45	40	35	25	30	20	30	20	25	15	D		26.95	(5-24)
	•SRA-12	800-1250	50-90	—	—	6.0	7.5	32	25	30	20	35	25	30	20	35	25	30	20	D		24.95	(5-24)
	★SRA-215	.05-1500	.05-500	6.0	7.5	7.0	9.0	25	20	25	20	35	25	35	25	30	20	25	15	—		23.95	(5-24)
	★SRA-220	.05-2000	.05-500	6.0	7.5	7.0	9.0	25	20	25	20	40	30	40	30	30	20	25	15	—		26.95	(5-24)
SBL SERIES case outline Fig. 6	SBL-1	1-500	DC-500	5.5	7.5	6.5	8.5	50	35	45	30	45	30	40	25	35	25	30	20	H		4.50	(10-49)
	•SBL-1X	10-1000	5-500	6.0	7.5	7.0	9.0	50	35	45	30	40	25	35	20	30	20	25	20	D		5.95	(10-49)
TAK SERIES case outline Fig. 4	TAK-5	.01-250	DC-250	5.5	7.0	6.5	8.5	60	50	55	45	50	35	45	30	40	30	35	25	F		18.95	(1-4)
	TAK-5R	.05-200	DC-200	5.5	6.5	6.5	8.0	55	50	50	45	45	35	40	30	45	35	40	30	J		15.95	(5-24)
	TAK-6	.5-600	DC-600	5.5	7.5	6.5	8.5	60	50	55	45	50	30	45	30	40	25	30	20	B		18.95	(1-4)
	TAK-6R	5-500	DC-500	6.0	7.0	6.5	8.0	55	50	45	40	45	30	40	25	35	30	30	25	B		15.95	(5-24)
	•TAK-7	2-1000	.5-500	5.5	7.5	6.5	8.5	45	30	45	30	35	20	35	20	30	20	30	20	D		20.95	(1-4)
GRA SERIES case outline Fig. 9	GRA-1	.5-500	DC-500	5.5	7.0	6.5	8.5	50	45	45	35	45	30	40	25	35	25	30	20	P		12.95	(6-49)
	GRA-3	.025-200	DC-200	5.5	7.5	6.5	8.5	60	50	45	35	45	35	40	30	35	25	30	20	Q		15.95	(6-49)
	GRA-6	.003-100	DC-100	5.5	7.5	6.5	8.5	60	50	60	45	45	30	40	25	35	25	30	20	R		22.95	(5-24)
	GRA-8	.0005-10	DC-10	6.5	7.5	7.0	8.5	60	50	60	50	50	40	50	40	45	35	45	35	R		25.95	(5-24)
SAM SERIES case outline Fig. 3	SAM-1	1-600	DC-600	5.5	7.0	6.5	8.5	55	45	50	40	45	30	40	25	35	20	30	20	B		15.95	(1-24)
	SAM-2	1-1000	DC-1000	6.0	7.5	7.0	9.5	55	45	50	40	40	25	40	25	35	20	30	20	B		17.95	(1-24)
	SAM-3	.1-500	DC-500	5.5	7.0	6.5	8.5	60	50	50	40	50	35	45	30	35	30	30	20	C		17.95	(1-24)
	•SAM-4	5-1250	.5-1000	6.5	8.5	6.5	8.5	55	40	50	40	35	25	35	25	30	20	30	20	D		19.95	(1-24)
	•SAM-5	5-1500	.5-1000	6.5	7.5	6.5	8.5	55	40	50	40	35	25	35	25	30	20	30	20	D		24.95	(1-24)

★ LO LEVEL + 10 dBm

● IF port is not DC coupled

NOTE 2: Additional specifications for compression level, phase detection, and attenuation are listed on page 7. Environmental specifications refer to page 1. SBL series not hermetically sealed.

Prices and specifications subject to change without notice. **† Consult factory**

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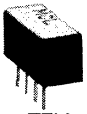
TSM SERIES


TFM SERIES

ASK SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin. Layout Fig.	PRICE $ Ea.	Qty.
TSM SERIES case outline Fig. 11	TSM-1	1-500	DC-500	6.0	7.5	6.5	8.5	60	45	55	45	45	35	40	30	35	25	35	25	N		17.95	(5-24)
	TSM-3	.1-400	DC-400	5.3	7.5	6.5	8.5	60	50	55	45	50	35	45	30	35	25	35	25	O		19.95	(5-24)
TFM SERIES case outline Fig. 2	TFM-2	1-1000	DC-1000	6.0	7.5	7.0	8.5	50	45	45	40	40	25	35	25	30	25	25	20	K		11.95	(1-49)
	TFM-3	.04-400	DC-400	5.3	7.0	6.0	8.0	60	50	55	40	50	35	45	30	35	25	35	25	L		19.95	(5-49)
	TFM-4	5-1250	DC-1250	6.0	7.5	7.5	8.5	50	45	45	40	40	30	35	25	30	25	25	20	K		21.95	(5-49)
	•TFM-11	1-2000	5-600	7.0	8.5	7.5	9.0	50	45	45	40	35	25	27	20	25	20	25	20	D		39.95	(1-24)
	•TFM-12	800-1250	50-90	—	—	6.0	7.5	35	25	30	20	35	25	30	20	35	25	30	20	D		39.95	(1-24)
	★TFM-15	10-3000	10-800	6.3	8.0	6.5	8.5	35	25	30	20	35	25	30	20	35	25	30	20	M		49.95	(1-9)
	★TFM-150	10-2000	DC-1000	6.0	8.0	6.5	8.0	32	25	33	20	35	25	30	20	35	25	30	20	M		39.95	(1-9)
ASK SERIES case outline Fig. 12	ASK-1	1-600	DC-600	5.5	7.0	6.0	8.5	50	40	45	35	35	25	30	20	30	20	25	15	A		5.95	(10-49)

† Consult factory

MIL—M-28837/1A SELECTION GUIDE

MIL-M-28837/1A-	MCL MODEL NO.	NATIONAL STOCK NO.
01N	TAK-5R	
01S	TAK-5R Hi-Rel	
02N	TAK-6R	
02S	TAK-6R Hi-Rel	
03N	SRA-1	NSN 6625-00-008-8272
03S	SRA-1 Hi-Rel	
07N	GRA-1	
07S	GRA-1 Hi-Rel	
09N	SRA-1W	
09S	SRA-1W Hi-Rel	
12N	SRA-8	NSN 5985-01-081-0977
12S	SRA-8 Hi-Rel	
	TFM-2-408	NSN 5821-01-076-2497
	SRA-3	NSN 5895-01-021-5914
	SAM-3	NSN 5895-01-062-9973
	SAM-5	NSN 5895-01-036-9507
	SBL-1	NSN 9058-00-256-6818

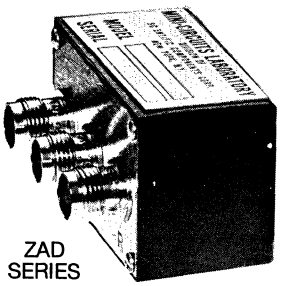
✓Designer's Check List

SRA - Hi-Rel MIL—M-28837
TAK - Low Profile, Hi-Rel MIL—M-28837
SBL - Rugged, Commercial Style
GRA - Compact, Hi-Rel, MIL—M-28837
SAM - Miniature, Hi-Rel, MIL—M-28837
TSM - Low Profile, Miniature, High Rel MIL—M-28837
TFM - Low Profile, Miniature, Flat Pack or Plug In Hi-Rel, MIL—M-28837
ASK - Micro Miniature, Flat-Pack, Plastic Case Commercial Type

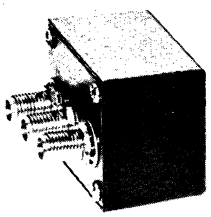
all models available for immediate delivery.

Double Balanced Mixers

LEVEL 1 Standard Level (+7 dBm LO) Connector Styles



ZAD SERIES



ZLW SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Conn. Layout Fig.	PRICE $ Ea.	Qty.
ZAD SERIES case outline Fig. 22	ZAD-1	.5-500	DC-500	5.5	7.0	6.5	8.5	50	45	45	35	45	30	40	25	35	25	30	20	A		29.95	(4-24)
	ZAD-1W	1-750	DC-750	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	N		34.95	(4-24)
	ZAD-1-1	.1-500	DC-500	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	O		31.95	(4-24)
	•ZAD-2	1-1000	.5-500	5.5	7.5	6.5	8.5	45	30	45	30	35	20	35	20	30	20	30	20	D		39.95	(4-24)
	ZAD-3	.025-200	DC-200	5.5	7.5	6.5	8.5	60	50	45	35	45	35	40	30	35	25	30	20	S		31.95	(4-24)
	•ZAD-4	5-1250	.5-500	5.5	7.5	6.5	8.5	50	40	50	40	40	20	40	20	30	20	30	20	D		41.95	(4-24)
	ZAD-6	.003-100	DC-100	5.5	7.5	6.5	8.5	60	50	60	45	45	30	40	25	35	25	30	20	T		39.95	(4-24)
	ZAD-8	.0005-10	DC-10	6.5	7.5	7.0	8.5	60	50	60	50	50	40	50	40	45	35	45	35	T		44.95	(4-24)
	•ZAD-11	5-2000	10-600	7.0	8.5	7.5	9.0	50	45	45	40	35	25	30	20	30	20	25	15	D		51.95	(4-24)
	•ZAD-12	800-1250	50-90	6.0	7.5	6.0	7.5	35	25	30	20	35	25	30	20	35	25	30	20	D		51.95	(4-24)
ZLW SERIES case outline Fig. 21	ZLW-1	.5-500	DC-500	5.5	7.0	6.5	8.5	50	45	45	35	45	30	40	25	35	25	30	20	A		39.95	(4-24)
	*ZLW-1W	1-750	DC-750	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	B		44.95	(4-24)
	ZLW-1-1	.1-500	DC-500	5.5	7.5	6.5	8.5	50	45	45	30	45	30	40	25	35	25	30	20	C		41.95	(4-24)
	ZLW-2	1-1000	DC-1000	6.0	7.5	7.0	9.5	55	45	50	40	40	25	40	25	35	20	30	20	B		44.95	(4-24)
	ZLW-3	.025-200	DC-200	5.5	7.5	6.5	8.5	60	50	45	35	45	35	40	30	35	25	30	20	F		41.95	(4-24)
	•ZLW-5	5-1500	.5-1000	6.5	7.5	6.5	8.5	55	40	50	40	35	25	35	25	30	20	30	20	D		51.95	(4-24)
	ZLW-6	.003-100	DC-100	5.5	7.5	6.5	8.5	60	50	60	45	45	30	40	25	35	25	30	20	G		49.95	(4-24)
	ZLW-8	.0005-10	DC-10	6.5	7.5	7.0	8.5	60	50	60	50	50	40	50	40	45	35	45	35	G		54.95	(4-24)
	•ZLW-11	5-2000	10-600	7.0	8.5	7.5	9.0	50	45	45	40	35	25	30	20	30	20	25	15	D		61.95	(4-24)
	•ZLW-12	800-1250	50-90	—	—	6.0	7.5	35	25	30	20	35	25	30	20	35	25	30	20	D		61.95	(4-24)

● IF Port is not DC coupled.

NOTE 2: Additional specifications for compression level, phase detection, and attenuation are listed on page 7. Environmental specifications refer to page 1.

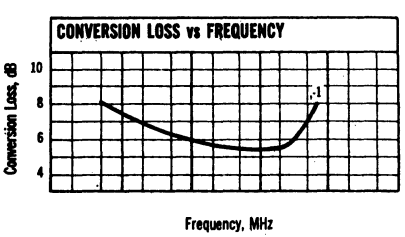
■ Lower Band 1.5-2.0 GHz, Mid Band 2-3,7 GHz, Upper Band 3.7-4.2 GHz

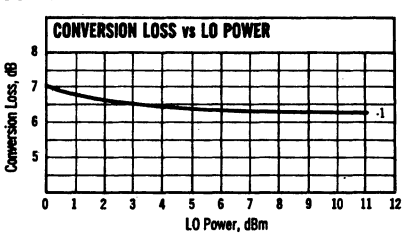
☆ +10 dBm LO, +5 dBm RF.

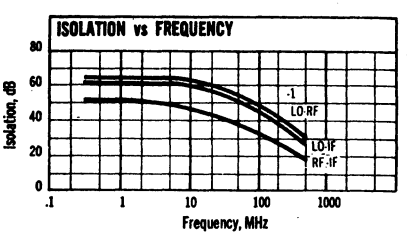
Prices and specifications subject to change without notice.

† Consult factory

TYPICAL PERFORMANCE CURVES







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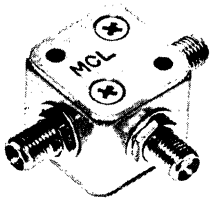
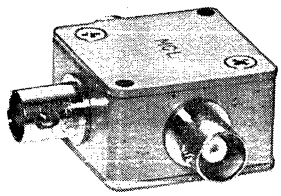
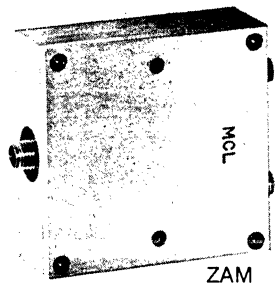


ZEM SERIES



ZFM SERIES



ZAM SERIES

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid-Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Conn. Layout Fig.	PRICE $ Ea.	Qty
ZEM SERIES case outline Fig. 21a	**ZEM-2**	10-1000	DC-1000	6.0	7.0	6.5	8.5	55	50	55	45	30	25	30	20	25	20	25	20	K		49.95	(4-24)
ZFM SERIES case outline Fig. 18	**ZFM-1W**	10-750	DC-750	6.0	7.0	6.2	8.0	50	45	45	40	45	30	40	25	35	25	27	20	U		41.95	(4-24)
	ZFM-2	1-1000	DC-1000	6.0	7.5	7.0	8.5	50	45	45	40	40	25	35	25	30	25	25	20	N		43.95	(1-24)
	ZFM-3	.04-400	DC-400	5.3	7.0	6.0	8.0	60	50	55	40	50	35	45	30	35	25	35	25	V		51.95	(1-24)
	ZFM-4	5-1250	DC-1250	6.0	7.5	7.5	8.5	50	45	45	40	40	30	35	25	30	25	25	20	U		51.95	(1-24)
	•**ZFM-11**	1-2000	5-600	7.0	8.5	7.5	9.0	50	45	45	40	35	25	27	20	25	20	25	20	D		81.95	(1-24)
	•**ZFM-12**	800-1250	50-90	—	—	6.0	7.5	35	25	30	20	35	25	30	20	35	25	30	20	D		71.95	(1-24)
	☆**ZFM-15**	10-3000	10-800	6.3	7.5	6.5	8.5	35	25	30	20	35	25	30	20	35	25	30	20	W		79.95	(1-9)
	☆**ZFM-150**	10-2000	DC-1000	6.0	7.0	6.5	8.0	32	25	33	28	35	25	30	20	35	20	25	20	W		59.95	(1-9)
ZAM SERIES †case outline	**ZAM-42**	1500-4200	DC-500	—	—	7.0	8.5	25	20	18	10	25	17	18	10	25	20	18	10	RR		74.95	(1-9)
	■ **ZAM-4212**	2000-4200	DC-1300	—	—	7.0	8.5	—	—	—	—	25	17	18	10	25	20	18	10	RR		79.95	(1-9)

† Consult factory

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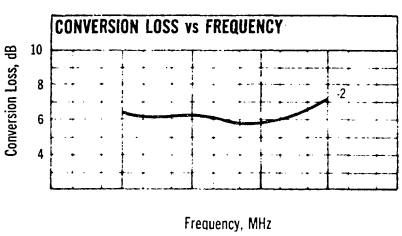
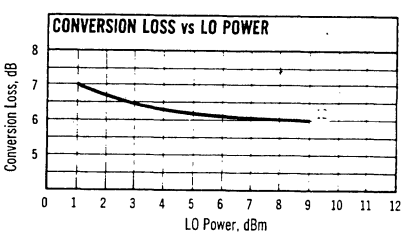
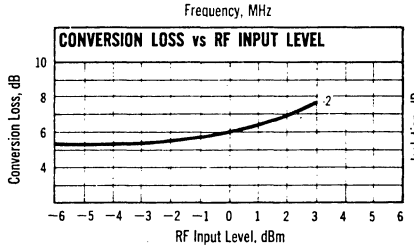
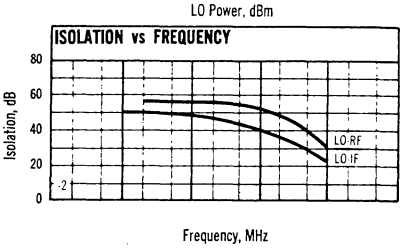
MCL MODEL NO.	NATIONAL STOCK NO.
ZAD-1B	5985-00-280-7750
ZLW-2B	6920-01-037-1974
ZLW-1W	5840-00-607-7010
ZLW-5-1	4920-01-017-2753

TYPICAL PERFORMANCE CURVES







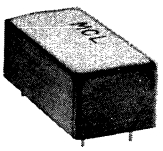


all models available for immediate delivery.

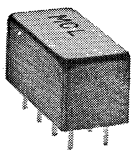
Double Balanced Mixers

LEVEL 2 High Level (+17 dBm LO) PC Board Mounting

SAM-H SERIES



GRA-H SERIES



SRA-H SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin. Layout Fig.	PRICE $ Ea.	Qty.
SRA-H case outline Fig. 1	**SRA-1H**	.5-500	DC-500	5.5	7.5	6.5	8.5	55	45	45	35	45	30	40	30	35	25	30	20	AA		$17.95	(5-24)
	SRA-1WH	1-750	DC-750	5.5	7.5	6.5	8.5	50	40	45	35	45	25	40	20	35	25	30	20	AA		21.95	(5-24)
	SRA-1HA	2-400	DC-400	6.0	7.5	7.0	8.5	50	40	45	35	40	30	35	25	30	25	25	20	BB		19.95	(5-24)
	SRA-2H	2-1000	DC-1000	6.0	7.5	8.5	10	50	40	45	35	35	25	30	20	35	25	25	20	CC		29.95	(5-24)
	SRA-3H	.05-200	DC-200	5.5	7.0	5.5	7.5	55	45	45	35	45	30	40	30	35	25	30	20	DD		19.95	(5-24)
	SRA-3HA	.1-100	DC-100	5.0	7.0	6.0	8.5	55	45	50	40	40	30	35	25	30	25	25	20	EE		17.95	(5-24)
	•SRA-11H	10-3000	10-1000	8.0	10	10	12	27	20	27	20	25	18	25	18	23	16	23	16	FF		39.95	(1-24)
GRA-H case outline Fig. 8	**■GRA-1H**	.5-500	DC-500	5.5	7.5	6.5	8.5	55	45	45	35	45	30	40	30	35	25	30	20	KK		18.95	(5-24)
	■GRA-3H	.05-200	DC-200	5.5	7.0	5.5	7.5	55	45	45	35	45	30	40	30	35	25	30	20	LL		20.95	(5-24)
	GRA-6H	.01-50	DC-50	5.5	6.0	5.5	7.0	50	45	50	40	47	40	47	35	35	30	32	25	MM		26.95	(5-24)
SAM-H case outline Fig. 3	**SAM-1H**	1-600	DC-600	6.0	7.5	6.5	8.5	55	45	50	40	40	25	35	25	35	20	30	20	GG		20.95	(1-24)
	SAM-2H	5-1000	DC-1000	6.7	8.0	7.5	9.5	55	45	50	40	40	25	35	20	35	20	25	15	HH		35.95	(1-24)
	SAM-3H	.1-500	DC-500	5.5	7.0	6.5	8.0	55	45	50	40	40	25	35	20	30	20	20	15	JJ		20.95	(1-24)

• IF port is not DC coupled.

■ **GRA-1H;** exact electrical and mechanical replacement for M9B, M93. **GRA-3H;** exact electrical and mechanical replacement for M9A, M9AC.

NOTE 2: Additional specifications for compression level, phase detection, and attenuation are listed on page 7. Environmental specifications refer to page 1.

Prices and specifications subject to change without notice. **† Consult factory**

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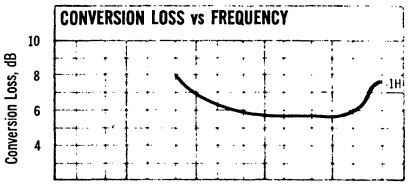
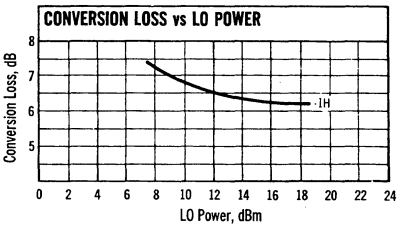
MIL-M-28837/1A-	MCL MODEL NO.		NATIONAL STOCK NO.
05N	GRA-3H		
05S	GRA-3H	Hi-Rel	
06N	GRA-1H		
06S	GRA-1H	Hi-Rel	
08N	SRA-1H		6625-00-594-0223
08S	SRA-1H	Hi-Rel	
10N	GRA-1H		
10S	GRA-1H	Hi-Rel	
	SRA-1WH		5840-00-576-0716
	SRA-2H		5895-01-063-1078

TYPICAL PERFORMANCE CURVES





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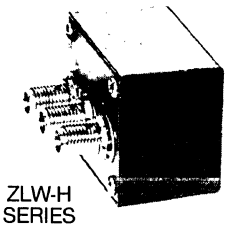
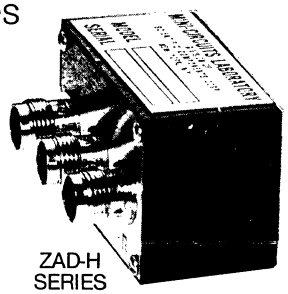
Mini-Circuits

Connector Styles



ZLW-H SERIES



ZAD-H SERIES

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	T - Conn. Layout Fig.	PRICE $ Ea.	Qty.
ZAD-H case outline Fig. 22	ZAD-1H	.5-500	DC-500	5.5	7.5	6.5	8.5	55	45	45	35	45	30	40	30	35	25	30	20	AA		$35.95	(4-24)
	ZAD-1WH	1-750	DC-750	5.5	7.5	6.5	8.5	50	40	45	35	45	25	40	25	35	25	30	20	AA		39.95	(4-24)
	ZAD-2H	2-1000	DC-1000	6.0	7.5	8.5	10	50	40	45	35	35	25	30	20	35	25	25	20	CC		49.95	(4-24)
	ZAD-3H	.05-200	DC-200	5.5.	7.0	5.5	7.5	55	45	45	35	45	30	40	30	35	25	30	20	DD		37.95	(4-24)
	•ZAD-11H	10-3000	10-1000	8.0	10	10	12	27	20	27	20	25	18	25	18	23	16	23	16	FF		81.95	(4-24)
ZLW-H case outline Fig. 21	ZLW-1H	.5-500	DC-500	5.5	7.5	6.5	8.5	55	45	45	35	45	30	40	30	35	25	30	20	AA		45.95	(4-24)
	ZLW-1WH	1-750	DC-750	5.5	7.5	6.5	8.5	50	40	45	35	45	25	40	25	35	25	30	20	AA		49.95	(4-24)
	ZLW-2H	2-1000	DC-1000	6.0	7.5	8.5	10	50	40	45	35	35	25	30	20	35	25	25	20	CC		59.95	(4-24)
	ZLW-3H	.05-200	DC-200	5.5	7.0	5.5	7.5	55	45	45	35	45	30	40	30	35	25	30	20	DD		47.95	(4-24)
	•ZLW-11H	10-3000	10-1000	8.0	10	10	12	27	20	27	20	25	18	25	18	23	16	23	16	FF		91.95	(4-24)

† Consult factory

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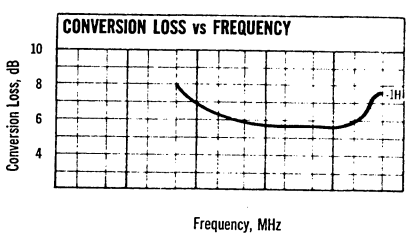
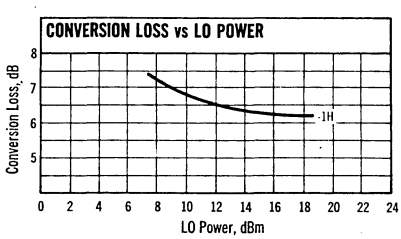
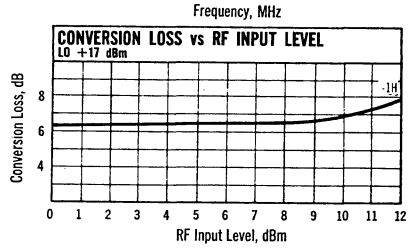
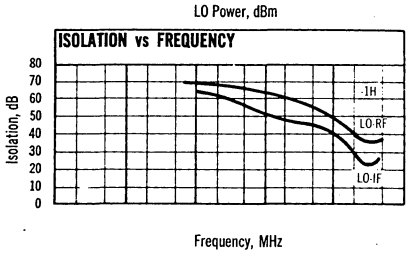
MCL MODEL NO.	NATIONAL STOCK NO.
ZAD-1WH	5895-01-045-4647
ZLW-1H	5985-01-080-7637
ZLW-1H-B	5962-01-045-7500

TYPICAL PERFORMANCE CURVES





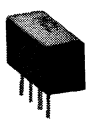




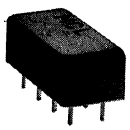
all models available for immediate delivery

Double Balanced Mixers

LEVEL 3 Very High Level (+17 dBm LO) PC Board Mounting



TFM-H SERIES



TAK-H SERIES

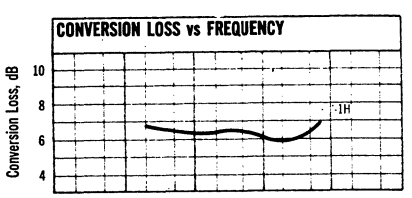
See page 7 for dimensions

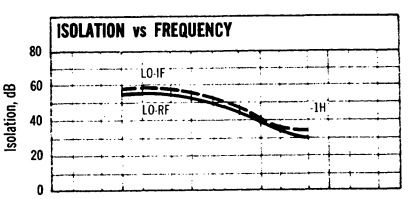
	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin. Layout Fig.	PRICE $ Ea.	Qty.
TFM-H case outline Fig. 2	TFM-1H	2-500	DC-500	6.0	7.5	7.0	8.5	50	45	45	40	40	30	35	25	30	20	25	20	1		23.95	(5-24)
	TFM-2H	5-1000	DC-1000	6.2	7.0	7.0	10	50	45	45	40	40	30	35	25	30	20	25	17	2		31.95	(5-24)
	TFM-3H	.1-250	DC-250	5.0	7.0	6.0	8.5	50	45	45	40	40	30	35	25	28	23	26	20	3		23.95	(5-24)
TAK-H case outline Fig. 5	TAK-1H	2-500	DC-500	6.0	7.5	7.0	8.5	50	40	45	35	40	30	35	25	30	25	25	20	4		19.95	(5-24)
	TAK-1WH	5-750	DC-750	6.2	7.5	7.0	9.0	50	40	45	35	40	30	35	25	30	25	30	20	5		23.95	(5-24)
	TAK-3H	.05-300	DC-300	5.0	7.0	6.0	8.5	55	45	50	40	40	30	35	25	30	25	25	20	6		21.95	(5-24)

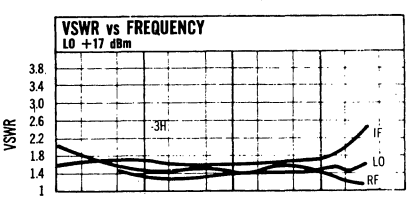
NOTE: 2: Additional specifications for dynamic range and VSWR are listed on page 7. Environmental specifications refer to page 1. Prices and specifications subject to change without notice.

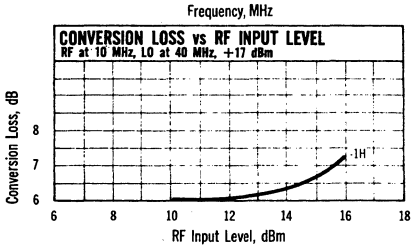
† Consult factory

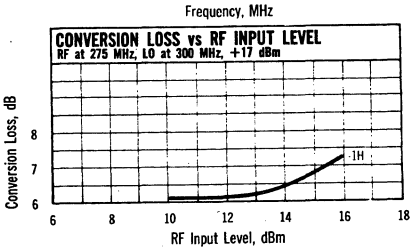
TYPICAL PERFORMANCE CURVES

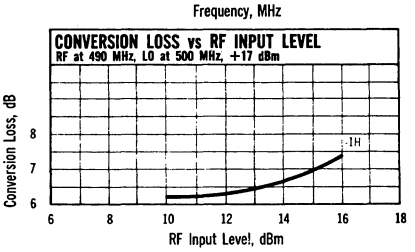












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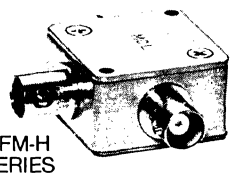
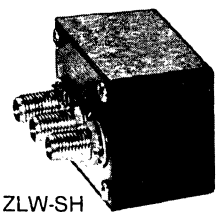
Mini-Circuits

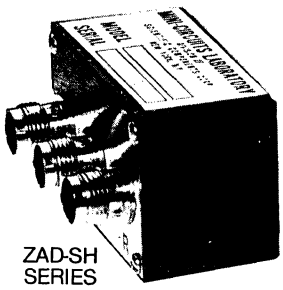
Connector Styles



ZFM-H SERIES



ZLW-SH SERIES

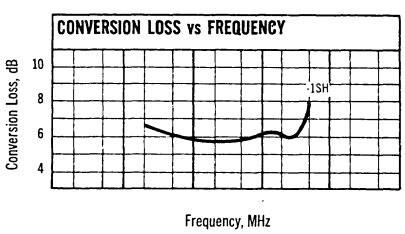


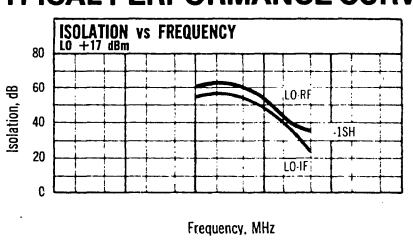
ZAD-SH SERIES

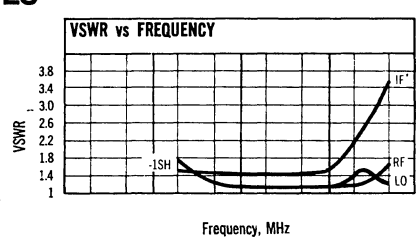
	Model No.	FREQUENCY RANGE MHz LO/RF	IF	CONVERSION LOSS dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	ISOLATION dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Conn. layout Fig.	PRICE $ Ea.	Qty.
ZAD-SH case outline Fig. 22	ZAD-1SH	2-500	DC-500	6.0	7.5	7.0	8.5	50	40	45	35	40	30	35	25	30	25	25	20	10		40.95	(4-24)
	ZAD-1WSH	5-750	DC-750	6.2	7.5	7.0	9.0	50	45	45	40	40	30	35	25	30	20	30	20	11		44.95	(4-24)
	ZAD-3SH	.05-300	DC-300	5.0	7.0	6.0	8.5	55	45	50	40	40	30	35	25	30	25	25	20	12		42.95	(4-24)
ZFM-H case outline Fig. 18	ZFM-1H	2-500	DC-500	6.0	7.5	7.0	8.5	50	40	45	35	40	30	35	25	30	25	25	20	7		53.95	(1-24)
	ZFM-2H	5-1000	DC-1000	6.2	7.0	7.0	10	50	45	45	40	40	30	35	25	30	20	25	17	8		61.95	(1-24)
	ZFM-3H	.05-300	DC-300	5.0	7.0	6.0	8.5	55	45	50	40	40	30	35	25	30	25	25	20	9		54.95	(1-24)
ZLW-SH case outline Fig. 21	ZLW-1SH	2-500	DC-500	6.0	7.5	7.0	8.5	50	40	45	35	40	30	35	25	30	25	25	20	13		50.95	(4-24)
	ZLW-1WSH	5-750	DC-750	6.2	7.5	7.0	9.0	50	45	45	40	40	30	35	25	30	20	30	20	14		54.95	(4-24)
	ZLW-3SH	.05-300	DC-300	5.0	7.0	6.0	8.5	55	45	50	40	40	30	35	25	30	25	25	20	15		52.95	(4-24)

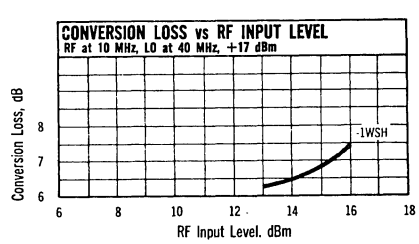
† Consult factory

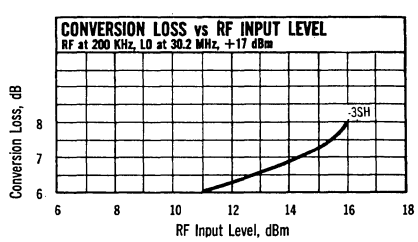
TYPICAL PERFORMANCE CURVES

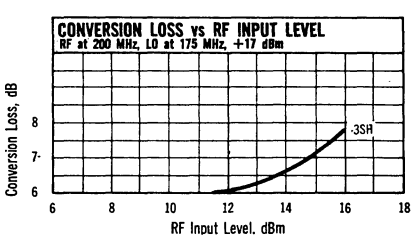








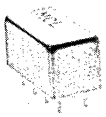




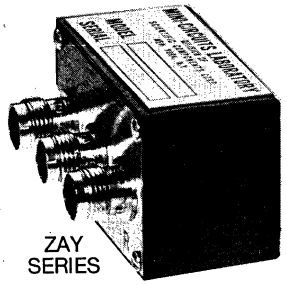
all models available for immediate delivery.

Double Balanced Mixers

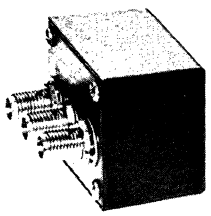
LEVEL 4 Very High Level (+23 dBm LO)



RAY SERIES



ZAY SERIES



ZMY SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	Conversion Loss dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	Isolation dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin/ Conn. Layout Fig.	PRICE $ Ea.	Qty.
RAY SERIES case outline Fig. 1	RAY-1	5-500	DC-500	6.0	7.5	7.5	8.5	55	45	55	45	40	30	40	30	30	25	30	20	00		34.95	(4-9)
	RAY-2	10-1000	DC-1000	7.0	8.5	8.5	10	50	35	50	35	40	30	35	25	35	25	25	20	PP		54.95	(4-9)
	RAY-3	.07-200	DC-200	6.0	7.5	6.5	8.0	55	45	55	45	40	30	40	30	30	25	30	20	QQ		34.95	(4-9)
ZAY SERIES case outline Fig. 22	ZAY-1	5-500	DC-500	6.0	7.5	7.5	8.5	55	45	55	45	40	30	40	30	30	25	30	20	00		47.95	(1-9)
	ZAY-2	10-1000	DC-1000	7.0	8.5	8.5	10	50	35	50	35	40	30	35	25	35	25	25	20	PP		67.95	(1-9)
	ZAY-3	.07-200	DC-200	6.0	7.5	6.5	8.0	55	45	55	45	40	30	40	30	30	25	30	20	QQ		47.95	(1-9)
ZMY SERIES case outline Fig. 21	ZMY-1	5-500	DC-500	6.0	7.5	7.5	8.5	55	45	55	45	40	30	40	30	30	25	30	20	00		57.95	(1-9)
	ZMY-2	10-1000	DC-1000	7.0	8.5	8.5	10	50	35	50	35	40	30	35	25	35	25	30	20	PP		77.95	(1-9)
	ZMY-3	.07-200	DC-200	6.0	7.5	6.5	8.0	55	45	55	45	40	30	40	30	30	25	30	20	QQ		57.95	(1-9)

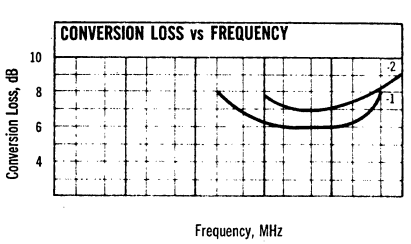
NOTE 3: Additional specifications for compression level, phase detection, and attenuation are listed on page 7. Environmental specifications page 1.
Prices and specifications subject to change without notice.

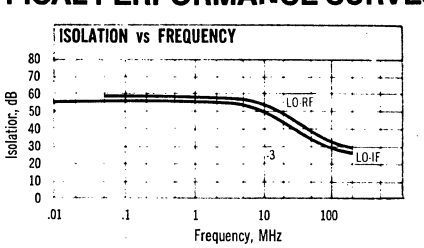
† Consult factory

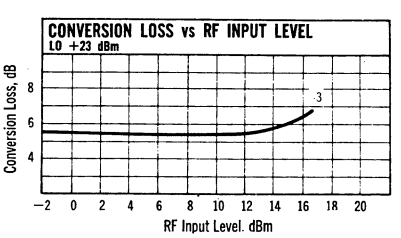
MIL-M-28837/1A SELECTION GUIDE

MIL-M-28837/1A-	MCL MODEL NO.	NATIONAL STOCK NO.
04N	RAY-1	
04S	RAY-1 Hi-Rel	
	RAY-3	5895-01-064-5082
	ZMY-2	4935-01-080-7636

TYPICAL PERFORMANCE CURVES



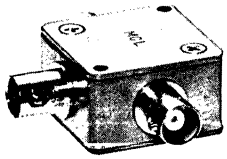




Mini-Circuits

LEVEL 5 Super High Level (+23 dBm LO)

SAY SERIES

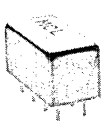


ZFY SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	Conversion Loss dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	Isolation dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin/ Conn. Layout Fig.	PRICE $ Ea.	Qty.
SAY SERIES case outline Fig. 1	SAY-1	0.1-500	.01-500	5.3	6.0	5.3	7.5	47	40	47	40	46	35	46	35	40	30	40	30	16		54.95	(1-9)
	SAY-2	0.1-1000	.01-500	5.3	7.5	7.5	9.5	47	40	47	40	40	30	40	25	30	25	25	20	17		59.95	(1-9)
	SAY-11	10-2400	5-1000	7.0	8.5	8.0	10	28	20	28	20	26	20	26	20	25	20	25	20	18		64.95	(1-9)
ZFY SERIES case outline Fig. 18	ZFY-1	0.1-500	.01-500	5.3	6.0	5.3	7.5	47	40	47	40	46	35	46	35	40	30	40	30	19		74.95	(1-9)
	ZFY-2	0.1-1000	.01-500	5.3	7.5	7.5	9.5	47	40	47	40	40	30	40	25	30	25	25	20	20		79.95	(1-9)
	ZFY-11	10-2400	5-1000	7.0	8.5	8.0	10	28	20	28	20	26	20	26	20	25	20	25	20	21		84.95	(1-9)

LEVEL 6 Ultra High Level (+27 dBm LO)



VAY-1 SERIES

See page 7 for dimensions

	Model No.	FREQUENCY RANGE MHz LO/RF	IF	Conversion Loss dB One Octave from Band Edge Typ.	Max.	Total Range Typ.	Max.	Isolation dB Lower Band Edge to One Decade Higher LO/RF Typ.	Min.	LO/IF Typ.	Min.	Mid. Range LO/RF Typ.	Min.	LO/IF Typ.	Min.	Upper Band Edge to One Octave Lower LO/RF Typ.	Min.	LO/IF Typ.	Min.	ADD'L DATA (Note 2)	† Pin Layout Fig.	PRICE $ Ea.	Qty.
VAY-1 case outline Fig. 1	VAY-1	.05-500	.02-500	6.0	7.5	7.5	8.5	47	40	47	40	46	35	46	35	35	25	35	25	22	5	74.95	(1-9)

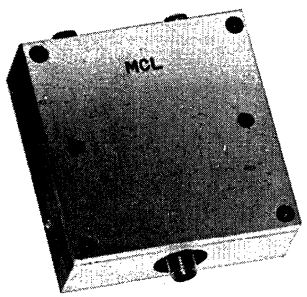
NOTE: 2: Additional specifications for dynamic range and VSWR are listed on page 7. Environmental specifications refer to page 1. Prices and specifications subject to change without notice.

† Consult factory

all models available for immediate delivery

Microwave Mixers

Standard Level (+7 dBm LO)



MODEL	FREQUENCY	Z (Ohms)	COST
ZAM-42	1500 MHz - 4.2 GHz	50	$74.95 (1-9)
ZAM-4212	2000 MHz - 4.2 GHz	50	$79.95 (1-9)

DESCRIPTION—This series is housed in an extremely rugged package, and is designed to withstand extreme environmental and outdoor weather conditions.

Offered with SMA connectors, the size of these units are 2 inches square by 0.75" high.

Designed for use in satellite communication systems, the ZAM series has optimum performance over the frequency range of 3.7 to 4.2 GHz. Isolation is greater than 20 dB, conversion loss is typically 7 dB, and an LO power level of only +4 dBm to +7 dBm is required.

Utilizing a new microstrip design the ZAM series is offered at ⅓ to ½ the price of competitive units. The ZAM units are available for off-the-shelf delivery.

The breakthrough in price/performance is a natural extension of our extensive experience in high-volume manufacturing, exacting quality-control and computer testing. This expertise assures you highly reliable mixers with guaranteed repeatability of performance at lowest cost.

FEATURES

- **Broadband:** 1.5 GHz to 4.2 GHz
- **IF Output:** DC to 500 MHz
- **Low Conversion Loss:** typically 7 dB
- **Isolation:** typically 25 dB
- **Rugged Construction:** microstrip circuit in a milled aluminum structure
- **Low Profile:** only 0.75" high
- **High Reliability:** 100% tested, 1 year guarantee
- **Low Cost:** only $74.95 in small quantity

APPLICATIONS

- Satellite communications
- Frequency mixing
- Pulse and amplitude modulation
- Phase detection
- Current controlled attenuation
- Bi-phase modulation

ABSOLUTE MAXIMUM RATINGS

- **Input Power:** 50 mW
- **Operating and Storage Temp.** −55°C to +100°C
- **Peak IF Input Current:** 20 mA
- **Environmental Specifications:** See page 1

DIMENSIONS AND CONNECTIONS

CONNECTORS: SMA (3mm) standard

	A	B	C	D	E	F	G	H	J	K	P
IN	.750	2.00	2.00	1.00	.375	.500	1.00	1.500	1.00	.250	.125
MM	19.05	50.80	50.80	25.40	9.53	12.70	25.40	38.10	25.40	6.35	3.18

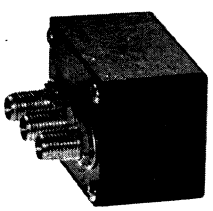
SPECIFICATIONS

Consult factory for case outlines and schematics.

Model No.	Frequency Range, GHz			Conversion Loss, dB			Isolation, dB				
								LO-RF		LO-IF	
	LO	RF	IF	Over Frequency Band	Typ.	Max.	Over Frequency Band	Typ.	Min.	Typ.	Min.
ZAM-42	1.5-4.2	1.5-4.2	DC-0.5	1500-200 MHz	7.0	8.5	1500-2000 MHz	25	20	18	10
				2000-3700 MHz	7.0	8.5	2000-3700 MHz	25	17	18	10
ZAM-4212	2.0-4.2	2.0-4.2	DC-1.3	3700-4200 MHz	7.0	8.5	3700-4200 MHz	25	20	18	10

WEIGHT 116 grams 4.09 ounces

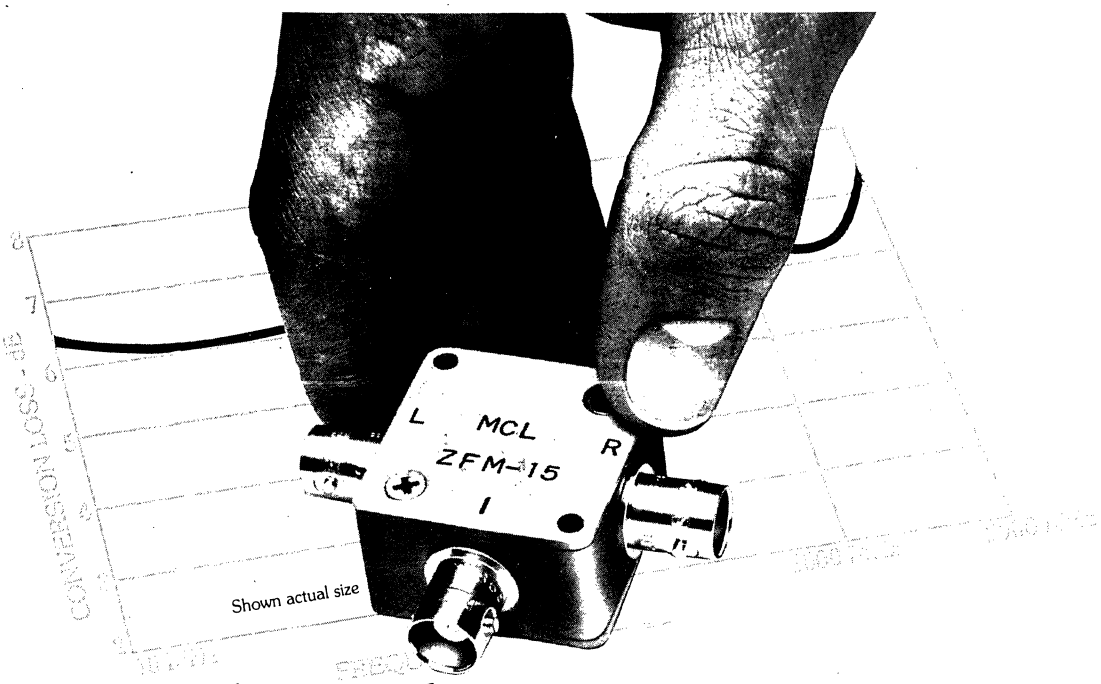
ZMA SERIES



MODEL NO.	FREQUENCY RANGE GHz		CONVERSION LOSS dB			ISOLATION dB				PRICE	
							LO/RF		LO/IF		$
	LO/RF	IF	OVER FREQUENCY BAND	Typ.	Max.	OVER FREQUENCY BAND	Typ.	Min.	Typ.	Min.	EA.	QTY.
ZMA-2	1-2.5	DC-.15	1.4-2 GHz	7.0	8.5	1.0-1.5 GHz	25	20	50	35	**63.95**	(1-9)
			1.0-2.5 GHz	8.0	9.0	1.5-2.0 GHz	22	17	40	30		
						2.0-2.5 GHz	20	15	35	25		
ZMA-3	1.4-3.0	DC-.5	1.6-2.5 GHz	6.5	8.0	1.4-2.0 GHz	25	20	50	35	**67.95**	(1-9)
			1.4-3.0 GHz	7.0	9.0	2.0-2.5 GHz	28	18	50	30		
						2.5-3.0 GHz	23	15	50	30		

WEIGHT 74 grams 2.6 ounces

Mini-Circuits 2625 E. 14th St., Brooklyn, NY 11235 (212) 769-0200/Dom. Telex 125460/Int'l. Telex 620156



super mixer

the world's first 10-3000 MHz mixer **with only 6.5 dB conversion loss**

The ZFM-15 from Mini-Circuits $79.95 (1-9)

Specify the ZFM-15 for such applications as wideband ECM receivers where wide dynamic range is essential; the 1 dB compression point for the ZFM-15 is +5 dBm. The price/performance of the ZFM-15 even makes it ideal for narrowband applications including TACAN and S-Band telemetry.

The miniature ZFM-15 is available in 4 connector versions and 3 mounting configurations. Of course, super mixers come with Mini-Circuits' one-year guarantee and are available for immediate delivery.

ZFM-15 SPECIFICATIONS

FREQUENCY RANGE, MHz
LO 10-3000 RF 10-3000 IF 10-800
LO Power + 10 dBm

CONVERSION LOSS, dB	Typ.	Max.
20-1500 MHz	6.3	7.5
10-3000 MHz	6.5	8.5

ISOLATION, dB (10-3000 MHz)	Typ.	Min.
LO-RF	30	20
LO-IF	30	20

SIGNAL 1 dB Compression Level +5 dBm
IMPEDANCE all ports 50 ohms

VSWR (at ports)	Typ.
LO	2.1
RF	2.1
IF	1.8

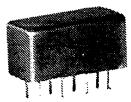
CONNECTORS BNC STD, TNC on request
Type N and SMA $5 additional
MOUNTING Thru-hole, Threaded insert, Flange
SIZE 1.25"x 1.25" sq. x 0.75" high

Mini-Circuits

A Division of Scientific Components Corp.
World's largest manufacturer of Double Balanced Mixers
2625 East 14th Street, Brooklyn, New York 11235 (212)769-0200
Domestic and International Telex 125460 International Telex 620156

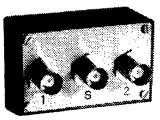
54 REV. C

POWER SPLITTER/COMBINER SERIES SELECTOR GUIDE

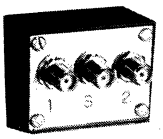


A. PSC-2, PSCQ-2, PSCJ-2 PSC-3, PSC-4

B. MSC-2

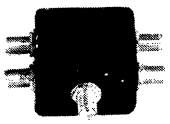


C. ZSC-2, ZSCJ-2, ZSCQ-2

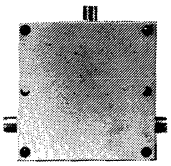


D. ZMSC-2, ZMSCJ-2, ZMSCQ-2

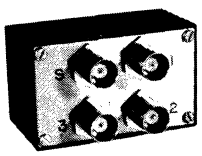
E. ZFSC-2, ZFSCJ-2



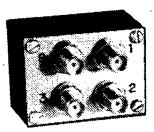
F. ZFSC-4



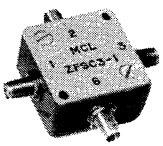
R. ZAPDQ



G. ZSC-3

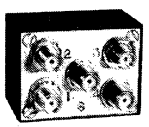


H. ZMSC-3

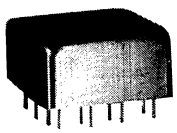


I. ZFSC-3

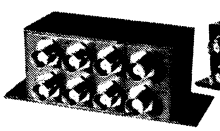
J. ZSC-4



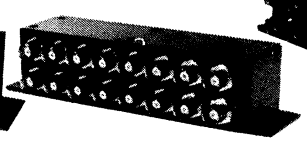
K. ZMSC-4



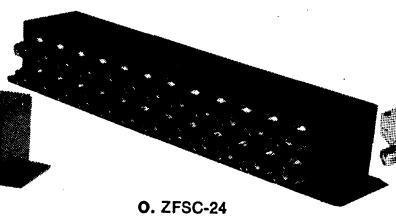
L. PSC-6, PSC-8



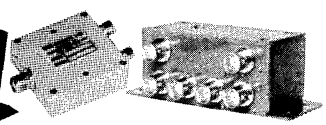
M. ZFSC-8



N. ZFSC-16



O. ZFSC-24



P. ZAPD Q. ZFSC-6

R. ZA4PD

SERIES	CASE STYLE SEE FIG.	OUTPUT PORTS	PHASE DEGREES	FREQUENCY RANGE	CONNECTORS	SIZE (INCHES) H x W x L	PRICE FROM (QTY.)
PSC-2	A	2	0	2 KHz - 1000 MHz	8 Pin	0.4 x 0.4 x 0.8	$ 9.95 (6-49)
MSC-2	B	2	0	100 KHz - 650 MHz	8 Pin	0.4 x 0.2 x 0.5	$16.95 (5-24)
ZSC-2	C	2	0	2 KHz - 650 MHz	BNC STD., TNC OPT.	1.4 x 1.15 x 2.25	$27.95 (4-24)
ZMSC-2	D	2	0	2 KHz - 650 MHz	SMA	1.15 x 0.88 x 1.5	$37.95 (4-24)
ZFSC-2	E	2	0	2 KHz - 1500 MHz	BNC STD., TNC, N, SMA OPT.	0.75 x 1.25 x 1.25	$31.95 (4-24)
ZAPD	P	2	0	0.5 GHz - 4.2 GHz	BNC STD., TNC, SMA, TYPE N	0.75 x 2 x 2	$39.95 (1-9)
PSCQ-2	A	2	90	25 MHz - 180 MHz	8 Pin	0.4 x 0.4 x 0.8	$12.95 (5-49)
ZSCQ-2	C	2	90	25 MHz - 180 MHz	BNC STD., TNC OPT.	1.4 x 1.15 x 2.25	$39.95 (4-24)
ZMSCQ-2	D	2	90	25 MHz - 180 MHz	SMA	1.15 x 0.88 x 1.5	$49.95 (4-24)
ZAPDQ	R	2	90	.5 GHz-4.2 GHz	SMA	0.75 x 2 x 2	$59.95 (1-9)
PSCJ-2	A	2	180	10 KHz - 200 MHz	8 Pin	0.4 x 0.4 x 0.8	$19.95 (5-49)
ZSCJ-2	C	2	180	10 KHz - 200 MHz	BNC STD., TNC OPT.	1.4 x 1.15 x 2.25	$37.95 (4-24)
ZMSCJ-2	D	2	180	10 KHz - 200 MHz	SMA	1.15 x 0.88 x 1.5	$47.95 (4-24)
ZFSCJ-2	E	2	180	1 MHz - 500 MHz	BNC STD., TNC, N, SMA OPT.	0.75 x 1.25 x 1.25	$39.95 (4-24)
PSC-3	A	3	0	10 KHz - 500 MHz	8 Pin	0.4 x 0.4 x 0.8	$19.95 (5-49)
ZSC-3	G	3	0	10 KHz - 200 MHz	BNC STD., TNC OPT.	1.4 x 1.15 x 2.25	$37.95 (4-24)
ZMSC-3	H	3	0	10 KHz - 200 MHz	SMA	1.15 x 0.88 x 1.5	$47.95 (4-24)
ZFSC-3	I	3	0	1 MHz - 750 MHz	BNC STD., TNC, SMA, N OPT.	0.75 x 1.25 x 1.25	$39.95 (4-24)
PSC-4	A	4	0	10 KHz - 1000 MHz	8 Pin	0.4 x 0.4 x 0.8	$23.95 (6-49)
ZSC-4	J	4	0	2 KHz - 250 MHz	BNC STD., TNC OPT.	1.4 x 1.15 x 2.25	$43.95 (4-24)
ZMSC-4	K	4	0	2 KHz - 250 MHz	SMA	1.15 x 0.88 x 1.5	$53.95 (4-24)
ZFSC-4	F	4	0	1 MHz - 1000 MHz	SMA, BNC OPT.	0.75 x 1.25 x 1.25	$74.95 (1-4)
ZA4PD	R	4	0	2.0-4.2 GHz	TNC, SMA, N	.75×2×2	$79.95 (1-9)
PSC-6	L	6	0	500 KHz - 175 MHz	16 Pin	0.4 x 0.8 x 0.8	$68.95 (1-5)
ZFSC-6	Q	6	0	1 MHz - 175 MHz	BNC STD., TNC, SMA	1.57 x 1.64 x 4.08	$89.95 (1-4)
PSC-8	L	8	0	10 KHz - 500 MHz	16 Pin	0.4 x 0.8 x 0.8	$58.95 (6-49)
ZFSC-8	M	8	0	10 KHz - 700 MHz	BNC STD., TNC, SMA OPT.	1.57 x 1.64 x 4.08	$89.95 (1-4)
ZFSC-16	N	16	0	500 KHz - 125 MHz	BNC STD., TNC, SMA OPT.	1.57 x 1.64 x 6.69	$174.95 (1-4)
ZFSC-24	O	24	0	200 KHz - 100 MHz	BNC STD., TNC, SMA OPT.	1.57 x 1.64 x 9.32	$264.95 (1-4)

FOR ADDITIONAL SPECIFICATIONS SEE FOLLOWING PAGES

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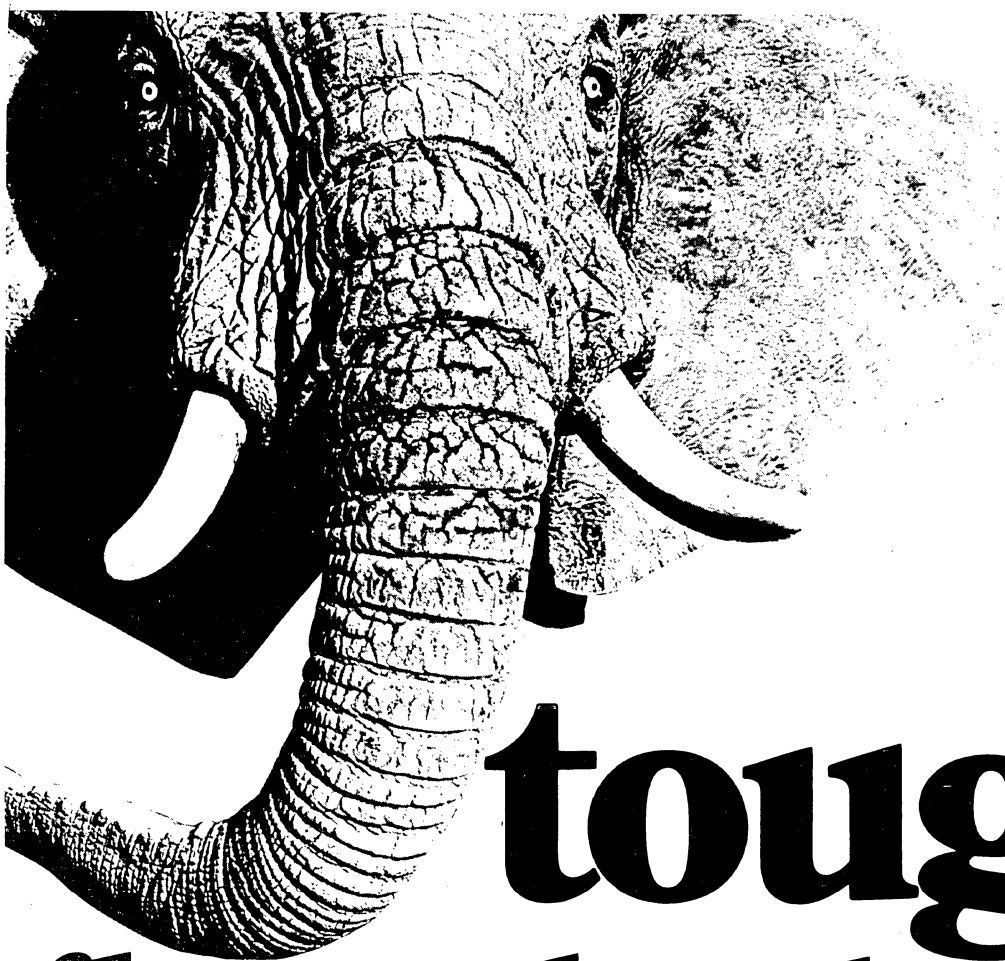

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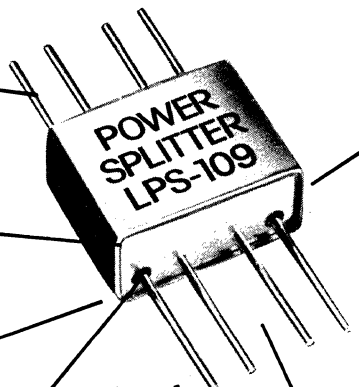

stronger glass seals prevents cracking when leads are bent and handled

tough competitive pricing only $17.95 (5-24) ½ to ⅕ cost of competitive units

Model LPS-109 Superior Electrical Characteristics

FREQUENCY RANGE, (MHz)	10-500
INSERTION LOSS, dB (above 3 dB)	TYP.
10-200 MHz	0.4
200-500 MHz	0.6
ISOLATION, dB	25
AMPLITUDE UNBAL.	0.2
PHASE UNBAL.	2°
IMPEDANCE	50 ohms

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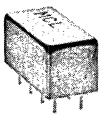
C-95 REV A

Power Splitter/Combiners

2 WAY-0° PC Board Mounting

For dimensions see Mixer dimensions Page 7



PSC-2 SERIES

MSC-2 SERIES

TSC-2 SERIES

			ISOLATION dB						INSERTION LOSS dB Above 3dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB					
			L = Low range (f_L to $10f_L$)		M = Mid range ($10f_L$ to $f_{up}/2$)		U = Upper range ($f_{up}/2$ to f_{up})														†		
	MODEL NO.	FREQ. RANGE MHz f_L-f_U	L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	L Max.	M Max.	U Max.	L Max.	M Max.	U Max.	Z Ω	Pin. Layout Fig.	PRICE $ EA.	QTY.
PSC-2 case outline Fig. 1	PSC-2-1	0.1-400	20	15	25	20	25	20	0.2	0.6	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	50		9.95	(6-49)
	PSC-2-1W	1-650	25	20	35	25	25	20	0.3	0.6	0.5	0.9	0.7	1.0	2.0	3.0	4.0	.15	0.2	0.3	50		14.95	(6-49)
	PSC-2-2	0.002-60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3	50		19.95	(6-49)
	PSC-2-4	10-1000	30	25	25	20	25	20	0.6	1.0	0.6	1.2	0.7	1.2	2.0	8.0	20	.15	0.2	0.4	50		19.95	(6-49)
	PSC-2375	55-85	—	—	35	25	—	—	—	—	0.3	0.5	—	—	—	1.0	—	—	0.1	—	75		19.95	(6-24)
	PSC-2-1-75	0.25-300	20	15	30	20	20	15	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	.15	0.2	0.3	75		11.95	(6-49)
MSC-2 case outline Fig. 3	MSC-2-1	0.1-450	20	15	30	20	30	20	0.3	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	50		16.95	(5-24)
	MSC-2-1W	2-650	22	18	30	25	22	18	0.3	0.5	0.5	0.8	0.8	1.2	1.0	2.0	4.0	.15	0.2	0.3	50		17.95	(5-24)
TSC-2 case outline Fig. 2	TSC-2-1	1-400	30	25	30	20	25	20	0.25	0.5	0.4	0.75	0.8	1.1	2.0	3.0	4.0	.15	.2	.8	50		13.95	(5-24)

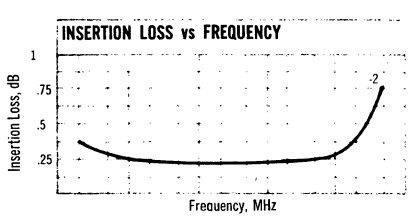
For environmental specifications refer to page 1.
Prices and specifications subject to change without notice.

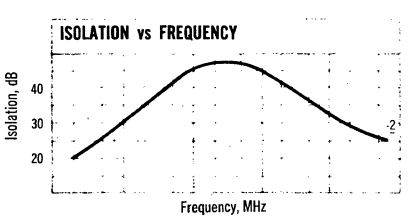
† Consult factory

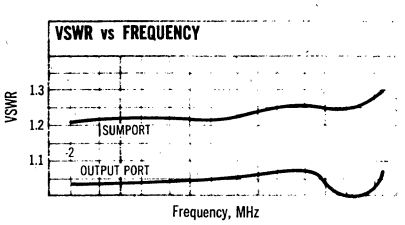
MIL-P-23971/15 SELECTION GUIDE

MIL-P-23971/15	MCL MODEL NO.	NATIONAL STOCK NO.
01	PSC-2-1	5820-00-548-0739
02	MSC-2-1	
	PSC-2-2	5825-01-044-8944

TYPICAL PERFORMANCE CURVES







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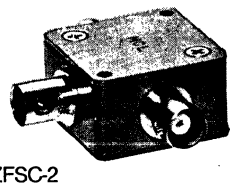
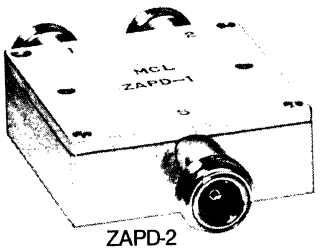
Mini-Circuits

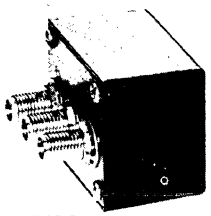
Connector Styles



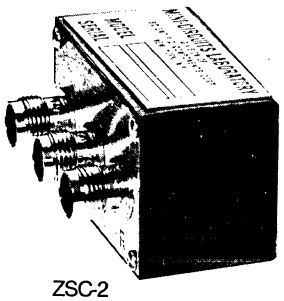
ZFSC-2 SERIES



ZAPD-2 SERIES



ZMSC-2 SERIES



ZSC-2 SERIES

L = Low range (f_L to $10f_L$) M = Mid range ($10f_L$ to $f_{up}/2$) U = Upper range ($f_{up}/2$ to f_{up})

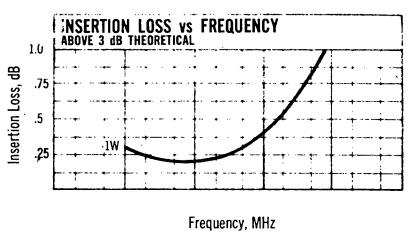
	MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	ISOLATION dB L Min.	ISOLATION dB M Typ.	ISOLATION dB M Min.	ISOLATION dB U Typ.	ISOLATION dB U Min.	INSERTION LOSS dB Above 3dB L Typ.	INSERTION LOSS dB Above 3dB L Max.	INSERTION LOSS dB Above 3dB M Typ.	INSERTION LOSS dB Above 3dB M Max.	INSERTION LOSS dB Above 3dB U Typ.	INSERTION LOSS dB Above 3dB U Max.	PHASE UNBALANCE Degrees L Max.	PHASE UNBALANCE Degrees M Max.	PHASE UNBALANCE Degrees U Max.	AMPLITUDE UNBALANCE dB L Max.	AMPLITUDE UNBALANCE dB M Max.	AMPLITUDE UNBALANCE dB U Max.	Z Ω	† Conn. Layout Fig.	PRICE $ EA.	PRICE QTY.
ZSC-2 case outline Fig. 22	ZSC-2-1	0.1-400	20	15	25	20	25	20	0.2	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	50	—	27.95	(4-24)
	ZSC-2-1W	1-650	25	20	35	25	25	20	0.2	0.5	0.5	0.8	0.7	1.0	2.0	3.0	4.0	.15	0.2	0.3	50	—	32.95	(4-24)
	ZSC-2-2	0.002-60	25	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3	50	—	37.95	(4-24)
	ZSC-2-4	10-1000	25	20	35	20	25	20	0.2	0.5	0.5	0.8	0.7	1.3	2.0	4.0	6.0	.15	0.2	0.3	50	—	37.95	(4-24)
	ZSC-2375	55-85	—	—	35	25	—	—	—	—	0.3	0.5	—	—	—	1.0	—	—	0.1	—	75	—	37.95	(4-24)
	ZSC-2-1-75	0.25-300	20	15	30	20	20	15	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	.15	0.2	0.3	75	—	29.95	(4-24)
ZMSC-2 case outline Fig. 21	ZMSC-2-1	0.1-400	20	15	25	20	25	20	0.2	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	50	—	37.95	(4-24)
	ZMSC-2-1W	1-650	25	20	35	25	25	20	0.3	0.5	0.5	0.8	0.7	1.0	2.0	3.0	4.0	.15	0.2	0.3	50	—	42.95	(4-24)
	ZMSC-2-2	0.002-60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3	50	—	47.95	(4-24)
ZFSC-2 case outline Fig. 18	ZFSC-2-1	5-500	30	25	28	20	25	20	0.2	0.5	0.3	0.6	0.6	0.8	2.0	4.0	4.0	.15	.15	.03	50	—	31.95	(4-24)
	ZFSC-2-1-75	0.25-300	20	15	30	20	20	15	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	.15	0.2	0.3	75	—	32.95	(4-24)
	ZFSC-2-1W	1-750	30	20	28	20	25	20	0.2	0.5	0.4	0.8	0.8	1.0	2.0	4.0	4.0	.15	.15	0.3	50	—	35.95	(4-24)
	ZFSC-2-2	10-1000	30	20	25	20	23	18	0.2	0.5	0.5	1.0	0.9	1.2	2.0	4.0	4.0	.15	.15	0.3	50	—	39.95	(4-24)
	ZFSC-2-4	0.2-1000	20	15	25	20	23	18	0.2	0.5	0.5	1.0	0.9	1.2	2.0	4.0	4.0	.15	.15	0.3	50	—	44.95	(4-24)
	ZFSC-2-5	10-1500	25	15	30	20	25	18	0.25	0.6	0.5	1.0	0.8	1.5	5.0	8.0	10.0	.15	0.2	0.5	50	—	49.95	(4-24)
	ZFSC-2-6	0.002-60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	50	—	36.95	(4-24)
	ZFSC-2-6-75	0.004-60 GHz	30	20	35	20	25	20	0.5	0.8	0.4	0.8	0.7	1.0	1.0	2.0	3.0	.15	0.2	0.3	75	—	38.95	(4-24)
ZAPD-2 †case outline	ZAPD-1	0.5-1.0	25	19	25	19	25	19	0.25	0.6	0.25	0.6	0.25	0.6	—	1	—	0.2	0.2	0.2	50	—	39.95	(1-9)
	ZAPD-2	1.0-2.0	25	19	25	19	25	19	0.25	0.6	0.25	0.6	0.25	0.6	—	2	—	0.2	0.2	0.2	50	—	39.95	(1-9)
	ZAPD-21	0.5-2.0	25	19	25	19	25	19	0.25	0.6	0.25	0.6	0.25	0.6	—	2	—	0.2	0.2	0.2	50	—	49.95	(1-9)
	ZAPD-4	2.0-4.2	25	19	25	19	25	19	0.4	0.8	0.4	0.8	0.4	0.8	—	6	—	0.4	0.4	0.4	50	—	39.95	(1-9)

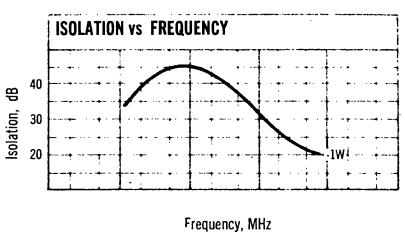
For environmental specifications refer to page 1. Prices and specifications subject to change without notice. † Consult factory

MIL-P-23971 SELECTION GUIDE

MCL MODEL NO.	NATIONAL STOCK NO.
ZSC-2-1	5895-01-036-6254
ZSC-2-1B	5820-00-270-3055
ZSC-2-2-75B	5915-01-012-8162
ZFSC-2-2A	6625-01-079-7021

TYPICAL PERFORMANCE CURVES





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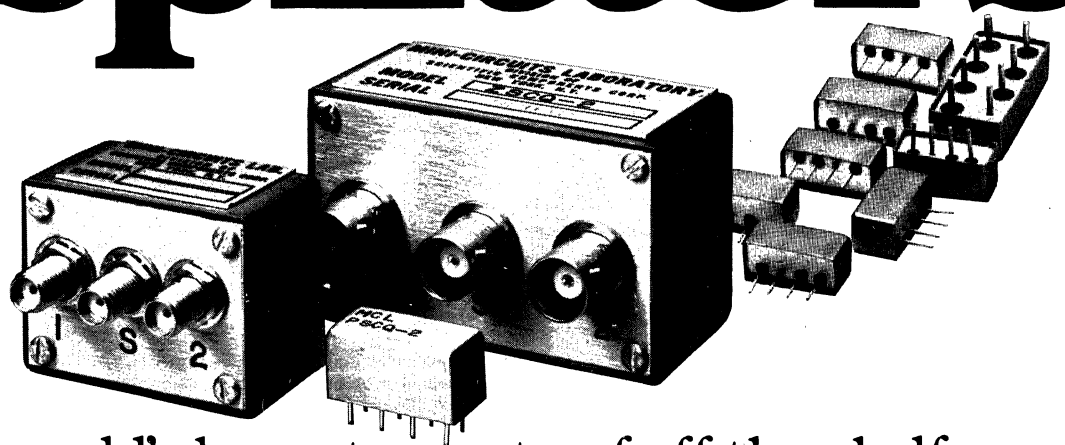

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90° SERIES SPECIFICATIONS

Model No.	Freq. Range MHz	Isolation dB Typ.	Isolation dB Min.	Insertion Loss dB* Typ.	Insertion Loss dB* Max.	Phase Unbalance Degrees Max.	Amplitude Unbalance dB Max.	Price $ Each	Price $ Qty.
PSCQ-2-1.5	1.4-1.7	29	25	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-3.4	3.0-3.8	30	25	0.4	0.7	3.0	1.2	16.95	(5-49)
PSCQ-2-6.4	5.8-7.0	30	25	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-7.5	7.0-8.0	35	25	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-10.5	9.0-11.0	25	20	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-13	12-14	29	25	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-14	12-16	30	25	0.3	0.6	3.0	1.8	16.95	(5-49)
PSCQ-2-21.4	20-23	30	25	0.4	0.7	3.0	1.2	12.95	(5-49)
PSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	19.95	(5-49)
PSCQ-2-70	40-70	25	20	0.3	0.7	3.0	1.2	19.95	(5-49)
PSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	19.95	(5-49)
PSCQ-2-120	80-120	25	18	0.3	0.7	3.0	1.5	19.95	(5-49)
PSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	19.95	(5-49)
PSCQ-2-250	150-250	23	18	0.4	0.8	4.0	1.5	19.95	(5-49)
PSCQ-2-400	250-400	22	16	0.4	0.9	4.0	1.5	19.95	(5-49)
PSCQ-2-450	350-450	22	16	0.4	0.9	4.0	1.5	19.95	(5-49)
ZSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	39.95	(4-24)
ZSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	39.95	(4-24)
ZSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	39.95	(4-24)
ZMSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	49.95	(4-24)
ZMSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	49.95	(4-24)
ZMSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	49.95	(4-24)

*Average of coupled outputs less 3 dB Impedance 50 ohms all models

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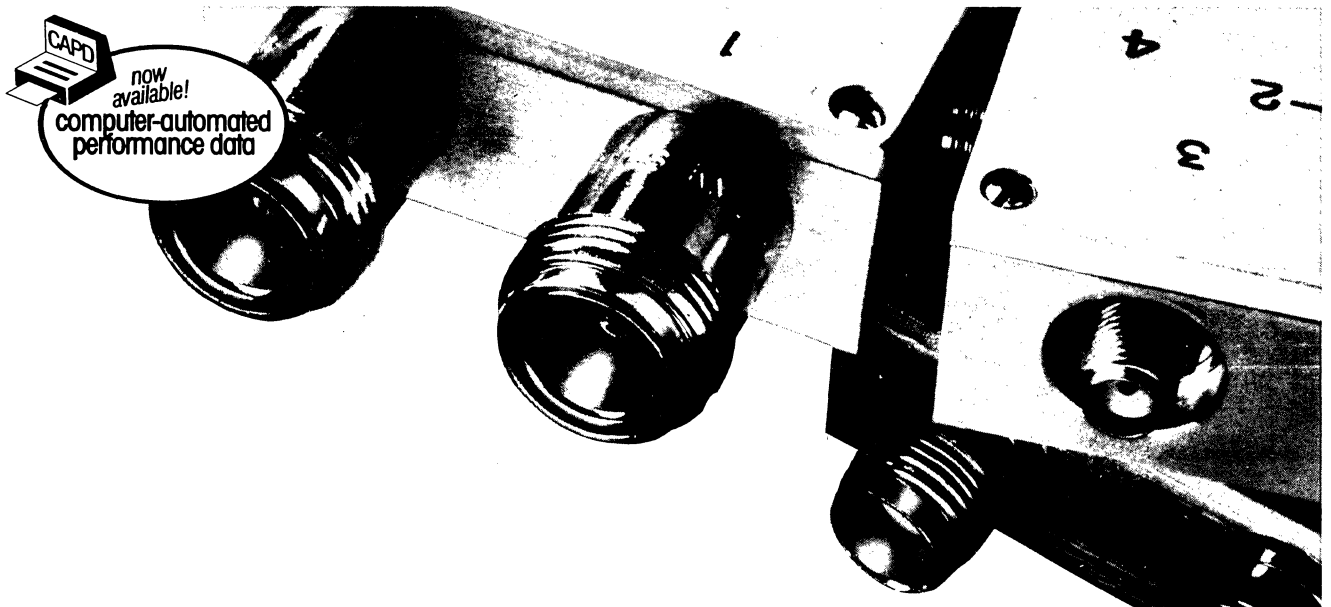
62 REV. A



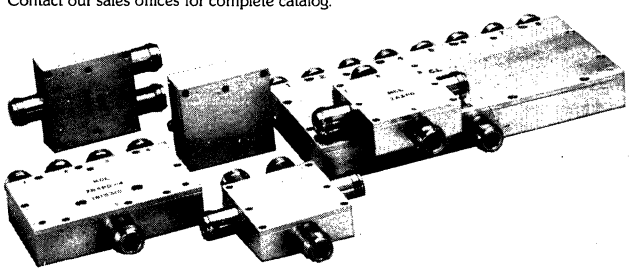
power dividers

0.5 to 4.2 GHz, to 10W (matched output) 2, 3, 4, and 8 way models...from $39.95 (1-9)

Now...a wide variety of microstrip power-dividers at 1/3 to 1/2 the price of competitive units, with immediate delivery.

These rugged RFI-shielded units meet MIL-202 E standards and are available with BNC, TNC, SMA and Type N connectors. They are also useful as power combiners at signal levels up to +100 mW.

For complete specifications and performance curves refer to the Microwaves Product Data Directory, the Goldbook, EEM or EBG. Contact our sales offices for complete catalog.



POWER DIVIDER SPECIFICATIONS

Model	N Way	Frequency Range, GHz	Insertion Loss, dB Typ.	Insertion Loss, dB Max.	Isolation dB Typ.	Isolation dB Min.	Max. Amplitude Unbalance dB	Price* (1-9)
ZAPD-1	2	0.5-1.0	0.3	0.6	25	19	0.3	39.95
ZAPD-2	2	1.0-2.0	0.3	0.6	25	19	0.3	39.95
ZAPD-21	2	0.5-2.0	0.4	0.7	25	18	0.4	49.95
ZAPD-4	2	2.0-4.2	0.4	0.8	25	18	0.4	39.95
ZA3PD-1	3	0.5-1.0	0.3	0.6	20	18	0.4	79.95
ZA3PD-1.5	3	0.75-1.5	0.3	0.7	20	17	0.3	84.95
ZA3PD-2	3	1.0-2.0	0.3	0.6	20	18	0.3	79.95
ZA3PD-4	3	2.0-4.2	0.7	1.0	18	14	0.8	79.95
ZA4PD-2	4	1.0-2.0	0.3	0.8	25	19	0.7	79.95
ZA4PD-4	4	2.0-4.2	0.5	1.0	25	18	0.8	79.95
ZB4PD-42	4	1.7-4.2	0.5	1.1	23	18	0.8	99.95
ZB4PD-4	4	3.7-4.2	0.6	1.1	24	20	0.8	89.95
ZB8PD-2	8	1.0-2.0	0.8	1.3	24	20	0.7	149.00
ZB8PD-4	8	2.0-4.2	0.8	1.4	30	20	0.9	149.00

*add $5.00 for SMA, N (ZAPD models only)

DIMENSIONS:
ZA L 2.0" x W 2.0" x H 0.75"
ZB4 L 3.5" x W 2.13" x H 0.88"
ZB8 L 7.06" x W 3.13" x H 0.88"

CONNECTORS:
BNC (not available—4 models) TNC, SMA, N

VSWR: all ports 1.2:1 Typ.

POWER RATING: as Divider: 10W as Combiner: 100 mW

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setting higher standards

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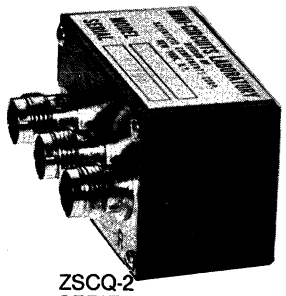
64 REV C

Power Splitter/Combiners

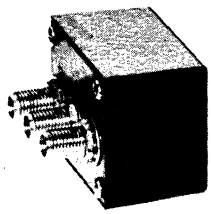
2 WAY-90°

For dimensions see Mixer dimensions page 7

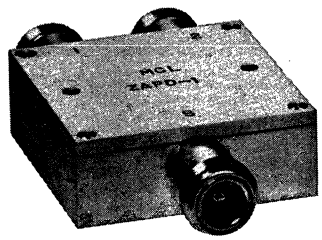
PSCQ-2 SERIES



ZSCQ-2 SERIES



ZMSCQ-2 SERIES

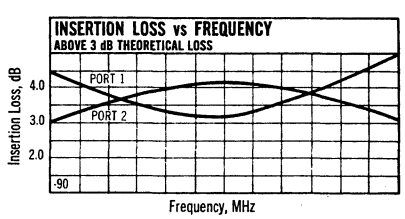


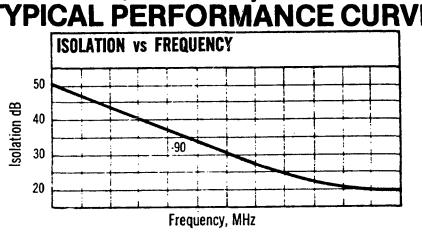
ZAPDQ SERIES

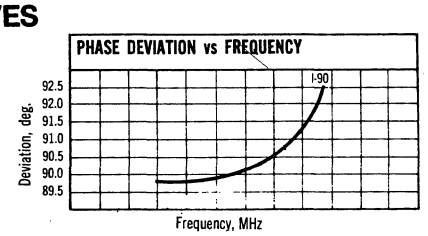
	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB Typ.	ISOLATION dB Min.	INSERTION LOSS dB Avg. of Coupled Outputs Less 3 dB Typ.	INSERTION LOSS dB Avg. of Coupled Outputs Less 3 dB Max.	PHASE UNBALANCE Degrees Max.	AMPLITUDE UNBALANCE dB Max.	Z Ω	† Pin/Conn. Layout Fig.	PRICE $ EA.	QTY.
PSCQ-2 case outline Fig. 1	PSCQ-2-1.5	1.4-1.7	29	25	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-3.4	3.0-3.8	30	25	0.4	0.7	3.0	1.2	50		16.95	(5-49)
	PSCQ-2-6.4	5.8-7.0	30	25	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-7.5	7.0-8.0	35	25	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-10.5	9.0-11.0	25	20	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-13	12-14	29	25	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-14	12-16	30	25	0.3	0.6	3.0	1.8	50		16.95	(5-49)
	PSCQ-2-21.4	20-23	30	25	0.4	0.7	3.0	1.2	50		12.95	(5-49)
	PSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	50		19.95	(5-49)
	PSCQ-2-70	40-70	30	20	0.3	0.7	3.0	1.5	50		19.95	(5-49)
	PSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	50		19.95	(5-49)
	PSCQ-2-120	80-120	25	18	0.3	0.7	3.0	1.5	50		19.95	(5-49)
	PSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	50		19.95	(5-49)
	PSCQ-2-250	150-250	25	18	0.4	0.8	4	1.5	50		19.95	(5-49)
	PSCQ-2-400	250-400	23	16	0.5	0.9	4	1.5	50		19.95	(5-49)
	PSCQ-2-450	350-450	23	16	0.5	0.9	5	1.5	50		19.95	(5-49)
ZSCQ-2 case outline Fig. 22	ZSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	50		39.95	(4-24)
	ZSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	50		39.95	(4-24)
	ZSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	50		39.95	(4-24)
ZMSCQ-2 case outline Fig. 21	ZMSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	50		49.95	(4-24)
	ZMSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	50		49.95	(4-24)
	ZMSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	50		49.95	(4-24)
ZAPDQ † case outline Fig. 33	ZAPDQ-2	1000-2000	22	18	0.4	0.9	5.0	1.0	50		59.95	(1-9)
	ZAPDQ-4	2000-4200	22	18	0.4	0.9	5.0	1.0	50		59.95	(1-9)

Environmental specifications refer to page 1.
Prices and specifications subject to change without notice. † Consult factory

TYPICAL PERFORMANCE CURVES







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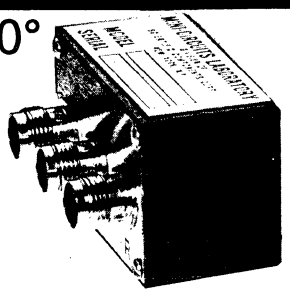
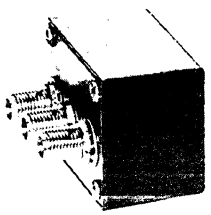
2 WAY-180°

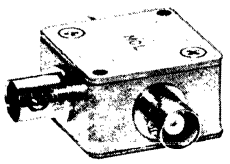
PSCJ-2 SERIES



ZSCJ-2 SERIES



ZMSCJ-2 SERIES



ZFSCJ-2 SERIES

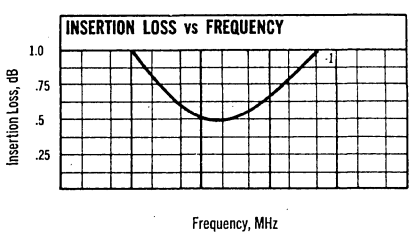
	MODEL NO.	FREQ. RANGE MHz f_L f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS dB Above 3dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	Z Ω	† Pin/ Conn. Layout Fig.	PRICE $ EA.	QTY.
			L = Low range (f_L to $10f_L$) M = Mid range ($10f_L$ to $f_{up}/2$) U = Upper range ($f_{up}/2$ to f_{up})																					
PSCJ-2 case outline Fig. 1	PSCJ-2-1	1-200	35	30	35	25	30	23	.75	1.0	0.6	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	50		19.95	(5-49)
	PSCJ-2-2	0.01-20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	50		29.95	(5-49)
ZSCJ-2 case outline Fig. 22	ZSCJ-2-1	1-200	35	30	35	25	30	23	.75	1.0	0.6	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	50		37.95	(4-24)
	ZSCJ-2-2	0.01-20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	50		47.95	(4-24)
ZMSCJ-2 case outline Fig. 21	ZMSCJ-2-1	1-200	35	30	35	25	30	23	.75	1.0	0.6	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	50		47.95	(4-24)
	ZMSCJ-2-2	0.01-20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	50		57.95	(4-24)
ZFSCJ-2 case outline Fig. 18	ZFSCJ-2-1	1-500	30	20	33	25	30	18	1.0	1.5	1.0	1.5	1.0	1.5	2.0	4.	6.0	.15	0.2	0.5	50		49.95	(4-24)
	ZFSCJ-2-3	5-300	30	20	33	25	30	18	1.0	1.5	1.0	1.5	1.0	1.5	2.0	4.0	6.0	.15	0.2	0.5	50		39.95	(4-24)

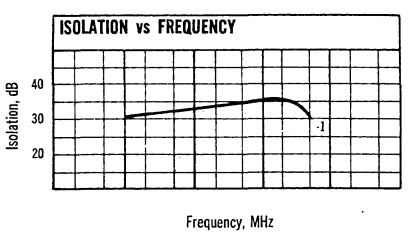
For environmental specifications refer to page 1.
Prices and specifications subject to change

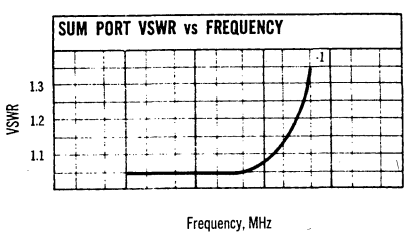
† Consult factory

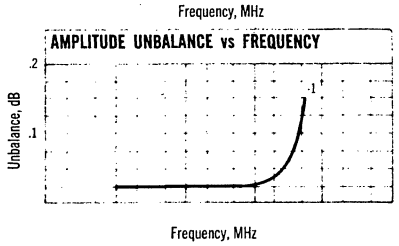
For dimensions see Mixer dimensions page 7

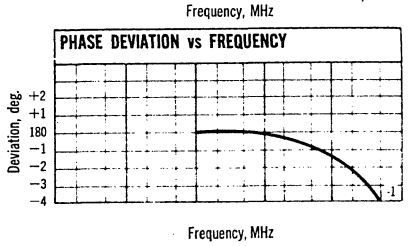
TYPICAL PERFORMANCE CURVES

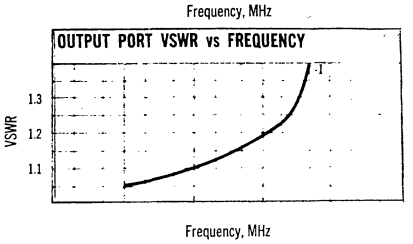










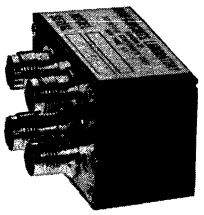


all models available for immediate delivery

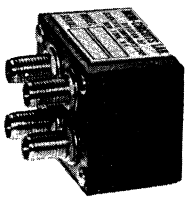
Power Splitter/Combiners

3 WAY-0°

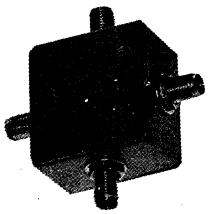
PSC-3 SERIES



ZSC-3 SERIES



ZMSC-3 SERIES



ZFSC-3 SERIES

	MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS dB Above 4.8dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	Z Ω	† Pin/ Conn. Layout Fig.	PRICE $ EA.	QTY.
PSC-3 case outline Fig. 1	•PSC-3-1	1-200	45	30	40	30	40	25	0.6	1.0	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3	50		19.95	(5-49)
	PSC-3-1W	5-500	25	20	31	15	25	15	0.4	0.8	0.4	1.4	0.8	1.4	6.0	14.	20.	0.1	0.3	0.6	50		29.95	(5-49)
	PSC-3-2	0.01-30	35	30	40	35	30	25	.25	.45	.15	0.3	45	.75	1.0	2.0	4.0	0.2	0.3	0.4	50		29.95	(5-49)
	PSC-3-1-75	1-200	35	30	35	25	35	25	0.6	1.0	0.4	0.7	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	75		20.95	(5-49)
	PSC-3-13	1-200	45	35	45	35	37	30	.25	0.5	.35	0.6	.35	0.6	1.0	3.0	4.0	0.1	0.2	0.2	50		24.95	(5-49)
ZSC-3 †case outline	ZSC-3-1	1-200	45	30	40	30	40	25	0.6	1.0	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3	50		37.95	(4-24)
	ZSC-3-2	0.01-30	35	30	40	35	30	25	.25	.45	.15	0.3	.45	.75	1.0	2.0	4.0	0.2	0.3	0.4	50		47.95	(4-24)
	ZSC-3-1-75	1-200	35	30	35	25	35	25	0.6	1.0	0.4	0.7	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	75		38.95	(4-24)
	ZSC-3-2-75	0.02-20	35	30	35	25	30	20	0.2	0.5	.25	0.6	.45	.75	2.0	3.0	4.0	0.2	0.3	0.3	75		48.95	(4-24)
ZMSC-3 †case outline	ZMSC-3-1	1-200	45	30	40	30	40	25	0.6	1.0	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3	50		47.95	(4-24)
	ZMSC-3-2	0.01-30	35	30	40	35	30	25	.25	.45	.15	0.3	.45	.75	1.0	2.0	4.0	0.2	0.3	0.4	50		57.95	(4-24)
ZFSC-3 †case outline	ZFSC-3-1	1-500	30	20	30	20	25	18	0.4	.75	0.5	0.9	0.8	1.2	2.0	3.0	4.0	0.2	0.3	0.4	50		39.95	(4-24)
	ZFSC-3-1W	2-750	30	20	30	20	25	18	0.4	.75	0.5	1.0	1.0	1.6	3.0	5.0	7.0	0.2	0.3	0.5	50		41.95	(4-24)
	ZFSC-3-13	1-200	45	30	48	35	37	30	.25	0.5	.35	0.6	.35	0.6	1.0	3.0	5.0	0.1	0.2	0.2	50		39.95	(4-24)

L = Low range (f_L to $10f_L$) M = Mid range ($10f_L$ to $f_{up}/2$) U = Upper range ($f_{up}/2$ to f_{up})

For environmental specifications refer to page 1.

Prices and specifications subject to change without notice.

• Model No. PSC 3-1 Manufactured under license Protected by Patent 3,428,920

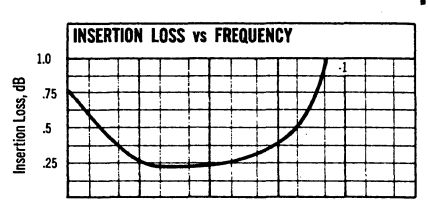
† Consult factory

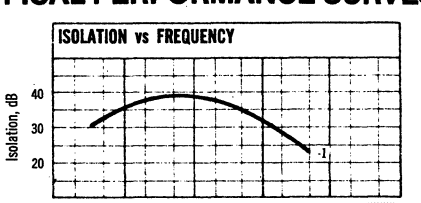
MIL-P-23971 SELECTION GUIDE

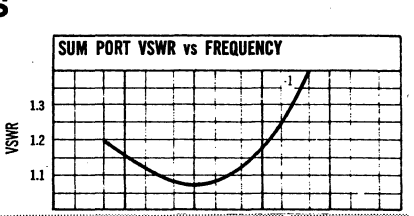
MCL MODEL NO.	NATIONAL STOCK NO.
PSC-3-1	5820-01-015-6027
ZSC-3-1B	5820-01-008-9566

See Mixer dimensions for PSC-3, PSC-4 dimensions, page 7. Other models, consult factory

TYPICAL PERFORMANCE CURVES







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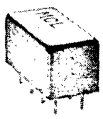
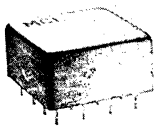
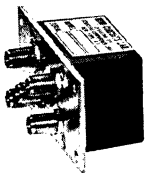
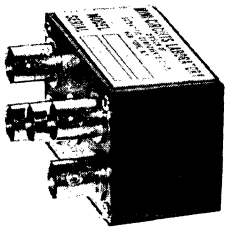
Mini-Circuits

4 WAY-0°


PSC-4 SERIES


PSC-4A SERIES


ZMSC-4 SERIES
(shown with bracket option)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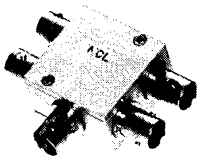
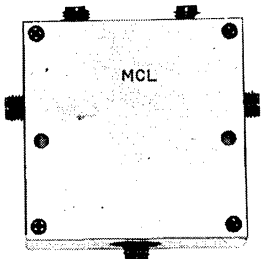

ZFSC-4 SERIES



ZA4PD SERIES

	MODEL NO.	FREQ. RANGE MHz f_L f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS dB Above 6dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	Z Ω	† Pin/ Conn. Layout Fig.	PRICE $ EA.	QTY.
			L = Low range (f_L to 10f_L) M = Mid range (10f_L to f_{up}/2) U = Upper range (f_{up}/2 to f_{up})																					
PSC-4 case outline Fig. 1 PSC-4A —Fig. 7	PSC-4-1	0.1-200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	—	—	—	.15	.20	.25	50		28.95	(6-49)
	PSC-4-1-75	1-200	30	20	25	20	25	20	0.4	0.7	0.5	0.9	0.7	1.2	—	—	—	.15	.02	0.3	75		24.95	(6-49)
	PSC-4-3	0.25-250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	—	—	—	.15	.20	.25	50		23.95	(6-49)
	PSC-4A-4	10-1000	25	20	21	15	18	15	0.5	0.8	0.8	1.1	1.5	2.5	—	—	—	0.2	0.3	0.7	50		49.95	(6-49)
	PSC-4-6	0.01-40	35	29	32	25	25	18	0.4	0.8	0.3	0.5	0.5	1.0	—	—	—	0.1	.15	0.2	50		29.95	(6-49)
ZSC-4 † case outline	ZSC-4-1	0.1-200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	—	—	—	.15	.20	.25	50		46.95	(4-24)
	ZSC-4-1-75	1-200	30	20	25	20	25	20	0.4	0.7	0.5	0.8	0.7	1.2	—	—	—	.15	.02	0.3	75		46.95	(4-24)
	ZSC-4-2	0.002-20	30	20	33	25	33	25	.45	.75	0.3	0.5	0.7	1.0	—	—	—	.15	.20	.25	50		69.95	(4-24)
	ZSC-4-3	0.25-250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	—	—	—	.15	.20	.25	50		43.95	(4-24)
ZMSC-4 † case outline	ZMSC-4-1	0.1-200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	—	—	—	.15	.20	.25	50		56.95	(4-24)
	ZMSC-4-2	0.002-20	30	20	33	25	33	25	.45	.75	0.3	0.5	0.7	1.0	—	—	—	.15	.20	.25	50		79.95	(4-24)
	ZMSC-4-3	0.25-250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	—	—	—	.15	.20	.25	50		53.95	(4-24)
ZFSC-4 † case outline	ZFSC-4-1	1-1000	25	20	23	18	20	15	0.4	0.8	0.6	1.5	1.6	2.5	—	—	—	0.2	0.4	0.7	50		89.95	(1-4)
	ZFSC-4-1-W	10-500	23	20	23	20	23	20	0.6	1.5	0.6	1.5	0.6	1.5	—	—	—	0.2	0.3	0.4	50		74.95	(1-4)
	ZFSC-4375	50-90	34	30	34	30	34	30	0.8	1.2	0.8	1.2	0.8	1.2	—	—	—	0.15	0.15	0.15	75		89.95	(1-4)
		GHz																						
ZA4PD † case outline	ZA4PD-2	1-2	25	19	25	19	25	19	0.3	0.8	0.3	0.8	0.3	0.8	—	—	—	0.7	0.7	0.7	50		$79.95	(1-9)
	ZA4PD-4	2-4.2	25	18	25	18	25	18	0.5	1.0	0.5	1.0	0.5	1.0	—	—	—	0.8	0.8	0.8	50		$79.95	(1-9)

† Consult factory

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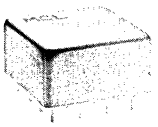
MCL MODEL NO.	NATIONAL STOCK NO.
PSC-4-1	5821-01-065-0106
PSC-4-2	5825-01-044-8945
ZSC-4-1B	5820-00-270-3056
ZSC-4-3B	6920-01-038-8553
PSC-4-3	5825-01-105-6189

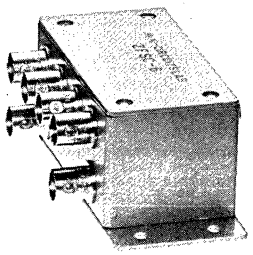
all models available for immediate delivery

Power Splitter/Combiners

6 WAY-0°



PSC-6 SERIES



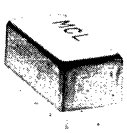
ZFSC-6 SERIES

See Mixer dimensions page 7 for PSC-6 dimensions

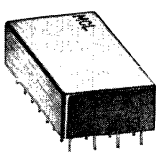
L = Low range (f_L to $10f_L$) **M** = Mid range ($10f_L$ to $f_{up}/2$) **U** = Upper range ($f_{up}/2$ to f_{up})

	MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS dB Above 7.8 dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	Z Ω	† Pin./ Conn. Layout Fig.	PRICE $ EA.	QTY.
PSC-6 case outline Fig. 7	PSC-6-1	1-175	30	24	26	18	26	18	0.5	0.8	0.7	1.0	1.0	1.5	4.0	6.0	12.0	0.2	0.4	0.8	50		68.95	(1-5)
ZFSC-6 † case outline	ZFSC-6-1	1-175	27	22	26	20	26	20	0.75	1.0	0.75	1.2	0.8	1.2	2.0	6.0	6.0	0.2	0.4	0.4	50		89.95	(1-4)

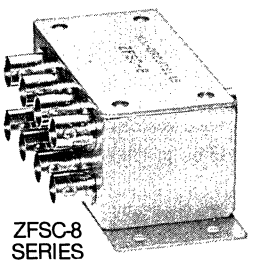
8 WAY-0°



PSC-8 SERIES



PSC-8A SERIES



ZFSC-8 SERIES

See Mixer dimensions page 7 for PSC-8 dimensions

L = Low range (f_L to $10f_L$) **M** = Mid range ($10f_L$ to $f_{up}/2$) **U** = Upper range ($f_{up}/2$ to f_{up})

	MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS dB Above 9dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	Z Ω	† Pin/ Conn. Layout Fig.	PRICE $ EA.	QTY.
PSC-8 case outline Fig. 7	PSC-8-1	0.5-175	30	20	30	20	23	18	0.8	1.2	0.7	1.1	1.0	1.6	1.0	3.0	6.0	0.2	.35	0.5	50		68.95	(1-5)
	PSC-8-1-75	0.5-175	25	20	30	25	25	20	0.5	1.0	0.5	0.8	0.8	1.3	1.0	2.5	5.0	0.2	.35	0.5	75		69.95	(1-5)
	PSC-8-6	0.01-10	40	30	35	23	35	23	0.3	0.7	0.6	1.1	0.6	1.1	1.0	3.0	3.0	0.1	0.2	0.2	50		79.95	(1-5)
PSC-8A † case outline	PSC-8A-4	5-500	25	20	23	18	20	15	0.7	1.2	1.0	1.8	1.4	2.0	3	8	16	0.2	0.3	0.5	50		89.95	(1-5)
	PSC-8A-1W	10-750	25	20	23	18	20	15	0.7	1.2	1.0	1.8	1.4	2.5	3	8	16	0.2	0.3	0.5	50		89.95	(1-5)
ZFSC-8 † case outline	ZFSC-8-1	0.5-175	30	20	30	20	23	18	0.8	1.2	0.7	1.1	1.0	1.6	1.0	3.0	6.0	0.2	.35	0.5	50		89.95	(1-4)
	ZFSC-8-1-75	0.5-175	25	20	30	25	25	20	0.5	1.0	0.5	0.8	0.8	1.3	1.0	2.5	5.0	0.2	.35	0.5	75		90.95	(1-4)
	ZFSC-8375	50-90	30	25	30	25	30	25	1.0	1.3	1.0	1.3	1.0	1.3	3	4	5	0.3	0.3	0.3	75		119.95	(1-4)
	ZFSC-8-4	5-700	35	25	25	20	20	17	0.75	1.2	1.0	1.5	1.5	2.5	2.0	5.0	15	0.2	0.4	0.7	50		129.95	(1-4)
	ZFSC-8-6	0.01-10	40	30	35	23	35	23	0.3	0.7	0.6	1.1	0.6	1.1	1.0	3.0	3.0	0.1	0.2	0.2	50		109.95	(1-4)

For environmental specifications refer to page 1.
Prices and specifications subject to change without notice.

† Consult factory

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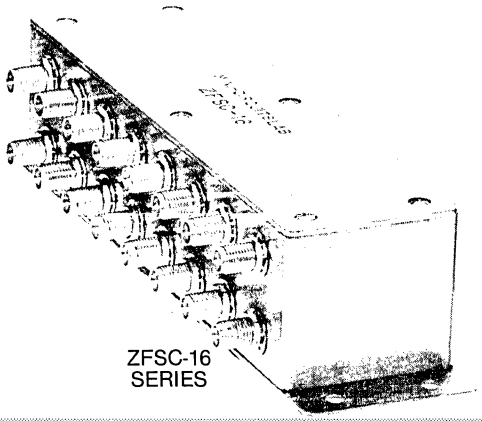
Mini-Circuits

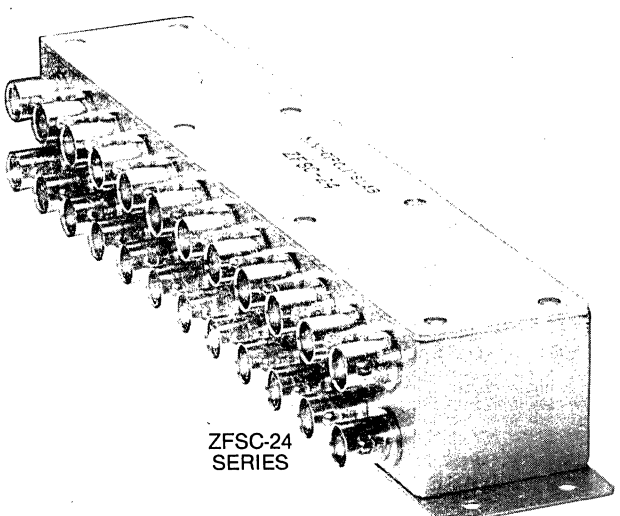
16 WAY-0°



ZFSC-16 SERIES

MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	ISOLATION dB L Min.	ISOLATION dB M Typ.	ISOLATION dB M Min.	ISOLATION dB U Typ.	ISOLATION dB U Min.	INSERTION LOSS dB Above 12 dB L Typ.	INSERTION LOSS dB Above 12 dB L Max.	INSERTION LOSS dB Above 12 dB M Typ.	INSERTION LOSS dB Above 12 dB M Max.	INSERTION LOSS dB Above 12 dB U Typ.	INSERTION LOSS dB Above 12 dB U Max.	PHASE UNBALANCE Degrees L Max.	PHASE UNBALANCE Degrees M Max.	PHASE UNBALANCE Degrees U Max.	AMPLITUDE UNBALANCE dB L Max.	AMPLITUDE UNBALANCE dB M Max.	AMPLITUDE UNBALANCE dB U Max.	Z Ω	† Conn. Layout Fig.	PRICE $ EA.	QTY.
ZFSC-16 †case outline		L = Low range (f_L to 10f_L) M = Mid range (10f_L to f_{up}/2) U = Upper range (f_{up}/2 to f_{up})																					
ZFSC-16-1	0.5-125	30	24	25	18	20	15	1.0	1.6	1.0	1.5	1.0	1.6	2.0	3.0	6.0	0.2	.35	0.5	50	—	174.95	(1-4)
ZFSC-16-6	.004-20	30	20	35	30	30	20	1.0	2.2	0.4	1.0	1.0	1.6	2.0	3.0	6.0	0.2	0.2	0.2	50	—	174.95	(1-4)
ZFSC-16-6-75	.004-20	30	20	35	30	30	20	1.0	2.2	0.4	1.0	1.0	1.6	2.0	3.0	6.0	0.2	0.2	0.2	75	—	174.95	(1-4)

24 WAY-0°



ZFSC-24 SERIES

MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	ISOLATION dB L Min.	ISOLATION dB M Typ.	ISOLATION dB M Min.	ISOLATION dB U Typ.	ISOLATION dB U Min.	INSERTION LOSS dB 13.0 dB L Typ.	INSERTION LOSS dB 13.0 dB L Max.	INSERTION LOSS dB 13.0 dB M Typ.	INSERTION LOSS dB 13.0 dB M Max.	INSERTION LOSS dB 13.0 dB U Typ.	INSERTION LOSS dB 13.0 dB U Max.	PHASE UNBALANCE Degrees L Max.	PHASE UNBALANCE Degrees M Max.	PHASE UNBALANCE Degrees U Max.	AMPLITUDE UNBALANCE dB L Max.	AMPLITUDE UNBALANCE dB M Max.	AMPLITUDE UNBALANCE dB U Max.	Z Ω	† Conn. Layout Fig.	PRICE $ EA.	QTY.
ZFSC-24 †case outline		L = Low range (f_L to 10f_L) M = Mid range (10f_L to f_{up}/2) U = Upper range (f_{up}/2 to f_{up})																					
ZFSC-24-1	0.2-100	25	20	25	20	25	20	1.0	2.0	1.0	2.0	1.0	2.0	2.0	3.0	5.0	0.3	0.4	0.5	50	—	264.95	(1-4)

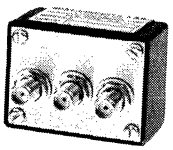
For environmental specifications refer to page 1.
† Consult factory

all models available for immediate delivery.

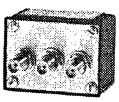
DIRECTIONAL COUPLERS

10-30 dB

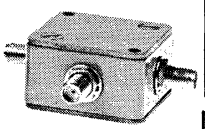
For dimensions see Mixer dimensions page 7
Case styles are as follows:
TDC: Fig. 2 ZMDC: Fig. 21
PDC: Fig. 1 ZDC: Fig. 22
ZFDC: Fig. 18



ZDC SERIES (BNC, TNC)



ZMDC SERIES (SMA)



ZFDC SERIES (BNC, TNC, SMA, N)

PDC SERIES

TDC SERIES

MODEL NO.	FREQ. MHz	COUPLING		VSWR	DIRECTIVITY, dB						MAIN LINE LOSS, dB (INCLUDES THEORETICAL (POWER SPLIT LOSS)						INPUT POWER (W)		IMPEDANCE	PRICE	
		L = Low range (f_L to $10f_L$) M = Mid range ($10f_L$ to $f_{up}/2$) U = Upper range ($f_{up}/2$ to f_{up})			L		M		U		L		M		U						
	f_L-f_U	(INPUT TO COUPLED PORT) dB	FLATNESS dB	(Typ.)	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	L	M, U	Ω	$ EA.	QTY.
TDC-10-1	1-400	10.0±0.5	±0.5	1.5	35	25	30	20	20	15	1.2	1.5	1.0	1.3	1.2	1.5	1	2	50	15.95	(5-49)
PDC-10-1	0.5-500	11.5±0.5	±0.6	1.2	32	25	32	25	22	15	0.85	1.3	0.65	1.0	0.85	1.3	1.5	3	50	11.95	(5-49)
PDC-10-2	250-1000	10.5±0.5	±1.0	1.5	40	30	30	20	20	15	1.1	1.4	—	—	1.6	1.9	—	5	50	27.95	(5-49)
H PDC-10-21	1-1000	11±0.5	±0.5	1.2	40	30	25	20	25	20	1.2	1.7	1.2	1.7	1.6	2	1	2	50	24.95	(5-49)
PDC-10-22	5-750	11±0.5	±0.5	1.25	35	30	25	20	25	20	1.1	1.6	1.2	1.7	1.6	1.9	1	2	50	19.95	(5-49)
PDC-15-6	0.01-35	15±0.5	±0.5	1.15	38	30	35	25	28	20	0.3	0.6	0.2	0.4	0.3	0.6	2	4	50	19.95	(5-49)
PDC-20-1	25-400	21±0.75	±0.5	1.25	25	20	35	25	25	20	0.2	0.5	0.1	0.2	0.15	0.3	3	5	50	19.95	(5-49)
PDC-20-3	0.2-250	19.5±0.5	±0.5	1.2	36	30	33	25	25	20	0.35	0.6	0.25	0.5	0.35	0.6	1.5	4	50	13.95	(5-49)
PDC-10-1-75	1-250	10.5±0.5	±0.75	2	30	20	30	20	30	20	1.1	1.5	1.1	1.5	1.1	1.5	2	4	75	12.95	(5-49)
PDC-15-6-75	0.02-35	14.5±0.5	±0.5	1.3	35	20	35	20	35	20	0.3	0.7	0.3	0.7	0.3	0.7	1.5	4	75	20.95	(5-49)
PDC-20-3-75	1-150	19.5±0.5	±0.75	2	25	20	25	20	25	20	0.35	0.8	0.35	0.8	0.35	0.8	2	4	75	12.95	(5-49)

MODEL NO.	FREQ. MHz	COUPLING		VSWR	DIRECTIVITY, dB						MAIN LINE LOSS, dB (INCLUDES THEORETICAL (POWER SPLIT LOSS)						INPUT POWER (W)		IMPEDANCE	PRICE	
		L = Low range (f_L to $10f_L$) M = Mid range ($10f_L$ to $f_{up}/2$) U = Upper range ($f_{up}/2$ to f_{up})			L		M		U		L		M		U						
	f_L-f_U	(INPUT TO COUPLED PORT) dB	FLATNESS dB	(Typ.)	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	L	M, U	Ω	$ EA.	QTY.
ZDC-10-1	0.5-500	11.5±0.5	±0.6	1.2	32	25	32	25	22	15	0.85	1.3	0.65	1.0	0.85	1.3	1.5	3	50	29.95	(4-24)
ZDC-10-2	250-1000	10.5±0.5	±0.5	1.5	40	30	30	20	20	15	1.1	1.4	—	—	1.6	1.9	—	5	50	37.95	(4-24)
ZDC-15-6	.01-35	15±0.5	±0.5	1.15	38	30	35	25	28	20	0.3	0.6	0.2	0.4	0.3	0.6	2	4	50	37.95	(4-24)
ZDC-20-1	25-400	21±0.75	±0.5	1.25	25	20	35	25	25	20	0.2	0.5	—	—	0.15	0.6	3	5	50	37.95	(4-24)
ZDC-20-3	.2-250	19.5±0.5	±0.5	1.2	36	30	33	25	25	20	0.35	0.6	0.25	0.5	0.35	0.6	1.5	4	50	29.95	(4-24)
ZDC-10-1-75	1-250	10.5±0.5	±0.75	2	30	20	30	20	30	20	1.1	1.5	1.1	1.5	1.1	1.5	2	4	75	29.95	(4-24)
ZDC-15-6-75	.02-35	14.5±0.5	±0.5	1.5	35	30	35	25	28	20	0.3	0.6	0.2	0.4	0.3	0.6	2	4	75	38.95	(4-24)
ZDC-20-3-75	1-150	19.5±0.5	±0.75	2	25	20	25	20	25	20	0.35	0.8	0.35	0.8	0.35	0.8	2	4	75	30.95	(4-24)
ZDC-2375	55-85	10.5±0.5	±0.5	1.5	35	30	35	30	35	30	1.6	2.1	1.6	2.1	1.6	2.1	—	4	75	38.95	(4-24)
ZMDC-10-1	0.5-500	11.5±0.5	±0.6	1.2	32	25	32	25	22	15	0.85	1.3	0.65	1.0	0.85	1.3	1.5	3	50	39.95	(4-24)
ZMDC-10-2	250-1000	10.5±0.5	±0.5	1.5	40	30	30	20	20	15	1.1	1.4	—	—	1.6	1.9	—	5	50	47.95	(4-24)
ZMDC-15-6	.01-35	15±0.5	±0.5	1.15	38	30	35	25	28	20	0.4	0.6	0.2	0.4	0.4	0.6	2	4	50	47.95	(4-24)
ZMDC-20-1	25-400	21±0.75	±0.5	1.25	25	20	35	25	25	20	0.2	0.5	—	—	0.15	0.6	3	5	50	47.95	(4-24)
ZMDC-20-3	.2-250	19.5±0.5	±0.5	1.2	36	30	33	25	25	20	0.35	0.5	0.25	0.5	0.35	0.6	1.5	4	50	39.95	(4-24)
ZMDC-30-1	0.1-250	30±0.5	±0.5	1.5	23	18	20	15	17	10	0.4	0.6	0.5	0.8	0.55	0.85	1.0	3	50	39.95	(4-24)
ZFDC-10-1	1-500	10.5±0.25	±0.6	1.2	32	25	33	25	22	15	1.0	1.3	0.8	1.1	1.0	1.3	1.5	3	50	29.95	(4-24)
ZFDC-10-2	10-1000	10.75±0.5	±0.75	1.5	35	28	30	25	27	20	1.5	2.0	1.2	1.6	1.5	2.0	1.5	3	50	39.95	(4-24)
ZFDC-10-21	1-1000	11±0.5	±0.5	1.2	40	30	25	20	25	20	1.2	1.7	1.2	1.7	1.6	2.0	1	2	50	44.95	(4-24)
ZFDC-10-22	1-750	11±0.5	±0.5	1.25	35	30	25	20	25	20	1.1	1.6	1.2	1.7	1.4	1.9	1	2	50	34.95	(4-24)
ZFDC-15-6	0.03-35	15±0.05	±0.5	1.15	38	30	35	25	28	20	0.3	0.6	0.2	0.4	0.3	0.6	2	4	50	34.95	(4-24)
ZFDC-20-3	.2-250	19.5±0.5	±0.25	1.2	36	25	33	25	25	20	0.35	0.6	0.25	0.5	0.35	0.6	1.5	4	50	29.95	(4-24)
ZFDC-20-4	1-1000	19.5±0.5	±0.5	1.1	36	28	27	20	23	18	1.2	1.5	0.6	0.8	1.2	1.5	.5	2	50	59.95	(1-4)
★ZFDC-20-5	0.1-2000	19.5±0.5	±0.5	1.2	30	20	27	20	22	10	0.3	1	0.7	1.4	1.5	2.3	.5	2	50	79.95	(1-4)
ZFDC-15-6-75	0.02-35	14.5±0.5	±0.5	1.3	35	20	35	20	35	20	0.3	0.7	0.3	0.7	0.3	0.7	1.5	4	75	35.95	(4-24)

★ Above 1000 MHz, coupling flatness ±2.0 dB.

H: Upper range coupling ±.75 dB

Prices and specifications subject to change without notice.

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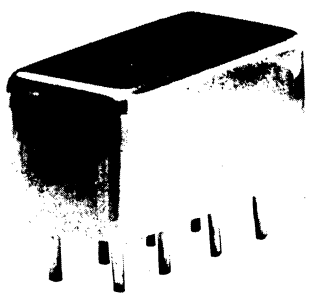
11.5dB directional couplers



0.5 to 500 MHz

only $11.95 (5-49)

IN STOCK... IMMEDIATE DELIVERY

- **MIL-C-15370/18-002 performance***
- low insertion loss, 0.85dB
- high directivity, 25dB
- flat coupling, ±0.5dB
- miniature, 0.4 x 0.8 x 0.4 in.
- hermetically-sealed
- 1 year guarantee

*Units are not QPL listed

PDC 10-1 SPECIFICATIONS

FREQUENCY (MHz) 0.5-500
COUPLING, dB 11.5

INSERTION LOSS, dB	TYP.	MAX.
one octave band edge	0.65	1.0
total range	0.85	1.3
DIRECTIVITY, dB	TYP.	MIN.
low range	32	25
mid range	32	25
upper range	22	15
IMPEDANCE	50 ohms.	

For complete specifications and performance curves refer to the Microwaves Product Data Director, the Goldbook, EEM, or Mini-Circuits catalog

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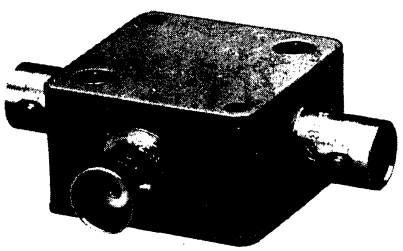
C 79-3 REV. B

directional couplers

19.5 dB



0.1 to 2000 MHz

only $79.95 (1-4)

AVAILABLE IN STOCK FOR IMMEDIATE DELIVERY

- rugged 1¼ in. sq. case
- 4 connector choices BNC, TNC, SMA and Type N
- connector intermixing male BNC, and Type N available
- low insertion loss, 1.5 dB
- flat coupling, ±1.0 dB

ZFDC 20-5 SPECIFICATIONS

FREQUENCY (MHz) 0.1-2000
COUPLING, db 19.5

INSERTION LOSS, dB	TYP.	MAX.
one octave band edge	0.8	1.4
total range	1.5	2.3
DIRECTIVITY dB	TYP.	MIN.
low range	30	20
mid range	27	20
upper range	22	10
IMPEDANCE	50 ohms	

For complete specifications and performance curves refer to the 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM

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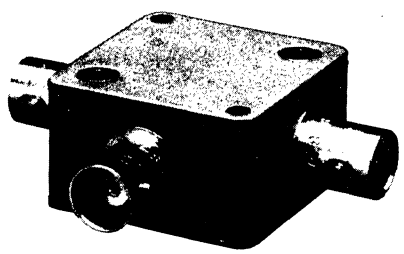
C 87-3 REV. ORIG.

10.5dB directional couplers



1 to 500 MHz

only $29.95 (4-24)

IN STOCK... IMMEDIATE DELIVERY

- **low insertion loss, 1dB**
- high directivity, 25 dB
- flat coupling, ±0.6dB
- rugged 1¼ inch square case
- 3 mounting options—thru hole, tapped hole, or flange
- 4 female connector choices—BNC, TNC, SMA and Type N
- 3 male connector choices—BNC, SMA and Type N
- connector intermixing available, please specify
- 1 year guarantee

ZFDC 10-1 SPECIFICATIONS

FREQUENCY (MHz) 1-500
COUPLING, db 10.75

INSERTION LOSS, dB	TYP.	MAX.
one octave band edge	0.8	1.1
total range	1.0	1.3
DIRECTIVITY dB	TYP.	MIN.
low range	32	25
mid range	33	25
upper range	22	15
IMPEDANCE	50 ohms	

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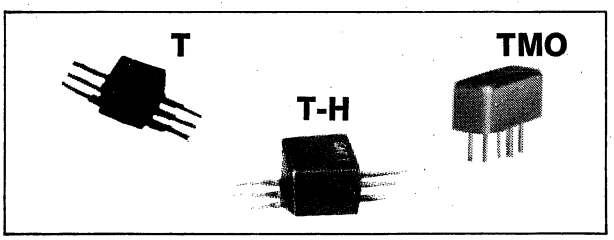
C 81-3 REV. B

Wideband (10 KHz to 800 MHz) RF TRANSFORMERS



DESCRIPTION — These microminiature wideband RF Transformers cover the frequency range from 10 KHz to 800 MHz. They operate with impedance levels from 12.5 ohms to 800 ohms and provide very low insertion loss, typically less than 0.5 dB.

These microminiature series are available in three basic configurations: (1) the primary and secondary windings are DC isolated (Fig. A), (2) primary and secondary windings are DC isolated and the secondary is center-tapped (Fig. B) and (3) the primary and secondary windings are unbalanced (i.e. they both have one end grounded) (Fig. C).

Although specified for a 50 ohm primary impedance they may be operated with a primary impedance as low as 12.5 ohms. The impedance matching ratio is essentially the same over this primary impedance range. However the frequency response may change somewhat.

T SERIES PLASTIC CASE

Very economically priced, the T-series units have a volume of less than 0.2 cu. inches. These tiny units have their adjacent pins spaced 0.1 inches; between rows the pin spacing is 0.3 inches. The T-series transformers can be inserted into a standard DIP socket.

TMO SERIES METAL CASE

The TMO units are hermetically sealed and require less PC area than a flat-pack or TO-5 can. Packaged within an EMI shielded metal enclosure (enclosure is 0.5 by 0.2 by 0.25 in.). Its pins are oriented on a 0.1 inch grid for printed circuit board mounting.

T-H SERIES

This new series allows high DC currents, up to 100 mA, to pass through the transformer primary without causing any appreciable saturation or change in its RF characteristics. Using this new technology, models are offered having impedance ratios of 1, 4, 9, and 16. Packaged in a plastic case, these models have their pins inserted into a standard DIP socket.

●T SERIES

FEATURES

- **Miniature Size:** 0.27″ Long, x 0.3″ Wide x 0.23″ High
- **Economically Priced:** From $2.95 in small quantity
- **Very Wide Bandwidth:** 10 KHz to 800 MHz

DESIGNERS KITS

TK-1: 2 transformers of each Type T1-1, T2-1, T4-1, T9-1, T16-1 **$32.00**

ABSOLUTE MAXIMUM RATINGS

- **Input Power:** 250 mW
- **Operating and Storage Temp.:** −20°C to +85°C
- **Pin Temperature:** (10 sec.) +260°C

●TMO SERIES

FEATURES

- **Hermetically Sealed**
- **High Reliability:** Manufactured to meet MIL STD 202E
- **Very Wide Bandwidth:** 10 KHz to 800 MHz

DESIGNERS KITS

TMK-2: 2 transformers of each Type TM01-1, TM02-1, TM04-1, TM09-1, TM016-1 **$49.50**

ABSOLUTE MAXIMUM RATINGS

- **Input Power:** 250 mW
- **Operating and Storage Temp.:** −55°C to +100°C
- **Pin Temperature:** (10 sec.) +260°C
- **Environmental Specifications:** See page 1

●T-H SERIES

FEATURES

- **Large Dynamic Range:** Up to 100 mA DC current
- **Miniature Size:** 0.27″ Long, x 0.3″ Wide, x 0.23″ High
- **Economically Priced:** From $4.95 in small quantity

DESIGNERS KITS

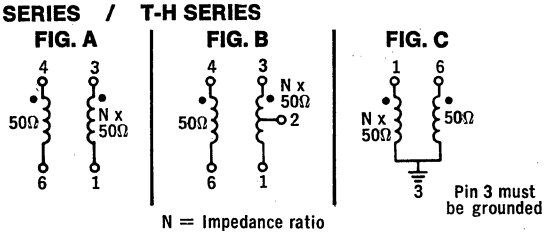
THK-1: 3 each of T1-1H, T4-1H, 2 each of T9-1H, T16-1H

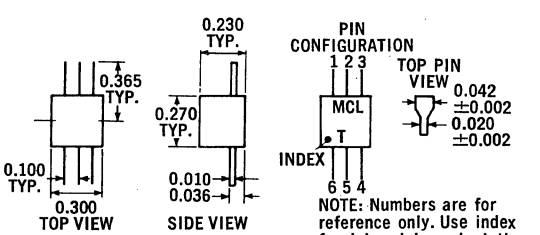
ABSOLUTE MAXIMUM RATINGS

- **Maximum DC Current In Primary** 100 mA
- **Input Power:** 500 mW
- **Operating and Storage Temp.:** −20°C to +85°C
- **Pin Temperature:** (10 sec.) +260°C

DIMENSIONS AND CONNECTIONS

● T SERIES / T-H SERIES

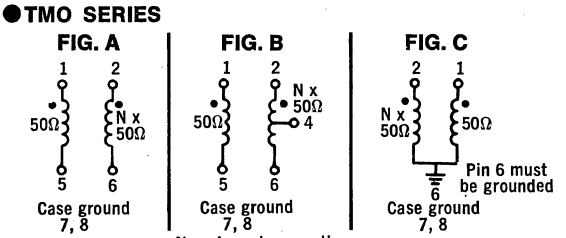


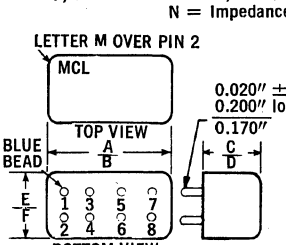


NOTE: Numbers are for reference only. Use index for determining orientation.

WEIGHT .35 grams .01 ounces

●TMO SERIES





NOTE: Numbers are for reference only. Use blue bead or letter M for determining orientation.

	A	B	C*	D*	E	F
IN	.500	.480	.255	.240	.230	.210
MM	12.7	12.2	6.4	6.0	5.8	5.3

* For models TMO-4-6, TMO-2.5-6, TMO-3-1T, TMO-2.5-6T, C dimension = .385, D dimension = .400.

WEIGHT 1.5 grams .07 ounces

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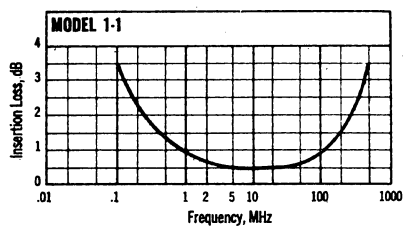
T Series
TMO Series

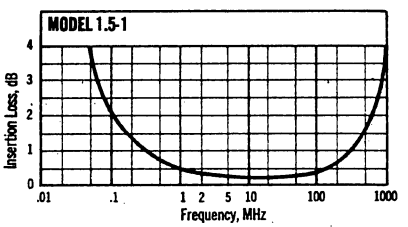
Mini-Circuits

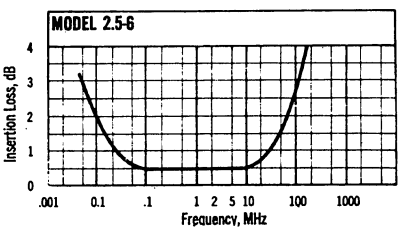
ALL MODELS FIG. A

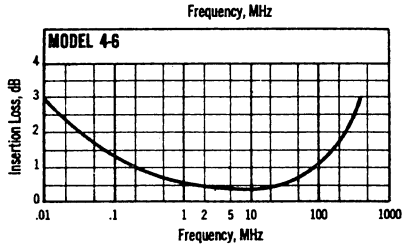
Z Ratio	Frequency MHz	Insertion Loss 3 dB MHz	Insertion Loss 2 dB MHz	Insertion Loss 1 dB MHz	Cost Quantity	Cost Price	Model No.
1	.15-400	.15-400	.35-200	2-50	10-49 10-49	$2.95 $4.95	T1-1 TM01-1
1.5	.1-300	.1-300	.2-150	.5-80	10-49 10-49	$3.95 $6.75	T1.5-1 TM01.5-1
2.5	.01-100	.01-100	.02-50	.05-20	10-49 10-49	$3.95 $6.45	T2.5-6 TM02.5-6
4	.02-200	.02-200	.05-150	.1-100	10-49 10-49	$3.95 $6.45	T4-6 TM04-6
9	.15-200	.15-200	.3-150	2-40	10-49 10-49	$3.45 $6.45	T9-1 TM09-1
16	.3-120	.3-120	.7-80	5-20	10-49 10-49	$3.95 $6.45	T16-1 TM016-1

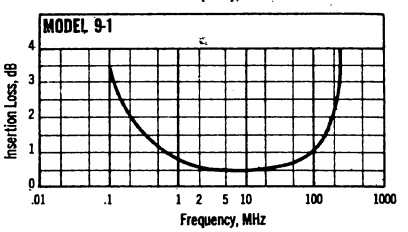
INSERTION LOSS VS FREQUENCY

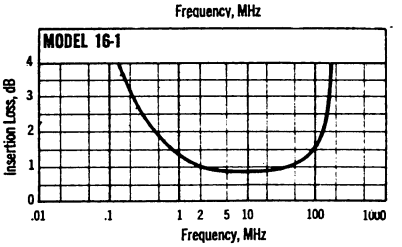








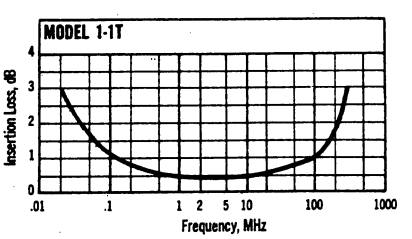


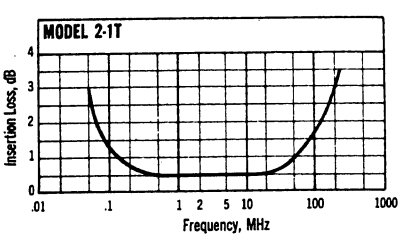


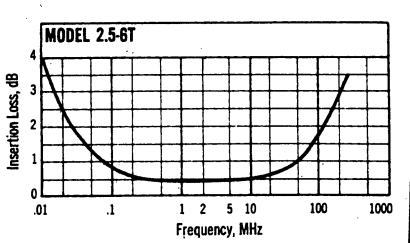
ALL MODELS FIG. B

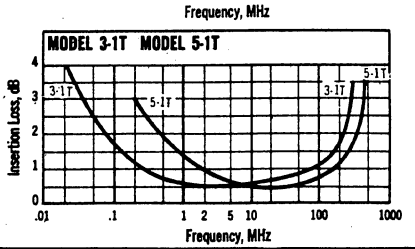
Z Ratio	Frequency MHz	Insertion Losss 3 dB MHz	Insertion Losss 2 dB MHz	Insertion Losss 1 dB MHz	Maximum Amplitude Unbalance .1 dB MHz	Maximum Amplitude Unbalance .5 dB MHz	Maximum Phase Unbalance Degrees 1° MHz	Maximum Phase Unbalance Degrees 5° MHz	Cost Quantity	Cost Price	Model No.
1	.05-200	.05-200	.08-150	.2-80	.5-80	.05-200	.5-80	.05-200	10-49 10-49	$3.95 $6.45	T1-1T TM01-1T
2	.07-200	.07-200	.1-100	.5-50	1-50	.07-200	1-50	.07-200	10-49 10-49	$4.25 $6.75	T2-1T TM02-1T
2.5	.01-100	.01-100	.02-50	.05-20	.1-20	.01-100	.1-20	.01-100	10-49 10-49	$4.25 $6.75	T2.5-6T TM02.5-6T
3	.05-250	.05-250	.1-200	.5-70	1-70	.05-250	1-70	.05-250	10-49 10-49	$3.95 $6.45	T3-1T TM03-1T
4	.2-350	.2-350	.35-300	2-100	.5-100	.2-350	5-100	.2-350	10-49 10-49	$2.95 $4.95	T4-1 TM04-1
5	.3-300	.3-300	.6-200	5-100	10-100	.3-300	10-100	.3-300	10-49 10-49	$4.25 $6.75	T5-1T TM05-1T
13	.3-120	.3-120	.7-80	5-20	5-20	.3-120	5-20	.3-120	10-49 10-49	$4.25 $6.75	T13-1T TM013-1T

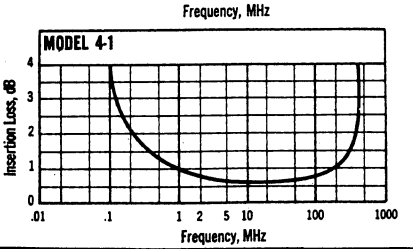
INSERTION LOSS VS FREQUENCY

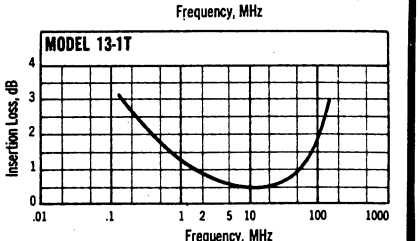










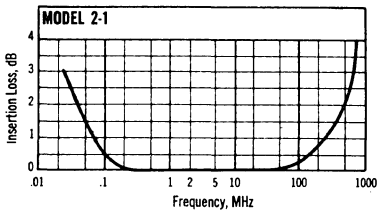


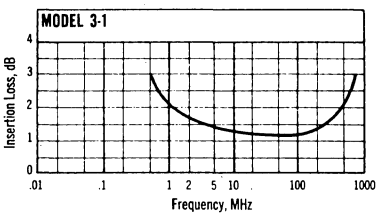
RF TRANSFORMERS (10 KHz to 800 MHz)

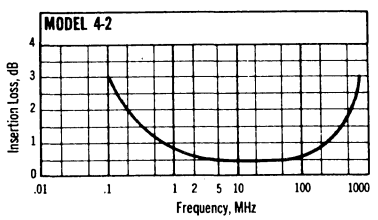
T Series
TMO Series

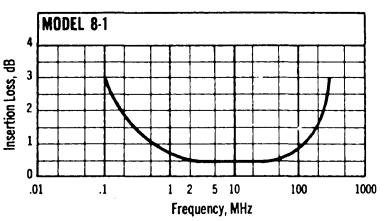
MODELS FIG. C INSERTION LOSS VS FREQUENCY

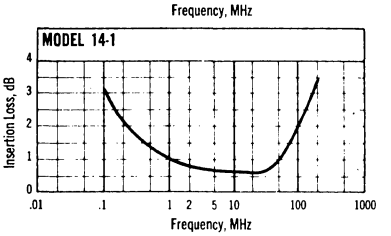
Impedance Ratio	Frequency MHz	Insertion Loss 3 dB MHz	Insertion Loss 2 dB MHz	Insertion Loss 1 dB MHz	Cost Quantity	Cost Price	Model No.
2	.025-600	.025-600	.05-400	.05-200	10-49 10-49	$3.45 $5.95	T2-1 TM02-1
3	.5-800	.5-800	2-400	—	10-49 10-49	$4.25 $6.95	T3-1 TM03-1
4	.2-600	.2-600	.5-500	2-250	10-49 10-49	$3.45 $5.95	T4-2 TM04-2
8	.15-250	.15-250	.25-200	2-100	10-49 10-49	$3.45 $5.95	T8-1 TM08-1
14	.2-150	.2-150	.5-100	2-50	10-49 10-49	$4.25 $6.75	T14-1 TM014-1







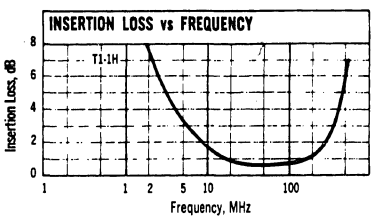


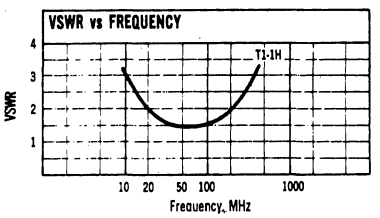


T-H Series SPECIFICATIONS

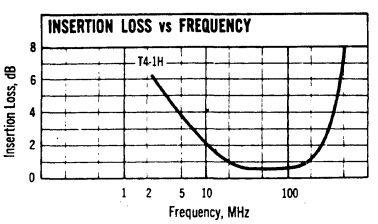
Impedance Ratio	Primary Impedance Ohms	Insertion Loss 3 dB MHz	Insertion Loss 2 dB MHz	Insertion Loss 1 dB MHz	Configuration	Quantity	Price	Model No.
1	50	8-300	10-200	25-100	A	10-49	$4.95	T1-1H
4	50	8-350	15-300	25-200	A	10-49	$4.95	T4-1H
9	50	2-90	3-75	6-50	A	10-49	$5.45	T9-1H
16	50	7-85	10-65	15-40	A	10-49	$5.95	T16-1H

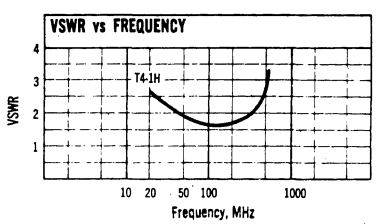
MODEL T1-1H



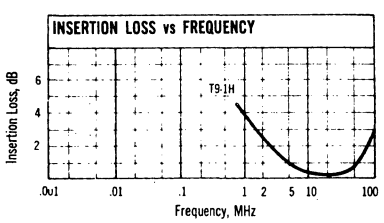


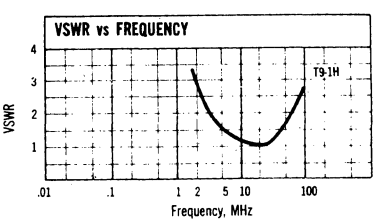
MODEL T4-1H



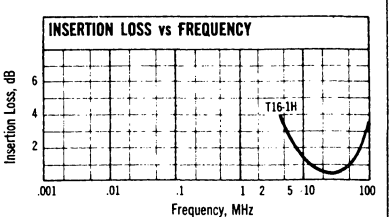


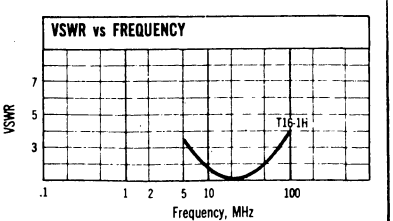
MODEL T9-1H





MODEL T16-1H



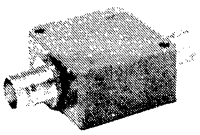


Mini-Circuits
2625 E. 14th St., Brooklyn, NY 11235 (212) 769-0200
Dom. Telex 125460 Int'l. Telex 620156

(10 KHz to 500 MHz)

Mini-Circuits

FT SERIES **FTB SERIES**



MODEL	FREQUENCY	INPUT Z (Ω)	COST
FT 1.5-1	0.1 MHz-400 MHz	50	$29.95 (1-4)
FTB 1-1	0.2 MHz-500 MHz	50	$29.95 (1-4)
FTB 1-6	0.01 MHz -200 MHz	50	$29.95 (1-4)
FTB 1-1-75	0.5 MHz - 500 MHz	75	$29.95 (1-4)

DESCRIPTION—These wideband RF transformers cover the frequency range from 10 KHz to 500 MHz. They operate with impedances of 50 ohms and 75 ohms. The FTB models offer a balanced input and an unbalanced output. This feature helps to eliminate ground loop problems, especially when long cable lines are utilized. The FT 1.5-1 is especially useful when matching between 50 and 75 ohm systems is required.

These units provide low insertion loss, and are manufactured in an extremely rugged 1¼ inch square metal case. Utilizing technology developed over a 10 year span, these transformers offer exceptional unit-to-unit matched performance.

BNC female connectors are standard. The unbalanced side is available with a male BNC or Type N connector. This option is available at a cost of $2 per unit.

The case finish is nickel plate over a copper flash. Internally, the transformers are bonded with silicone rubber to provide protection against shock, vibration, and acceleration.

Three case mounting configurations are available; (1) standard - 2 thru holes, (2) option A - 2 tapped holes, 4-40, (3) option B - a flange bracket.

FEATURES

- **Broadband:** 10 KHz to 500 MHz
- **Compact Size:** 1¼ in. square by 0.75 in. high
- **Balanced/Unbalanced Ports:** High isolation between balanced output to case.
- **Connectors:** Available with female BNC and male BNC or Type N.
- **High Reliability:** 100% tested, one year guarantee
- **Low Cost**: as little as $29.95 in small quantity.

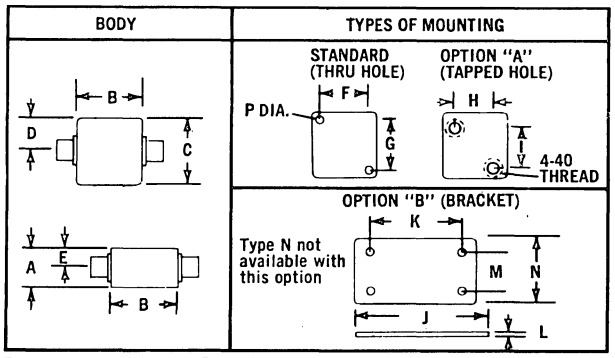
APPLICATIONS

- **Isolate ground loops in systems.**
- **Match 50 ohm to 75 ohm port connections.**
- **DC isolate high voltage common ground.**

ABSOLUTE MAXIMUM RATINGS

- **Input Power:** 250 mW
- **Operating and Storage Temp.:** −55° C to +100° C

DIMENSIONS AND CONNECTIONS

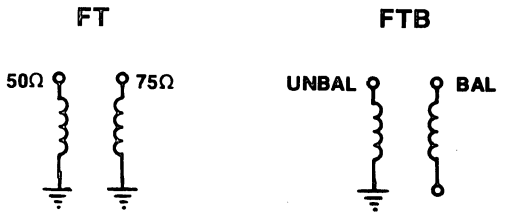


For mounting option A or B add Letter to P/N
BNC female (STD). On unbalanced side for male BNC or N please specify and add $2 to unit cost.

	A	B	C	D	E	F	G	H
IN	.75	1.25	1.25	.625	.375	1.00	1.00	0.8
MM	19.1	31.8	31.8	15.9	9.5	25.4	25.4	20.3

	I	J	K	L	M	N	P
IN	0.8	2.188	1.688	.060	.75	1.25	.125
MM	20.3	55.6	42.9	1.5	19.1	31.8	3.18

WEIGHT 54.5 grams 1.92 ounces



SPECIFICATIONS

Ω Ratio	Frequency MHz	Insertion Loss 3 dB MHz	Insertion Loss 2 dB MHz	Insertion Loss 1 dB MHz	Model No.
1.5	0.1-400	0.1-400	0.5-200	1-100	FT1.5-1
1	0.2-500	0.2-500	0.5-300	10-100	FTB1-1
1	0.01-200	0.01-200	0.05-100	0.1-50	FTB1-6
1	0.5-500	0.5-500	5-300	10-100	FTB1-1-75

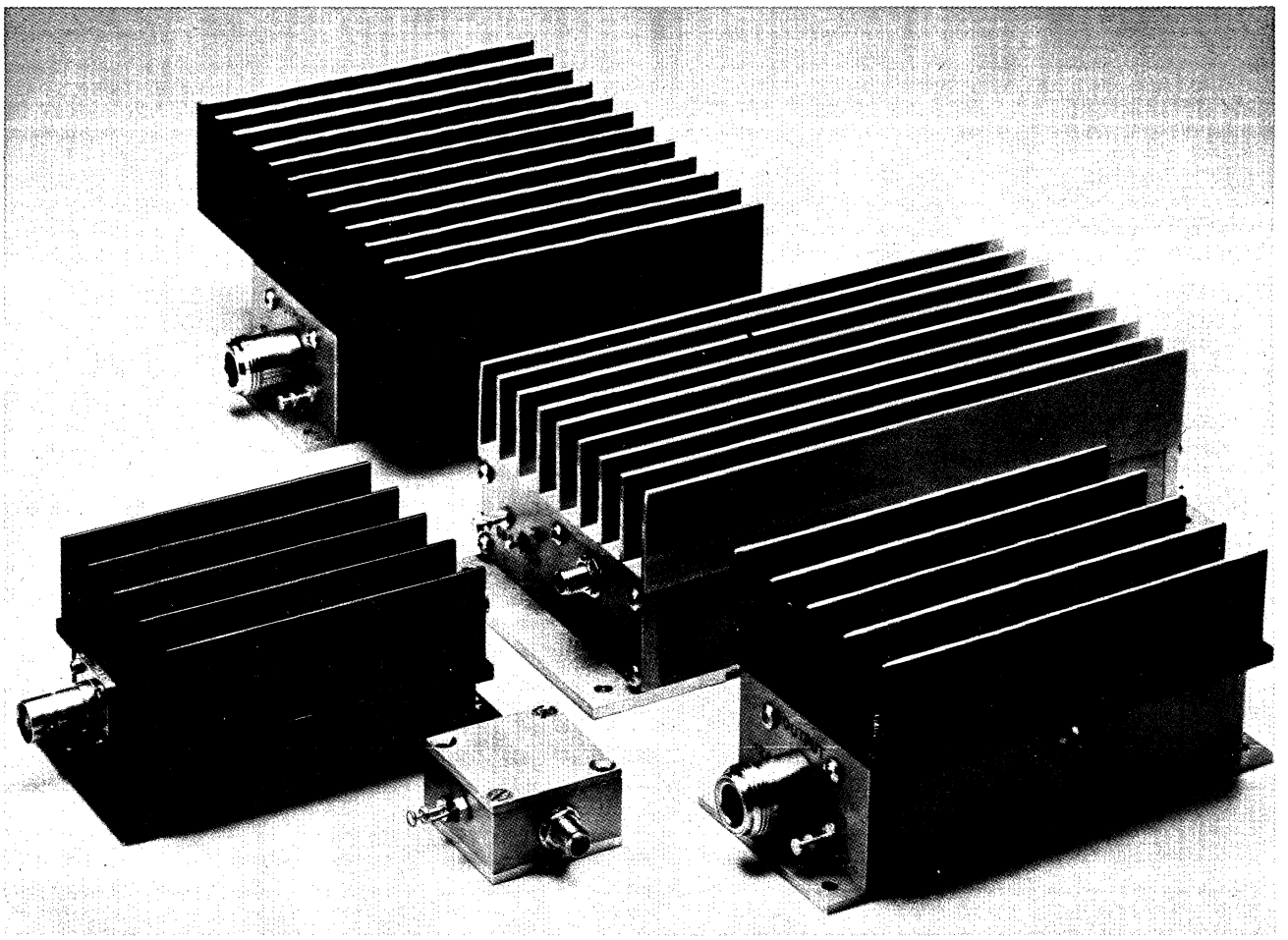
Mini-Circuits 2625 E. 14th St., Brooklyn, NY 11235 (212) 769-0200/Dom. Telex 125460/Int'l. Telex 620156

broadband linear

Power Amplifiers

up to 2 Watts (+33 dBm)

50 KHz to 4.2 GHz



Up to 1 watt linear output at 4.2 GHz, 2 watts at 800 MHz are now available at exceptionally low prices with Mini-Circuits' line of broadband amplifiers. Ultra-linear Class A design provides unconditional stability so any load impedance may be connected without concern for damage or oscilation. These amplifiers are ideally suited for TACAN, mobile radio, telemetry, anti-collision and satellite communications systems. Use these amplifiers to boost signal/sweep generator output to achieve broadband isolation, and to provide four test setups, using only one generator with a 4-way splitter...to name just a few applications.

Mini-Circuits P.O. BOX 166, Brooklyn, New York 11235 (212) 934-4500

50 ohms

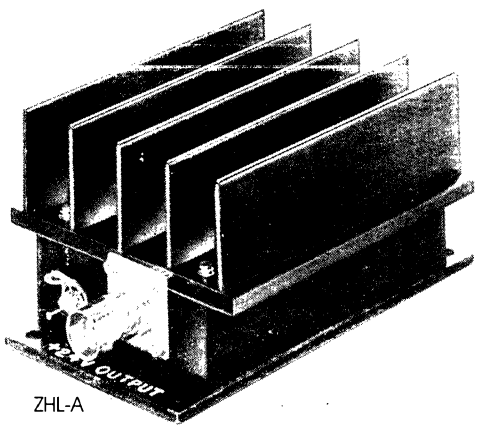
Mini-Circuits

up to 1 Watt (+30 dBm)

50 KHz to 500 MHz

case style selection

outline drawings pages 58-62



ZHL-A

	MODEL NO.	FREQUENCY MHz	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output (1dB) Compression	MAXIMUM POWER, dBm Input (no damage)	DYNAMIC RANGE NF, dB Typ.	DYNAMIC RANGE Intercept pt., dBm 3rd order Typ.	VSWR In	VSWR Out	DC POWER Volt.	DC POWER Current	PRICE $ Ea.	PRICE $ Qty.
ZHL-A case S 32 BNC, N SMA, TNC	**ZHL-1A**	2-500	16	±1.0	+28	+20	11	+38	2:1	2:1	+24V	0.6A	199	1-9
	ZHL-3A	0.4-150	24	±1.0	+29.5	+10	11	+38	2:1	2:1	+24V	0.6A	199	1-9
	ZHL-32A	0.05 -130	25	±1.0	+29	+10	10	+38	2:1	2:1	+24V	0.6A	199	1-9

NOTES:
1. Operating temperature −20°C to +65°C.
   Storage temperature −55°C to +100°C.
2. With no lead on output, derate maximum input power (no damage) by 10dB.
3. Prices and specifications subject to change without notice.

MIL-M-28837/1A, NSN GUIDE

MCL NO.	NSN
ZHL-1A	6130-01-088-2322

computer-automated performance data

typical production unit / for data of other models consult factory

ZHL-1A

FREQ. (MHz)	GAIN (dB) 12V	15V	20V	24V	REVERSE GAIN (dB) 12V	15V	20V	24V	VSWR (IN) 12V	15V	20V	24V	VSWR (OUT) 12V	15V	20V	24V
2.00	17.90	18.27	18.46	18.52	29.03	29.07	28.96	28.88	1.09	1.13	1.14	1.14	1.10	1.16	1.15	1.15
28.21	17.88	18.27	18.48	18.52	29.53	29 72	29.54	29.24	1.09	1.11	1.13	1.14	1.20	1.19	1.19	1.18
54.42	17.88	18.33	18.54	18.59	29.57	29.62	29.58	29.39	1.12	1.12	1.13	1.14	1.24	1.24	1.24	1.24
80.63	17.94	18.41	18.65	18.70	29.91	29.78	29.64	29.56	1.19	1.17	1.16	1.16	1.30	1.29	1.30	1.30
106.84	17.90	18.41	18.69	18.78	29.85	30.12	29.97	29.75	1.31	1.24	1.21	1.21	1.36	1.36	1.37	1.37
133.05	17.91	18.42	18.75	18.83	30.02	30.06	30.15	29.87	1.42	1.32	1.28	1.27	1.41	1.41	1.42	1.44
159.26	17.68	18.34	18.71	18.81	30.25	30.32	30.03	30.00	1.56	1.42	1.36	1.34	1.46	1.48	1.50	1.52
185.47	17.64	18.34	18.78	18.84	30.50	30.36	30.12	29.99	1.71	1.553	1.45	1.43	1.50	1.53	1.57	1.60
211.68	17.52	18.25	18.74	18.82	30.50	30.64	30.19	30.05	1.83	1.63	1.52	1.50	1.51	1.56	1.63	1.67
237.89	17.46	18.20	18.73	18.81	30.85	30.64	30.35	30.32	1.96	1.72	1.59	1.57	1.52	1.58	1.67	1.73
264.10	17.34	18.09	18.66	18.74	30.99	30.75	30.40	30.43	2.04	1.79	1.64	1.62	1.48	1.56	1.66	1.75
290.31	17.28	18.03	18.58	18.69	31.08	30.89	30.66	30.58	2.14	1.86	1.69	1.66	1.44	1.53	1.66	1.76
316.52	17.33	18.08	18.69	18.79	30.64	30.77	30.51	30.49	2.16	1.88	1.70	1.67	1.40	1.50	1.64	1.75
342.73	17.32	18.06	18.69	18.79	30.50	30.44	30.41	30.44	2.17	1.87	1.69	1.65	1.33	1.43	1.59	1.71
368.94	17.30	18.04	18.71	18.79	30.09	30.23	30.24	30.27	2.09	1.81	1.63	1.59	1.27	1.35	1.49	1.62
395.15	17.23	18.02	18.67	18.82	29.81	29.95	29.91	30.18	2.03	1.75	1.57	1.53	1.24	1.28	1.41	1.55
421.36	17.32	18.13	18.83	18.98	29.19	29.36	29.52	29.85	1.96	1.68	1.49	1.44	1.32	1.29	1.36	1.50
447.57	17.37	18.23	18.96	19.08	28.50	28.79	29.05	29.22	1.90	1.61	1.41	1.36	1.47	1.36	1.34	1.43
473.78	17.17	18.10	18.90	19.08	27.94	28.28	28.64	28.82	1.93.	1.64	1.42	1.37	1.68	1.51	1.39	1.42
500.00	17.07	18.14	19.06	19.26	27.68	27.17	28.22	28.50	2.07	1.79	1.57	1.54	1.01	1.79	1.61	1.58

In Stock... Immediate Delivery

broadband linear

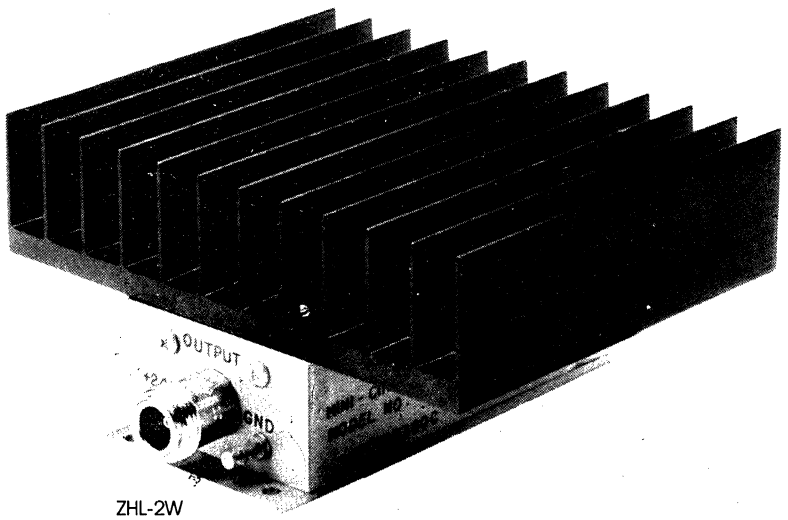
Power Amplifiers

up to 2 Watts (+33 dBm)

5 MHz to 800 MHz

case style selection

outline drawings pages 58-62



ZHL-2W

	MODEL NO.	FREQUENCY MHz	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output (1dB) Compression	MAXIMUM POWER, dBm Input (no damage)	DYNAMIC RANGE NF, dB Typ.	DYNAMIC RANGE Intercept pt., dBm 3rd order Typ.	VSWR In	VSWR Out	DC POWER Volt.	DC POWER Current	PRICE $ Ea.	PRICE $ Qty.
ZHL-2W case T 35 BNC, N SMA TNC	**ZHL-1-2W**	5-500	29	±1.0	+33	+10	12	+44	2:1	2:1	+24V	0.9A	495	1-9
	ZHL-7-2W NEW	600-800	28	±1.0	+33	+10	12	+43	2:1	2:1	+24V	0.9A	525	1-9

NOTES:

1. Operating temperature −20°C to +65°C.
   Storage temperature −55°C to +100°C.
2. With no lead on output, derate maximum input power (no damage) by 10dB.
3. Prices and specifications subject to change without notice.

ZHL-1-2W

FREQ. (MHz)	GAIN (dB)	REVERSE GAIN (dB)	VSWR in	VSWR out	LINEARITY Pout (dBm)	LINEARITY Comp. (dB)
5.00	32.25	16.59	1.46	1.65	32.86	0.25
031.05	31.64	17.55	1.39	1.67	32.74	0.26
057.10	31.58	16.46	1.38	1.70	32.70	0.36
083.15	31.59	17.70	1.36	1.74	32.58	0.42
109.20	31.51	16.92	1.33	1.80	32.56	0.39
135.25	31.43	17.30	1.28	1.85	32.48	0.51
161.30	31.49	17.02	1.22	1.91	32.49	0.52
187.35	31.46	16.61	1.15	1.99	32.39	0.61
213.40	31.39	16.91	1.08	2.05	32.38	0.60
239.45	31.39	17.63	1.03	2.07	32.38	0.62
265.50	31.32	16.44	1.12	2.03	32.34	0.66
291.55	31.25	17.19	1.24	1.89	32.31	0.64
317.60	31.22	18.48	1.36	1.67	32.38	0.64
343.65	31.11	20.85	1.49	1.43	32.33	0.70
369.70	30.89	21.35	1.59	1.20	32.35	0.58
395.75	30.74	15.87	1.67	1.04	32.43	0.66
421.80	30.70	15.95	1.73	1.24	32.41	0.67
447.85	30.73	15.78	1.78	1.49	32.38	0.64
473.90	31.07	15.83	1.83	1.76	32.31	0.77
500.00	31.95	15.87	1.90	1.99	32.02	1.00

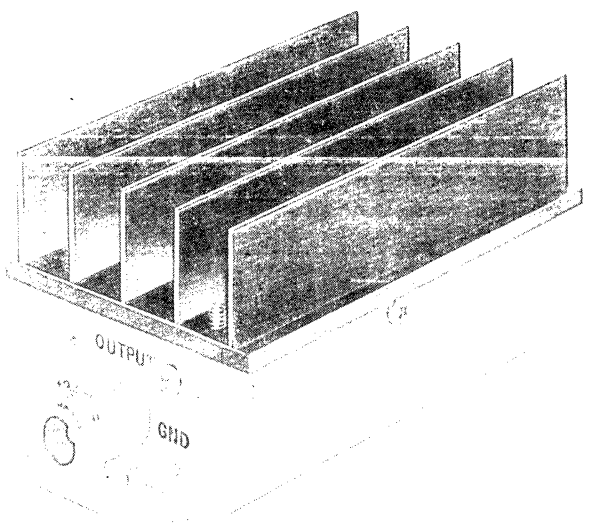
Mini-Circuits P.O. BOX 166, Brooklyn, New York 11235 (212) 934-4500

50 ohms

Mini-Circuits

up to 1 Watt (+30 dBm)

10 MHz to 1200 MHz



ZHL

	MODEL NO.	FREQUENCY MHz	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output (1dB) Compression	MAXIMUM POWER, dBm Input (no damage)	DYNAMIC RANGE NF, dB Typ.	DYNAMIC RANGE Intercept pt., dBm 3rd order Typ.	VSWR In	VSWR Out	DC POWER Volt.	DC POWER Current	PRICE $ Ea.	PRICE $ Qty.
ZHL case T 34 BNC, N SMA, TNC	**ZHL-2**	10-1000	16	±1.0	+29	+20	18	+38	2:1	2:1	+24V	0.6A	349	1-9
	ZHL-2-8★	10-1000	27	±1.0	+29	+10	10	+38	2:1	2:1	+24V	0.6A	474	1-9
	ZHL-2-12	10-1200	24	±1.0	+29★	+10	10	+38	2:1	2:1	+24V	0.75A	599	1-9

★ + 28.5 dBm maximum output 1000 to 1200 MHz; available only with SMA

computer-automated performance data

typical production unit / for data of other models consult factory

ZHL-2

FREQ. (MHz)	GAIN (dB)	REVERSE GAIN (dB)	VSWR in	VSWR out	LINEARITY Pout (dBm)	LINEARITY Comp. (dB)
10.00	16.85	39.91	1.12	1.88	29.81	0.24
62.05	17.06	39.66	1.19	1.80	29.77	0.27
114.10	17.19	39.40	1.28	1.70	29.66	0.32
166.15	12.18	39.08	1.38	1.61	29.50	0.42
218.20	17.17	39.18	1.49	1.54	29.46	0.48
270.25	17.23	38.58	1.57	1.48	29.51	0.40
322.30	17.29	37.81	1.64	1.44	29.45	0.58
374.35	17.15	37.43	1.68	1.42	29.41	0.53
426.40	17.10	36.70	1.70	1.36	29.42	0.59
478.45	17.11	36.23	1.72	1.28	29.39	0.55
530.50	17.09	35.35	1.75	1.19	29.37	0.59
582.55	17.15	35.20	1.77	1.14	29.37	0.63
634.60	17.38	34.64	1.74	1.29	29.41	0.59
686.65	17.28	33.51	1.69	1.53	29.39	0.52
738.70	17.14	32.25	1.67	1.71	29.39	0.57
790.75	17.25	30.98	1.71	1.76	29.37	0.56
842.80	17.32	29.64	1.80	1.61	29.27	0.72
894.85	17.44	28.71	1.90	1.31	29.25	0.66
946.90	17.49	28.01	1.88	1.12	29.22	0.75
999.00	16.89	28.24	1.63	1.48	29.06	0.96

ZHL-2-8

GAIN (dB)	REVERSE GAIN (dB)	VSWR in	VSWR out	LINEARITY Pout (dBm)	LINEARITY Comp. (dB)
39.33	50.00	2.48	2.74	39.73	0.40
29.38	40.00	1.41	1.66	29.51	0.45
29.22	40.00	1.36	1.60	29.46	0.54
29.13	40.00	1.31	1.59	29.40	0.63
29.08	40.00	1.26	1.61	29.37	0.67
29.03	40.00	1.23	1.66	29.27	0.71
28.97	40.00	1.27	1.74	29.29	0.72
29.00	40.00	1.36	1.81	29.37	0.64
28.82	40.00	1.45	1.80	29.40	0.64
28.58	40.00	1.53	1.68	29.41	0.52
28.39	40.00	1.58	1.50	29.51	0.59
28.30	40.00	1.59	1.29	29.45	0.60
28.47	40.00	1.55	1.08	29.36	0.61
28.73	40.00	1.47	1.13	29.43	0.53
28.94	40.00	1.42	1.34	29.52	0.49
29.04	40.00	1.48	1.50	29.45	0.48
28.99	40.00	1.62	1.51	29.42	0.60
28.86	40.00	1.76	1.41	29.38	0.62
28.61	40.00	1.82	1.36	29.24	0.73
28.11	40.00	1.83	1.53	29.14	0.81

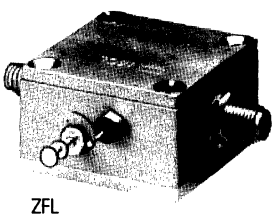
In Stock... Immediate Delivery

broadband linear
Power Amplifiers

up to 50mW (+17 dBm)
10 MHz to 2000 MHz

case style selection
outline drawings pages 58-62

NEW!



ZFL

	MODEL NO.	FREQUENCY MHz	GAIN, dB Min.	GAIN, dB Flatness Max	MAXIMUM POWER, dBm Output (1dB) Compression	MAXIMUM POWER, dBm Input (no damage)	DYNAMIC RANGE NF, dB Typ.	DYNAMIC RANGE Intercept pt., dBm 3rd order Typ.	VSWR In	VSWR Out	DC POWER Volt.	DC POWER Current	PRICE $ Ea.	PRICE $ Qty.
ZFL case Y 39 SMA	**ZFL-2000**	10-2000	20	±1.5	+17*	+5	7.0	+30	2:1	2:1	+15V	100mA	179	(1-9)

NOTES:

* +16dBm at 1000 MHz.

1. Operating temperature −55°C to +100°C
   Storage temperature −55°C to +100°C
2. With no load output, derate maximum input power (no damage) by 10 dB.
3. Prices and specifications subject to change without notice.

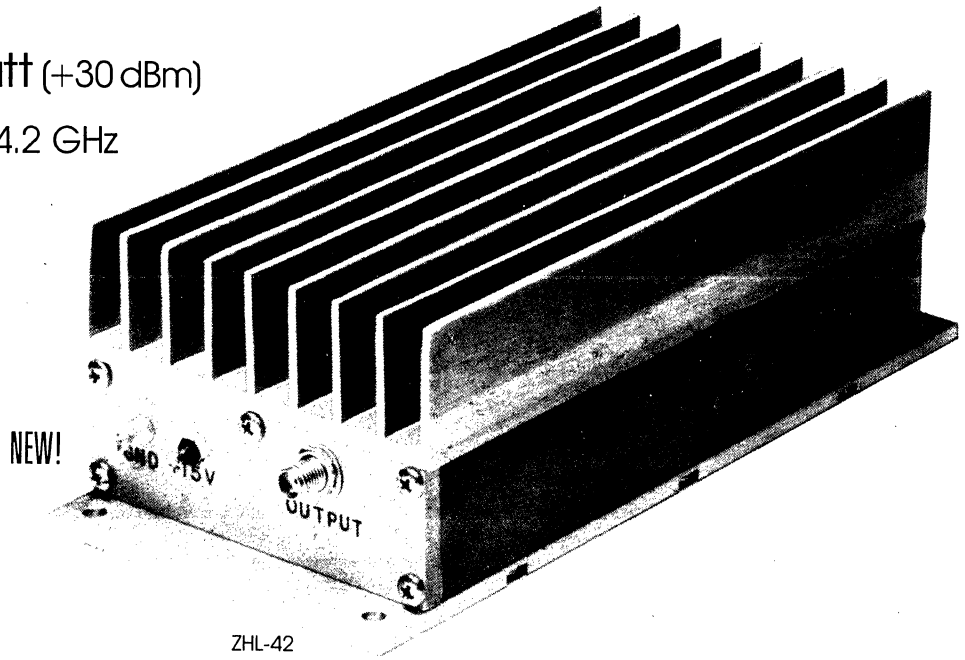
ZFL-2000 FREQUENCY (MHz)	GAIN (dB)	REVERSE GAIN (dB)	VSWR in	VSWR out	LINEARITY Pout (dBm)	LINEARITY Comp. (dB)
10.00	22.68	33.41	1.44	1.28	15.44	1.26
105.42	22.58	33.31	1.46	1.21	15.35	1.26
200.83	22.60	33.35	1.44	1.13	15.32	1.30
296.25	22.48	33.37	1.35	1.09	15.24	1.28
391.67	22.32	33.45	1.24	1.13	15.19	1.05
487.08	21.96	33.60	1.18	1.14	15.11	0.92
582.50	21.63	34.05	1.21	1.18	14.74	0.80
677.92	21.60	34.33	1.37	1.24	14.86	0.82
773.33	22.03	34.03	1.48	1.30	15.28	0.74
868.75	22.42	33.59	1.53	1.36	15.74	0.71
964.17	22.64	33.12	1.49	1.45	15.98	0.62
1059.40	22.89	32.74	1.39	1.59	16.25	0.68
1154.70	23.14	32.22	1.25	1.71	16.42	0.79
1250.20	23.44	31.64	1.05	1.76	16.54	0.88
1345.80	23.34	31.15	1.19	1.67	16.57	0.73
1441.00	23.18	30.81	1.44	1.52	16.55	0.63
1535.90	22.96	30.64	1.64	1.31	16.45	0.49
1631.50	22.64	30.73	1.77	1.10	16.22	0.38
1726.90	22.32	30.57	1.78	1.11	15.97	0.33
1822.20	22.08	30.05	1.67	1.28	15.80	0.26
1917.60	21.70	29.21	1.54	1.43	15.67	0.03
2014.80	21.03	29.26	1.55	1.53	15.58	−0.46
2108.20	20.24	28.70	1.97	1.57	15.20	−0.89
2204.00	19.23	28.44	2.93	1.48	14.47	−1.17
2299.70	18.26	28.28	4.15	1.29	13.35	−1.11

50 ohms

Mini-Circuits

up to 1 Watt (+30 dBm)

700 MHz to 4.2 GHz



ZHL-42

MODEL NO.	FREQUENCY GHz	GAIN, dB		MAXIMUM POWER, dBm		DYNAMIC RANGE		VSWR		DC POWER		PRICE $	
		Min.	Flatness Max	Output (1dB) Compression	Input (no damage)	NF, dB Typ.	Intercept pt., dBm 3rd order Typ.	In	Out	Volt.	Current	Ea.	Qty.
ZHL-42 case U 36 SMA **ZHL-42**	0.7-4.2	30	±1.0	+29	+10	10	+38	2.5:1	2.5:1	15	0.69A	895	(1-9)

NOTES:
1. Operating temperature −20°C to +65°C
   Storage temperature −55°C to +100°C
2. With no load output, derate maximum input power (no damage) by 10 dB.
3. Prices and specifications subject to change without notice.

computer-automated performance data

typical production unit / for data of other models consult factory

ZHL-42 FREQUENCY (MHz)	GAIN (dB)	REVERSE GAIN (dB)	VSWR in	VSWR out	LINEARITY Pout (dBm)	LINEARITY Comp. (dB)
700.25	33.56	47.42	1.57	1.98	28.91	1.18
845.84	33.44	47.61	1.54	1.67	28.82	1.05
991.85	33.61	47.66	1.51	1.42	29.29	0.86
1137.60	34.37	47.97	1.46	1.37	29.98	0.93
1283.50	34.54	47.96	1.43	1.36	30.42	0.61
1429.70	34.09	48.08	1.60	1.33	30.65	0.07
1575.50	34.06	48.00	1.67	1.47	30.53	0.16
1720.90	34.65	48.03	1.72	1.43	30.65	0.80
1866.60	35.05	48.15	1.62	1.32	30.46	1.41
2013.10	35.42	48.30	1.57	1.20	30.57	1.75
2158.00	35.21	48.36	1.47	1.21	30.53	1.40
2304.20	34.72	48.35	1.48	1.16	30.13	1.30
2448.60	34.42	48.27	1.49	1.15	29.77	1.22
2595.20	34.55	48.36	1.51	1.18	29.91	1.05
2741.40	33.78	48.26	1.37	1.24	30.01	0.31
2887.60	34.03	48.29	1.34	1.52	30.35	0.32
2999.40	34.25	48.39	1.28	1.94	30.38	0.49
3033.30	34.05	48.50	1.24	1.99	30.50	0.29
3179.70	33.85	48.35	1.24	1.74	30.27	0.36
3324.30	34.01	48.62	1.30	1.56	30.04	0.77
3470.30	34.34	48.51	1.39	1.43	30.19	0.79
3616.70	34.49	48.76	1.58	1.28	29.91	1.07
3763.00	34.65	48.61	1.67	1.11	29.73	0.72
3909.00	32.36	48.49	1.54	1.21	29.69	0.33
4053.50	33.32	48.74	1.39	1.39	30.30	0.05
4199.90	34.60	48.69	1.44	1.84	30.04	0.08

In Stock... Immediate Delivery

phase detectors

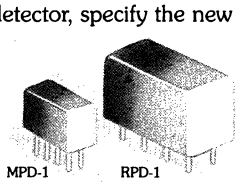
the world's highest performance
1000 mV output, 1 mV DC offset... only +7 dBm input
from $15.95

These new high efficiency phase detectors are the only units in the world offering a figure-of-merit greater than 125 for only $15.95.

The figure-of-merit M or efficiency of a phase detector can be defined as the ratio of maximum DC output voltage (in mV) divided by the RF power (in dBm). The maximum DC output from these units is 1000 mV with +7 dBm applied to the LO and RF ports, and DC offset is typically 400 micro-volts. Thus, its figure-of-merit M is 143, which indicates a highly efficient phase detector. For comparison, a double-balanced mixer used as a phase detector offers 350 mV DC output with the same LO and RF inputs for a figure-of-merit M of 50.

Both the RPD-1 and MPD-1 are packaged in a hermetically-sealed EMI-shielded metal case. The miniature RPD-1 measures 0.4 x 0.8 x 0.4 in. and the micromin MPD-1 is only 0.2 x 0.5 x 0.25 in.

So when your system requires a high output phase detector, specify the new RPD or MPD series.



RPD-1, MPD-1 SPECIFICATIONS

FREQUENCY RANGE:	
L and R ports	1-100 MHz
Output ports	DC-50 MHz
SCALE FACTOR	8 mV/Degree
IMPEDANCE	
L and R ports	50 ohms
I port	500 ohms
L and R SIGNAL LEVELS	+7 dBm
ISOLATION, L-R	40 dB min
MAXIMUM DC OUTPUT, mV	1000 mV typ 750 mV min
DC OUTPUT POLARITY (L and R in-phase)	Negative
DC OUTPUT OFFSET	0.2 mV typ 1 mV max
FIGURE-OF-MERIT, M	143 Typical

	SIZE	PRICE
RPD-1	0.4 X 0.8 X 0.4	$15.95 (5-24)
MPD-1	0.2 X 0.5 X 0.25	$18.95 (5-24)

CAPD now available! computer-automated performance data

For complete specs and CAPD data, refer to EEM or Gold Book and request technical bulletin Q&A no. 3

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A Division of Scientific Components Corporation
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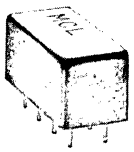
63 REV. B

Phase Detectors

High-Figure-Of-Merit



RPD SERIES

MODEL	FREQUENCY	Z (Ohms)	COST
RPD-1	1-100 MHz	50	$15.95(5-24)

DESCRIPTION — These new high efficiency phase detectors offer state-of-the-art performance while still economically priced. These are the only units in the world offering a figure-of-merit greater than 125—at only $15.95.

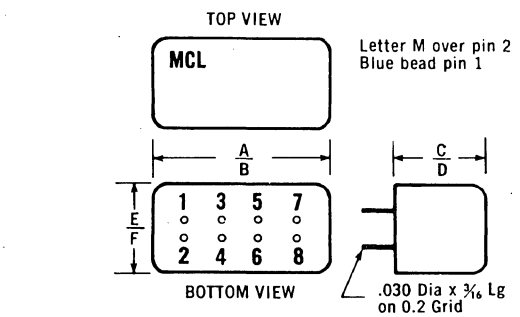
The figure-of-merit M or efficiency of a phase detector can be defined as the ratio of maximum DC output voltage (in mV) divided by the RF power (in dBm). The maximum DC output of the RPD-1 is 1000 mV with +7 dBm applied to the LO and RF ports. Thus, its figure-of-merit M is 143, which represents a highly efficient phase detector. For comparison, a standard phase detector offers 350 mV DC output with the same LO and RF inputs for a figure-of-merit M of 50.

Only 0.40 inches high, the low profile RPD series of phase detectors covers a very broad frequency range from 1 to 100 MHz. Exhibiting a flat frequency response, these units are designed to operate with a 50 ohm impedance at the L & R ports, and 500 ohms at the I port. Output is 1000 mV (typ) and isolation is greater than 50 dB (typ).

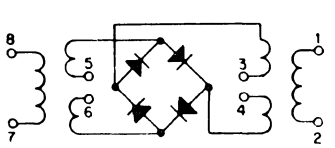
Packaged within an RFI shielded metal enclosure and hermetically sealed header, these high performance units have their 8 pins located on a 0.2 inch grid.

High reliability is a characteristic of the RPD series. Each unit carries a one-year guarantee by Mini-Circuits.

DIMENSIONS AND CONNECTIONS



	A	B	C	D	E	F
IN.	.770	.800	.385	.400	.370	.400
MM	19.5	20.3	9.7	10.1	9.3	10.1



PIN LAYOUT

Model No.	-1
LO	8
RF	1
IF	3,4
Ground	2,5,6,7
Case Ground	2

NOTE: PINS 3 AND 4 MUST BE CONNECTED TOGETHER

WEIGHT 5.2 grams .18 ounces

FEATURES

Broadband, 1-100 MHz
High Output, 1000 mV
High Figure-Of-Merit, M, 143 typical
High Isolation, typically greater than 50 dB
Low DC Offset, 0.2 mV typical
Miniature, 0.128 in. cu., 0.4 in x 0.8 PC area, 0.4 in. high
High Reliability, 100% tested
Low Cost, $15.95 (5-24)

APPLICATIONS

- Radar
- ECM Systems
- Test instruments
- Phase-lock loops

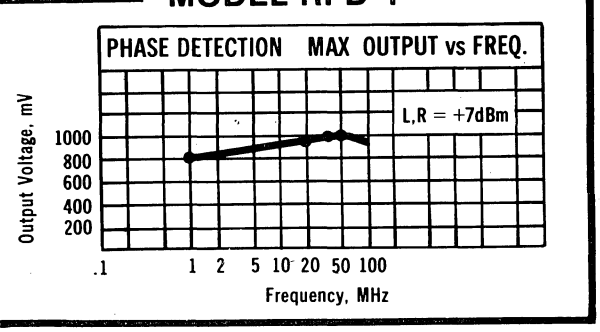
ABSOLUTE MAXIMUM RATINGS

- **Input Power:** 50 mW
- **Peak IF Input Current:** 40 mA
- **Operating and Storage Temp.:** —55°C to +100°C
- **Pin Temperature:** (10 sec.) +260°C

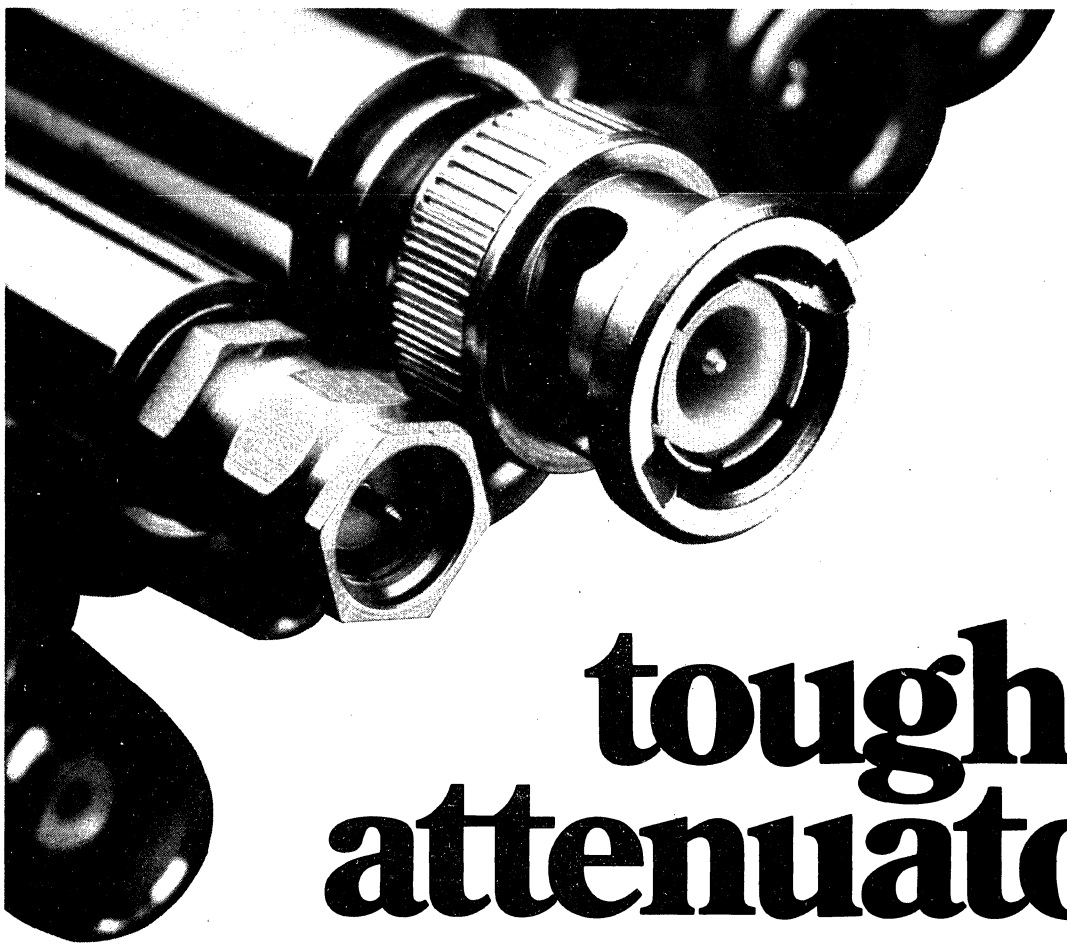
RPD-1 SPECIFICATIONS

FREQUENCY RANGE: L and R ports / Output ports	1-100 MHz / DC-50 MHz
SCALE FACTOR	8 mV/Degree
IMPEDANCE L and R ports / 1 port	50 ohms / 500 ohms
L and R SIGNAL LEVELS	+7 dBm
ISOLATION, L-R	40 dB min
MAXIMUM DC OUTPUT, mV	1000 mV typ / 750 mV min
DC OUTPUT POLARITY (L and R in-phase)	Negative
DC OUTPUT OFFSET VOLTAGE	0.2 mV typ / 1 mV max
FIGURE-OF-MERIT, M	143 Typical

MODEL RPD-1



Mini-Circuits 2625 E. 14th St., Brooklyn, NY 11235 (212) 769-0200/Dom. Telex 125460/Int'l. Telex 620156



tough attenuators

from $11.95 (1-49)

the world's lowest-priced coax attenuators
3, 6, 10 or 20 dB... from DC to 1500 MHz
one-piece design defies rough handling

Check these features:

- √ Solid one-piece tubular construction
- √ Available with BNC, N, SMA, TNC connectors
- √ Male/female connectors standard
- √ Connector series intermixing available
- √ 2 watts max. power (except 0.5W for SMA)
- √ Excellent temperature stability, .002 dB/°C
- √ Low-cost, only $11.95 BNC (1-49 qty.) attenuation values may be combined
- √ Delivery, from stock
- √ Exclusive one-year guarantee

Model	Attenuation, dB	Attenuation Tolerance	Frequency MHz	Attention Change over Frequency Range, MHz		VSWR Max. (50 ohms)	
				DC-1000	1000-1500	DC-1000	1000-1500
—AT—3	3	±0.2dB	DC-1500	0.6dB	1.0dB	1.3:1	1.5:1
—AT—6	6	±0.3dB	DC-1500	0.6dB	0.8dB	1.3:1	1.5:1
—AT—10	10	±0.3dB	DC-1500	0.6dB	0.8dB	1.3:1	1.5:1
—AT—20	20	±0.3dB	DC-1500	0.6dB	0.8dB	1.3:1	1.5:1

Add prefix **C** for BNC ($11.95), **T** for TNC ($12.95), **N** for Type N ($15.95), **S** for SMA ($14.95)

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A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 East 14th Street, Brooklyn, New York 11235 (212)769-0200
Domestic and International Telex 125460 International Telex 620156

plug-in attenuators

3 to 40 dB...from DC to 1500 MHz

from **$1.95**
AT SERIES
1,000 Qty.

CAPD now available! computer-automated performance data

Check these features:

- √ High stability; thick-film construction in a hermetically-sealed case
- √ Rugged construction meets MIL STD 202
- √ Miniature size:
  AT-Series: 0.4″ × 0.8″ × 0.2″ h
  MAT-Series: 0.5″ × 0.21″ × 0.25″ h
- √ Flat frequency response, ± 0.3dB (typ.)
- √ Excellent VSWR, less than 1.2:1 (typ.)
- √ Low cost: Models may be combined for group pricing
  AT-Series: $1.95 (1,000 qty.), $3.95 (10-49)
  MAT-Series: $2.95 (1,000 qty.) $4.95 (10-49)
- √ Delivery from stock

DESIGNERS KIT AVAILABLE:
KAT-1...4 of each (3, 6, 10, 20 dB), only $39.95
KMAT-1...2 of each (3, 6, 9, 10, 12, 15, 20), only $39.95

AT-SERIES	MAT-SERIES	Attenuation, dB Nominal	Attenuation, dB Tolerance	Attenuation Variation With Frequency DC-1000	Attenuation Variation With Frequency 1000-1500	VSWR Max DC-1000	VSWR Max 1000-1500
AT-3	MAT-3	3	±0.2dB	0.6dB	1.0dB	1.3:1	1.5:1
AT-6	MAT-6	6	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
—	MAT-9	9	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
AT-10	MAT-10	10	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
—	MAT-12	12	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
—	MAT-15	15	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
AT-20	MAT-20	20	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1
AT-40*		40	±0.3dB	0.6dB	0.8dB	1.3:1	1.5:1

*AT-40 Frequency Range DC-500 MHz
Frequency Range: DC-1500 MHz, power (max.) MAT = 0.5W, AT = 1W

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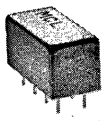
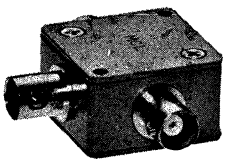
C96 REV. A

Electronic Attenuators

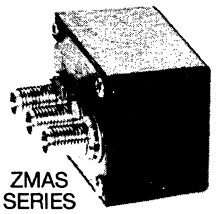
Broadband



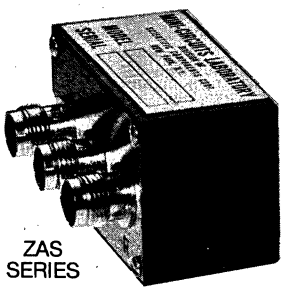
PAS SERIES



ZFAS SERIES



ZMAS SERIES (SMA)



ZAS SERIES

	MODEL NO. (Note 1) (Note 2)	FREQUENCY MHz INPUT	FREQUENCY MHz CONTROL	INSERTION LOSS, dB ONE OCTAVE FROM BAND EDGE Typ.	INSERTION LOSS, dB ONE OCTAVE FROM BAND EDGE Max.	INSERTION LOSS, dB TOTAL RANGE Typ.	INSERTION LOSS, dB TOTAL RANGE Max.	ISOLATION dB LOWER BAND EDGE TO ONE DECADE HIGHER IN-OUT Typ.	ISOLATION dB LOWER BAND EDGE TO ONE DECADE HIGHER IN-OUT Min.	ISOLATION dB LOWER BAND EDGE TO ONE DECADE HIGHER IN-CON Typ.	ISOLATION dB LOWER BAND EDGE TO ONE DECADE HIGHER IN-CON Min.	ISOLATION dB MID RANGE IN-OUT Typ.	ISOLATION dB MID RANGE IN-OUT Min.	ISOLATION dB MID RANGE IN-CON Typ.	ISOLATION dB MID RANGE IN-CON Min.	ISOLATION dB UPPER BAND EDGE TO ONE OCTAVE LOWER IN-OUT Typ.	ISOLATION dB UPPER BAND EDGE TO ONE OCTAVE LOWER IN-OUT Min.	ISOLATION dB UPPER BAND EDGE TO ONE OCTAVE LOWER IN-CON Typ.	ISOLATION dB UPPER BAND EDGE TO ONE OCTAVE LOWER IN-CON Min.	† Pin/ Conn. Layout Fig.	PRICE $ Ea.	PRICE Qty.
PAS SERIES case outline Fig. 1	PAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	65	50	35	25	45	35	25	15	35	25	20	10		27.95	(5-24)
	PAS-2	10-1000	DC-0.05	4.0	6.0	6.5	8.5	50	40	30	20	40	30	17	10	35	25	17	10		37.95	(5-24)
	PAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	65	50	35	25	50	40	20	15	50	35	15	10		28.95	(5-24)
ZAS SERIES case outline Fig. 22	ZAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	65	50	35	25	55	45	25	15	35	25	20	10		45.95	(4-24)
	ZAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	65	50	35	25	50	40	20	15	50	35	15	10		46.95	(4-24)
ZMAS SERIES case outline Fig. 21	ZMAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	65	50	35	25	55	45	25	15	35	25	20	10		55.95	(4-24)
	ZMAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	65	50	35	25	50	40	20	15	50	35	15	10		56.95	(4-24)
ZFAS SERIES case outline Fig. 18	ZFAS-15	10-2500	DC-200	3.5	4.0	3.5	5.0	20	18	19	15	35	25	28	20	30	20	20	15		89.95	(1-4)

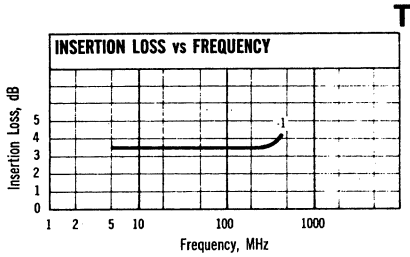
For environmental specifications refer to page 1.
Prices and specifications subject to change without notice.
† Consult factory

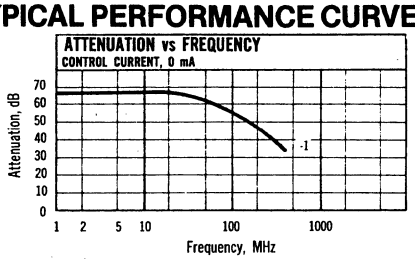
See Mixer dimensions page 7 for dimensions

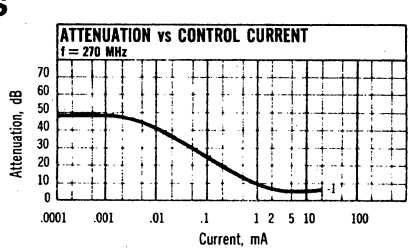
NATIONAL STOCK NUMBER

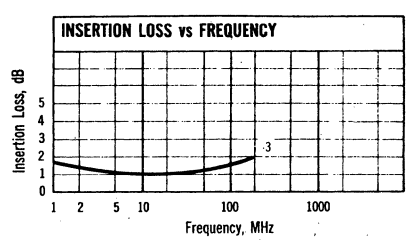
MCL MODEL	NSN NO.
PAS-3	5985-01-067-3035

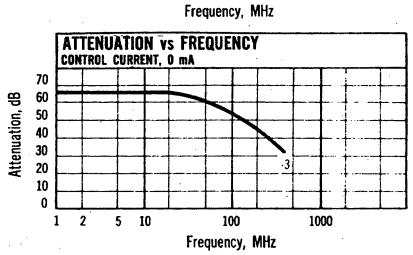
TYPICAL PERFORMANCE CURVES

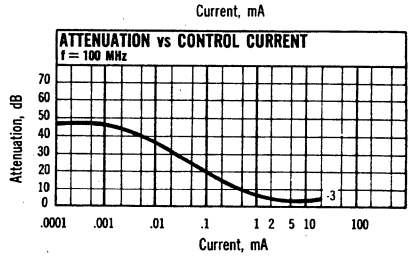












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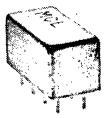
Limiters
Broadband

Mini-Circuits



PLS SERIES

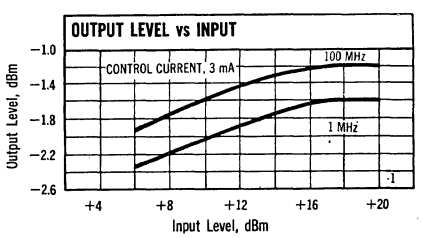
For dimensions see Mixer dimensions Page 7

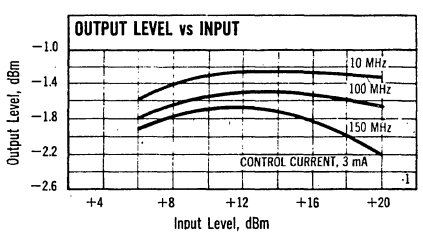
	MODEL NO. (Note 1)	FREQ. MHz	INPUT LEVEL RANGE dBm	OUTPUT LEVEL (TYP.) (CONTROL CURRENT 3mA)	LIMITING (OVER RF INPUT LEVEL, dBm) △ OUT/△1dB IN			RELATIVE PHASE VARIATION (OVER RF INPUT LEVEL, dBm) △ °/ △ 1dB IN			TYP. CONTROL CURRENT mA	Z	† Pin/ Layout Fig.	PRICE $ Ea.	Qty.
PLS SERIES case outline Fig. 1	PLS-1	0.1-150	6 to 20	—1.6 dBm	(6 to 10) 0.1	(10 to 16) 0.1	(16 to 20) 0.2	(6 to 10) 0.5°	(10 to 16) 0.5°	(16 to 20) 1.0°	3	50		18.95	(5-49)
	PLS-2	100-900	3 to 15	—5 dBm	(3 to 8) 0.2	(8 to 12) 0.2	(12 to 15) 0.4		(3 to 15) 2.0°		10	50		18.95	(5-49)
	PLS-6	0.003-1	6 to 20	—3 dBm	(6 to 10) 0.2	(10 to 16) 0.1	(16 to 20) 0.15		(6 to 20) 1.0°		5	50		29.95	(5-49)

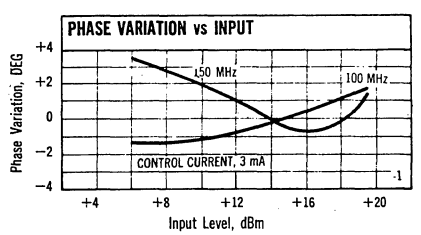
NOTE 1: For environmental specifications refer to page 1.
Prices and specifications subject to change without notice.

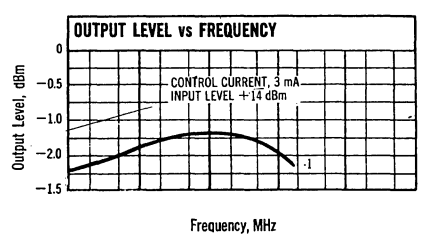
† Consult factory

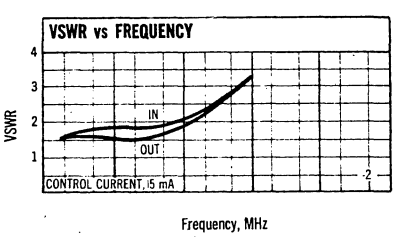
TYPICAL PERFORMANCE CURVES

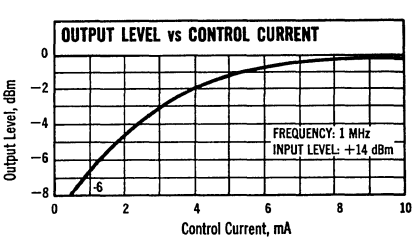












all models available for immediate delivery

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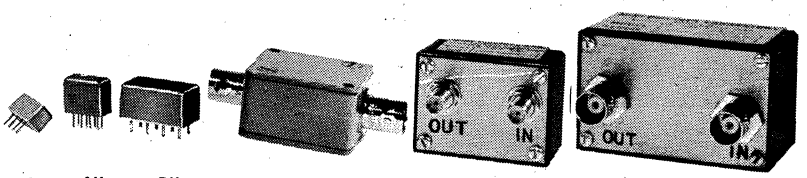
For dimensions see Mixer dimensions page 7
AK: Fig. 3
RK: Fig. 1
SK: Fig. 2
MK: Fig. 21
for GK and FK consult factory



SK AK RK FK MK GK

CHOOSE FROM A WIDE SELECTION....
50 KHz-2000 MHz 0 dBm to +20 dBm

Check these specifications.

MODEL NO. (NOTE 1)	FREQUENCY MHz		RF INPUT POWER	CONVERSION LOSS, dB			HARMONIC OUTPUT Spurious Harmonic Output, dB Relative to F2								PRICE	
	INPUT	OUTPUT	FULL RANGE dBm	OVER FREQ. BAND MHz	Typ.	Max.	OVER FREQ. BAND MHz	F1 Typ.	F1 Max.	F3 Typ.	F3 Max.	F4 Typ.	F4 Max.	$ EA.	QTY.
AK-2	1-500	2-1000	+1 to +15	1-100 100-300 300-500	13 13.5 14.0	15 15.5 16.5	2-200 200-600 600-1000	−40 −25 −20	−30 −20 −15	−50 −40 −30	−40 −30 −25	−16 −16 −16	−12 −12 —	19.95	(5-24)
RK-2	1-500	2-1000	+1 to +15	1-100 100-300 300-500	13 13.5 14.0	15 15.5 16.5	2-200 200-600 600-1000	−40 −25 −20	−30 −20 −15	−50 −40 −30	−40 −30 −25	−16 −16 −16	−12 −12 —	15.95	(5-24)
RK-3	.05-150	.1-300	+0 to +13	.05-50 50-150	11 11.5	13 15	.1-100 100-300	−40 −35	−30 −20	−45 −40	−30 −20	−16 −16	−12 −12	14.95	(5-24)
RK-6	.005-25	.01-50	+0 to +10	.005-1 1-25	11 11.5	13 15	.01-2 2-50	−40 −35	−30 −20	−45 −40	−30 −20	−16 −16	−12 −12	21.95	(5-24)
SK-2	1-500	2-1000	+1 to +15	1-100 100-300 300-500	13 13.5 14.0	15 15.5 16.5	2-200 200-600 600-1000	−40 −25 −20	−30 −20 −15	−50 −40 −30	−40 −30 −25	−16 −16 −16	−12 −12 —	21.95	(5-24)
GK-2	1-500	2-1000	+1 to +15	1-100 100-300 300-500	13 13.5 14.0	15 15.5 16.5	2-200 200-600 600-1000	−40 −25 −20	−30 −20 −15	−50 −40 −30	−40 −30 −25	−16 −16 −16	−12 −12 —	32.95	(1-4)
GK-3	.05-150	.1-300	+0 to +13	.05-50 50-150	11 11.5	13 15	.1-100 100-300	−40 −35	−30 −20	−45 −40	−30 −20	−16 −16	−12 −12	30.95	(1-4)
★GK-5	10-1000	20-2000	+10 to +20★	10-600 600-1000	13 14	15 17	10-1000	−20	−15	−25	−20	—	—	57.95	(1-4)
MK-2	1-500	2-1000	+1 to +15	1-100 100-300 300-500	13 13.5 14.0	15 15.5 16.5	2-200 200-600 600-1000	−40 −25 −20	−30 −20 −15	−50 −40 −30	−40 −30 −25	−16 −16 −16	−12 −12 —	42.95	(1-4)
MK-3	.05-150	.1-300	+0 to +13	.05-50 50-150	11 11.5	13 15	.1-100 100-300	−40 −35	−30 −20	−45 −40	−30 −20	−16 −16	−12 −12	37.95	(1-4)
★MK-5	10-1000	20-2000	+10 to +20★	10-600 600-1000	13 14	15 17	10-1000	−20	−15	−25	−20	—	—	67.95	(1-4)
★FK-5	10-1000	20-2000	+10 to +20★	10-600 600-1000	13 14	15 17	10-1000	−20	−15	−25	−20	—	—	59.95	(1-4)

★ For Models GK-5; MK-5; FK-5 full range is +13 dBm to +15 dBm above 700 MHz.

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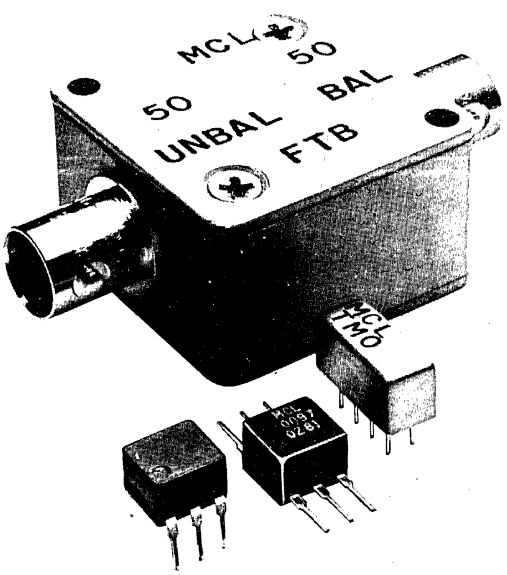

Bent Lead version, please specify

Select from the economical, microminiature T-series (plastic case) or TMO series (hermetically-sealed metal case) covering 10 KHz to 800 MHz. These models operate from 12.5 to 800 ohms with insertion loss typically less than 0.5 dB.

For large dynamic range applications, specify the T-H series which can handle up to 100 mA primary current without saturation or distortion.

Need a connector version? Select from the FT or FTB series, available with unbalanced or balanced outputs. Connector choices are female (BNC, Isolated BNC, and Type N) and male (BNC and Type N). These units operate from 10 KHz to 500 MHz with impedances of 50 and 75 ohms.

Of course, Mini-Circuits' one-year guarantee is included.

DC ISOLATED PRIMARY & SECONDARY	Model No.	T1-1 TMO1-1	T1-1H	T1.5-1 TMO1.5-1	T2.5-6 TMO2.5-6	T4-6 TMO4-6	T9-1 TMO9-1	T9-1H	T16-1 TMO16-1	T16-1H
	Imped. Ratio	1	1	1.5	2.5	4	9	9	16	16
	Freq. (MHz)	.15-400	8-300	.1-300	.01-100	.02-200	.15-200	2-90	.3-120	7-85
	T Model (10-49)	$2.95	$4.95	$3.95	$3.95	$3.95	$3.45	$5.45	$3.95	$5.95
	TMO model (10-49)	$4.95		$6.75	$6.45	$6.45	$6.45		$6.45	

CENTER-TAPPED DC ISOLATED PRIMARY & SECONDARY	Model No.	T1-1T TMO1-1T	T2-1T TMO2-1T	T2.5-6T TMO2.5-6T	T3-1T TMO3-1T	T4-1 TMO4-1	T4-1H	T5-1T TMO5-1T	T13-1T TMO13-1T
	Imped. Ratio	1	2	2.5	3	4	4	5	13
	Freq. (MHz)	.05-200	.07-200	.01-100	.05-250	2-350	8-350	.3-300	.3-120
	T Model (10-49)	$3.95	$4.25	$4.25	$3.95	$2.95	$4.95	$4.25	$4.25
	TMO model (10-49)	$6.45	$6.75	$6.75	$6.45	$4.95		$6.75	$6.75

UNBALANCED PRIMARY & SECONDARY	Model No.	T2-1 TMO2-1	T3-1 TMO3-1	T4-2 TMO4-2	T8-1 TMO8-1	T14-1 TMO14-1
	Imped. Ratio	2	3	4	8	14
	Freq. (MHz)	.025-600	.5-800	2-600	.15-250	.2-150
	T model (10-49)	$3.45	$4.25	$3.45	$3.45	$4.25
	TMO Model (10-49)	$5.95	$6.95	$5.95	$5.95	$6.75

FT FTB	Model No.	FT1.5-1	FTB1-1	FTB1-6	FTB1-1-75
	Imped. Ratio	1.5	1	1	1
	Freq. (MHz)	.1-400	.2-500	.01-125	.5-500
	(1-4)	$29.95	$29.95	$29.95	$29.95

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C59 REV. B

Shown actual size

the shrinker

the worlds smallest and lowest priced flatpack mixer **shrinks size and cost.**

The ASK-1 from Mini-Circuits 5^{95} (10-49)

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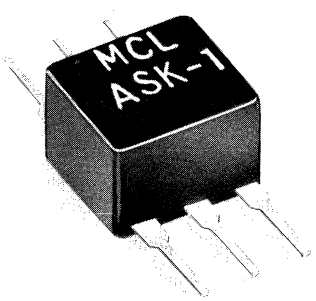

Mini-circuits
Model ASK-1/Plastic Case

Until now, the smallest mixer flatpack available was 0.510 by 0.385 inches or 0.196 sq. inches.

Now, Mini-Circuits introduces the ultra-compact ASK series, measuring only 0.300 by 0.270 inches or 0.081 sq. inches, more than doubling packaging density on a PC board layout.

Utilizing high production techniques developed by Mini-Circuits, the world's largest manufacturer of double-balanced mixers, the ASK-1 is offered at the surprisingly low price of only $5.95 (in 10 quantity).

Production quantities are available now for immediate delivery. And, of course, each unit is manufactured under the high quality standards of Mini-Circuits and is covered by a one-year guarantee.

ASK-1 SPECIFICATIONS

FREQUENCY RANGE:
RF, LO: 1-600 MHz;
IF: DC-600 MHz

CONVERSION LOSS:
One Octave from Bandedge: 8.5 dB Max.
Mid-Range: 7.0 dB Max.

ISOLATION:
L-R: 45 dB Typ.; L-I: 30 dB Typ.

ABSOLUTE MAXIMUM RATINGS:
Total Input Power: 50 mW
Total Input Current, peak: 20 mA
Operating Temperature: −55°C, +100°C
Storage Temperature: −55°C to +100°C
Pin Temperature (10 sec): +260°C

WEIGHT: .35 grams (.01 ounces) *CASE:* Plastic

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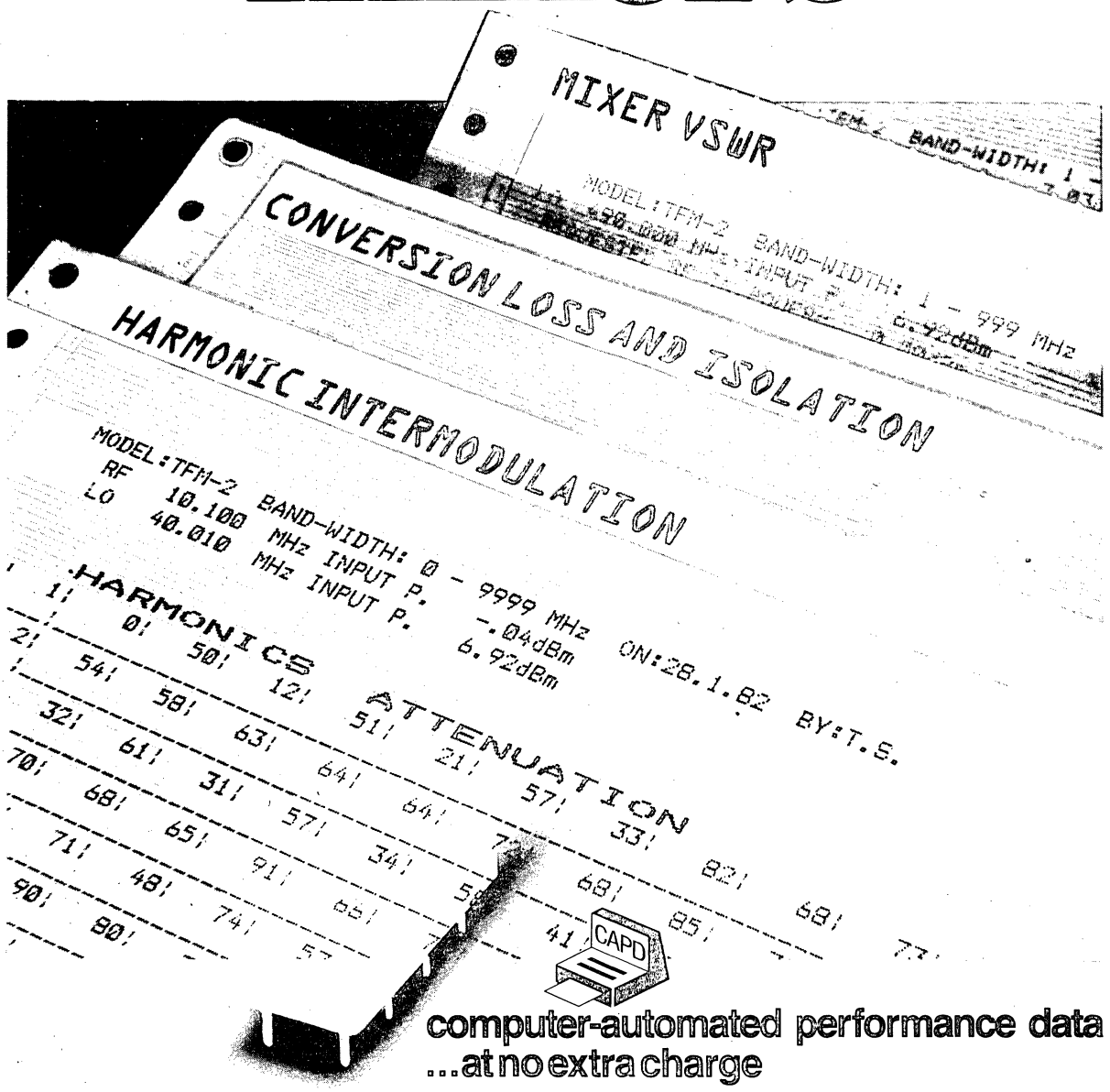
52 REV A

value-added mixers



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Fully detailed specs on mixer conversion loss, isolation, VSWR, and intermod characteristics. No more guesswork on how your selected mixer will interact with filters, see how critical parameters vary with frequency, spot in-band spurious responses, observe how LO drive variations affect VSWR and intermod...with precise data points generated from a computer controlled HP 8566A spectrum analyzer.

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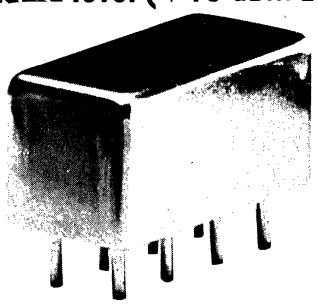
Domestic and International Telex 125460 International Telex 620156

C77REV.A

double balanced mixers

standard level (+10 dBm LO)



50 KHz to 2000 MHz

only $26.95 (5-24)

AVAILABLE IN STOCK FOR IMMEDIATE DELIVERY

- miniature 0.4 x 0.8 x 0.4 in.
- **MIL-M-28837/1A performance***
- low conversion loss 6.0 dB
- high isolation 25 dB

SRA-220 SPECIFICATIONS

FREQUENCY RANGE, (MHz)			
LO, RF	.05 - 2000		
IF	.05 - 500		
CONVERSION LOSS, dB		TYP.	MAX.
One octave from band edge		6.0	7.5
Total range		7.0	9.0
ISOLATION, dB		TYP.	MIN.
.05-.5	LO-RF	25	20
	LO-IF	25	20
.5-1000	LO-RF	40	30
	LO-IF	40	30
1000-2000	LO-RF	30	20
	LO-IF	25	15

Signal 1 dB Compression level +3dBm

For complete specifications and performance curves refer to the 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM.

*units are not QPL listed

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
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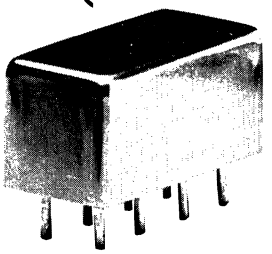
85-3 REV. ORIG.

hi-level mixers

(+17 dBm LO)



0.5 to 500 MHz

only $17.95 (5-24)

IN STOCK . . . IMMEDIATE DELIVERY

- **RF input up to +10dBm**
- MIL-28837/1A-08N performance* for-08S specify SRA-1H HI-REL
- NSN 6625-00-594-0223
- low conversion loss, 6dB
- hi isolation, 40dB
- hermetically-sealed
- hi reliability, diode burn-in 1 volt, 168 hrs., 150° C
- 1 year guarantee

*Units are not QPL listed

SRA-1H SPECIFICATIONS

FREQUENCY RANGE, (MHz)			
LO, RF	0.5-500		
IF	DC-500		
CONVERSION LOSS, dB		TYP.	MAX.
One octave band edge		5.5	7.5
Total range		6.5	8.5
ISOLATION, dB		TYP.	MIN.
low range	LO-RF	55	45
	LO-IF	45	35
mid range	LO-RF	45	30
	LO-IF	40	30
upper range	LO-RF	35	25
	LO-IF	30	20

SIGNAL 1dB Compression level +10 dBm

For complete specifications and performance curves refer to the Microwaves Product Data Director, the Goldbook, EEM, or Mini-Circuits catalog

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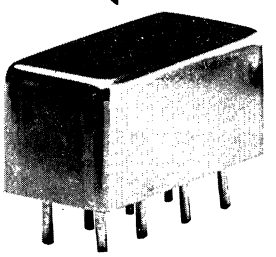
C 72-3 REV. B

ultra hi-level mixers

(+27 dBm LO)



.05 to 500 MHz

only $74.95 (1-9)

IN STOCK . . . IMMEDIATE DELIVERY

- **low distortion, +38 dBm intercept point, (two-tone, 3rd order)**
- up to +24 dBm RF input
- low conversion loss, 6 dB
- hi isolation, 40 dB
- miniature 0.4 x 0.8 x 0.4 in.
- hermetically-sealed
- MIL-M-28837/1A performance*
- one year guarantee

*Units are not QPL listed

VAY-1 SPECIFICATIONS

FREQUENCY RANGE, (MHz)			
LO-RF	0.05-500		
IF	0.02-500		
CONVERSION LOSS, dB		TYP.	MAX.
One octave from band edge		6.0	7.5
Total range		7.5	8.5
ISOLATION, dB		TYP.	MIN.
low range	LO-RF	47	40
	LO-IF	47	40
mid range	LO-RF	46	35
	LO-IF	46	35
upper range	LO-RF	35	25
	LO-IF	35	25

SIGNAL 1 dB Compression level +24 dBm Typ.

finding new ways...
setting higher standards

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A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 E. 14th St. B'klyn, N.Y. 11235 (212) 769-0200

C 74-3 REV. B

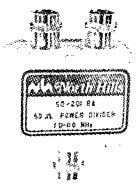
WIDEBAND POWER DIVIDERS/COMBINERS, HYBRID TRANSFORMERS, & TERMINATIONS

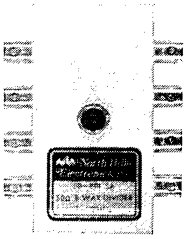
North Hills

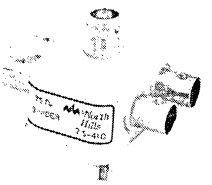
POWER DIVIDERS/COMBINERS

0.2 - 110 and 30 - 225 MHz
2, 4, and 8-way
50 and 75 ohms

Series 01 and 10 Power Dividers are designed for low power applications in the 0.2 to 110 and 30 to 225 MHz frequency ranges.
Hybrid Junction Techniques are employed to assure superior isolation and minimal insertion loss. VSWR is optimized at all ports.
50 and 75 ohm impedances are standard. Other impedances available on special order.



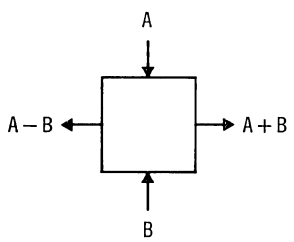




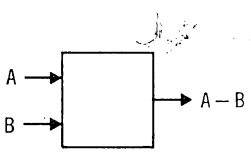
Model	2-WAY				4-WAY				8-WAY			
	50-201RA	75-201RA	50-210RA	75-210RA	50-401RB	75-401RB	50-410RB	75-410RB	50-801SA	75-801SA	50-810SA	75-810SA
Impedance (Ω)	50	75	50	75	50	75	50	75	50	75	50	75
Frequency Range (MHz)	0.2 - 110		30 - 225		0.2 - 110		30 - 225		0.2 - 110		30 - 225	
Insertion Loss (dB)	0.5		1.0		0.5		1.0		1.0		1.5	
Isolation (dB min)	30		30		30		30		30		30	
Amplitude Balance (± dB)	0.5		0.5		0.5		0.5		1.0		0.5	
Phase Balance (± °)	0.5		2.0		1.0		2.0		0.5		2.0	
Input VSWR	1.1		1.25		1.1		1.25		1.1		1.25	
Input Power (watts)	5		3		5		3		5		3	
Case Style	RA		RA		RB		RB		SA		SA	
Weight (gm)	50		50		65		65		160		160	

HYBRID TRANSFORMERS

SUM & DIFFERENCE (4-port)



DIFFERENCE DIVIDER (3-port)



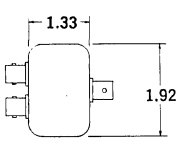
Port Impedance Type	50Ω 50-212RE	75Ω 75-212RE
Frequency Range	0.2 - 110 MHz	
Insertion Loss	1 dB max	
Isolation	30 dB min	
Amplitude Balance	±.3 dB	
Phase Balance	1° max	
VSWR	1.20 max	
Power	0.5 watt max	

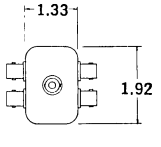
Port Impedance Type	50Ω 50-221RA	75Ω 75-221RA
Frequency Range	.2 - 110 MHz	
Insertion Loss	1 dB max	
Isolation	30 dB min	
Null	40 dB min	
VSWR	1.20 max	
Power	0.5 watt max	

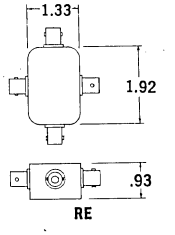
TERMINATIONS

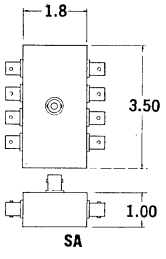
Model	Impedance	Frequency Range	VSWR	Connector
R50-101	50 Ω	DC - 1 GHz	1.06 max.	BNC Male
R75-101	75 Ω	DC - 1 GHz	1.06 max.	BNC Male

CASE STYLES









BNC Connectors are standard. Other connectors available on special order. Stud mounting standard.

Different case styles, including printed circuit types with solder terminals, available on special order.

SPECIAL UNITS — 10 Hz to 1 GHz

In addition to our standard lines, North Hills custom designs to specific requirements. Examples of these include:

- Active unity – or high-gain power splitters, adders and combiners.
- High power dividers.
- Resistive dividers from dc to 500 MHz
- Power dividers for video applications with response down to 1 kHz.
- Non-standard impedances.

North Hills Electronics, INC.
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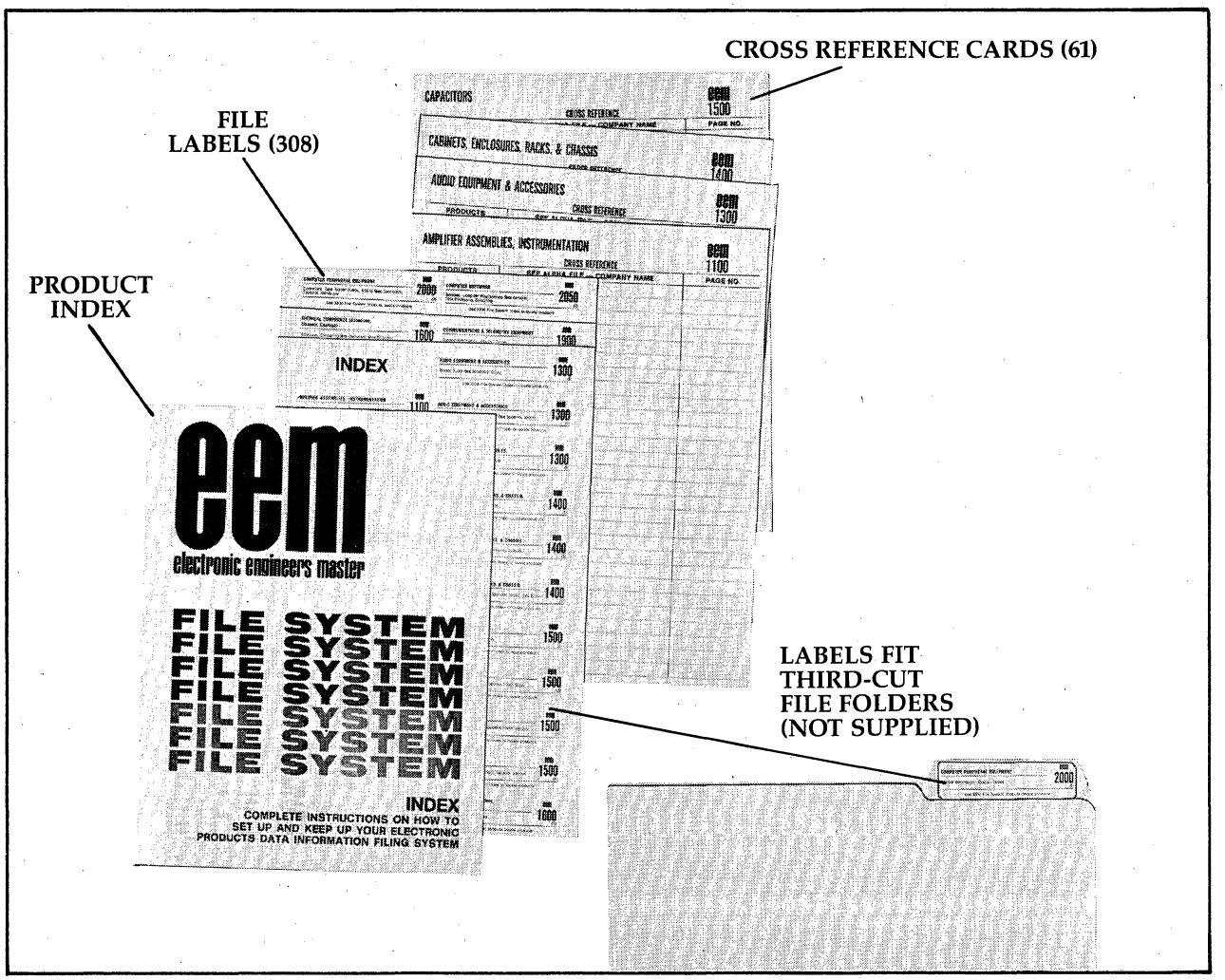


WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

Microwave Filters and RF Attenuators

TUBULAR LOWPASS FILTERS

Cutoff frequency range: 30 to 2,750 MHz. Available with 2 thru 12 sections and virtually any RF connector.

SERIES TLP
100 to 2,750 MHz
½" diam.
low cost
small size

SERIES TLA
50 to 1,500 MHz
¾" diam.
intermediate loss
size power

SERIES TLC
30 to 1,000 MHz
1¼" diam.
low loss
highest power

TUBULAR BANDPASS FILTERS

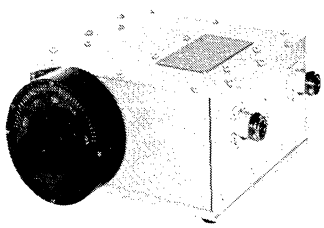
Featuring 0.1 dB Chebyschev design, these cover 30 to 2,400 MHz, 2 to 30% bandwidth, 2 to 12 sections.

SERIES TBP
100 to 2,400 MHz
½" inch diam.
lowest cost
most popular

SERIES TBA
50 to 1,000 MHz
¾" inch diam.
medium loss
and power

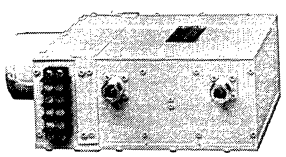
SERIES TBC
30 to 900 MHz
1¼" inch diam.
lowest loss
highest power

TUNABLE BAND-PASS FILTERS



MANUAL VERSION
Iris-coupled, 0.05 dB Chebyschev design. Frequency-Reading Dials, Full Octave Coverage 48 MHz to 4 GHz Range, Individually Calibrated, Vernier Tuning, 3 or 5 sections.

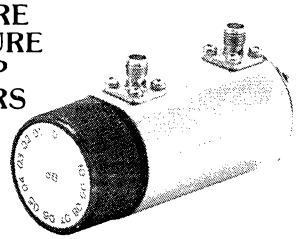
SPECIFICATIONS	TTA 3% & 5 % SERIES	TTF 5% SERIES
VSWR	1.5:1 Maximum	1.5:1 Maximum
Impedance	50 Ohms	50 Ohms
Maximum Input Power	20 Watts	50 Watts
Dial Accuracy —	± 1%	± 1%



COMPUTER-CONTROLLED VERSION
New, digitally-addressable tunable rf filters also available with IEEE 488, RS232 and BCD addressing.

SUBMINIATURE AND MINIATURE ROTARY STEP ATTENUATORS

Available in nine models with ranges from 1 to 100 dB

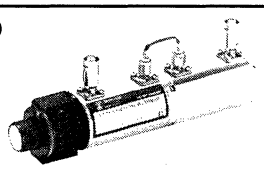


Accuracy to 0.5% available in custom units.

Model No.	dB Range	dB Steps	Frequency Range	Impedance (ohms)	VSWR	Accuracy*
8051	0-60	10	2 GHz	50	1.3:1 max.	3%
8052	0-10	1	2 GHz	50	1.3:1 max.	±0.2 dB or 3%
8120	0-100	10	2 GHz	50	1.3:1 max.	3%
8121	0-60	10	2 GHz	50	1.3:1 max.	3%
8122	0-10	1	2 GHz	50	1.3:1 max.	±0.2 dB or 3%
8123	0-1	0.1	500 MHz	50	1.3:1 max.	±02 dB
8131	0-70	10	1 GHz	75	1.3:1 max.	3%
8132	0-10	1	1 GHz	75	1.3:1 max.	±0.2 dB or 3%
8133	0-1	0.1	500 MHz	75	1.3:1 max.	±0.02 dB

TANDEM MOUNTED ROTARY STEP ATTENTUATORS

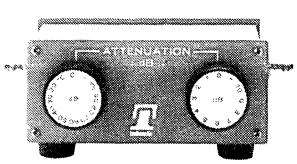
Combinations of step units (described above) in one assembly



Model No.	dB Range	dB Steps	Frequency Range	Impedance (ohms)	VSWR	Accuracy
8107	0-69	1	2 GHz	50	1.3:1 to 1 GHz	±0.2 dB or 3%
8140	0-109	1	2 GHz	50	1.4:1 to 2 GHz	±0.2 dB or 3%
8142	0-69	1	2 GHz	50		±0.2 dB or 3%
8149	0-10.9	0.1	500 MHz	50	dc to 500 MHz 1.3:1 max	±0.2 dB or 3%

BENCH TYPE ROTARY STEP ATTENUATORS

Discrete instruments for electonics lab, production, testing, or quality assurance



Model No.	dB Range	dB Steps	Frequency Range	Impedance (ohms)	VSWR	Accuracy
8128	0-100	10	2 GHz	50		3%
8129	0-10	1	2 GHz	50	1.3:1 to 1 GHz	±0.2 dB or 3%
8143	0-110	1	2 GHz	50	1.4:1 to 2 GHz	±0.2 dB or 3%
8145	0-80	1	1 GHz	75	1.4:1 max.	±0.2 dB or 3%
8148	0-11	0.1	500 MHz	50	1.3:1 max.	

Since 1960, Telonic has been a leading name in precision electronic components. Telonic's approach is to offer an *exceptionally wide* choice of standard filter types that can be delivered promptly—and which meet your specification requirements. Electrical test design data accompanies each order on request—and is your guarantee of quality assurance.

In the early 1960's when Telonic needed a precision step attenuator for one of their newly designed sweep generators, they had to revert to the ultimate supplier—themselves—to get the performance and dependability the instrument engineer demanded. Today, the product line has expanded into a complete series of rotary step, toggle, fixed, programmable, and custom units.

■ Technical assistance ■ Custom designs ■ Competitive prices ■ Outstanding product quality—backed by full warranty ■ Prompt delivery of stock items.

Call toll free for specs, prices and delivery on standard or special orders.

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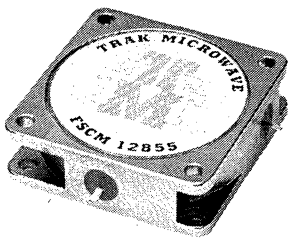
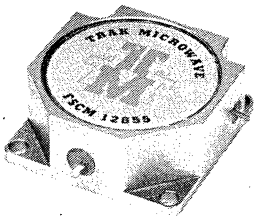
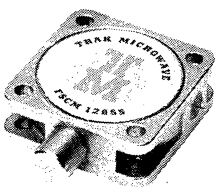
TRAK MICROWAVE CORPORATION

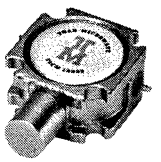
CIRCULATORS AND ISOLATORS

Drop-In Type









ISOLATORS

FREQ. RANGE (GHz)	MODEL # ISOLATORS	BANDWIDTH %	ISOLATION dB min.	INSERTION LOSS dB max.	VSWR max.	OPERATING TEMP. C	PEAK POWER KW	AVERAGE POWER WATTS	HEAT SINK TEMP. C	POWER RATING SIZE (INCHES NOMINAL) L x W x H
0.5-0.7	29*0401	5	20	0.7	1.25	-54 to +95	0.1	1.0	+50	1.00 x 1.00 x 0.30
0.7-1.0	29*0501	7	20	0.6	1.25	-54 to +95	0.1	1.0	+50	1.00 x 1.00 x 0.30
1.0-1.3	29*1401	10	20	0.5	1.25	-54 to +95	0.1	1.0	+50	1.00 x 1.00 x 0.30
1.3-1.65	29*1501	10	20	0.5	1.25	-54 to +95	0.1	1.0	+50	1.00 x 1.00 x 0.30
1.65-2.0	29*1601	5	20	0.5	1.25	-54 to +95	0.1	1.0	+50	.075 x .075 x 0.25
2.0-2.5	29*3401	10	20	0.5	1.25	-54 to +95	0.1	1.0	+50	0.75 x 0.75 x 0.75
2.5-3.7	29*3501	10	20	0.6	1.25	-54 to +95	0.1	1.0	+50	0.75 x 0.75 x 0.75
2.5-3.7	29*3601	5	18	0.6	1.30	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
3.7-4.6	29*6401	5	18	0.6	1.30	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
4.6-6.2	29*6501	10	18	0.6	1.30	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
6.2-8.0	29*6601	10	18	0.6	1.35	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
8.0-10.0	29*9401	10	18	0.6	1.35	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
10.0-12.0	29*9501	10	18	0.6	1.35	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
12.0-15.0	29*2401	10	17	0.6	1.45	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25
15.0-18.0	29*2501	10	17	0.6	1.45	-54 to +95	0.1	1.0	+50	0.50 x 0.50 x 0.25

NOTE: Circulators are also available.

Ultraminiature, shielded drop-in isolators and circulators.

µicr©puck™

Ultraminiature, shielded drop-in isolators and circulators.

CIRCULATORS

MODEL #	FREQUENCY (GHz)	BANDWIDTH %	ISOLATION dB min.	INSERTION LOSS dB max.	VSWR max.	OPERATING TEMP. C	PEAK PWR (W)	AVG. PWR (W)	HEAT SINK TEMP.	SIZE DIA. INCH.	SIZE HEIGHT INCH.
79*6101	4-8	10	18	.5	1.3	-54 to +95	500	25	50	.375	.200
79*9001	8-12	10	18	.4	1.3	-54 to +95	50	20	50	.250	.156
79*2001	12-18	10	17	.5	1.35	-54 to +95	50	20	50	.250	.156
79A9101	8-12	FULL BAND	16	17	1.45	-54 to +95	50	20	50	.375	.200

ISOLATORS

89*6101	4-8	10	20	.5	1.25	-54 to +95	50	.7	50	.375	.200
89*9001	8-12	10	20	.4	1.25	-54 to +95	50	.5	50	.250	.156
89*2001	12-18	10	17	.5	1.35	-54 to +95	50	.5	50	.250	.156
89A2201	12-18	FULL BAND	17	.7	1.50	-55 to +100	50	.7	50	.250	.156
89A9101	8-12	FULL BAND	16	.7	1.45	-54 to +95	50	.5	50	.375	.200

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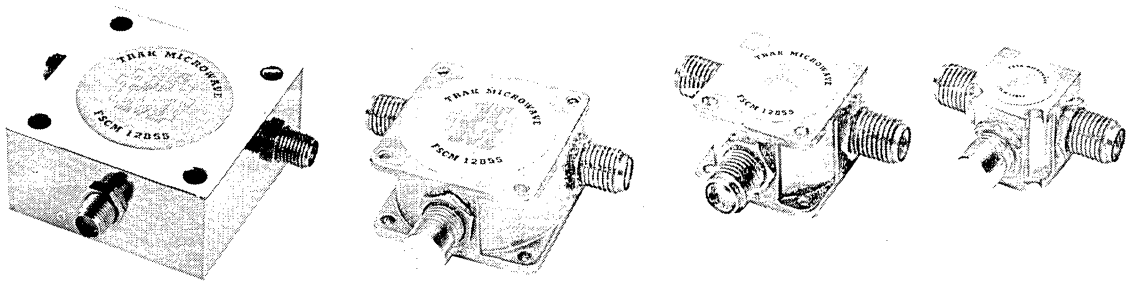
TRAK MICROWAVE CORPORATION

CIRCULATORS AND ISOLATORS
OCTAVE AND BROAD BANDWIDTH COAXIAL TYPE

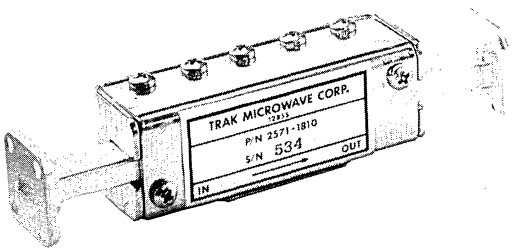


ISOLATORS

FREQ. RANGE (GHz)	MODEL #	ISOLATION dB min.	INSERTION LOSS dB max.	VSWR max.	OPERATING TEMP. C	POWER RATING PEAK POWER KW	POWER RATING AVERAGE POWER WATTS	HEAT SINK TEMP. C	SIZE (Inches Nominal) L x W x H
1.0-2.0	60A1101	15	0.6	1.40	0 to +50	0.2	1.0	+35	1.60 x 1.60 x 0.75
2.0-4.0	60A3001	18	0.5	1.30	-10 to +70	0.6	1.0	+40	1.00 x 1.00 x 0.50
2.6-5.2	60A3011	18	0.5	1.30	-25 to +80	1.0	1.0	+45	1.00 x 1.00 x 0.50
3.0-6.0	60A6301	18	0.5	1.40	-45 to +85	0.1	1.0	+50	0.75 x 0.75 x 0.50
4.0-8.0	60A6001	18	0.5	1.30	-45 to +95	2.0	1.0	+50	0.75 x 0.75 x 0.50
5.0-10.0	60A6071	18	0.5	1.30	-55 to +95	0.5	2.0	+50	0.75 x 0.75 x 0.50
6.0-12.0	60A9201	16	0.7	1.35	-55 to +95	0.1	1.0	+50	0.75 x 0.75 x 0.50
8.0-12.4	20B9201	20	0.5	1.30	-55 to +110	0.5	3.0	+50	0.50 x 0.50 x. 0.50
8.0-16.0	60A2001	17	0.5	1.35	-40 to +95	0.5	3.0	+50	0.50 x 0.50 x 0.50
7.5-18.0	60C2051	14	0.9	1.50	-54 to +95	0.5	3.0	+50	0.50 x 0.50 x 0.50
12.0-18.0	20B2201	18	0.5	1.30	-55 to +110	2.0	3.0	+50	0.50 x 0.50 x 0.50
8.0-18.0	60A2051	14	0.6	1.50	-54 to +95	0.5	3.0	+50	0.50 x 0.50 x 0.50
18.0-22.0	20A8101	18	0.7	1.30	-54 to +95	0.5	3.0	+50	0.50 x 0.50 x 0.50

NOTE: Circulators are also available.

WAVEGUIDE



FREQUENCY GHz	MODEL #	ISOLATION dB min.	INSERTION LOSS dB max.	VSWR BILATERAL max.	POWER KW PEAK	MAX. W. AVE.	LENGTH INCHES	WEIGHT OUNCES NOMINAL	WAVEGUIDE TYPE	FLANGE TYPE
5.85-8.2	XB951LI	30	1.0	1.15	20	20	5.00	32	RG-50/U	UG-344/U
5.85-8.2	XB103LI	30	1.0	1.15	20	20	6.13	56	RG-50/U	UG-344/U
7.05-10.0	XL103LIA	30	1.0	1.15	5	20	6.13	36	RD-51/U	UG-51/U
8.2-12.4	X956LI	30	1.0	1.10	10	40	4.50	24	RG-52/U	UG-39/U
8.2-12.4	X110LIA*	30	1.0	1.10	5	20	5.00	28	RG-52/U	UG-39U
10.0-15.0	M111LI	30	1.0	1.15	10	10	5.00	32	WR-75	WR-75
12.4-18.0	Ku915LI	30	1.0	1.10	10	20	4.00	24	RG-91/U	UG-419/U
12.4-18.0	Ku110LI*	30	1.0	1.15	10	10	5.00	28	RG-91/U	UG-419/U
18.0-26.5	2561-1810*	25	1.0	1.25	3	3	4.50	6.0	WR-42	UG-595/U
26.5-40.0	2571-1810*	23	1.5	1.15	3	3	4.125	5.5	WR-28	UG-599/U

Specifications subject to change without notice.

**These units are normally available from stock.*

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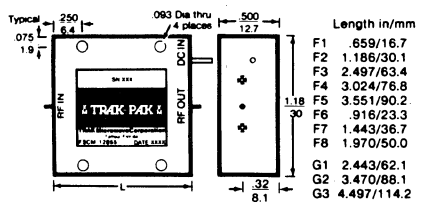
TRAK MICROWAVE CORPORATION

GaAs FET AMPLIFIERS

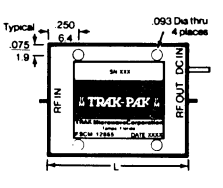
Drop-In Wide Band
Temperature Compensated Type

MODEL	FREQUENCY GHz	GAIN (dB)[1,2] MINIMUM	GAIN (dB)[1,2] NOMINAL	GAIN (dB)[1,2] MAXIMUM	MAXIMUM NOISE FIGURE (dB) -54°C	+25°C	+85°C	MINIMUM POWER OUT (dBm)[4]	3rd ORDER INTERCEPT dBm min	VSWR[2]	mA max @ +15VDC[2,3]	PACKAGE OUTLINE
8081-1601	2.0 - 8.0	8.0	9.0	10.0	5.5	6.0	7.0	+12	+22	2.0:1	40	F1
8081-1602	2.0 - 8.0	17.0	18.0	19.0	5.5	6.0	7.0	+12	+22	2.0:1	80	F2
8081-1603	2.0 - 8.0	25.0	27.0	29.0	5.5	6.0	7.0	+12	+22	2.0:1	180	F8
8081-1604	2.0 - 8.0	34.0	36.0	38.0	5.5	6.0	7.0	+12	+22	2.0:1	220	F3
8081-1605	2.0 - 8.0	43.0	45.0	47.0	5.5	6.0	7.0	+12	+22	2.0:1	260	F4
8081-1610	2.0 - 6.0	15.0	16.0	17.0	4.0	4.5	5.5	+14	+24	2.0:1	100	G1
8081-1611	2.0 - 6.0	24.0	25.0	26.0	4.0	4.5	5.5	+14	+24	2.0:1	140	G2
8081-1612	2.0 - 6.0	32.5	34.0	35.5	4.0	4.5	5.5	+14	+24	2.0:1	180	G3
8081-1301	2.0 - 4.0	12.0	13.0	14.0	3.0	3.5	4.5	+9	+19	2.0:1	60	F1
8081-1302	2.0 - 4.0	24.0	25.0	26.0	3.0	3.5	4.5	+10	+20	2.0:1	100	F8
8081-1303	2.0 - 4.0	39.0	40.0	41.0	3.0	3.5	4.5	+10	+20	2.0:1	140	F3
8081-1620	4.0 - 8.0	13.0	14.0	15.0	5.0	5.5	6.5	+10	+20	2.0:1	100	F7
8081-1621	4.0 - 8.0	21.0	22.0	23.0	5.0	5.5	6.5	+10	+20	2.0:1	140	F8
8081-1622	4.0 - 8.0	28.5	30.0	31.5	5.0	5.5	6.5	+10	+20	2.0:1	180	F3
8081-1201	6.0 - 18.0	13.0	14.0	15.0	7.5	8.0	9.0	+9	+19	2.0:1	180	H3
8081-1202	6.0 - 18.0	16.5	18.0	19.5	7.5	8.0	9.0	+9	+19	2.0:1	220	H4
8081-1203	6.0 - 18.0	21.0	23.0	25.0	7.5	8.0	9.0	+9	+19	2.0:1	260	H5
8081-1210	8.0 - 18.0	4.0	5.0	6.0	7.5	8.0	9.0	+10	+20	2.0:1	40	H1
8081-1211	8.0 - 18.0	8.0	10.0	12.0	7.5	8.0	9.0	+10	+20	2.0:1	80	H2
8081-1212	8.0 - 18.0	13.0	14.0	15.0	7.5	8.0	9.0	+10	+20	2.0:1	180	H3
8081-1213	8.0 - 18.0	16.5	18.0	19.5	7.5	8.0	9.0	+10	+20	2.0:1	220	H4
8081-1214	8.0 - 18.0	20.0	22.0	24.0	7.5	8.0	9.0	+10	+20	2.0:1	260	H5
8081-1901	8.0 - 12.0	12.0	13.0	14.0	4.5	5.0	6.0	+9	+19	2.0:1	140	H6
8081-1902	8.0 - 12.0	16.5	18.0	19.5	4.5	5.0	6.0	+9	+19	2.0:1	180	H3
8081-1903	8.0 - 12.0	21.0	23.0	25.0	4.5	5.0	6.0	+9	+19	2.0:1	220	H4
8081-1904	8.0 - 12.0	26.0	28.0	30.0	4.5	5.0	6.0	+9	+19	2.0:1	260	H5
8081-1220	12.0 - 18.0	12.5	14.0	15.5	6.5	7.0	8.0	+10	+20	2.0:1	180	H3
8081-1221	12.0 - 18.0	16.0	18.0	20.0	6.5	7.0	8.0	+10	+20	2.0:1	220	H4
8081-1222	12.0 - 18.0	19.5	22.0	24.5	6.5	7.0	8.0	+10	+20	2.0:1	260	H5
8081-1223	12.0 - 18.0	23.5	26.0	28.5	6.5	7.0	8.0	+10	+20	2.0:1	300	H7

[1]Gain over temperature and frequency.
[2]-54°C to +85°C.
[3]Supply voltage may be any value between +12 and +18 VDC.
[4]Power output at 1 dB compression.



Length in/mm
F1 .659/16.7
F2 1.186/30.1
F3 2.497/63.4
F4 3.024/76.8
F5 3.551/90.2
F6 .916/23.3
F7 1.443/36.7
F8 1.970/50.0
G1 2.443/62.1
G2 3.470/88.1
G3 4.497/114.2



Length in/mm
H1 .659/16.7
H2 1.186/30.1
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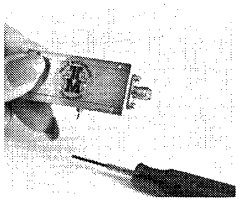
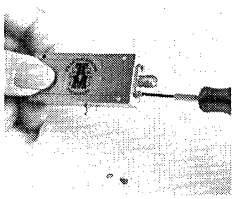
H4 3.024/76.8
H5 3.551/90.2
H6 1.970/50.0
H7 4.078/103.6

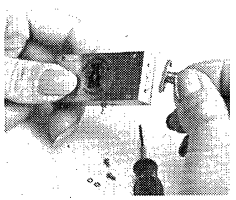
*Refer to photographs on top of next page.



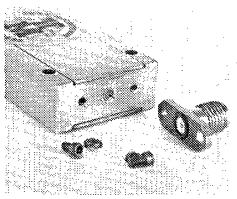
Amplifier is shipped with connector in place to simplify testing.



After test, screws are removed.



Connector is removed. Unit remains hermetically sealed. TRAK PAK™ impedance remains 50 ohms.



Amplifier is ready to drop into microstrip circuit.

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TRAK MICROWAVE CORPORATION

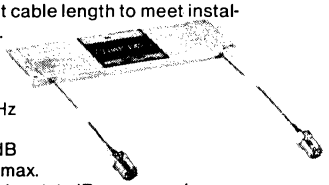
GaAs FET AMPLIFIERS

CUSTOM DESIGN

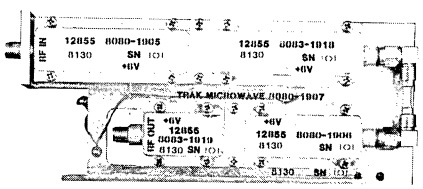
TRAK manufactures custom designs tailored to specific requirements. A few examples are depicted below.

ULTRA-THIN

Special thin package design which features semi-rigid coax cables at the input and output. Units are tested with SMA connectors attached as shown. User may cut cable length to meet installation requirements.



Frequency: 2 - 6 GHz
Gain: 28 dB min.
Gain Flatness: +2 dB
Noise Figure: 6 dB max.
Output: +18 dBm min. at 1 dB compression.
Temp. Range: -30 to +71°C
VSWR: 2:1
Phase Matching: ±30° at 25°C
Gain Matching: ±1 dB at 25°C
Supply: +15V at 160 mA
Size: 3.6" x 1.0" x 0.15"

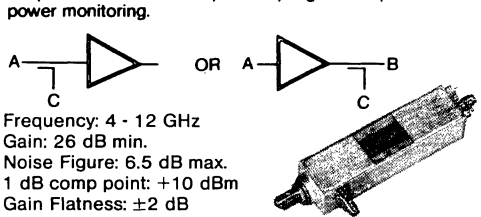


IFM AMPLIFIER

Frequency: 6 - 12 GHz
Gain: 60 dB typical
Gain Flatness: ±1 dB
Power: +13±1 dBm, at 1 dB compression.
Temp. Range: -54 to 85°C
Supply: +6VDC @ 400 mA, typical

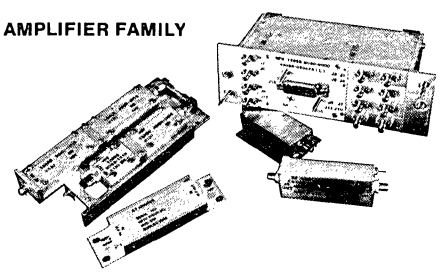
AMPLIFIER/COUPLER

Broadband amplifiers which contain microstrip coupler for additional input coupling or output power monitoring.



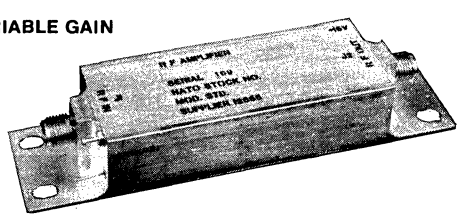
Frequency: 4 - 12 GHz
Gain: 26 dB min.
Noise Figure: 6.5 dB max.
1 dB comp point: +10 dBm
Gain Flatness: ±2 dB
Coupler: input or output coupler; customer specified value
VSWR: 2.0:1
Temp: -30 to +71°C

AMPLIFIER FAMILY



- Broadband - Low noise amplifiers in 2 - 18 GHz frequency range
- Custom designed packages to customer specifications
- Temperature compensation available
- Phase matching capability
- Input, output couplers, or bite test functions available
- SMA connectors
- Drop-in configurations
- 1 watt power amplifiers

VARIABLE GAIN



Frequency: 2 - 6 GHz
Gain: 20-30 dB typical
TTL Gain Control: 20 dB typical
VSWR: 2:1
Temp. Range: -54 to +115°C

FET Amplifiers Also Available:

- **Temperature Compensated Wideband Coaxial**
- **Non-Temperature Compensated Wideband Coaxial and Drop-Ins**
- **Non-Temperature Compensated Narrowband Coaxial and Drop-Ins**
- **Customized-Designs to Your Specifications**

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TRAK MICROWAVE CORPORATION

OSCILLATORS, COMB GENERATORS, IF AMPLIFIERS AND POWER AMPLIFIERS

12 - 18 GHz GaAs FET Dielectrically Stabilized Oscillators (DSO's)

ELECTRICAL SPECIFICATIONS

Frequency:	Factory set between 8 and 18 GHz
Frequency Set Accuracy:	±1 MHz
Power Output:	+12 dBm minimum
Inband Spurious:	None
Stability:	
Frequency vs temperature	5ppm/°C maximum
Frequency pulling:	1 MHz peak to peak into 3:1 load VSWR
Frequency pushing:	2 KHz/volt, typical
Power vs temperature:	±1 dB
Power Supply:	+15 VDC @ 70 mA, nominal

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature Range:	-54 to +115°C
Storage Temperature:	-54 to +125°C
Shock:	100g, 11ms
Vibration:	20g, 20-2000cps

MECHANICAL SPECIFICATIONS

Size:	2.28 x 1.0 x 1.0 inches (60 x 25.5 x 25.5 mm) nominal, excluding projections
Weight:	100 grams, nominal
RF connector:	SMA Female
DC connections:	Solder Terminal

Options: The following components can be added to tailor the oscillator to meet specific system requirements and to obtain the optimum cost-performance tradeoff.

- PIN switch for dual frequency mode.
- Amplifier stages for increased output power.
- RF coupler for RF power monitoring or other functions.
- Power dividers for driving multiple mixers.
- PIN attenuator for external amplitude modulation.
- Varactors for external frequency modulation.
- Heater for increased frequency stability.

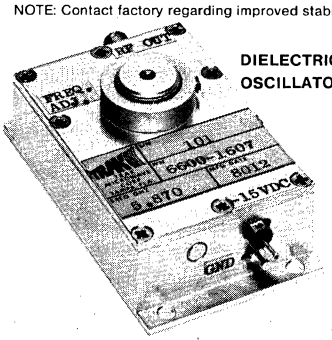
In addition to adding other functions, TRAK can provide special models to provide minimal FM under 50g operating vibration. Models with mechanical tuning capability are also available.

DIELECTRICALLY STABILIZED OSCILLATORS (DSO's)

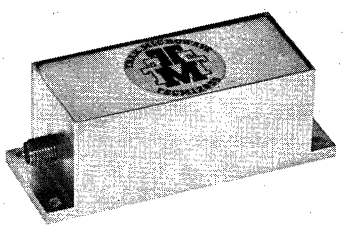
Model Number	Frequency Range (GHz)	Output Power (mw Minimum)	Second Harmonic (dBc min.)	(Ounces Nominal)	Size, inches Nominal,
6600-1300	3.65 - 4.05	30	30	3.0	2.7 x 1.7 x 1
6600-1610	4.25 - 4.75	30	30	2.5	2.5 x 1.5 x .9
6600-1611	4.75 - 5.25	30	30	2.5	2.5 x 1.5 x .9
6600-1612	5.10 - 5.60	30	30	2.5	2.5 x 1.5 x .9
6600-1613	5.40 - 5.90	30	30	2.5	2.5 x 1.5 x .9
6600-1614	5.60 - 6.10	30	30	2.5	2.5 x 1.5 x .9
6600-1615	5.70 - 6.20	30	30	2.5	2.5 x 1.5 x .9
6600-1616	5.90 - 6.40	30	30	2.5	2.5 x 1.5 x .9
6600-1617	6.40 - 6.90	30	30	2.5	2.5 x 1.5 x .9
6600-1618	7.00 - 7.45	15	35	2.0	2.2 x 1.3 x .9
6600-1910	8.00 - 8.40	15	35	2.0	2.2 x 1.3 x .9
6600-1911	8.60 - 9.00	15	35	2.0	2.2 x 1.3 x .9
6600-1912	9.00 - 9.50	15	35	2.0	2.2 x 1.3 x .9

Power Supply: -15 VDC @ 30 mA nom.
Frequency Stability: 10ppm/ C max. 5 ppm/ C, typical
Temperature Range: -54 to +95 C

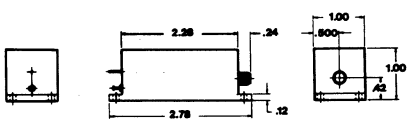
NOTE: Contact factory regarding improved stability requirements.



DIELECTRICALLY STABILIZED OSCILLATORS (DSO's)

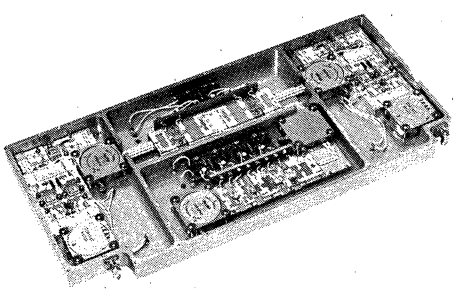


6700 Series



TACAN BAND DUAL CHANNEL POWER AMPLIFIER

Frequency Range: 960 - 1215 MHz
Power Output: 165 watts peak per channel
Gain: 42 dB
Duty Factor: 20%
Bandwidth: 255 MHz



TACAN BAND DUAL CHANNEL POWER AMPLIFIER

Also Available:

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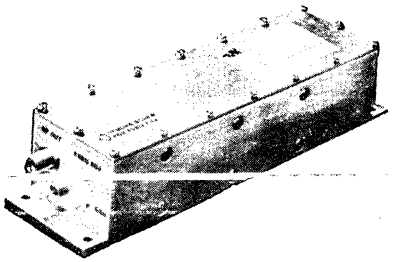
TRAK MICROWAVE CORPORATION

OSCILLATORS, COMB GENERATORS, IF AMPLIFIERS AND POWER AMPLIFIERS

OVENIZED Ku BAND CRYSTAL CONTROLLED OSCILLATORS

Frequency:	12, 13, or 14 GHz
Power Output:	+10 dBm minimum
Frequency Stability:	±5 ppm (-20 C to +71 C)
Frequency Set Accuracy:	±2 ppm (at +25 C)
Harmonics and Spurs:	>40 dBc
Load VSWR:	1.5:1 maximum
Power Supply:	+15 V @ 430 mA steady state (800 mA max. at turn-on)
Warm-up Time to meet 5 ppm frequency stability:	120 sec. max.
Size:	5 x 1.5 x 1.25 inches nominal, excluding projections
Temperature Range:	-55 to +85 C

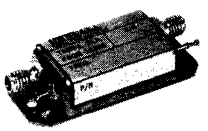


OVENIZED KU BAND CRYSTAL CONTROLLED OSCILLATORS

WIDE DYNAMIC RANGE LOW NOISE IF AMPLIFIER
Model 8400-1080

Center Frequency:	Customer specified 20 to 150 MHz
3 dB Bandwidth:	10 MHz, nominal
Bandpass Ripple:	1 dB, typical
Skirt Selectivity:	12 dB/octave, typical
Gain:	70 ± 3 dB
Noise Figure:	3 dB max.
Input Impedance:	50 ohms nominal
1 dB Compression Point:	0 dBm min.
3rd Order Intercept Point:	+10 dBm nominal
Input Dynamic Range (with AGC):	80 dB min.
AGC Range:	60 dB min.
AGC Voltage:	0 to + 5 volts
Size:	1.28 x .71 x 0.5 inches, nominal excluding projections
Temperature Range:	0 to +50°C (see note)

NOTE: Temperature compensation circuits are optionally available for higher stability and/or wider temperature ranges.



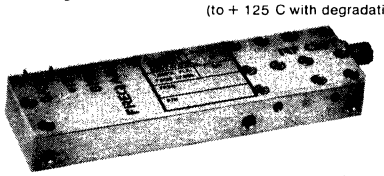
WIDE DYNAMIC RANGE LOW NOISE IF AMPLIFIER

2.5 - 18 GHz MINIATURE CRYSTAL CONTROLLED OSCILLATORS

ELECTRICAL PARAMETERS (general)
Frequency set accuracy at room temperature: ±0.001%
Frequency stability: ±0.003%
Aging rate: ±0.005% per year
Power variation with temperature: ±2 dB
Power supply: +15 VDC (other voltages optional)

MODEL NUMBER	FREQUENCY (GHz)	POWER OUTPUT AT +25 C (dBm min.)	OUTPUT HARMONICS AND SPURIOUS (dBc)	CURRENT (mA nom.)
5044-1311	2.5 - 4.0	+10	>40	100
5044-1611	4.0 - 8.0	+10	>40	110
5045-1911	8.0 - 10.0	+10	>40	120
5045-1913	10.0 - 12.0	+10	>40	140
5045-1240	12.0 - 18.0	+10	>40	150

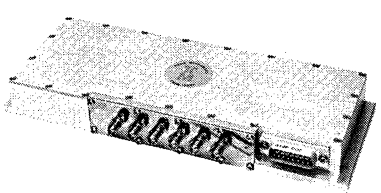
CONTACT FACTORY FOR OTHER FREQUENCIES AND/OR POWER LEVELS
Temperature Range: -55 to +85 C (to + 125 C with degradation)



2.5-18 GHz MINIATURE CRYSTAL CONTROLLED OSCILLATORS

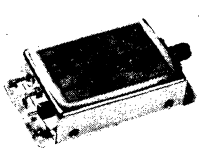
CUSTOM DESIGNED SWITCHED MULTIPLE OUTPUT OSCILLATOR

This custom designed unit provides several electronically selectable output frequencies. Output signals can be in various bands and with various power levels. Thin-film hybrid techniques minimize size. Contact TRAK with your needs.



COMB GENERATORS

Model Number	3900-1210	3900-1900	3900-1203	3900-1200
Frequency Range	.5 - 18 GHz	0.5 - 12 GHz	.95 - 13.3 GHz	0.1 - 18 GHz
Comb Spacing (MHz)	500	500	950	100
Freq Stability (ppm)	30	30	30	30
Power Output (dBm)	-40 min.	+6 max. -22 min.	-20 min.	0 max. -40 min.
Load VSWR (max.)	1.5:1	1.5:1	1.5:1	1.5:1
In-band Spurious (dBc max.)	>24	>30	>40	>60
Power Supply +15 VDC @ (mA max.)	200	200	150	300
Size (inches, nominal excluding projections)				
Length	1.9	1.33	1.9	1.9
Width	1.33	1.33	1.33	1.33
Weight	0.5	0.15	0.6	0.6
Temperature Range:	-54 to +85 C			



COMB GENERATOR

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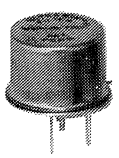
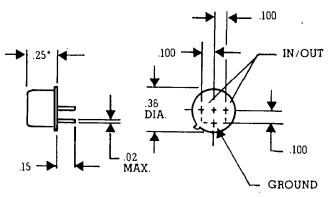
Ultramin® Series RF and Microwave Filters

- Filters in TO-5 size packages are only 0.36 inches in diameter and weigh less than 0.046 oz.
- Standard Models cover 10 to 1000 MHz frequency range. 1000 to 2000 MHz frequency range available on special order.
- Bandpass, lowpass, highpass, and bandstop filters are available.
- Models are available that meet MIL-E-5400R, MIL-STD-202E, MIL-E-8189H, MIL-F-18327D and MIL-STD-883A. A glass-to-hermetic seal is standard with most configurations.

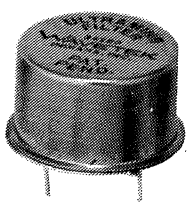
T5



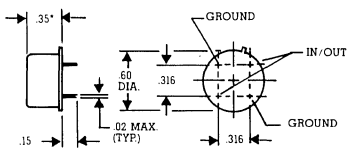
Frequency Range: 25 to 500 MHz.
Filter Sections: 3, bandpass; 3 to 4, lowpass.
Package: TO-5 metal case. Glass/metal hermetic seal.
Connectors: Pin.
*Standard height; shorter package available on request.



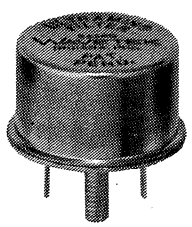
T8



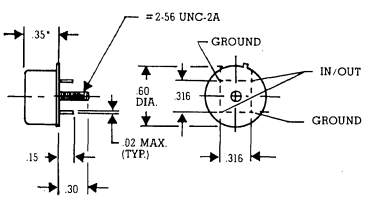
Frequency Range: 10 to 1000 MHz.
Filter Sections: 3 to 6, bandpass; 3 to 6, lowpass.
Package: TO-8 metal case. Glass/metal hermetic seal.
Connectors: Pin.
*Standard heights are 0.250, 0.300 and 0.350 inches.



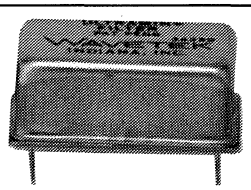
T8S



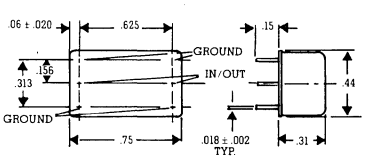
Frequency Range: 10 to 1000 MHz.
Filter Sections: 3 to 5, bandpass; 3 to 6, lowpass.
Package: TO-8 metal case. #2-56 threaded mounting stud and glass/metal hermetic seal. Recommended above 100 MHz for improved grounding.
Connectors: Pin.



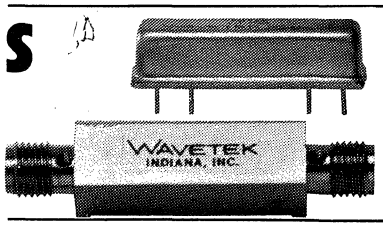
R



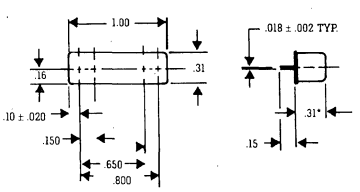
Frequency Range: 10 to 1500 MHz.
Filter Sections: 3 to 8, bandpass; 3 to 10; lowpass.
Package: Rectangular metal case. Glass/metal hermetic seal is optional.
Connectors: Pin or coaxial.



S



Frequency Range: 10 to 2000 MHz.
Filter Sections: 3 to 10, bandpass; 3 to 12, lowpass.
Package: Rectangular metal case. Glass/metal hermetic seal.
Connectors: Pin or coaxial.



	Average Power	VSWR	Impedance	3 dB Percentage Bandwidths	Shock	Vibration	Temperature	Humidity
Standard	1 W	Less than 1.5:1	50Ω	5% to 100%	50 G's 11 ms	20 G's 0-500 Hz	0° to +50°C	100% (Pin Connectors)
Special Order	Consult Factory	Less than 1.2:1	Consult Factory	1% to 200%	200 G's 20 ms	50 G's 0-3000 Hz	−55° to +125°C	100% (All Connectors)

Note: All Ultramin® Series Filters are passive, bidirectional devices. Filter characteristics are the same for power flow in either direction. Specifications are subject to change without notice.

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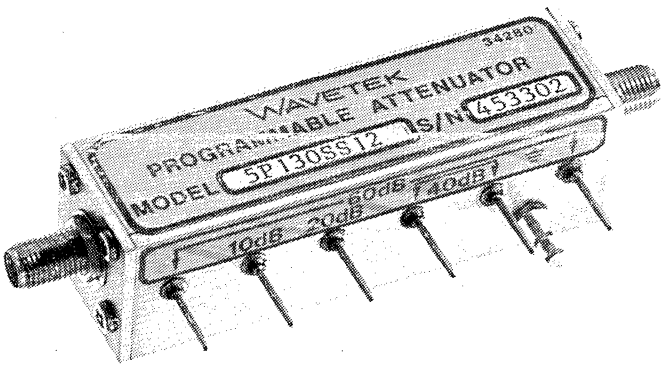
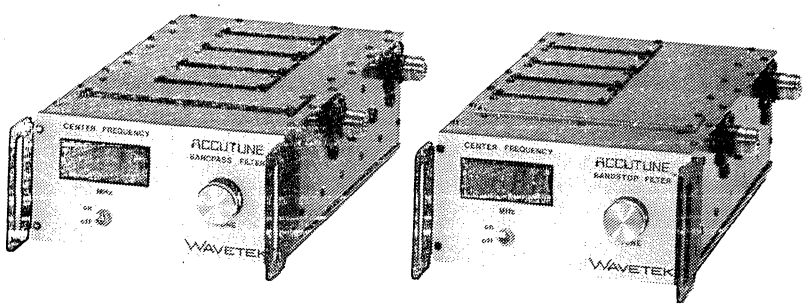
Programmable Attenuators



- World's Smallest Design
- Ideal for OEM Systems Applications
- High Volume Delivery
- Custom Design Capability
- Optional TTL Interface

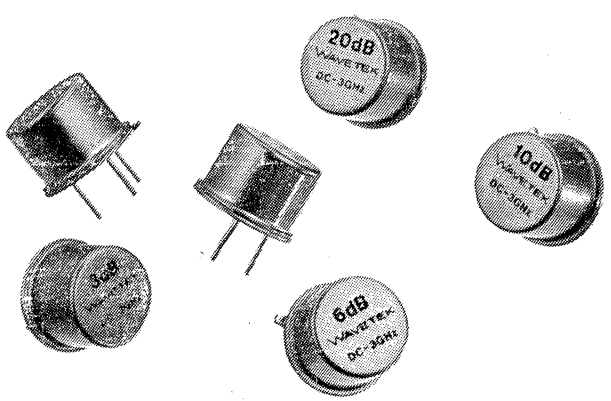
Model	Attenuation	Frequency
5P70	0 to 70 dB	DC to 2000 MHz
5P127	0 to 127 dB	DC to 1500 MHz
5P130	0 to 130 dB	DC to 1500 MHz

Series 5200 and 7200 Accutune™ Tunable Filters



- LDC Readout Accuracy of ±0.15%
- 2000 Discrete Calibration Frequencies Available
- 2.2 Typical Form Factor
- 30 to 2000 MHz
- 60 Watt Power Rating
- Custom Bandwidths and Tuning Ranges Available

Micropad Series MA5 Stripline/Microstrip Fixed Attenuators



- DC to 3 GHz
- ±0.2 dB Accuracy to 1 GHz
- 5 Standard Attenuation Values
- Ultraminiature Packaging
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- Custom Values Available

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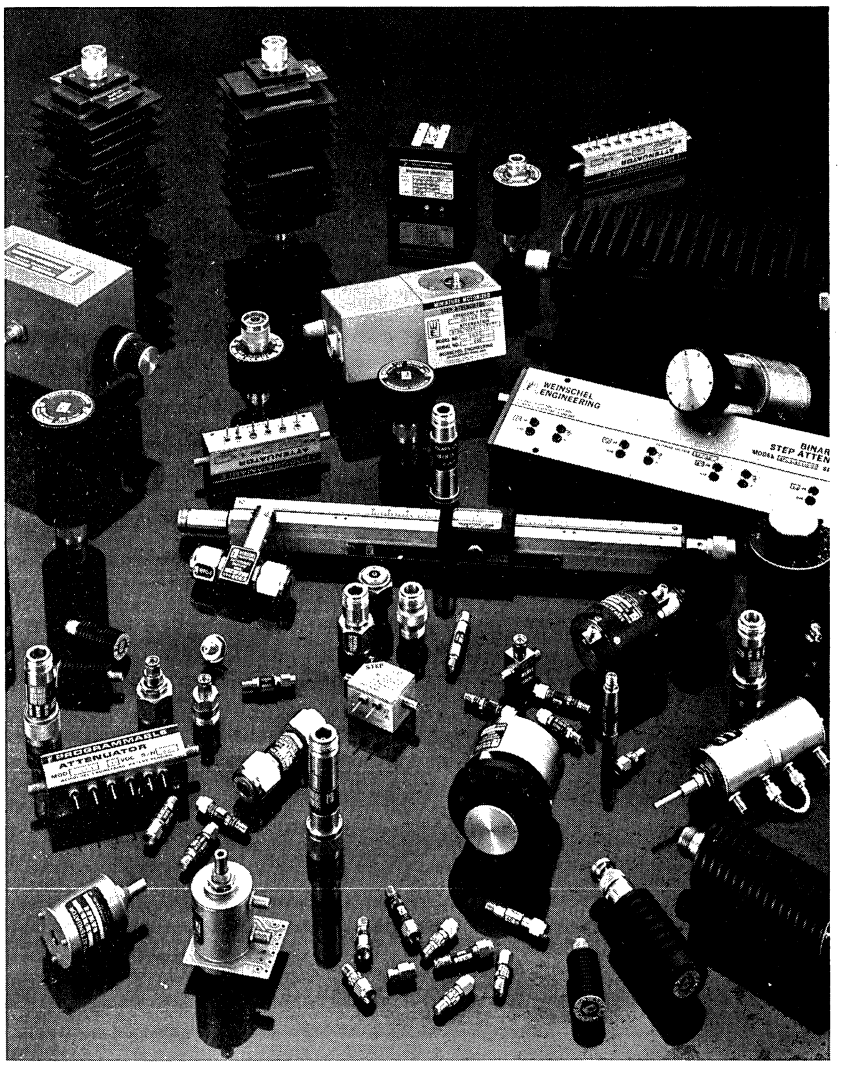
Weinschel RF components . . .

DC-40 GHz

Weinschel Engineering offers the industry's most comprehensive line of high quality microwave components. Covering the frequency spectrum from DC to 40 GHz, these components include fixed, continuously variable, and step attenuators as well as precision terminations, connectors, adapters and power dividers. Consistent performance and virtually flat attenuation versus frequency characteristics are well-known qualitites of Weinschel components. Power ratings from 1 watt to 250 watts are available.

Conservatively rated, Weinschel's high power attenuators handle at least 24% more power than specified. Due to innovative engineering and state-of-the-art manufacturing techniques, our high-power line is continually being improved and expanded. Not only do we offer a 250 watt attenuator but high power attenuators with broadband capabilities are also now available. For example, Weinschel's model 48, rated for 100 watts average, 1 KW peak, operates from DC to 18 GHz. Proprietary film processes produce resistive elements with features such as low temperature coefficients, low aging rates and immunity to overload. By eliminating the need for heat conducting liquids, size can be reduced while reliability is improved.

For more information about our component line contact your nearest Weinschel representative or call us toll free.



a long line of excellence.

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Weinschel Engineering
One Weinschel Lane
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Telex: ITT440702 or WU89-8352

EEM PRODUCT SELECTION GUIDES

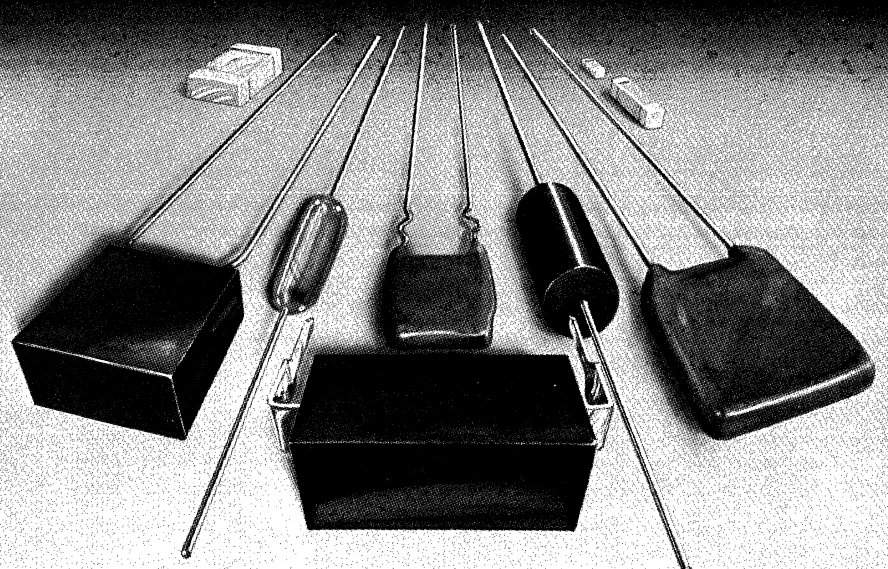
Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

Buy by the numbers. Buy #1

Today multilayer ceramic capacitors (MLC's) are being sold in greater numbers than ever before. In fact, they make up over 60% of all the capacitor units sold in the industry. And, out of all these, AVX Ceramics is the leading manufacturer worldwide.

Here's some other impressive numbers. Follow them to link up with AVX MLC chips (p 1•1014), SpinGuards (p 1•1011), DipGuard (p 1•1013), molded axials (p 1•1012) and SkyCaps (p 1•1010) listed in this catalog. For military radials and axials (p 1•1672) and for military DipGuards and chips (p 1•1673).

To locate the right MLC for your application, just follow the numbers. They'll lead you straight to number one.



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eem qualified products lists selection guide

"Qualified Products Lists" are issued periodically by the U.S. Government as a guide for the procurement of electronic components by government contractors. Each list contains every separately designated part that has qualified under the lated Mil. Specification for its class and the name(s) of the Manufacturer(s) of each.

EEM is publishing the names of those companies that are qualified producers of one or more products in each of the lists that apply to a selected group of electronic products normally cataloged in these pages.

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QPL-20-87
MIL-C-20 FSC 5910
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*AVX Ceramics Corporation
19th Avenue South
Myrtle Beach, SC 29577

Cera-Mite Corporation
1327 Sixth Avenue
Grafton, WI 53024

*Republic Electronics Corporation
176 East Seventh Street
Paterson, NJ 07524

San Fernando Electric
1501 First Street
San Fernando, CA 91341

*Tusonix, Incorporated
2155 North Forbes Boulevard
Tucson, AZ 85705

Union Carbide Corporation
Route 276 Southeast
Greenville, SC 29606

QPL-27-82
MIL-T-27 FSC 5950
Transformers and Inductors (Audio, Power, and High-Power Pulse)

ADC Products
4900 West 78th Street
Minneapolis, MN 55435

Adec, Incorporated
12 Kulick Road
Fairfield, NJ 07006

AEL-EMTECH Corporation
P.O. Box 552
Lansdale, PA 19446

AMI/Coast Magnetics
AMI Division
1207 North La Brea Avenue
Inglewood, CA 90302

Berkshire Transformer Corporation
Route 341
Kent, CT 06757

Beta Transformer Technology Corp.
One Comac Loop
Ronkonkoma, NY 11779

B. G. Laboratories, Incorporated
75 Travis Avenue
Binghampton, NY 13904

Bourns, Incorporated
1200 Columbia Avenue
Riverside, CA 92507

*Dale Electronics, Incorporated
P.O. Box 609
Columbus, NE 68601

DB Products, Incorporated
253 North Vinedo Avenue
Pasadena, CA 91107

Dytek Laboratories, Inc.
110 Wilbur Place
Bohemia, NY 11716

Electro Networks, Incorporated
Maple Street
Caledonia, NY 14423

Electronic Transformer Corporation
460 Totowa Avenue
Paterson, NJ 07509

Espey Manufacturing and
Electronics Corporation
223-239 Ballston Avenue
Saratoga Springs, NY 12866

*EWC, Incorporated
725 Federal Avenue
Kenilworth, NJ 07033

Fernwood Transformer Company
580 Marshall Street
Phillipsburg, NJ 08865

*Freed Transformer Company, Inc.
1718 Weirfield Street
Ridgewood, Brooklyn, NY 11227

Grimes Division
Midland-Ross Corporation
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Urbana, OH 43078

Robert M. Hadley Company, Inc.
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Los Angeles, CA 90037

Kenyon Magnetics, Incorporated
1057 Summit Avenue
Jersey City, NJ 07307

Keytronics, Incorporated
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Endicott, NY 13760

*Magnetico, Incorporated
182 Morris Avenue
Holtsville, NY 11742

*Microtran Company, Incorporated
145 Mineola Avenue
Valley Stream, NY 11582

*OPT Industries, Incorporated
300 Red School Lane
Phillipsburg, NJ 08865

*Pico Electronics, Incorporated
50 South MacQuestion Parkway
Mount Vernon, NY 10551

Raytheon Company
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Waltham, MA 02154

Sigmapower, Incorporated
20790 Leapwood Avenue
Carson, CA 90746

Titan Transformer Company
134 Coolidge Avenue
Watertown, MA 02172

*Torwico Electronics, Incorporated
Route 70 and New Hampshire Avenue
Lakewood, NJ 08701

Transformer Design, Incorporated
7377 North 76th Street
Milwaukee, WI 53223

*TRW/UTC Transformers
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New York, NY 10013

Worner Electronic Devices
121 North Main Street
Rankin, IL 60960

Zenith Transformer Company, Inc.
1728 West 130th Street
Gardena, CA 90249

* **See data pages in this EEM.**

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MIL-C-11015 **FSC 5910**
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Santa Monica, CA 90404

Centralab
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Los Angeles, CA 90039

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*Corning Glass Works
3900 Electronics Drive
Raleigh, NC 27602

*Murata Erie North America, Inc.
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State College, PA 16801

*Republic Electronics Corporation
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Patterson, NJ 07524

San Fernando Electric Manufacturing Company
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San Fernando, CA 91341

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*Tusonix, Incorporated
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Bridgeport, CT 06601

QPL-19500-82
MIL-S-19500 **FSC 5961**
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Smithtown, NY 11787

CODI Semiconductor
350 Hurst Street
Linden, NJ 07036

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166 Tremont Street
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Crystalonics
147 Sherman Street
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313 Fairchild Drive
Mountain View, CA 94040

*General Electric Company
P.O. Box 339
Liverpool, NY 13088

***General Instrument Corporation**
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Hicksville, NY 11802

General Semiconductor Industries, Inc.
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Tempe, AZ 85281

Germanium Power Devices Corporation
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Andover, MA 01810

Hewlett-Packard
350 West Trimble Road
San Jose, CA 95131

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Optoelectronics Division
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Palo Alto, CA 94304

International Rectifier Corporation
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El Segundo, CA 90245

Intersil, Incorporated
10710 North Tantau Avenue
Cupertino, CA 95014

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Lansdale Transistor and Electronics Corporation
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Microwave Associates, Incorporated
Northwest Industrial Park
Burlington, MA 01803

*Motorola, Incorporated
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Phoenix, AZ 85008

NAE, Incorporated
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Parametric Industries, Incorporated
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Winchester, MA 01890

Power Tech, Incorporated
0-02 Fairlawn Avenue
Fairlawn, NJ 07011

Raytheon Company
350 Ellis Street
Mountain View, CA 94040

RCA Corporation
Route 202
Somerville, NJ 08876

Semicon, Incorporated
10 North Avenue
Burlington, MA 01803

Samtech Corporation
652 Mitchell Road
Newbury Park, CA 91320

Sensitron Semiconductor
221 West Industry Court
Deer Park, NY 11729

Siemens Corporation
Components Group
8700 East Thomas Road
Scottsdale, AZ 85252

Silicon Transistor Corporation
Division of BBF, Inc.
Katrina Road
Chelmsford, MA 01824

Siliconix, Incorporated
2201 Laurelwood Road
Santa Clara, CA 95054

Solid Power Corporation
440 Eastern Parkway
Farmingdale, NY 11735

Solid State Devices, Incorporated
14830 Valley View Avenue
La Mirada, CA 90638

*** See data pages in this EEM.**

Solitron Devices, Incorporated
1177 Blue Heron Boulevard
Riviera Beach, FL 33404

Solitron Devices, Incorporated
8808 Balboa Avenue
San Diego, CA 92123

Sprague Electric Company
87 Marshall Street
North Adams, MA 01247

Teledyne Semiconductor
1300 Terra Bella Avenue
Mountain View, CA 94040

Texas Instruments, Incorporated
P.O. Box 225012, MS 2
Dallas, TX 75265

Unitrode Computer Products Corp.
4 Gleason Street
Methuen, MA 01844

Unitrode Corporation
580 Pleasant Street
Watertown, MA 02172

Westinghouse Electric Corporation
Semiconductor Division
Armbrust Road
Youngwood, PA 15697

QPL-28787-21
MIL-M-28787 **FSC 5963**
Modules, Standard Electronic

C-Tech Incorporated
Proctor Avenue
Commerce Park
Ogdensburg, NY 13669

Circuit Technology Incorporated
160 Smith Street
Farmingdale, NY 11735

Electro Networks Incorporated
Maple Street
Caledonia, NY 14423

General Electric Company
Farrell Road Plant #1
P.O. Box 4840
Syracuse, NY 13221

General Electric Company
French Road
Utica, NY 13503

*General Electric Company
Relay Production Facility
Waynesboro, VA 22980

General Electric Ordnance Systems
100 Plastics Avenue
Pittsfield, MA 01201

GTE Products Corporation
2333 Reach Road
Williamsport, PA 17701

GTE Products Corporation (Sales)
2401 Reach Road
Williamsport, PA 17701

*ILC Data Device Corporation
105 Wilbur Place
Bohemia, L. I., NY 11716

*Perkin-Elmer Corporation
Main Avenue
Norwalk, CT 06856

Polyphase Instrument Corporation
175 Commerce Drive
Fort Washington, PA 19304

Raytheon Company
ASW Center
P.O. Box 360
Portsmouth, RI 02871

QPL-38510-52
MIL-M-38510 **FSC 5962**
Microcircuits

Advanced Micro Devices, Incorporated
901 Thompson Place
Sunnyvale, CA 94086

Fairchild Semiconductor
464 Ellis Street
Mountain View, CA 94040

Harris Semiconductor
P.O. Box 883
Melbourne, FL 32901

Intel Corporation
3065 Bowers Avenue
Santa Clara, CA 95051

Intersil, Incorporated
10900 North Tantau Avenue
Cupertino, CA 95014

Mostek
P.O. Box 169
1215 West Crosby Road
Carrollton, TX 75006

*Motorola, Incorporated
P.O. Box 20906
Phoenix, AZ 83506

Precision Monolithics, Incorporated
1500 Space Park Drive
Santa Clara, CA 95050

Raytheon Company
350 Ellis Street
Mountain View, CA 94040

RCA Corporation
Route 202
Somerville, NJ 08876

Signetics Corporation
811 East Arques Avenue
Sunnyvale, CA 94086

Siliconix, Incorporated
2201 Laurelwood Road
Santa Clara, CA 95054

Solid State Scientific, Incorporated
Commerce Drive
Montgomeryville, PA 18936

Texas Instruments, Incorporated
P.O. Box 225012
Dallas, TX 75265

QPL-39012-43
MIL-C-39012 **FSC 5935**
Connectors, Coaxial, Radio Frequency

*AMP, Inc.
P.O. Box 3608
Harrisburg, PA 17105

Amphenol R F Division
33 East Franklin Street
Danbury, CT 06810

Automatic Connector, Incorporated
400 Moreland Road
Commack, L.I., NY 11725

*Bendix Corporation
Sherman Avenue
Sidney, NY 13838

Cablewave Systems, Incorporated
60 Dodge Avenue
North Haven, CT 06473

Delta Electronics Mfg. Corp.
93 Park Street
Beverly, MA 01915

*ITT Cannon Electric
2801 Air Lane
Phoenix, AZ 85034

Kings Electronics Company, Inc.
40 Marbledale Road
Tuckahoe, NY 10707

OMNI Spectra, Incorporated
140 Fourth Avenue
Waltham, MA 02154

*Sealectro Corporation
225 Hoyt Street
Mamaroneck, NY 01543

Socapex
6660 Variel Avenue
Canoga Park, CA 91303

Solitron/Microwave
P.O. Box 287
Cove Road
Port Salerno, FL 33492

* **See data pages in this EEM.**

QPL-39014-62
MIL-C-39014 **FSC 5910**
Capacitors, Fixed, Ceramic, Dielectric (General Purpose)

*AVX Ceramics Corporation
19th Avenue South
Myrtle Beach, SC 29577

Centralab
4561 Colorado Boulevard
Los Angeles, CA 90039

Centre Engineering
2820 East College Avenue
State College, PA 16801

*Corning Glass Works
3900 Electronics Drive
Raleigh, NC 27602

Murata-Erie North America, Inc.
1900 West College Avenue
State College, PA 16801

San Fernando Electric Manufacturing Company
1501 First Street
San Fernando, CA 91341

Sprague Electric Company
Marshall Street
North Adams, MA 01247

Union Carbide Corporation
P.O. Box 5928
Greenville, SC 29606

Vitramon, Incorporated
P.O. Box 544
Bridgeport, CT 06601

QPL-39029-12
MIL-C-39029 **FSC 5935**
Contacts, Electrical Connector

*AMP, Incorporated
P.O. Box 3608
Harrisburg, PA 17105

Amphenol Connector Division
2801 South 25th Avenue
Broadview, IL 60153

*Appleton Electric Company
1701 Wellington Avenue
Chicago, IL 60657

*Appleton Electric Company
2205 12th Avenue
South Milwaukee, WI 53172

*Bendix Corporation
Sherman Avenue
Sidney, NY 13838

Burndy Corporation
Richards Avenue
Norwalk, CT 06856

*Continental Connector Corporation
34-63 56th Street
Woodside, NY 11377

Deutsch Company
Municipal Airport
Banning, CA 92220

G & H Technology, Incorporated
1649 17th Street
Santa Monica, CA 90404

General Connector Corporation
80 Bridge Street
Newton, MA 02158

Flight Connector Corporation
14128 Lemoli Avenue
Hawthorne, CA 90250

*Hughes Aircraft Company
17150 Von Karman Avenue
Irvine, CA 92705

*ITT Cannon Electric
666 East Dyer Road
Santa Ana, CA 92702

Matrix Science Corporation
435 Maple Avenue
Torrance, CA 90503

Positronic Industries, Incorporated
208 West Center Street
Rogersville, MO 65742

Pyle-National Company
1334 North Kostner Avenue
Chicago, IL 60651

Raychem Corporation
300 Constitution Drive
Menlo Park, CA 94025

SAE, Incorporated
3080 Airway Drive
Costa Mesa, CA 92626

Souriau, Incorporated
7765 Kester Avenue
Van Nuys, CA 91405

T. J. Electronics, Incorporated
1900 Holt Road
P.O. Box 5427
Arlington, TX 76011

TRI-STAR Electronics, Incorporated
362 Main Street
Venice, CA 90291

*TRW Cinch Connectors
1015 South Sixth Street
Minneapolis, MN 55415

*TRW Cinch Connectors
1501 Morse Avenue
Elk Grove Village, IL 60007

U.S. Components, Incorporated
34 Carlough Road
Bohemia, NY 11716

VEAM
Division of Litton Systems, Inc.
56 New Wood Road
Watertown, CT 06795

*Viking Industries, Incorporated
2100 Nordhoff Street
Chatsworth, CA 91311

Winchester Electronics
Main Street and Hillside Avenue
Oakville, CT 06779

QPL-55681-31
MIL-C-55681 **FSC 5910**
Capacitors, Chip, Multiple Layer, Fixed, Unencapsulated, Ceramic Dielectric

*American Technical Ceramics
One Norden Lane
Huntington Station, NY 11746

*AVX Ceramics Corporation
19th Avenue South
Myrtle Beach, SC 29577

*Republic Electronics Corporation
176 East Seventh Street
Paterson, NJ 07524

San Fernando Electric Manufacturing Company
1501 First Street
San Fernando, CA 91341

Sprague Electric Company
87 Marshall Street
North Adams, MA 01247

Union Carbide Corporation
Route 276 Southeast
Greenville, SC 29606

Unitrode Corporation
11494 Sorrento Valley Road
San Diego, CA 92121

Vitramon, Incorporated
P.O. Box 544
Bridgeport, CT 06601

QPL-81714-1
MIL-T-81714 **FSC 5940**

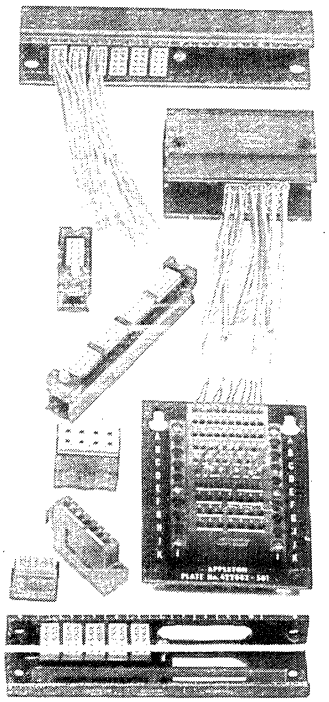
Terminal Junction System
Matrix Science Corporation
435 Maple Avenue
Torrance, CA 90503

*Appleton Electronics, Inc.
2205 12th Avenue
South Milwaukee, WI 53172

T. J. Electronics, Inc.
1900 Holt Road
P.O. Box 5427
Arlington, TX 76011

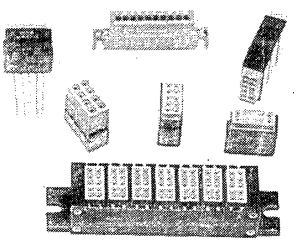
*** See data pages in this EEM.**

Make better connections with Appleton's wide line of 6106 type relay sockets... M81714 TJS modules... low-cost terminal blocks, plus specials.



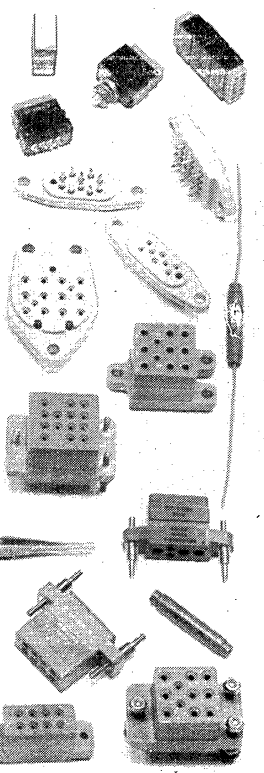
RELAY SOCKETS FOR MIL-R-6106 RELAYS—A wide range of sockets for your systems needs. Includes standard styles with fixed or removable closed entry socket contacts. Low profile designs, for top panel or bottom panel mounting, and designs for use with M39029/5 socket contacts.

MIL-R-6106 TRACK MOUNT—The track system allows the relay socket and relay to be locked into a mounted track, with significant reduction in size over a panel mounted relay system. Appleton manufactures the relay sockets and tracks as well as the insertion/removal tools.



MIL-T-81714 TERMINAL JUNCTION SYSTEM MODULES—QPL APPROVED—Pin contacts per MIL-C-39029. Feedback and feedthru styles in sizes 12, 16, 20 and 22, with a full selection of bussing arrangements. Exclusive total peripheral pin-to-socket surface contact and one-piece contact-bus design provides electrical continuity. Appleton supplies complete systems including mounting tracks and wire splices.

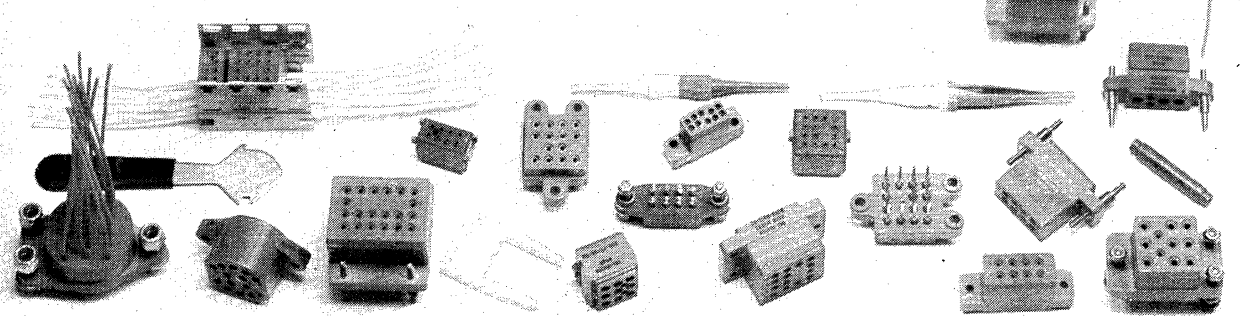
LOW-COST PROGRAMMING TERMINAL BLOCKS—Let our individual terminal blocks and plate mounted groups meet your needs for interconnection, bussing and signal distribution. Unique one-piece contact design provides an uninterrupted circuit through all bussed positions for consistent electrical performance. Feedback and feedthru designs are available, color-coded for AWG wire sizes 16 through 24.



CUSTOM DESIGNS—Appleton is interested in your special connector needs. Let us help you meet those needs. Call (414) 764-7200, or write, APPLETON ELECTRONICS, INC., 2205 12th Ave., South Milwaukee, WI 53172.

(In California call (805) 529-0276, or write, APPLETON ELECTRONICS, INC., P.O. Box 1025, Thousand Oaks, CA 91360.) 81212

APPLETON ELECTRONICS, INC.



Military Multilayer Ceramic Capacitors

MILITARY CROSS REFERENCE GUIDE DIMENSIONS

RADIAL

FIG. 1

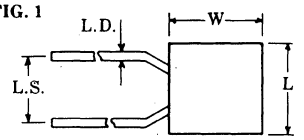
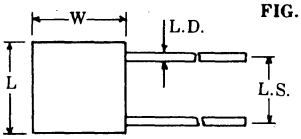


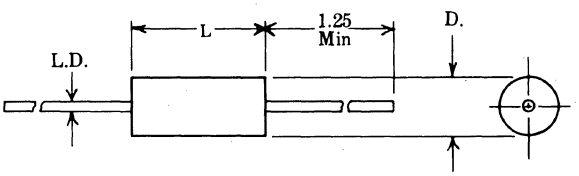
FIG. 2



		Per Mil-Spec			Case Size				
Figure	AVX Style	MIL-C-11015	MIL-C-39014	MIL-C-20	Length (L)	Width (W)	Thickness (T)	Lead Spacing (LS)	Lead Diameter (LD)
1	MR05	CK05	CKR05	CCR05/CC05	.190 ± .010 (4.83 ± .25)	.190 ± .010 (4.83 ± .25)	.090 ± .010 (2.29 ± .25)	.200 ± .015 (5.08 ± .38)	.025 ± .002 (.64 ± .05)
2	MR06	CK06	CKR06	CCR06/CC06	.290 ± .010 (7.37 ± .25)	.290 ± .010 (.37 ± .25)	.090 ± .010 (2.29 ± .25)	.200 ± .015 (5.08 ± .38)	.025 ± .002 (.64 ± .05)
2	CR08	—	CKR08	—	.290 ± .010 (7.37 ± .25)	.290 ± .010 (7.37 ± .25)	.145 ± .015 (3.68 ± .38)	.200 ± .015 (5.08 ± .38)	.025 ± .002 (.64 ± .05)
2	MR07	—	—	CCR07/CC07	.480 ± .020 (12.19 ± .51)	.480 ± .020 (12.19 ± .51)	.140 ± .010 (3.56 ± .25)	.400 ± .020 (10.16 ± .51)	.025 ± .002 (.64 ± .05)
2	MR08	—	—	CCR08/CC08	.480 ± .020 (12.19 ± .51)	.480 ± .020 (12.19 ± .51)	.240 ± .010 (6.1 ± .25)	.400 ± .020 (10.16 ± .51)	.025 ± .002 (.64 ± .051)

Dimensions: Inches (Millimeters)

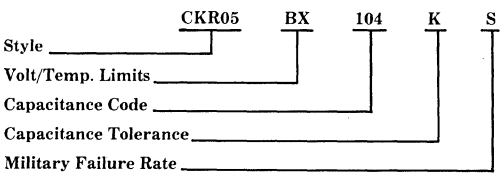
AXIAL



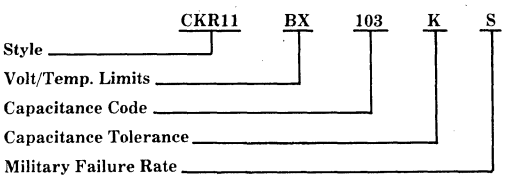
	Per Mil-Spec			Case Size		
AVX Style	MIL-C-11015	MIL-C-39014	MIL-C-20	Length (L)	Diameter (D)	Lead Diameter (LD)
MA10	CK12	CKR11	CCR75/CC75	.160 ± .010 (4.07 ± .25)	.090 ± .010 (2.29 ± .25)	.019 ± .002 (.48 ± .05)
MA20	CK13	CKR12	CCR76/CC76	.250 ± .010 (6.35 ± .25)	.090 ± .010 (2.29 ± .25)	.019 ± .002 (.48 ± .05)
MA40	CK14	CKR14	CCR77/CC77	.390 ± .010 (9.91 ± .25)	.140 ± .010 (3.36 ± .25)	.025 ± .002 (.63 ± .05)
MA50	CK15	CKR15	CCR78/CC78	.500 ± .020 (12.7 ± .51)	.250 ± .015 (6.35 ± .38)	.025 ± .002 (.63 ± .05)
MA60	CK16	CKR16	CCR79/CC79	.690 ± .020 (17.53 ± .51)	.350 ± .015 (8.89 ± .51)	.025 ± .002 (.63 ± .05)

Dimensions: Inches (Millimeters)

RADIAL PART NUMBER EXAMPLE



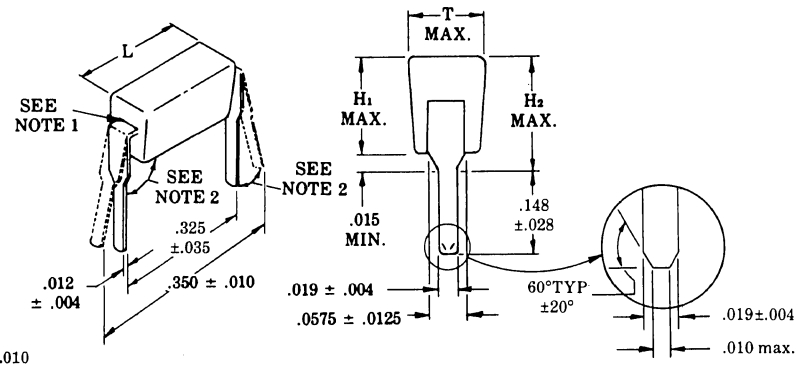
AXIAL PART NUMBER EXAMPLE



WHERE TO ORDER

AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

DIPGUARD



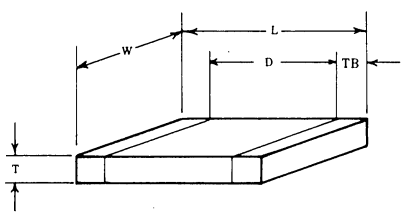
Note 1: Leads centered within ±.010
Note 2: The angle shall be 95°, +10°, −5°

AVX Style	MIL-C-39014	Length (L)	Height (H_1)	Height (H_2)	Thickness
MD01	CKR22	.260 ±.020 (6.60)	.128 max. (3.25)	.165 max. (4.19)	.098 max. ±.006
MD02	CKR23*	.260 ±.020 (6.60)	.155 max. (3.94)	.185 max. (4.70)	.098 max. ±.006

*Contact factory for CKR23 availability

Dimensions: Inches (Millimeters)

CHIPS



AVX Style	MIL-C-55681	Length (L)	Width (W)	Thickness (T)		D		Termination Band (TB)	
				Max.	Min.	Max.	Min.	Max.	Min.
0805	CDR01	.080±.015	.050±.015	.055	.020	—	.030	—	.010
1805	CDR02	.180±.015	.050±.015	.055	.020	—	—	.030	.010
1808	CDR03	.180±.015	.080±.015	.080	.020	—	—	.030	.010
1812	CDR04	.180±.015	.125±.015	.080	.020	—	—	.030	.010
1825	CDR05	$.180^{+.020}_{-.015}$	$.250^{+.020}_{-.015}$	.080	.020	—	—	.030	.010
2225	CDR06	$.225^{+.020}_{-.015}$	$.250^{+.020}_{-.015}$	.080	.020	—	—	.030	.010

Dimensions: Inches (Milimeters)

DIPGUARD PART NUMBER EXAMPLE

CKR22 BX 104 K S

- Style
- Volt/Temp. Limits
- Capacitance Code
- Capacitance Tolerance
- Military Failure Rate

CHIPS PART NUMBER EXAMPLE

CDR01 BX 101 A K S M

- Military Style
- Volt/Temp. Limits
- Capacitance Code
- Rated Voltage
- Capacitance Tolerance
- Termination Finish
- Military Failure Rate

WHERE TO ORDER

AVX Corporation, Myrtle Beach, SC 29577 Tel: (803) 448-9411 TWX: 810-661-2252
AVX Corporation, Olean, NY 14760 Tel: (716) 372-6611 TWX: 510-245-2815
AVX Limited, Aldershot, England Tel: (0252) 312131 Telex:858473
AVX K.K., Tokyo, Japan Tel: 03-490-6501 Telex: AVXTYO 246 8091

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Your resistor/capacitor company with tomorrow's technology today.

STANDARD RESISTOR MIL SPECIFICATION APPROVALS

RESISTORS:	RL standard military: 2% and 5% metal film resistor —RL07 (¼ watt) and RL20 (½ watt) —temperature coefficient: ±100 ppm/°C	MIL-R-22684
	RN standard military: 0.1% to 1% metal film resistor —RN50, RN55, RN60, RN65 styles	MIL-R-10509
	RLR established reliability: 1% and 2% metal film resistor —RLR05, RLR07 and RLR20 —temperature coefficient: ±100 ppm/°C —failure rate S (.001%)	MIL-R-39017
	RNC established reliability: 0.1% to 1% metal film resistor —RNC50, RNC55, RNC60, RNC65 —resistance tolerance: ±0.1%, 0.5%, 1.0% —failure rate: S (.001%) —temperature coefficient: K (±100 ppm/°C), H (±50 ppm/°C), J (±25 ppm/°C) —non-hermetic seal	MIL-R-55182
	RNR established reliability: 0.1% to 1% metal film resistor —RNR55, RNR60, RNR65, RNR70 —resistance tolerance: ±0.1%, 0.5%, 1.0% —failure rate: S (.001%) —temperature coefficient: C (±50 ppm/°C), E (±25 ppm/°C) —hermetic seal	MIL-R-55182
NETWORKS:	Single-In-Line (S.I.P.'s) —RZ040 and RZ050 —resistance tolerance: ±1.0%, 2.0%, 5.0% —temperature coefficient: ±100 ppm and ±300 ppm/°C —resistance range: 47.5 ohm — 1M —6 pin and 8 pin	MIL-R-83401/04/05
	Flat Packs —RZ030 —resistance tolerance: ±1.0%, 2.0%, 5.0% —temperature coefficient: ±100 ppm and ±300 ppm/°C —resistance range: 100 ohm — 100K —14 pin	MIL-R-83401/03
CHIP RESISTORS:	SMD™ established reliability (chip) resistor —RM0505, RM1005, RM1505, RM0705 —resistance tolerance: ±1%, 5%, 10% —temperature coefficient: K (±100 ppm/°C), M (±300 ppm/°C) —resistance range: 1 ohm — 1M	MIL-R-55342
TRIMMER RESISTORS:	RJ24/RJR24 cermet trimmer —multiturn, ⅜" square —resistance range: 10 ohm — 5M —resistance tolerance: ±10% —temperature coefficient: ±100 ppm/°C (standard) ±50 ppm/°C (RJR) available	MIL-R-22097/MIL-R-39035
	RJ26/RJR26 cermet trimmer —multiturn, ¼" square —resistance range: 10 ohm — 5M —resistance tolerance: ±10% —temperature coefficient: ±100 ppm/°C (standard) ±50 ppm/°C (RJR) available	MIL-R-22097/MIL-R-39035
	RJ50/RJR50 cermet trimmer —single turn, ¼" diameter round —resistance range: 10 ohm — 5M —resistance tolerance: ±10% (5% available) —temperature coefficient: ±100 ppm/°C (standard)	MIL-R-22097/MIL-R-39035

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Your resistor/capacitor company with tomorrow's technology today.

STANDARD CAPACITOR MIL SPECIFICATION APPROVALS

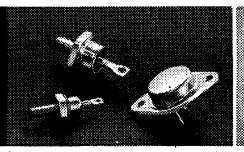
ALUMINUM ELECTROLYTIC: Computer Grade (screw terminal type)
MIL-C-39018/04: CU71 (M/E Style 3126)

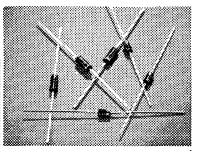
TANTALUM:

Wet Slug		MIL-C-3965
CL14/CL16	hermetic seal, screw mount, cylindrical case	
CL17/CL18	hermetic seal, stud mount, cylindrical case	
CL55	hermetic seal, rectangular module	
CL64/CL65	elastomer seal, axial lead, tubular case	
CL66/CL67	hermetic seal, axial lead, tubular case	
Wet Slug, established reliability		MIL-C-39006
CLR10	extended range, axial lead, tubular case	
CLR14	extended range, cylindrical case, solder lug terminal	
CLR17	extended range, cylindrical case, solder lug terminal	
CLR65-8000 Series	glass-to-tantalum hermetic seal, axial lead, tubular case	
CLR79	hermetic seal, non-silver case, axial lead, tubular case	
Wet Foil		MIL-C-3965
CL20/CL21	polar, etched foil, tubular case, axial lead	
CL22/CL23	non-polar, etched foil, tubular case, axial lead	
CL30/CL31	polar, plain foil, tubular case, axial lead	
CL32/CL33	non-polar, plain foil, tubular case, axial lead	
CL51	polar, plain foil, KSR, hermetic rectangular module	
CL52	non-polar, plain foil, KSR, hermetic rectangular module	
CL53	polar, etched foil, KSR, hermetic rectangular module	
CL54	non-polar, etched foil, KSR, hermetic rectangular module	
CL70/CL71	polar, high etched foil, tubular case, axial lead	
CL72/CL73	non-polar, high etched foil, tubular case, axial lead	
Wet Foil, established reliability		MIL-C-39006
CLR25	polar, etched foil, hermetic and non-hermetic, axial lead	
CLR27	non-polar, etched foil, hermetic and non-hermetic, axial lead	
CLR35	polar, plain foil, hermetic and non-hermetic, axial lead	
CLR37	non-polar, plain foil, hermetic and non-hermetic, axial lead	
CLR71	polar, high etched foil, hermetic and non-hermetic, axial lead	
CLR73	non-polar, high etched foil, hermetic and non-hermetic, axial lead	
Solid Slug		MIL-C-26655
CS12/CS13	hermetic seal, axial lead, tubular case	
Solid Slug, established reliability		MIL-C-39003
CSR09	polar, miniature, hermetic seal, axial lead, tubular case	
CSR13	polar, hermetic seal, axial lead, tubular case	
CSR23	polar, extended range, hermetic seal, axial lead, tubular case	
CSR33	polar, extended range, hermetic seal, for low impedance application	
CSR91	non-polar, hermetic seal, axial lead, tubular case	
Solid Chip, established reliability		MIL-C-55365
CWR06	polar hybrid tantalum chip	

For information on Mepco/Electra's RESISTORS/CAPACITORS/POTENTIOMETERS, see pages 1•1998, 1•1142 and 1•2141.

SEMICON QUALIFIED PRODUCTS PER MIL-S-19500 REVISION "F"





TYPE NUMBER	DETAIL SPECIFICATION NUMBER	QUALIFICATION REFERENCE
JAN 1N538	MIL-S-19500/202A	19500-1257-70
JAN 1N540	MIL-S-19500/202A	19500-1257-70
JAN 1N547	MIL-S-19500/202A	19500-1257-70 Canadian #S11968
JAN 1N560	MIL-S-19500/167B	19500-140-71
JAN 1N561	MIL-S-19500/167B	19500-140-71 Canadian #S11967
JAN 1N1124A & RA	MIL-S-19500/104C	19500-658-75
JAN 1N1126A & RA	MIL-S-19500/104C	19500-658-75
JAN 1N1128A & RA	MIL-S-19500/104C	19500-658-75
JAN 1N3649 & R	MIL-S-19500/104C	19500-658-75
JAN 1N3650 & R	MIL-S-19500/104C	19500-658-75
**JAN 1N1184	MIL-S-19500/297A	
**JAN 1N1186	MIL-S-19500/297A	
**JAN 1N1188	MIL-S-19500/297A	
**JAN 1N1190	MIL-S-19500/297A	19500-466-78
**JAN 1N3766	MIL-S-19500/197A	
**JAN 1N3768	MIL-S-19500/197A	
**JAN 1N1202A,RA	MIL-S-19500/260	19500-705-77
**JAN 1N1204A,RA	MIL-S-19500/260	19500-705-77
**JAN 1N1206A,RA	MIL-S-19500/260	19500-705-77
**JAN 1N3671A,RA	MIL-S-19500/260	19500-705-77
**JAN 1N3673A,RA	MIL-S-19500/260	19500-705-77
JAN 1N1614	MIL-S-19500/162B	19500-704-77
JAN 1N1615	MIL-S-19500/162B	19500-704-77
JAN 1N1616	MIL-S-19500/162B	19500-704-77
JAN 1N4458	MIL-S-19500/162B	19500-704-77
JAN 1N4459	MIL-S-19500/162B	19500-704-77
*JAN 1N2153	MIL-S-19500/91 (Sig C)	7781
JAN 1N2361	MIL-S-19500/187A (EL)	CDKF7765
*JAN 1N3189	MIL-S-19500/155E	19500-490-73/Canadian #11792
*JAN 1N3190	MIL-S-19500/155E	19500-490-73/Canadian #11792
*JAN 1N3191	MIL-S-19500/155E	19500-490-73/Canadian #11792
**JAN 1N3016B thru	MIL-S-19500/115F	19500-217-75 Canadian #S11940
**JAN 1N3032B	MIL-S-19500/115F	
**JAN 1N3033B thru	MIL-S-19500/115F	19500-218-75 Canadian #11940
**JAN 1N3043B	MIL-S-19500/115F	
**JAN 1N3044B thru	MIL-S-19500/115F	19500-219-75 Canadian #S11940
**JAN 1N3051B	MIL-S-19500/115F	
**JAN 1N3885	MIL-S-19500/304A	19500-67-76
**JAN 1N3886		
**JAN 1N3888		
**JAN 1N3890,R	MIL-S-19500/304F	19500-67-76
**JAN 1N3891,R		
**JAN 1N3893,R		
**JAN 1N3909	MIL-S-19500/308	19500-970-78
**JAN 1N3910		
**JAN 1N3911		
**JAN 1N3912		
**JAN 1N3913		
*JAN 1N5555 thru JAN 1N5558	MIL-S-19500/434	19500-8-76
**JAN 1N5629A thru **JAN 1N5665A	MIL-S-19500/500	19500-8-76
JAN 1N5812,R	MIL-S-19500/478A	19500-930-80
JAN 1N5814,R		
JAN 1N5816,R		
**JAN 1N5907	MIL-S-19500/500	19500-8-76
**JAN 1N6036A thru **JAN 1N6072A	MIL-S-19500/507	19500-684-80

Note: Semicon can supply devices for which no formal JAN, JAN TX, or JAN TXV military specifications exist to in-house developed high reliability processing specifications of an equivalent nature.

*TX versions available **TX and TXV versions available

Complete facilities for qualification and high reliability processing of zeners, transient suppressors and rectifiers.

SEMICONDUCTOR SI DEVICES

Semicon INC.

10 North Ave., Burlington, MA 01803
Phone: 617-272-9015 • TWX: 710-332-1919

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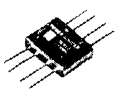
Tel. 603-668-0120 Cable: TRAM Manchester, N.H., USA
TWX 710-220-6765

MICROWAVE COMPONENTS
1.8KHz to 26GHz

POWER DIVIDER/COMBINER

FERRITE

DL SERIES
2,3,4,6,8 & 12 Ways



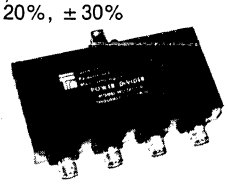
FREQ. BANDS
.02 - 20 MHz
0.1 - 100
20 - 200
100 - 400
0.2 - 200
5.0 - 500
10 - 1,000

TYP. SPEC.	
Loss	0.5dB
Isolation	30dB
VSWR	1.3:1
Input Power	2.5W

Impedance
Avail. 50 or 75Ω

COAXIAL

DM SERIES
2,3,4,6 & 8 Ways
F Center 100 to 1,500 MHz
Bandwidths = ±20%, ±30%
INPUT POWER
DM = 60w CW
1 Kw Peak



TYP. SPEC.	
Loss	0.3dB
Isol.	30dB
VSWR	1.3:1

DMS 285 (2 way)
Freq. 1-20 GHz

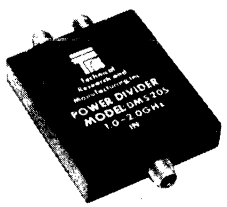
	Low end	High end
Loss(TYP.)	0.2dB	0.6dB
Iso. (TYP.)	25dB	19dB

STRIPLINE

DMS SERIES
2,4 & 8 Ways

FREQ. BANDS
OCTAVE
.125 - 12.4 GHz
MULTI-OCTAVE
1.0 - 12.4 GHz
7 - 18 GHz
2 - 18 GHz

TYP. SPEC.	
Loss	0.5dB
Isolation	20dB
VSWR	1.3:1
Phase	0°



INPUT POWER
50 watts CW
1 K watt Peak

BROADBAND 0, 90, 180° HYBRIDS OCTAVE, MULTI-OCTAVE 0, 90, 180°

FERRITE

HS 150 SERIES 0/180°

MODEL FREQ. (MHz)	
HS 151	.02 - 20
HS 152	0.1 - 100
HS 153	20 - 200
HS 154	100 - 400
HS 155	.2 - 200
HS 156	5 - 500

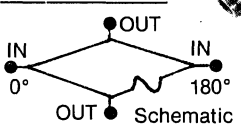
TYP. SPEC.	
Loss	1.0dB
Isolation	30dB
VSWR	1.5:1
Phase Bal.	3°
Amp. Bal.	0.3dB
Input Power	2.5w

IMPEDANCE
Avail. 50 or 75Ω

COAXIAL

HS 100 SERIES 0/180°
Center Frequency 100 - 1,500 MHz
Bandwidth ± 10,20,30%

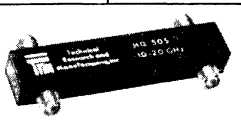
TYP. SPEC.	
Loss	.3dB
Isolation	30dB
VSWR	1.3:1
Phase Bal.	2°
Amp. Bal.	.2dB
In Power	60 w



Schematic

STRIPLINE

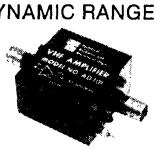
HQ 500 SERIES 90°	HS 500 SERIES 180°
FREQ. BAND	
.125 - 18 GHz OCTAVE .5 - 12 GHz	
TYP. SPEC.	
Loss 0.2dB	Loss 0.5dB
Isolation 20dB	Isolation 20dB
VSWR 1.2:1	VWSR 1.5:1
Phase Bal. 1.5°	Phase Bal. 5.0°



AMPLIFIERS

AD SERIES HIGH DYNAMIC RANGE

FREQ. BANDS
0.5 - 100 MHz
1 - 100
10 - 300



Avail. Gain 10, 20, 30dB
1dB Comp. Point + 20dBM
Noise Fig. 5dB Typical

Freq. 5 - 400 MHz
Avail. Gain 6, 9, 13dB
1 dB Comp. Point + 20dBM
Noise Fig. 7dB typ.

POWER SUPPLIES

For AD Series Amplifiers
Input 115 or 220 VAC
Ripple & Noise 20 mv P-P

MIXERS

DOUBLE BALANCED-SINGLE BALANCED

MD SERIES

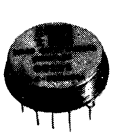
FREQ. BANDS	TYP. SPEC.
.2 - 200	Conv. Loss 7dB
5 - 500	Isolations 25dB
10 - 1,000	

STRIPLINE COUPLERS FERRITE

WIDE BAND DIRECTIONAL
BI-DIRECTIONAL - DIRECTIONAL
AVAILABLE COUPLING
6, 10, 20, 30dB

MULTI-OCTAVE & OCTAVE BANDS .125 - 18 GHz	TYP. SPEC.	
	Loss	0.25dB
	Directivity	25dB
	VSWR	1.3:1

DB Series
Coupling
20.5 ± 0.5dB
Freq. 1-2000MHz
VSWR 1.2 Max.
Input 1.5 watts max.



FREQUENCY DOUBLERS

Freq. 0.1 - 2100 MHz
Input power 10 to 20 mw Oper.
1 w max.
Impedance 50 ohms

TRANSFORMERS

Freq. 0.02 - 1000 MHz
Input Power 2.5 watts cw
VSWR 1.3 max.

All TRM products are designed to meet the applicable specifications of:
MIL-E-16400 Class 1
MIL-E- 5400 Class 3
MIL-C-15370
MIL-C-39012
and manufactured in accordance with:
MIL-I- 45208 and MIL-C-45662

EEM MINIGLOSSARY OPTO SEMICONDUCTORS

Avalanche Photodiode: A photodiode that takes advantage of avalanche multiplication of photocurrent. It is particularly suited to low noise and/or high speed applications.

Contrast: A noticeable difference in color, brightness, or other characteristics in a side-by-side comparison.

Chrominance Contrast: The color contrast between two adjacent surfaces of identical area, shape, texture, and luminance. The human eye is more sensitive to differences in color than it is to differences in brightness.

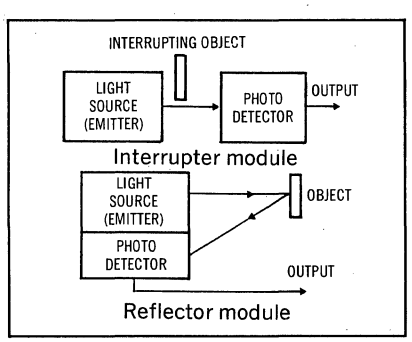
Current Transfer Ratio: The ratio of an optocoupler's output current to input current at a specified bias.

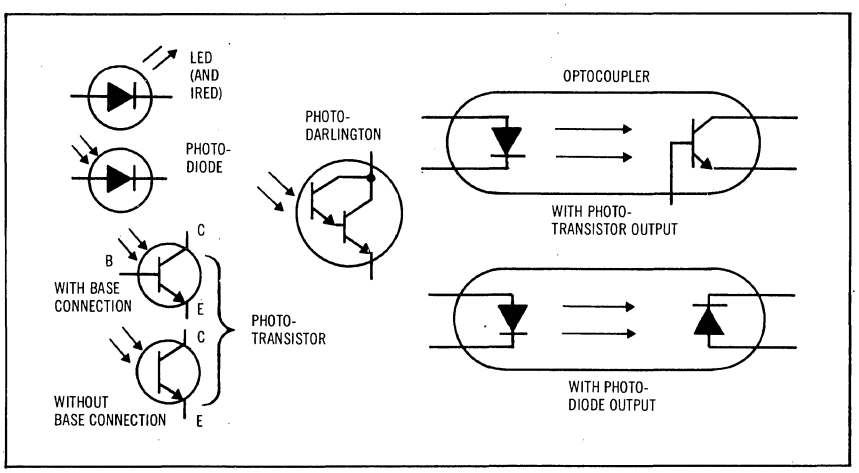
Dark Current: The leakage current of a photodetector with no incident light.

Dominant Wavelength: The wavelength that is a quantitative measure of apparent color of light as perceived by the human eye.

Infrared Radiation: The electromagnetic wavelength region between approximately 0.75 and 100 micrometers longer than the wavelength of visible light.

Interrupter (module): A device that produces an electrical output signal when an object breaks the light (visible or invisible) between a light source and a photodetector.





IRED: An infrared-emitting diode. See light-emitting diode.

Light Current: The current that flows through a photodetector when it is exposed to radiant energy.

Light-Emitting Diode (LED): A semiconductor diode that emits incoherent light at its PN junction when forward biased. The light can be in the visible or invisible (infrared) wavelength region.

Luminance Contrast: The observed brightness of a light-emitting element compared to the brightness of the "surround," an integral part of the device and inseparable from it.

Optocoupler: A device that transmits electrical signals, without electrical connection, between a light source (input) and the receiver (output). The input is generally an LED; the output might be a photodiode, phototransistor, a photo–Darlington, etc. Sometimes referred to as optoisolator.

Peak Wavelength: The wavelength at the peak of the radiated spectrum of an emitter.

Photo–Darlington: A light-sensitive Darlington-connected transistor pair. The photo–Darlington has a very high sensitivity to illumination or radiation.

Photodetector: A device that provides an electrical output signal when subjected to radiation in the visible, infrared, or ultraviolet regions of the electromagnetic spectrum. Photodiodes, phototransistors, and photo–Darlingtons are the most common type of photodetectors.

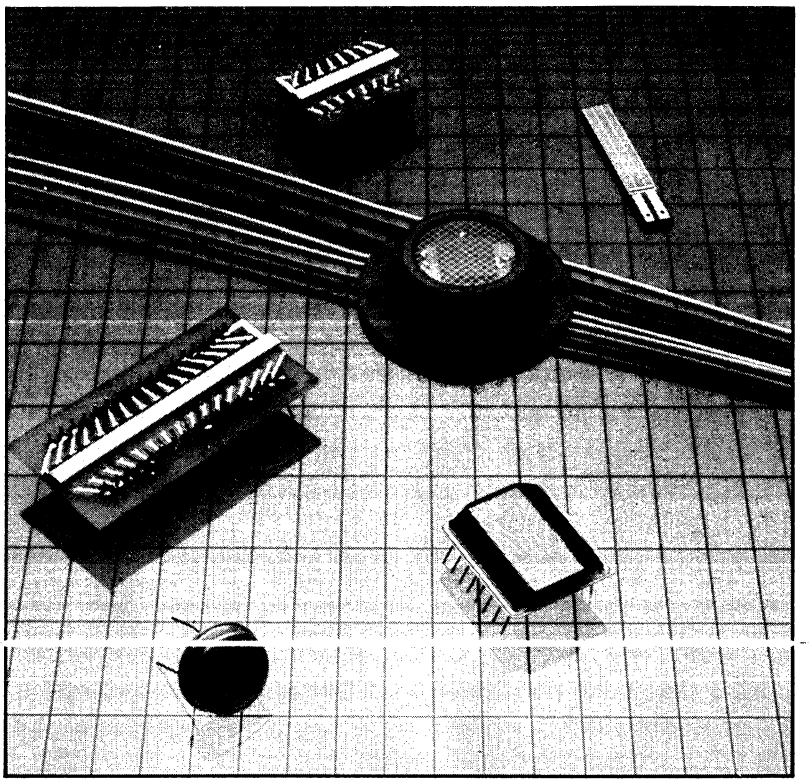
Photodiode: A junction diode that is responsive to radiant energy. Photodiodes have a high degree of linearity between the input radiation and the output current, and faster switching speeds than phototransistors.

Photothyristor: A thyristor whose switching action is controlled by light applied to the thyristor gate.

Phototransistor: A light-sensitive transister that delivers an electrical output proportional to the light intensity at its input. The low-level photocurrent that is generated is amplified by the current gain of the transistor. The base region (or gate in a FET) may or may not be brought out as an external terminal.

Point Source: A source with a maximum dimension less than one-tenth the distance between sources and detector.

Reflector (module): A device containing a light source and a photodetector that detects any object that reflects light produced by the source back to the detector.



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SINGLE ELEMENT HIGH PERFORMANCE PHOTODIODES

Type No.	Active Area mm^2 (circular)	Dark Current @ 30VnA
OSD 1	1	5
OSD 5	5	30
OSD 50	50	350
OSD 100	100	800

Add the following suffix to Type No. for selected optimized wavelength response

Suffix	Optimized Wave Length	mm	Typical Resp. A/W	Vop Max Volts	Rise Time Vmax
–0	General Purpose	0.9	0.52	30	15ns
–1	UV/Blue	0.25	0.08	10	20ns
–2	Red	0.63	0.38	60	10ns
–3	IR	0.9	0.62	100	10ns
–4	1.06	1.06	0.55	180	20ns

HIGH SPEED, HIGH PERFORMANCE PHOTODIODES

Type No.	Cap. pF @ Vop Max.	Vop Max. Volts	Typical Dark Current nA	Risetime ns	Typical Resp. @ Optimized Wavelength	Optimized Wavelength μm
OSD††-3 HSA	8.5	80	5	1	0.40 A/W	0.9
OSD††-4 HSA*	3.0	100	10	10	0.25	1.06
OSD††-4 HSA**	2.5	180	10	15	0.38	1.06
BPX 65	3.5	50	1 (<5)	1 (<5)	0.55	0.85
BPX 66	3.5	50	0.15 (<0.3)	0.5 (<1)	0.55	0.85

† Isolated version available (suffix R2) *35% Q.E. at 1064 μm **50% Q.E. at 1064 μm

HYBRIDS (Detector & Amplifier Combinations)

Type No.	Active Area mm^2	Rise-time μs	Typical NEP (Noise Equiv. Power) @ Wave-length μm	Typical NEP (Noise Equiv. Power) W. $Hz^{-1/2}$	Minimum Responsivity $mV/\mu W/cm^2$ @ Wavelength μm 0.25	0.43	0.63	0.9	1.06
GENERAL PURPOSE									
OSI-5J	5	30	0.25	4×10^{-11}	15	60	–	–	–
OSI-5K	5	30	0.9	2×10^{-12}	–	30	160	250	–
OSI-5L	5	30	1.06	4×10^{-12}	–	–	–	220	130
HIGH SPEED									
OSI-1J HSA	1	.05	0.25	6.3×10^{-11}	0.06	0.24	–	–	–
OSI-1K HSA	1	.05	0.9	3.8×10^{-12}	–	0.1	0.6	1.0	–
OSI-1L HSA	1	.05	1.06	5.4×10^{-12}	–	–	–	1.0	0.7

Spectral Responses J — UV and Blue optimized L — 1.06 μ optimized
K — General Purpose 350 — 1150 nm

HIGH PERFORMANCE PHOTOVOLTAIC DETECTORS (High Blue Sensitivity)

PHOTOVOLTAIC DETECTORS (High Blue Response)

Type No.	Min. Responsivity @ 0.45 μm A/W	Max. Response Time (@ 0 V) μs	Min. Dynamic Resistance MΩ	Typical Capacitance (@ 0 V) pF	Min. Breakdown Volts (10 μA)	Typical I_D @ 0 V nA	Typical NEP (Noise Equiv. Power) @ 0.45 μm
OSD 1-5	0.15	1	100	40	10	0.2	6×10^{-14}
OSD 5-5	0.15	1	40	150	10	0.5	7×10^{-10}
OSD 50-5	0.15	1	1.5	1500	10	1	2×10^{-13}
OSD 100-5	0.15	1	1	2500	10	2	2×10^{-13}

QUADRANTS & BI-CELLS

Type No.	Nom. Active Area (Total) mm^2	Dia. Active Area mm	Metal-lurgical Sep. of Elements†† mm	Typical Dark Cur. per Element nA @ Vop 30 V	Typical NEP (Noise Equiv. Power) @ 0.9 μm W. $Hz^{-1/2}$
QD 7-0	7	3	0.2	10	1.0×10^{-13}
QD 50-0	50	8	0.2	100	3.3×10^{-13}
QD 100-0	100	11	0.2	300	5.0×10^{-13}
QD 320-0	320	20	0.3	1000	1.0×10^{-12}

-0 is General Purpose Response Also available in -1, -2, -3, -4 and -5 (photovoltaic) responses
†† Optical separation is typically 50% of metallurgical for $\lambda = 1.06$ μm

Type No.	Vop (V) Typ.	Isc (μA) Typ.	EV (Lux.)	I_L A/W	λp (nm)	No. of Elements	Total Active Area mm^2
HPI-0814	0.35		1.000	0.4	780	4	1.2 x 1.2
HPI-0750	0.35		1.000	0.4	780	8	—
HPI-0114	0.35		1.000	0.4	780	1	1.2ϕ
PN-4-150	0.4		1.000	0.35	850	4	1.5 x 1.5
PN-4-23	0.4		1.000	0.35	850	4	4.1 x 8.1
CD-33H-4D	0.4	14	1.000	—	930	4	2.5 x 2.5
CD-33H-2D	0.4	30	1.000	—	930	2	6 x 3

(Ta = 25°C)

EYE RESPONSE DETECTORS, HYBRID & PHOTODIODES

EYE RESPONSE DETECTORS

Type No.	Active Area mm^2	Typical Capaci-tance @ 0 V pF	Min. Dynamic Impedance @ 0 V MΩ	Min. Break-down Volts (10 μA)	Response Time @ 0 V μs	Min. Respon-sivity (Tungsten 2856 K) nA. Lux^{-1}	Typical Equiv. Noise Illumination @ 0 V Lux. $Hz^{-1/2}$
OSD 1-E	1	50	100	10	1	0.3	4×10^{-5}
OSD 5-E	5	200	40	10	1	1.5	1.3×10^{-5}
BPW 21	7.5	1000	10	10	3.5	7	1×10^{-5}
OSD 50-E	50	2000	1	10	1	15	8×10^{-6}
OSD 100-E	100	4000	0.5	10	1	30	6×10^{-6}

EYE RESPONSE HYBRID

Type No.	Active Area mm^2	Typical Response Time μs	Maximum Output Noise mV rms	Typical NEP Lux. $Hz^{-1/2}$	Minimum Responsivity (Tungsten 2856 K) $mV\text{-}Lux^{-1}$
OSI 5-E	5	30	1	7×10^{-4}	15

LOW COST EYE RESPONSE PHOTODIODES

Type No.	Vop (V) Typ.	Ish (μA) Typ.	Ev (Lux)	I_D (pA) Typ.	V_R (V)	C_J (pF) Typ.	Topr (°C)	Area mm^2
BP-2BC	0.32	0.11	100	4	1	450	–20 ~ +60	0.97
BP-5BC	0.32	0.28	100	6	1	650	–20 ~ +60	2.4

λ=500 – 600 nm, p = 560 nm, Ta = 25°C.

PARALLEL & SCANNED ARRAYS (High Performance Multi-Element)

PARALLEL

Type No.	Active Elements No.	Format	Lgth. mm	Width mm	Sep. (Met.) mm	Typical Dark Cur. Per Element @ Vop 10V nA	Typical NEP (Noise Equiv. Power) @ 0.9 μm	Guard Ring
LD 2-5	2	2 x 1	2	0.5	0.05	5	7×10^{-14}	
LD 20-5	20	20 x 1	4	0.9	0.05	20	1.4×10^{-13}	✓
MD 25-5	25	5 x 5	3	3	0.1	70	2.6×10^{-13}	✓
MD 100-5	100	10 x 10	1.4	1.4	0.1	20	1.4×10^{-13}	✓

-5 is Photovoltaic Responses. Also available in -0, -1, -2, -3, -4 responses.

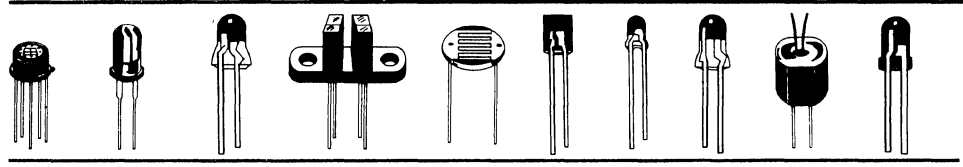
SELF SCANNED ARRAYS

Type No.	No. of Elements	Spacing μm	Notes
4000 Series	50 to 256	100	Voltage or recharge
7000 Series	50 to 256	100	OCR Type
8000 Series	256, 512	13 μm x 3.3 mm	Spectroscopic uses
M Series	256 to 1024	25	recharge only
2D1 Series	64 x 64	75	recharge only

All are in 16 or 24 pin DIP packages

GERMANIUM IR PHOTODETECTORS

Type No.	Active Area mm^2	Breakdown Voltage V	Id μA	Cj Pf	QE %	Peak Response nm	Response Range nm	Pkg.
CGP-0.3	.3	15	<4	3	60	1.55	1.1 – 1.8	TO-8
CGP-1.0	1	25	<6	18	60	1.55	1.1 – 1.8	TO-8
CGP-3.0	3	25	<10	65	60	1.55	1.1 – 1.8	TO-8



CENTRONIC

PHOTO INTERRUPTERS

Type No.	Absolute Maximum Ratings							V_F (V) Max.	I_R (μA) Max.	I_{CEO} (μA) Max.
	I_F (mA)	V_R (V)	P_D (mW)	V_{CEO} (V)	I_C (mA)	P_C (mW)	Topr (°C)	I_F = 20mA	V_R = 5V	V_{CE} = 10V
SG-27N	100	20	150	–	–	150	−20 ~ +80	1.5	10	–
SG-11FKT	50	5	100	30	20	100	−20 ~ +85	1.5	20	0.4
SD-ICL$_3$K	30	3	70	25	50	70	−25 ~ +70	2.8	15	1.0
SG-11FK	50	3	50	40	100	300	−20 ~ + 85	1.4	20	1.0
SG-23FC	60	6	100	30	100	150	−40 ~ +100	1.5	1	1.0

(Ta = 25°C)

PHOTODARLINGTONS

Type No.	Absolute Maximum Ratings			I_{CEL}		V_{CE} (V)	E_V (Lux)	I_{CEO} (μA) Max.	V_{CE} (V)	$\Delta\theta$ (deg.) Typ.	λp (nm) Typ.	λ (nm) Typ.
	V_{CEO} (V)	P_C (mW)	Topr (°C)	(mA) Min.	(mA) Max.							
PTR-1ML	25	300	−25 ~ +100	5	–	5	20	1.0	5	±70	830	500 ~ 1000
PTR-1F	25	100	−30 ~ +85	5	–	5	20	1.0	5	±80	830	500 ~ 1000
PT-7L	25	150	−20 ~ +65	5	–	5	200	1.0	10	±18	830	500 ~ 1000
PT-23F	30	150	−40 ~ +100	5	–	5	200	1.0	25	±35	830	500 ~ 1000

(Ta = 25°C)

LOW COST PHOTOVOLTAIC DIODES

Type No.	Ish (μA) Typ.	I_D (μA) Max.	C_J (pF) Typ.	Active Area (mm^2)	Outside Dimension (mm)	Notes
S-15S	32	1.0	320	4.4	1.5 x 5.7	Tin Coated Cu Wire 0.18φ x 50 mm
S-19S	25	1.0	300	3.5	1.9 x 4.0	Tin Coated Cu Wire 0.18φ x 50 mm
SP-27S	80	1.0	750	10.78	2.7 x 6.0	Tin Coated Cu Wire 0.18φ x 50 mm
SP-26S	92	1.0	1200	10.65	2.6 x 7.6	Tin Coated Cu Wire 0.18φ x 50 mm
SP-550S	130	1.5	1600	15.75	5.0 x 5.0	Tin Coated Cu Wire 0.18φ x 50 mm
SP-652S	670	1.5	9400	103.35	6.5 x 20.0	Tin Coated Cu Wire 0.18φ x 50 mm
SP-60H	400	2.0	5500	61.25	6.0 x 13.0	Polyurethane Coated Cu Wire
SP-651V	330	2.0	4500	50.35	6.5 x 10.0	Vinyl Tube Coated Wire (7/0, 12φ)
SP-113V	1300	2.0	17,000	196.95	11.3 x 20.0	Vinyl Tube Coated Wire (7/0, 12φ)
SP-10S	590	2.0	7000	90.16	10.1 x 10.1	Tin Coated Cu Wire 0.18φ x 50 mm
SP-R20	2000	2.0	30,000	314.0	20.5 x 20.5	Active Area: Ring Type

Ev = 1000 Lux, Vr = 1v, λp = 830 nm (typ.), Ta = 25°C.

LOW COST PHOTODIODES

Type No.	Vop (V) Typ.	Ish (μA) Typ.	I_D (μA) Typ.	C_J (pF) Typ.	Δθ (deg) Typ.	t rise time μsec	Topr (°C)	Active Area mm^2	Package
SP-2ML	0.38	25	1.0	230	±70	0.2	−20 ~ +80	2.8	TO-18 Epoxy Resin
SP-45ML	0.38	160	2.0	1000	±70	2.0	−20 ~ +80	15.5	TO-5 Epoxy Resin
SP-2K	0.38	20	1.0	230	±50	0.2	−25 ~ +100	2.8	TO-18 Hermetic Seal
SP-8K	0.40	300	5.0	3900	±60	10	−25 ~ +100	47.1	TO-8 Hermetic Seal
SP-3MHL	0.39	150	1.0	600	±58	0.6	−20 ~ +80	7.2	TO-5 Epoxy Resin
SP-55C	0.40	115	3.0	1500	±90	5.0	−10 ~ +60	–	–

V_R = 10V, Ev = 1000 Lux, λ = 500 — 1000 nm, λp = 830 nm, Ta = 25°C.

HIGH SPEED, LOW COST PHOTODIODES

Type No.	Vop (V) Typ.	Ish (μA) Typ.	I_D (μA) Typ.	C_J (pF) Typ.	Δθ (deg) Typ.	t rise time μsec	Topr (°C)	Active Area mm^2	Package
SP-7L	0.38	5	50	40	±16	20	−10 ~ +70	0.45	Epoxy Resin
SP-ICL$_3$	0.35	10	50	40	±50	–	−25 ~ +70	0.5	Ceramic Epoxy Resin
SP-1ML	0.38	12	50	50	±60	12	−20 ~ +80	0.49	TO-18 Epoxy Resin
HP-3MLR*	0.30	60	100	175	±70	–	−20 ~ + 80	7.2	TO-5 Epoxy Resin
HP-3K	0.32	65	100	175	±55	65	−25 ~ +100	7.2	TO-5 Hermetic Seal

Ev = 1000 Lux, V_R = 10V, λ = 500 — 1000 nm, λp = 830 nm, Ta = 25°C.
* λ = 700 — 1000 nm, Yp = 900 nm.

PIN PHOTODIODES

Type No.	Vop (V) Typ.	Isc (μA) Typ.	Ev (Lux)	Chip size (mm x mm)	λp (nm) Typ.	Δθ (deg) Typ.	λ (nm)	Topr (°C)	Package
HPI-1K	0.35	10	1,000	1.2 x 1.2	830	±50	500 ~ 1,000	−25 ~ +100	TO-18
HPI-2C	0.35	10	1,000	1.3 x 2.0	830	±70	500 ~ 1,000	−20 ~ +70	
HPI-2CR11	0.30	8	1,000	1.3 x 2.0	900	±70	700 ~ 1,000	−20 ~ +70	

(Ta = 25°C)

PHOTOTRANSISTORS (NPN)

Type No.	Absolute maximum ratings			I_{CEL}		V_{CE} (V)	E_V (Lux)	I_{CEO} (μA) Max.	V_{CE} (V)	Δθ (deg) Typ.	λp (nm) Typ.	λ (nm) Typ.
	V_{CEO} (V)	P_C (mW)	Topr (°C)	(mA) Min.	(mA) Max.							
SPA-1MLA	40	100	−25 ~ +100	2.0	6	10	500	1.0	10	±70	830	500 ~ 1000
SPA-1KLA	40	100	−35 ~ +125	8.0	17	10	500	1.0	10	±18	830	500 ~ 1000
ST-ICL$_3$H	40	75	−25 ~ +75	0.5	2.4	3	1000	1.0	10	±50	800	500 ~ 950
ST-23F	30	150	−40 ~ +100	0.5	–	5	1000	1.0	25	±35	830	500 ~ 1000
ST-SKLT	50	100	−45 ~ +125	0.7	–	5	1000	1.0	30	±12	830	500 ~ 1000
SPA-1MLAR1	40	100	−25 ~ +100	2.0	–	10	500	1.0	10	±70	900	700 ~ 1000
SPA-1MLBR1	40	100	−25 ~ +100	2.0	–	10	500	1.0	10	±70	900	700 ~ 1000

(Ta = 25°C)

VISIBLE LED's (Red, Orange, Yellow, Green)

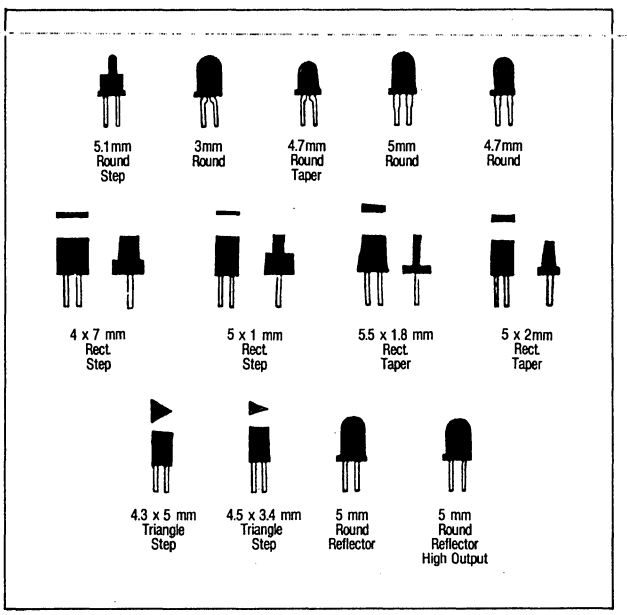
OPERATING CHARACTERISTIC (Ta = 25 Degree C)

Parameter	Condition	Red	Red(GaP)	Green	Yellow	Orange	Unit
Vf Forward Voltage (TYP)	IF=20mA	1.7	2.1	2.2	2.2	2.2	V
Vf Forward Voltage (MAX)	IF=20mA	2.0	2.8	2.8	2.8	2.8	V
Ir Reverse Current	Vr=5v	100	100	100	100	100	μA
P Wave Length at Peak Emission	IF=20mA	655	695	565	585	635	nm
Special Line Half-Width	IF=20mA	35	25	25	25	25	nm

ABSOLUTE MAXIMUM RATING (Ta= 25 Degree C)

Parameter	Red(GaAsp)	Red(GaP)	Green	Yellow	Orange	Unit
Reverse Voltage Min.	3	5	5	5	5	V
Average Forward Current	20	20	30	30	30	mA
Power Dissipation	100	120	105	105	105	mW
Operation Temp Range	−40 to 80 degree C					
Storage Temp. Range	−40 to 100 degree C					
Lead Solder Temperature (1.6 mm From Body) 230 Degree C For 5 Second						

Typical luminous intensities are 0.4 to 2.5 MCD at 20mA. Those with −H suffix are 1.5 to 15 MCD at 20mA.
Also available LED strips and arrays.
All LED's available diffused, clear, or water clear



INFRARED LED's

Type No.	Absolute maximum ratings				P_o (mW)	I_F	V_F (V)	I_F	λ (nm)	Δθ (deg)	
	I_F (mA)	V_R (V)	P (mW)	Topr (°C)	Typ.	(mA)	Max.	(mA)	Typ.	Typ.	Package
EL-1ML$_2$	100	6	170	−25 ~ +100	2.7	50	1.5	50	940	±32	TO-18 Epoxy Resin
EL-1KL$_2$	100	6	200	−40 ~ +100	6.0	100	1.7	100	940	±5	TO-18 Hermetic Seal
EL-1K$_3$	100	6	200	−40 ~ +100	4.0	100	1.7	100	940	±36	TO-18 Hermetic Seal
EL-SKLT	100	6	100	−45 ~ +100	0.7	50	1.5	50	940	±12	Hermetic Seal
EL-1CL$_3$	40	4	70	−20 ~ +65	1.8	40	1.5	40	940	±53	Ceramic, Epoxy Resin
EL-1L$_1$	100	5	100	−30 ~ +100	20.0	100	1.7	100	940	±10	Epoxy Resin
EL-1L$_2$	100	5	100	−30 ~ +100	15.4	100	1.7	100	940	±30	Epoxy Resin

Complete product specifications are also available for: CdS and CdSe detectors; Opto-Couplers; Photodiode Arrays; Self-Scanning Photodiode Arrays; Solar Cells; Photomultipliers and Custom Electro-Optics Design.

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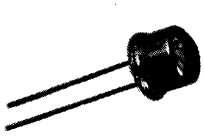
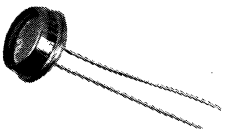
CENTRONIC



Clairex Photoconductive Cells



Part No.	Diam. X Length (inches)	Resistance @ 2 ftc ± 33-1/3%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)
CL5M9M	.55 X .18	11K	1:1000	170	2000-500[1]
CL709L	.36 X .18	28K		100	125
CL909L	.21 X .15	100K		100	50

Type 9 CdS, peak spectral response 5500 angstroms combines high speed with extreme temperature stability and high linearity.

CL5M3	.55 X .18	7.2K	1:10,000	250	2000-500[1]
CL603	.25 X .5	133K		300	75
CL603A	.25 X .5	75K		300	75
CL603AL	.25 X .5	3.5K		170	75
CL703	.36 X .18	133K		300	125
CL703A	.36 X .18	67K		300	125
CL703L	.36 X .18	2.7K		100	125
CL903	.21 X .15	133K		250	50
CL903A	.21 X .15	67K		250	50
CL903L	.21 X .15	6.0K		100	50

Type 3 CdSe, peak spectral response 7350 angstroms, fast response, and very high light-to-dark resistance ratio. Can be used for high speed switching or counting. Sensitive to near infra red. For use with incandescent or neon lamps.

CL5M4	.55 X .18	1.5K	1:400	250	2000-500[1]
CL5M4L	.55 X .18	0.25K		170	2000-500[1]
CL604	.25 X .5	30K		300	75
CL604L	.25 X .5	1.5K		170	75
CL704	.36 X .18	30K		300	125
CL704L	.36 X .18	0.6K		100	125
CL904	.21 X .15	30K		250	50
CL904L	.21 X .15	2K		100	50

Type 4 CdSe, peak spectral response 6900 angstroms, lowest resistance photocells available. Can be used for "on-off" applications when low resistance is desired. For use with incandescent or neon lamps.

CL5M5	.55 X .18	9K	1:100	250	2000-500[1]
CL5M5L	.55 X .18	1.5K		170	2000-500[1]
CL605	.25 X .5	166K		300	75
CL605L	.25 X .5	7.5K		170	75
CL705	.36 X .18	166K		300	125
CL705L	.36 X .18	3.3K		100	125
CL905	.21 X .15	166K		250	50
CL905L	.21 X .15	10K		100	50

Type 5 CdS, peak spectral response 5500 angstroms (closely matches the human eye), most stable, lowest memory photocell available. Can be used in light measuring applications and precision low speed switching. For use with incandescent, fluorescent or neon lamps.

CL705HL	.36 X .18	28K	1:1000	100	125
CL905HLL	.21 X .15	15K		60	50
CL905HL	.21 X .15	100K		100	50
CL905HN	.21 X .15	700K		100	50

Type 5H CdS, peak spectral response 5500 angstroms (closely matches the human eye). Combines high speed, stability, linearity, and uniform color temperature response. Footnote 1. with and without heat sink.

Part No.	Diam. X Length (inches)	Resistance @ 2 ftc ± 33-1/3%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)
CL707H	.36 X .18	500K	1:1000	300	125
CL707HM	.36 X .18	100K		250	125
CL907H	.21 X .15	600K		250	50
CL907HN	.21 X .15	300K		100	50
CL907HL	.21 X .15	24K		100	50

Type 7H CdS peak Spectral response 6200 angstroms. Very fast decay time coupled with low resistance and high linearity. Ideal for beam breaking applications.

CL5M7	.55 X .18	7.2K	1:300	250	2000-500[1]
CL607	.25 X .5	133K		300	75
CL707	.36 X .18	133K		300	125
CL707L	.36 X .18	2.7K		100	125
CL907	.21 X .15	133K		250	50
CL907N	.21 X .15	66K		100	50

Type 7 CdS, peak spectral response 6150 angstroms, moderate speed and ratio. Can be used in general beam breaking applications. For use with incandescent, neon or fluorescent lamps.

Part No.	Diam. X Length (inches)	Resistance @ 2 fc ± 33-1/3%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)	Type
CL703/2	.36 X .18	50K	1:10,000	300	125	3 CdSe
CL703L/2	.36 X .18	6.5K	1:10,000	100	125	3 CdSe
CL704/2	.36 X .18	17K	1:400	300	125	4 CdSe
CL704L/2	.36 X .18	1.5K	1:400	100	125	4 CdSe
CL705/2	.36 X .18	166K	1:100	300	125	5 CdS
CL705L/2	.36 X .18	7.5K	1:100	100	125	5 CdS

Plastic Encapsulated Photoconductive Cells

CL5P4	.430 X .130	2.7K	1:400	250	250	Type 4 CdSe
CL5P4L	.430 X .130	0.45K		170	250	
CL7P4	.283 X .075	54K		300	125	
CL7P4L	.283 X .075	1K		170	125	
CL9P4L	.180 X .065	2K		100	50	
CL5P5	.430 X .130	9K	1:100	250	250	Type 5 CdS
CL5P5M	.430 X .130	6K		250	250	
CL5P5L	.430 X .130	1.5K		170	250	
CL7P5	.283 X .075	166K		300	125	
CL7P5L	.283 X .075	3.3K		170	125	
CL9P5	.180 X .065	166K		250	50	
CL9P5L	.180 X .065	10K		100	50	
CL7P5HL	.283 X .075	28K	1:1000	170	125	Type 5H CdS
CL9P5HL	.180 X .065	100K		100	50	
CL7P7HL	.283 X .075	10K	1:1000	170	125	Type 7H CdS
CL7P7HM	.283 X .075	30K		400	125	
CL9P7HL	.180 X .065	24K		100	50	
CL9P7HLL	.180 X .065	4.5K		70	50	
CL5P9M	.430 X .130	9K	1:1000	250	250	Type 9 CdS
CL7P9L	.283 X .075	28K		170	125	
CL9P9L	.180 X .065	100K		100	50	
CL9P9LL	.180 X .065	15K		70	50	

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TO 18 FLAT WINDOW

Part No.	I_L (ma) V_{CE} = 5V Min	Max	H (Note 1) mw/cm²	BV_{CEO} Volts	I_{CEO} (na) V_{CE} = 10V	P_T (mw) 25°C
CLT 2065	7.0	—	5.0	40	50	250
CLT 2064	3.0	7.0	5.0	50	50	250
CLT 2030	1.0	3.0	5.0	30	25	250
CLT 2020	0.4	1.2	5.0	30	25	250
CLT 2010	0.2	0.6	5.0	50	25	250
CLR 2060	1.4 14.0	4.0 —	0.2 2.0	40	100	250
CLR 2050	0.6 6.0	1.8 —	0.2 2.0	40	100	250
CLR 2049	2	.6	0.2	40	100	250

TO 18 LENS.

Part No.	I_L (ma) V_{CE} = 5V Min	Max	H (Note 1) mw/cm²	BV_{CEO} Volts	I_{CEO} (na) V_{CE} = 10V	P_T (mw) 25°C
CLT 2165	15.0	—	5.0	40	50	250
CLT 2164	7.0	—	5.0	40	50	250
CLT 2160	4.0	12.0	5.0	30	25	250
CLT 2150	2.4	7.2	5.0	40	25	250
CLT 2140	1.2	3.6	5.0	40	25	250
CLT 2130	0.6	1.8	5.0	50	25	250
CLR 2180	0.6 4.0	— —	0.02 0.20	40	100	250
CLR 2170	0.2 2.0	0.8 —	0.02 0.20	40	100	250

WINDOW LENS .115 LENGTH X .077 DIAMETER

Part No.	Lens	I_L (ma) V_{CE}=5V Min	Max	H (Note 1) mw/cm²	BV_{CEO} Volts	I_{CEO} (na) V_{CE}=10V	P_T (mw) 25°C
CLT 5170	L	1.4 6.0	— —	5 20	40	25	50
CLT 5160	L	0.5 2.0	— 7.0	5 20	40	25	50
CLR 5101	L	2.0 20.0	— —	0.2 2.0	40	100	50

-2 Designation is with second lead welded to the header

PLASTIC ENCAPSULATED SIDE VIEW

Part No.	I_L (ma) V_{CE}=5V Min	Max	H (Note 1) mw/cm²	BV_{CEO} Volts	I_{CEO} (na) V_{CE}=10V	P_T(mw) 25°C
CLT 4000	.3	—	5	30	50	75
CLT 4140	.5	—	5	40	50	75
CLT 4150	1.0	3.0	5	40	50	75
CLT 4160	2.0	—	5	40	50	75
CLR 4180	.1	—	.1	40	200	75
CLR 4185	.6	—	.1	40	200	75

PHOTO DIODES

Part No.	Active Area Inches	Package	I_{SC} (ua) Min.	H mw/cm²	I_D(na) V=-.1V
CLD 31	.222 x .122	Plastic	120	5	100
CLD 41	.051 x .051	To 18	6	5	50
CLD 42	.051 x .051	To 18	35	5	50
CLD 56	.222 x .122	To 5	100	5	100
CLD 71	.125 x .125	Plastic	70	5	100
CLD 72	.051 x .051	Plastic	17	5	10

Note 1: The light source is a frosted tungsten incandescent lamp at 2854°K.

INFRARED EMITTERS

Part No.	Package	Material	Power Out (mw)	Vf (Volts)	Pt 25°C	Peak Wave Length nm
CLED-1	T046 lens	GaAs	1.0 @ 50 ma	1.8 @ 60 ma	200 mw	930
CLED-1F	T046 Window	GaAs	1.0 @ 50 ma	1.8 @ 60 ma	200 mw	930
CLED-3	Pill-lens	GaAs	0.75 @ 50 ma	1.6 @ 50 ma	75 mw	930
CLED-5	Post lens	GaAs	0.80 @ 50 ma	1.6 @ 50 ma	75 mw	930
CLED-400	Plastic	GaAs	0.50 @ 50 ma	1.6 @ 50 ma	100 mw	930
CLED-155	T046 lens	GaAlAs	3.0 @ 50 ma	1.8 @ 50 ma	200 mw	880
CLED-155F	T046 Window	GaAlAs	3.0 @ 50 ma	1.8 @ 50 ma	200 mw	880
CLED-305	Pill-lens	GaAlAs	2.0 @ 50 ma	1.7 @ 40 ma	75 mw	880
CLED-405	Plastic	GaAlAs	2.0 @ 50 ma	1.7 @ 40 ma	100 mw	880
CLED-505	Post-lens	GaAlAs	2.0 @ 50 ma	1.7 @ 40 ma	75 mw	880

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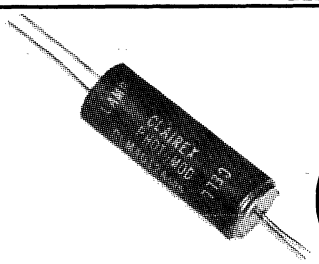
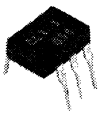


Clairex Opto-Isolators



LED PHOTOCONDUCTIVE CELL ISOLATORS

Part No.	Package	R "ON" Ohms Max	10 SEC R "OFF" Ohms Min	Cell Volts PAC	Isol. Volts
CLM6000	Axial	500@20ma	500K	60	2000
CLM6200	Axial	10K@10ma	10Meg	60	2000
CLM6500	Axial	400@20ma	10Meg	100	2000
CLM8000	Axial	400@40ma	500K	220	2500
CLM8200	Axial	2.8K@16ma	10Meg	220	2500
CLM8200/2	Axial	5.0K@16ma	10Meg	100	2500
CLM8500	Axial	2.0K@16ma	10Meg	220	2000
CLM8500/2	Axial	1.0K@16ma	1Meg	100	2000

Part No.	Package	R "ON" Ohms Max	10 SEC R "OFF" Ohms Min	Cell Volts PAC	Isol. Volts
CLM8500HV	Axial	5K@16ma	10Meg	400	2000
CLM8600	Axial	2K@16ma	10Meg	500	3000
CLM9000	Axial	1.2Meg@16ma	1000Meg	3500	7000
CLM50	DIP	2.5K@16ma	1Meg	250	2500
CLM51	DIP	4.5K@1ma	1Meg	250	2500
CLM60	DIP	4K@±16ma	1Meg	250	2500
CLM61	DIP	7K@±1ma	1Meg	250	2500

IRED – PHOTOTRANSISTOR AXIAL ISOLATOR

Part No.	C.T.R. V_{CE}=10V % Min	I_F ma	Isolation Volts PAC	BV_{CEO} I_C=1ma Volts	I_{CEO} @V_{CE}=10V na
CLA7	20	10	7000	40	50
CLA7AA	10	10	7000	40	100

IRED – PHOTODARLINGTON AXIAL ISOLATOR

Part No.	C.T.R. V_{CE}=10V % Min	I_F ma	Isolation Volts PAC	BV_{CEO} I_C=.1ma Volts	I_{CEO} @V_{CE}=10V na
CLA7D	400	10	7000	40	100
CLA7DA	200	10	7000	40	100

THE SURVIVOR® – HERMETICALLY SEALED COMPONENTS – AXIAL ISOLATOR

Part No.	C.T.R. V_{CE}=10V % Min	I_F ma	Isolation Volts PAC	BV_{CEO} I_C=1ma Volts	I_{CEO} @V_{CE}=10V na	Type of Units
CLA60	40	10	10,000	55	50	IRED — PHOTOTRANSISTOR
CLA60AA	20	10	10,000	55	50	IRED — PHOTOTRANSISTOR
CLA60AB	10	10	10,000	40	100	IRED — PHOTOTRANSISTOR
CLA65	400	10	10,000	55	100	IRED — PHOTO DARLINGTON
CLA65AA	200@ V_{CE}= 5V	10	10,000	40	100	IRED — PHOTO DARLINGTON
CLA90	3.5 volts	1	10,000	—	.4 volts	IRED — PHOTO INTEGRATED CIRCUIT
CLA90AA	3.5 volts	5	10,000	—	.4 volts	IRED — PHOTO INTEGRATED CIRCUIT

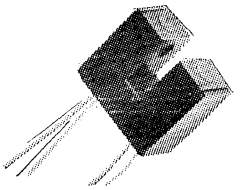
PHOTOMOD® PHOTOCONDUCTIVE CELL – LAMP ISOLATORS

Part No.	Dia. Inch	Length Inch	R "ON" Ohms Max	@ Lamp Rated Voltage Volts	10 SEC R "OFF" Ohms Min	Cell Volts PAC	Isolation Voltage PAC
CLM3006A	.415	1.125	160	6	10 Meg	200	2500
CLM4006A	.415	1.125	55	6	1 Meg	200	2500
CLM3012A	.415	1.125	160	12	100 Meg	200	2500
CLM4012A	.415	1.125	30	12	1 Meg	200	2500
CLM5H10A	.415	1.125	3000	10	10 Meg	200	2500
CLM7H16A	.415	1.125	550	16	10 Meg	200	2500
CLM3120A	.415	1.125	1150	120 *	100 Meg	200	2500
CLM4120A	.415	1.125	160	120 *	1 Meg	200	2500
CLM3000	.420 X .445 X .620		500	14	1 Meg	200	1600
CLM3500	.420 X .445 X .620		160	120 *	1 Meg	250	1600
CLM3500/2	.420 X .445 X..620		500	120 *	1 Meg	120	1600
CLM3700	.420 X .445 X .620		1000	120 *	1 Meg	250	1600

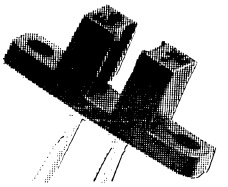
*Series resistor required.

U.L. RECOGNIZED COMPONENT

CLAIREX ELECTRONICS
A DIVISION OF CLAIREX® CORPORATION
560 South Third Avenue, Mount Vernon, N.Y. 10550 (914) 664-6602
WRITE FOR NAME OF YOUR NEAREST CLAIREX REPRESENTATIVE OR DISTRIBUTOR



Clairex



OPTICAL SWITCHES

HERMETICALLY SEALED EMITTERS AND SENSORS

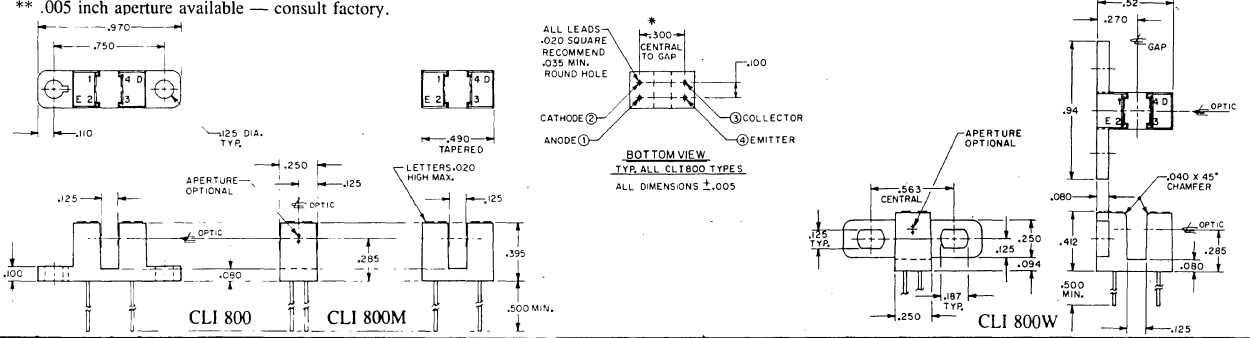
Part No.	Dimensions Height, Width, Thickness Inches	Gap Width Inches	Slit on Sensor	I_{CE} min (ma) V_{CE} = 5V	@ I_F ma	BV_{CEO} Volts	I_D max (na) V_{CE} = 10V	Internal R_L	Sensor Darlington	Sensor Transistor
CLI 200	.425 x .500 x .250	.100	—	1.0	20	40	50	No		✓
CLI 210	.425 x .500 x .250	.100	.005	0.1	20	40	50	No		✓
CLI 220	.425 x .500 x .250	.100	—	10.0	20	40	100	No	✓	
CLI 230	.425 x .500 x .250	.100	.005	2.0	20	40	100	No	✓	
CLI 305	1.3 x .950 x .500	.250	.005	.5V Max.	20	30	4.7V Min.	No	Emitter Follower	
CLI 325	1.3 x .950 x .500	.250	—	3.0	10	30	100	No	✓	
CLI 355	1.3 x .950 x .500	.250	—	12.0	10	30	100	Yes	✓	
CLI 375	1.3 x .950 x .500	.250	—	1.0	20	30	100	No		✓
CLI 385	1.3 x .950 x .500	.250	—	4.0 Volts	20	15	.4V @ .5V	No	Integrated Circuit	
CLI 395	1.3 x .950 x .500	.250	—	.5	10	30	100	No		✓

PLASTIC ENCAPSULATED EMITTERS AND SENSORS

Part Numbers			Gap Width Inches	Slit** on Sensor	I_{CE} min ma	V_{CE} Volts	@ I_F ma	BV_{CEO} Volts	I_D max (na) VCE=10V	Sensor Darlington	Sensor Transistor
CLI 800	CLI 800M	CLI 800W	.125	—	0.4	5	20	30	100		✓
CLI 810	CLI 810M	CLI 810W	.125	—	1.0	5	20	30	100		✓
CLI 820	CLI 820M	CLI 820W	.125	—	2.0	5	20	30	100		✓
CLI 830	CLI 830M	CLI 830W	.125	—	4.0	5	20	30	100		✓
CLI 835	CLI 835M	CLI 835W	.125	.010	0.4	5	20	30	100		✓
CLI 811	CLI 811M	CLI 811W	.125	—	1.0	5	20	50	50		✓
CLI 821	CLI 821M	CLI 821W	.125	—	2.0	5	20	50	50		✓
CLI 831	CLI 831M	CLI 831W	.125	—	4.0	5	20	50	50		✓
CLI 836	CLI 836M	CLI 836W	.125	.010	0.4	5	20	50	50		✓
CLI 840	CLI 840M	CLI 840W	.125	—	2.5	1.5	5	30	250	✓	
CLI 850	CLI 850M	CLI 850W	.125	—	5.0	1.5	5	30	250	✓	
CLI 860	CLI 860M	CLI 860W	.125	—	10.0	1.5	5	30	250	✓	
CLI 870	CLI 870M	CLI 870W	.125	.010	1.0	1.5	10	30	250	✓	
CLI 841	CLI 841M	CLI 841W	.125	—	2.5	1.5	5	55	100	✓	
CLI 851	CLI 851M	CLI 851W	.125	—	5.0	1.5	5	55	100	✓	
CLI 861	CLI 861M	CLI 861W	.125	—	10.0	1.5	5	55	100	✓	
CLI 871	CLI 871M	CLI 871W	.125	.010	1.0	1.5	10	55	100	✓	

* The respective CLI 800 types are available with lead spacing of .220 inches. Add the suffix A, ie. CLI 800A

** .005 inch aperture available — consult factory.



CLAIREX ELECTRONICS
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WRITE FOR NAME OF YOUR NEAREST CLAIREX REPRESENTATIVE OR DISTRIBUTOR

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

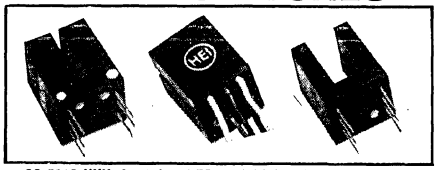
WPS word processing software

Y

YIG yttrium iron garnet

HEI OPTOELECTRONIC PRODUCTS

OPTICAL SWITCHES



HEI optical switches consist of an LED/photo-transistor pair operating across an air gap. Light beam interruption causes a change in output. Switches are contactless, highly reliable, and extremely long-lived. The LEDs operate in the infrared range.
Choose from 32 models, including some with integral hybrid amplifiers and Schmitt triggers. Both analog and digital models.

Two small packages available with either DIP pins or 12-in. leads. Most styles compatible with TTL/DTL/MOS circuits. OS-591S series have TTL/DTL square wave output. Switches are normally closed when uninterrupted. Precise alignment gives maximum output, and lens system reduces ambient light. HEI offers custom packaging, and can meet special performance requirements. Contact factory representative for specific information.

- **OS-521S-XXX** Contains LED and high-gain photo transistor. Medium speed, analog output.
- **OS-581-XXX** Contains LED and photo Darlington transistor. High gain, medium speed. Ideal for limit switching, presence detection. Analog output.
- **OS-561A-XXX** LED/photo transistor with integral hybrid amplifier for high speed, high output current. Used with TTL/DTL gates, analog output.
- **OS-591S-XXXL** Ultimate optical switch with hybrid amplifier and Schmitt trigger. Square wave output at TTL levels. Positive switching at all speeds.

PART NUMBER EXAMPLE:

OS - 5 6 2 A - 200 L W

- Optical Switch
- LED Series
- Sensor Series
- No. of LED/Sensor Pairs
- Optional Circuitry: Amplifier (A), Schmitt Trigger (S)
- Gap Dimension in mils: 060, 200
- Package Size: Small Housing (Blank), Large Housing (L)
- Wire Added Optional (W)

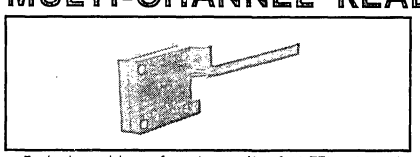
Absolute Maximum Ratings (25°C free air)

Single Channel — Part Number / Dual Channel — Part Number		OS-521-XXX OS-522-XXXL	OS-581-XXX OS-582-XXXL	OS-561A-XXX OS-562A-XXXL	OS-591S-XXXL OS-592S-XXXL
LED Side:					
Forward Current (mA)	$I_{F/LED}$	50	50	50	50
Reverse Voltage (V)	V_R	3	3	3	3
Power Dissipation (mW)	$P_{/LED}$	75	75	75	75
Sensor Side:					
Voltage Collector to Emitter (V)	V_{CEO}	20	20	25	5
Voltage Emitter to Collector (V)	V_{ECO}	5	5	5	5
Light Current (mA)	I_L	5	5	10	50
Power Dissipation (mW)	$P_{/Sensor}$	100	100	100	200

Electrical Characteristics (Typ.)

Light Current (I_F=35mA, V_{CC}=5V, R_L=1K) (mA)	I_L	1.0	2.0	4.7	4.9
Dark Current (I_F=0, V_{CE}=5V, H=0) (μA)	I_D	0.1	0.1	10	0.1
LED Forward Voltage (I_F=40mA) (V)	V_F	1.3	1.3	1.3	1.3
Sensor Saturation Voltage (I_F=35mA, R_L=10K, V_{CC}=5V) (V)	$V_{CE(SAT)}$	.35	.8	0.2	0.1
Switching Speeds (For .060 Gap)					
Rise Time (μsec)	t_r	25	150	15	.05
Fall Time (μsec)	t_f	30	170	20	.1
Frequency (KHz)	f	10	2.5	10	15

MULTI-CHANNEL READER



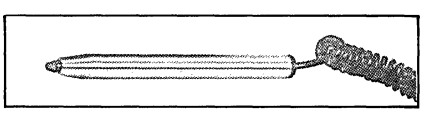
The 125-1 assembly contains infra-red LEDs which are spectrally matched with silicon photo transistors. Hybrid circuitry is included for TTL compatibility. Primarily designed as an 8 or 12 channel vertical format unit for line printers.
Number of channels and centerline spacing may be varied to suit assorted applications. Air gap may be specified, along with analog or digital output.
Using a data hole width of .030", an obstruction of ≤15% transmissivity will result in a low output. Obstruction of ≥40% transmissivity causes a high output. A glass wear plate provides self cleaning and dust elimination.

- Each channel has a fanout capacity of 10 TTL gates, with CMOS compatibility optionally available.
- Source and sensor sides electrically isolated to avoid ground loop.
- Non-standard data holes (less than .030" or greater than .073") available on request.
- Standard sensor spacing is .1094" for 12 channel unit, .100" for 8 channel unit (except for channels 6 and 7 which are .250").
- Supply voltage 4.5 to 5.5V. Output current 800 μA high, 16 mA low.
- Slot depth 1.725" standard, width 1.5", gap .020".

CHARACTERISTICS		MIN.	TYP.	MAX.
High Level Output Voltage (V_{CC}=4.75V, I_{OH}=-800 μA)	V_{OH}	4.5V	4.75V	
Low level Output Voltage (V_{CC}=4.75V, I_{OL}=16 mA)	V_{OL}		0.2V	0.4V
*Short Circuit Output Current (V_{CC}=5.25V)	I_{OS}	-1.8 mA		-2.5 mA
Supply Current (Per Channel)				
Source Side (V_{CC}=5.25V)	I_{CC}		21 mA	25 mA
Detector Side (V_{CC}=5.25V)	I_{CC}		3.6 mA	5.0 mA

*Not more than one output should be shorted at one time.

LIGHT PENS (New Color-Sensitive Light Pen Available in 1983)



HEI light pens for CRT terminals are solid state assemblies which utilize opto-electronics and hybrid circuitry to provide two TTL-compatible outputs: "Light Pen Hit" and "Light Pen Switch". The latter is generated when tip of pen is pressed against CRT face. A "Hit" is generated when an unblanked spot on the CRT face is under the pen tip. Signals are transmitted to control logic of the terminal for fast data manipulation.
Two models available: 120-3 has black plastic barrel, 120-2 has slimmer stainless steel barrel. Both available with optional coiled cord, and adjustable sensitivity. Resolution is excellent, along with high ambient light rejection. Both models light weight, meet Mil Stds. for radiation susceptibility and vibration.

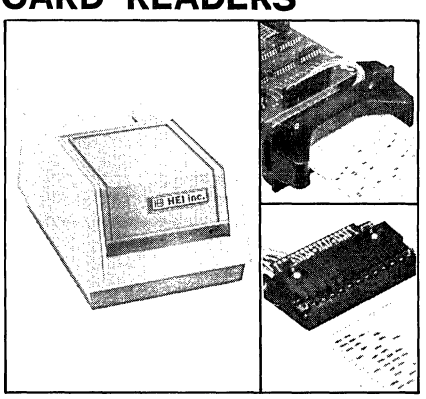
ELECTRICAL

Input Power ..... 5V @ 125 mA
Sensitivity ..... 7 FL Spot Brightness (Minimum Pickup)
Ambient Rejection ..... 100 FL
Response Time ..... <.5us @ 20 FL
Field of View ..... <.075 inches
Light Pen Switch .... TTL compatible (Normally high, low while nose cone is actuated)
Light Pen Hit ..... TTL compatible (Normally high, low during pulse period)

MECHANICAL

	120-3	120-2
Length	<6.2 inches	5.96 inches
Diameter	<.625 inches	.495 inches
Weight	<2 ounces	<2 ounces
Nose Cone Travel	<.100 inches	.090 inches
Cable Length	4 feet	4 feet
Cable Diameter	<.150 inches	.150 inches
Color	Black	Silver

CARD READERS



HEI offers several card reader models as well as OEM read heads. Call or write for details.

HEI's hand-fed card reader offers capability to interpret either marked or punched cards. High reliability hybrid circuitry provides TTL-compatible output. Designed to read standard 80-column cards with clock marks. Can handle other cards of reasonable length.
This reader has superior mark detection capability, and will read a wide variety of pencil and ink colors. Toleration of worn or mutilated cards is good.

The reader head is self cleaning, and no lubrication is required. Cards are fed by hand, internal mechanism transports cards through at 6"/second.
Either parallel or RS-232 interface format available. The unit may be ordered with or without internal power supply. For mark/sense applications, cards must have printed strobe marks on either margin.

Specifications

Input Power	115VAC, 60 Hz, .35A +5VDC, .2A −12VDC, .1A	Physical Size	4.75" (120.6mm) W 9.75" (247.6mm) D 4.25" (108mm) H
Output	TTL Compatible 12 rows paralleled up to 80 rows serial	Weight	4.5 lbs. (2 kg)

The Optoelectronic Specialists

HEI inc. **DEPT. EM • VICTORIA, MN 55386 • (612) 443-2500**

Introduction

Honeywell

Honeywell offers industry's broadest range of optoelectronic products. They include:

- LEDs
- Silicon photodetectors (Transistor, SCR and IC)
- Optically coupled isolators
- Transmissive switches
- Reflective switches
- V/LED and I/LED displays
- Encoders
- Emitter/Detector arrays
- Discrete chips
- Custom components and assemblies
- Laser diodes
- Pin diodes
- InSb photodiodes
- Mercury cadmium telluride photoconductors
- Fiber optic components
- Fiber optic systems (analog and digital)
- Fiber optic radial couplers

Honeywell strives for continuing leadership in high-technology optoelectronic products — today and tomorrow. That's why we're committing substantial resources to research and development efforts for the next generation of optoelectronics.

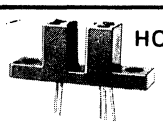
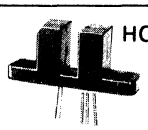
In addition to its standard products, Honeywell can develop custom components, assemblies and systems to meet exact customer requirements.

For more information or the name of your local distributor or representative, contact Honeywell today at (214) 234-4271.

Optical switches

- LED and photodetector in the same package.
- Reflective and transmissive (interrupter) types.
- Plastic and hermetic components.
- Transistor, Darlington and Schmitt trigger outputs.
- Variety of package designs.

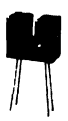
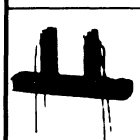
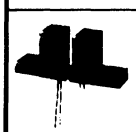
Optoschmitt switches

Characteristic	Components	Output voltage		Forward voltage	Propagation delay				Rise time	Fall time	Required LED current		Slot width
		Low	High		Low-high		High-low						
Test condition				I_F = 20 mA									
Symbol		V_{OL}	V_{OH}	V_F	T_{DLH}		T_{DHL}		t_r	t_f	I_{FT}		d
Units		V	V	V	μs		μs		ns	ns	mA		mm
		max.	typ.	max.	typ.	max.	typ.	max.	typ.	typ.	typ.	max.	
 HOA 2001	plastic	0.4	V_{CC}	1.5	1	5	2.5	5	60	6	4	10	.120
 HOA 2002(a)	plastic	0.4	V_{CC}	1.5	1	5	2.5	5	60	6	4	10	.125

(a) Features .010 x .040 aperture (b) V_{CC} operating range = 4.5 to 16 Volts

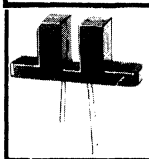
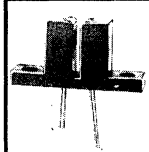
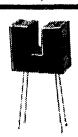
Honeywell

Transmissive switches

Characteristics		Com-ponents	Sensor aperture	On-state collector current			Off-state collector current	Saturation voltage			LED forward voltage		Response time		Slot width	Output
Test condition				V_{CE} = 5 V, I_F as shown			V_{CE} = 10 V, I_F = 0	I_C and I_F as shown			I_F as shown		R_L = 1000 Ω, V_{CC} = 5 V, I_C = 1 mA			
Symbol				I_L			I_D	$V_{CE(SAT)}$			V_F		t_r, t_f		d	
Units			inches	mA			nA	V			V		μs		inches	
				min.	max.	I_F(mA)	max.	max.	I_C(mA)	I_F(mA)	max.	I_F(mA)	rise (typ.)	fall (typ.)	nom	
	HOA 1870-21	plastic	.012x.040	0.4	2.8	20	100	0.4	.05	20	1.5	20	10	12	.070	transistor
	HOA 1870-23	plastic	.012x.040	2.5	18.0	20	250	1.1	.31	20	1.5	20	500	750	.070	darlington
	HOA 1870-31	plastic	.006x.040	.30	2.1	20	100	0.4	.04	20	1.5	20	10	12	.070	transistor
	HOA 1870-33	plastic	.006x.040	2.0	14.0	20	250	1.1	.25	20	1.5	20	500	750	.070	darlington
	HOA 1872-1	hermetic		.30	2.0	20	100	0.4	.04	20	1.6	50	10	12	.100	transistor
	HOA 1872-2	hermetic		1.8	10.0	20	100	0.4	.23	20	1.6	50	10	12	.100	transistor
	HOA 1872-3	hermetic		4.0	25.0	20	250	1.1	.50	20	1.6	50	500	750	.100	darlington
	HOA 1872-11	plastic		.30	2.0	20	100	0.4	.04	20	1.5	20	10	12	.100	transistor
	HOA 1872-12	plastic		1.8	10.0	20	100	0.4	.23	20	1.5	20	10	12	.100	transistor
	HOA 1872-13	plastic		4.0	25.0	20	250	1.1	.50	20	1.5	20	500	750	.100	darlington
	HOA 1873-1	hermetic		.30	2.0	20	100	0.4	.04	20	1.6	50	10	12	.100	transistor
	HOA 1873-2	hermetic		1.8	10.0	20	100	0.4	.23	20	1.6	50	10	12	.100	transistor
	HOA 1873-3	hermetic		4.0	25.0	20	250	1.1	.50	20	1.6	50	500	750	.100	darlington
	HOA 1873-11	plastic		.30	2.0	20	100	0.4	.04	20	1.5	20	10	12	.100	transistor
	HOA 1873-12	plastic		1.8	10.0	20	100	0.4	.23	20	1.5	20	10	12	.100	transistor
	HOA 1873-13	plastic		4.0	25.0	20	250	1.1	.50	20	1.5	20	500	750	.100	darlington
	HOA 1874-1	hermetic		.30	2.0	20	100	0.4	.04	20	1.6	50	10	12	.120	transistor
	HOA 1874-2	hermetic		1.8	10.0	20	100	0.4	.23	20	1.6	50	10	12	.120	transistor
	HOA 1874-3	hermetic		4.0	25.0	20	250	1.1	.50	20	1.6	50	500	750	.120	darlington
	HOA 1874-11	plastic		.30	2.0	20	100	0.4	.04	20	1.5	20	10	12	.120	transistor
	HOA 1874-12	plastic		1.8	10.0	20	100	0.4	.23	20	1.5	20	10	12	.120	transistor
	HOA 1874-13	plastic		4.0	25.0	20	250	1.1	.50	20	1.5	20	500	750	.120	darlington
	HOA 1875-1	hermetic		.15	.75	30	100	0.4	.02	20	1.6	50	10	12	.200	transistor
	HOA 1875-2	hermetic		.60	3.0	30	100	0.4	.08	20	1.6	50	10	12	.200	transistor
	HOA 1875-3	hermetic		1.8	12.0	30	250	1.1	.23	20	1.6	50	500	750	.200	darlington
	HOA 1876-1	hermetic		.15	.75	30	100	0.4	.02	20	1.6	50	10	12	.200	transistor
	HOA 1876-2	hermetic		.60	3.0	30	100	0.4	.08	20	1.6	50	10	12	.200	transistor
	HOA 1876-3	hermetic		1.8	12.0	30	250	1.1	.23	20	1.6	50	500	750	.200	darlington
	HOA 1877-1	hermetic		.10	.60	30	100	0.4	.01	20	1.6	50	10	12	.375	transistor
	HOA 1877-2	hermetic		.50	2.5	30	100	0.4	.06	20	1.6	50	10	12	.375	transistor
	HOA 1877-3	hermetic		1.5	10.0	30	250	1.1	.19	20	1.6	50	500	750	.375	darlington
	HOA 1878-11	plastic		.20	2.0	20	100	0.4	.03	20	1.5	20	10	12	.125	transistor
	HOA 1878-12	plastic		1.8	10.0	20	100	0.4	.23	20	1.5	20	10	12	.125	transistor
	HOA 1878-13	plastic		4.0	25.0	20	250	1.1	.50	20	1.5	20	500	750	.125	darlington

Honeywell

Transmissive switches

Characteristics	Components	Sensor aperture	On-state collector current			Off-state collector current	Saturation voltage			LED forward voltage		Response time		Slot width	Output
Test condition			V_{CE} = 5 V, I_F as shown			V_{CE} = 10 V, I_F = 0	I_C and I_F as shown			I_F as shown		R_L = 1000 Ω, V_{CC} = 5 V, I_C = 1 mA			
Symbol			I_L			I_D	$V_{CE(SAT)}$			V_F		t_r, t_f		d	
Units		inches	mA			nA	V			V		μs		inches	
			min	max	I_F(mA)	max.	max.	I_C(mA)	I_F(mA)	max.	I_F(mA)	rise (typ.)	fall (typ.)	nom	
 HOA 1879-11	plastic		.40	2.0	20	100	0.4	.05	20	1.5	20	10	12	.125	transistor
HOA 1879-12	plastic		1.8	10.0	20	100	0.4	.22	10	1.5	20	10	12	.125	transistor
HOA 1879-15	plastic	.010x.040	.50	4.0	20	100	0.4	.06	20	1.5	20	10	12	.125	transistor
HOA 1881-11	plastic		.30	2.0	20	100	0.4	0.025	20	1.5	20	10	12	.125	transistor
HOA 1881-12	plastic		1.8	10.0	20	100	0.4	0.075	20	1.5	20	10	12	.125	transistor
HOA 1881-13	plastic		4.0	25.0	20	250	1.1	0.250	20	1.5	20	500	750	.125	darlington
 HOA 2762-1	hermetic	.007x.040	0.1	1.1	20	100	0.4	0.010	20	1.6	50	10	12	.060	transistor
HOA 2762-2	hermetic	.007x.040	1.0	5.0	20	100	0.4	0.025	20	1.6	50	10	12	.060	transistor
HOA 2762-3	hermetic	.007x.040	2.0	15.0	20	250	1.1	0.250	20	1.6	50	500	750	.060	darlington
 HOA 2862-1	hermetic	.025x.040	0.2	2.0	20	100	0.4	0.025	20	1.6	50	10	12	.100	transistor
HOA 2862-2	hermetic	.025x.040	1.8	10.0	20	100	0.4	0.075	20	1.6	50	10	12	.100	transistor
HOA 2862-3	hermetic	.025x.040	4.0	25.0	20	250	1.1	0.500	20	1.6	50	500	750	.100	darlington

Notes:

(1) Storage temperature −65°C to +100°C (hermetic)
−40°C to +85°C (plastic)

(2) Operating temperature −65°C to +100°C (hermetic)
−40°C to +80°C (plastic)

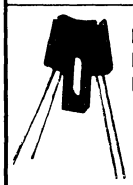
(3) BV_{CEO} @ I_C = 100μA, 30V min (transistor), 15V min (darlington)

(4) BV_{ECO} @ I_C = 100μA, 5V min

(5) I_R = 10μA max @ V_R = 3V

Reflective switches

Characteristics	Components	Light current				Dark current		LED forward voltage		Light current rise time	Collector-emitter breakdown	Output
Test condition		V_{CE} = 5 V, I_F as shown				I_F = 0, H = 0, V_{CE} as shown		I_F as shown		V_{CC} = 5 V, I_C = 1 mA, R_L = 1000 Ω		
Symbol		I_L				I_D		V_F		t_r	BV_{CEO}	
Units		mA				nA		V		μs	V	
		min	max	I_F(mA)	d Inch (a)	max.	V_{CE}(V)	max.	I_F(mA)	typ.	min.	
HOA 1160-1	hermetic	0.5	2.5	30	.075	100	10	1.6	50	8	30	transistor
HOA 1160-2	hermetic	2.0	10.0	30	.075	100	10	1.6	50	10	30	transistor
HOA 1160-3	hermetic	5.0	35.0	30	.075	250	10	1.6	50	50(c)	15	darlington
HOA 1180-1	hermetic	.04	.20	30	.50	100	10	1.6	50	6	30	transistor
HOA 1180-2	hermetic	.16	.80	30	.50	100	10	1.6	50	6	30	transistor
HOA 1180-3	hermetic	2.0	14.0	30	.50	250	10	1.6	50	50(c)	15	darlington

	HOA 1397-1	plastic	.20	.80	20	.050(b)	100	10	1.5	20	6	30	transistor
	HOA 1397-2	plastic	.70	2.8	20	.050(b)	100	10	1.5	20	6	30	transistor
	HOA 1397-31	plastic	2.0	8.0	20	.050(b)	250	10	1.5	20	50(c)	15	darlington
	HOA 1397-32	plastic	7.0	28.0	20	.050(b)	250	10	1.5	20	50(c)	15	darlington
	HOA 1404-1	hermetic	.20	1.0	30	.20	100	10	1.6	50	6	30	transistor
	HOA 1404-2	hermetic	.80	4.0	30	.20	100	10	1.6	50	8	30	transistor
	HOA 1404-3	hermetic	2.0	14.0	30	.20	250	10	1.6	50	50(c)	15	darlington
	HOA 1405-1	plastic	.20	1.0	30	.20(b)	100	10	1.5	20	6	30	transistor
	HOA 1405-2	plastic	.80	4.0	30	.20(b)	100	10	1.5	20	6	30	transistor
	HOA 2498-1	hermetic	.04	.20	30	.50	100	10	1.6	50	6	30	transistor
	HOA 2498-2	hermetic	.16	.80	30	.50	100	10	1.6	50	8	30	transistor
	HOA 2498-3	hermetic	2.0	14.0	30	.50	250	10	1.6	50	50(c)	15	darlington

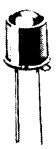
(a) d is the distance to the reflective object (a mirror), see test circuit below.
(b) Reflective surface is an Eastman Kodak® neutral white test card having 90% diffuse reflectance.
(c) $R_L = 100\Omega$

Light emitting diodes

- hermetic and plastic packages
- long operating life
- high conversion efficiency

Characteristics	Package	Output power			Beam angle	Forward voltage		Reverse breakdown	Radiation rise time	Forward continuous current	Peak wave-length
Test condition		I_F as shown			3	I_F as shown		$I_R = 10\,\mu A$		25 °C	
Symbol		P_O			Ø	V_F		V_R	t_r	I_F	λ
Units		mW			degrees	V		V	μs	mA	nm
		min.	max.	I_F(mA)	typ.	max.	I_F(mA)	min.	typ.	max.	typ.
SE 1450-1	hermetic	0.20		50	12	1.6	50	2	0.7	100	930
SE 1450-2	hermetic	0.36		50	12	1.6	50	2	0.7	100	930
SE 1450-3	hermetic	0.7		50	12	1.6	50	2	0.7	100	930
SE 1450-4	hermetic	1.00		50	12	1.6	50	2	0.7	100	930
SE 1450-1L	hermetic	0.20		50	12	1.6	50	2	0.7	100	930
SE 1450-2L	hermetic	0.35		50	12	1.6	50	2	0.7	100	930
SE 1450-3L	hermetic	0.70		50	12	1.6	50	2	0.7	100	930
SE 1450-4L	hermetic	1.00		50	12	1.6	50	2	0.7	100	930
SE 2460-1	hermetic	0.27		50	18	1.6	50	2	0.7	100	930
SE 2460-2	hermetic	0.40		50	18	1.6	50	2	0.7	100	930
SE 2460-3	hermetic	1.00		50	18	1.6	50	2	0.7	100	930
SE 3453-1	hermetic	1.3		100	80	1.7	100	2	1.0	500	930
SE 3453-2	hermetic	2.4		100	80	1.7	100	2	1.0	500	930
SE 3453-3	hermetic	3.2		100	80	1.7	100	2	1.0	500	930
SE 3453-4	hermetic	4.8		100	80	1.7	100	2	1.0	500	930
SE 3455-1	hermetic	2.0		100	90	1.7	100	2	0.7	100	930
SE 3455-2	hermetic	3.5		100	90	1.7	100	2	0.7	100	930
SE 3455-3	hermetic	4.8		100	90	1.7	100	2	0.7	100	930
SE 3455-4	hermetic	5.4		100	90	1.7	100	2	0.7	100	930
SE 3470-1	hermetic	7.0		100	75	1.9	100	6	0.7	100	880
SE 3470-2	hermetic	9.0		100	75	1.9	100	6	0.7	100	880
SE 3470-3	hermetic	10.5		100	75	1.9	100	6	0.7	100	880
SE 3470-4	hermetic	12.0		100	75	1.9	100	6	0.7	100	880

Honeywell

Characteristics		Package	Output power			Beam angle	Forward voltage		Reverse breakdown	Radiation rise time	Forward continuous current	Peak wave-length
Test condition			I_F as shown			3	I_F as shown		$I_R = 10\,\mu A$		25 C	
Symbol			P_O			Ø	V_F		V_R	t_r	I_F	λ
Units			mW			degrees	V		V	μs	mA	nm
			min.	max.	I_F(mA)	typ.	max.	I_F(mA)	min.	typ.	max.	typ.
	SE 5450-1	hermetic	0.8	1.5	20	30	1.5	50	5	0.7	100	930
	SE 5450-2	hermetic	1.4	1.9	20	30	1.5	50	5	0.7	100	930
	SE 5450-3	hermetic	1.7	2.5	20	30	1.5	50	5	0.7	100	930
	SE 5450-4	hermetic	2.3	3.0	20	30	1.5	50	5	0.7	100	930
	SE 5450-5	hermetic	2.8		20	30	1.5	50	5	0.7	100	930
	SE 5453-1	hermetic	1.0		100	30	1.7	100	2	1.0	500	930
	SE 5453-2	hermetic	1.9		100	30	1.7	100	2	1.0	500	930
	SE 5453-3	hermetic	2.5		100	30	1.7	100	2	1.0	500	930
	SE 5453-4	hermetic	3.8		100	30	1.7	100	2	1.0	500	930
	SE 5455-1	hermetic	2.0		100	20	1.7	100	2	0.7	100	930
	SE 5455-2	hermetic	3.5		100	20	1.7	100	2	0.7	100	930
	SE 5455-3	hermetic	4.8		100	20	1.7	100	2	0.7	100	930
	SE 5455-4	hermetic	5.4		100	20	1.7	100	2	0.7	100	930
	SE 5470-1	hermetic	7.0		100	20	1.9	100	6	0.7	100	880
	SE 5470-2	hermetic	9.0		100	20	1.9	100	6	0.7	100	880
	SE 5470-3	hermetic	10.5		100	20	1.9	100	6	0.7	100	880
	SE 5470-4	hermetic	12.0		100	20	1.9	100	6	0.7	100	880
	SEP 8503-1	plastic	0.5		20	40	1.5	20	3	0.6	100	930
	SEP 8503-2	plastic	1.0		20	40	1.5	20	3	0.6	100	930
	SEP 8503-3	plastic	1.5		20	40	1.5	20	3	0.6	100	930
	SEP 8503-4	plastic	2.0		20	40	1.5	20	3	0.6	100	930
	SEP 8505-1	plastic	0.5(a)		20	15	1.5	20	3	0.6	40	930
	SEP 8505-2	plastic	1.5(a)	3.0(a)	20	15	1.5	20	3	0.6	40	930
	SEP 8505-3	plastic	2.5(a)	4.5(a)	20	15	1.5	20	3	0.6	40	930
	SEP 8505-4	plastic	3.5(a)		20	15	1.5	20	3	0.6	40	930
	SEP 8506-1	plastic	.05(b)	.36(b)	20	25	1.6	20	3	0.6	40	930
	SEP 8506-2	plastic	.33(b)	.52(b)	20	25	1.6	20	3	0.6	40	930
	SEP 8506-3	plastic	.45(b)	.90(b)	20	25	1.6	20	3	0.6	40	930
	SEP 8506-4	plastic	.80(b)	2.2(b)	20	25	1.6	20	3	0.6	40	930
	SEP 8703-1	plastic	1.0		20	40	1.5	20	3	0.6	100	880
	SEP 8703-2	plastic	2.0		20	40	1.5	20	3	0.6	100	880
	SEP 8703-3	plastic	3.0		20	40	1.5	20	3	0.6	100	880
	SEP 8703-4	plastic	4.0		20	40	1.5	20	3	0.6	100	880

Notes:

(1) Storage temperature −65°C to +150°C (hermetic)
−40°C to +85°C (plastic)

(2) Operating temperature −65°C to +125°C (hermetic)
−40°C to +80°C (plastic)

Specifications indicated are for 25°C ambient temperature.
See individual data sheets for temperature derating information.

(3) Beam angle is defined to be the total included angle between half intensity points.

(a) Output power is in mW/cm^2. The on-axis power is measured using a .081 (2.06mm) diameter apertured sensor placed .400 (10.16mm) from lens tip.

(b) Output power is in mW/cm^2. The on-axis power is measured using a .104 (2.65mm) diameter apertured sensor placed .535 (13.6mm) from lens tip.

Honeywell

Photodetectors

- Choice of diode, transistor, darlington and Schmitt outputs.
- Photodiodes for fast speed of response.
- Phototransistors offer medium response and high stability.
- Photodarlingtons for applications requiring extremely high sensitivity.
- Optoschmitt devices have voltage regulator, differential amplifier and Schmitt trigger on the same chip, eliminating additional signal processing circuitry.
- Plastic and hermetic packages available.

Photodiodes

Characteristics	Package	Light current		Dark current	Reverse breakdown voltage	Light current rise time	Angular response
Test condition		V_R = 20 V H as shown		V_R = 20 V H = 0	I_R = 10 μA		3
Symbol		I_L		I_D	BV_R	t_r	Ø
Units		μA		nA	V	ns	degrees
		min.	H*	max.	min.	typ.	typ.
SD 1420-2	hermetic	5	5	5	50	50	24
SD 1420-2L	hermetic	5	5	5	50	50	24
SD 2420-2	hermetic	7	20	5	50	50	48
SD 3421-2	hermetic	10	5	20	75	5(max.)	90
SD 5421-2	hermetic	40	5	20	75	5(max.)	18

Notes:

(1) Storage temperature −65°C to +150°C

(2) Operating temperature −65°C to +125°C
Specifications indicated are for 25°C ambient temperature.
See individual data sheets for temperature derating information.

(3) Angular response is defined to be the total included angle between half sensitivity points.

*The value of H is measured in mW/cm^2 from a tungsten source @ a color temperature of 2870°K.

phototransistors

Characteristics	Package	Light current			Dark current		Collector breakdown	Emitter breakdown	Saturation voltage	Light current rise time	Angular response
Test condition		V_{CE} = 5 V H as shown			H=0 V_{CE} as shown		I_C = 100 μA	I_C = 100 μA	I_C = 0.4 mA	R_L = 1000 Ω V_{CC} = 5 V, I_L = 1 mA	3
Symbol		I_L			I_D		BV_{CEO}	BV_{ECO}	V_{CE} (sat)	t_r	Ø
Units		mA			nA		V	V	V	μs	degrees
		min.	max.	H*	max.	V_{CE}	min.	min.	typ.	typ.	typ.
SD 1440-1	hermetic	0.7		5	100	10	30	7	0.3	4	24
SD 1440-2	hermetic	1.5		5	100	10	30	7	0.3	4	24
SD 1440-3	hermetic	3.0		5	100	10	30	7	0.3	8	24
SD 1440-4	hermetic	6.0		5	100	10	30	7	0.3	16	24

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	SD 1440-1L	hermetic	0.7		5	100	10	30	7	0.3	4	24
	SD 1440-2L	hermetic	1.5		5	100	10	30	7	0.3	4	24
	SD 1440-3L	hermetic	3.0		5	100	10	30	7	0.3	8	24
	SD 1440-4L	hermetic	6.0		5	100	10	30	7	0.3	16	24
	SD 2440-1	hermetic	0.5		20	100	10	30	7	0.3	4	48
	SD 2440-2	hermetic	2.0		20	100	10	30	7	0.3	4	48
	SD 2440-3	hermetic	4.0		20	100	10	30	7	0.3	8	48
	SD 2440-4	hermetic	7.0		20	100	10	30	7	0.3	14	48
	SD 3440-1	hermetic	0.5	1.1	2.5(a)	100	10	30	7	0.3	4	45
	SD 3440-2	hermetic	0.9	1.5	2.5(a)	100	10	30	7	0.3	4	45
	SD 3440-3	hermetic	1.3	2.2	2.5(a)	100	10	30	7	0.3	4	45
	SD 3440-4	hermetic	2.0	2.8	2.5(a)	100	10	30	7	0.3	8	45
	SD 3440-5	hermetic	2.6		2.5(a)	100	10	30	7	0.3	8	45
	SD 3443-1	hermetic	0.5		5	100	10	30	7	0.2	6(b)	90
	SD 3443-2	hermetic	1.0		5	100	10	30	7	0.2	6(b)	90
	SD 3443-3	hermetic	2.0		5	100	10	30	7	0.2	8(b)	90
	SD 5443-1	hermetic	1.0		5	100	10	30	7	0.2	4(b)	18
	SD 5443-2	hermetic	4.0		5	100	10	30	7	0.2	4(b)	18
	SD 5443-3	hermetic	8.0		5	100	10	30	7	0.2	6(b)	18
	SD 5443-4	hermetic	16.0		5	100	10	30	7	0.2	8(b)	18
	SDP 8403-1	plastic	0.7		5	100	10	30	7	0.3	8	80
	SDP 8403-2	plastic	1.5		5	100	10	30	7	0.3	10	80
	SDP 8403-3	plastic	3.0		5	100	10	30	7	0.3	14	80
	SDP 8403-4	plastic	4.5		5	100	10	30	7	0.3	16	80

Notes:

(1) Storage temperature −65°C to +150°C (hermetic)
−40°C to +85°C (plastic)

(2) Operating temperature −65°C to +125°C (hermetic)
−40°C to +80°C (plastic)

Specifications indicated are for 25°C ambient temperature.
See individual data sheets for temperature derating information.

(3) Angular response is defined to be the total included angle between half sensitivity points.

(a) Light source is 940nm LED.

(b) R_L = 100Ω

*The value of H is measured in mW/cm^2 from a tungsten source @ a color temperature of 2870°K.

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Phototransistors

Characteristics	Package	Light current			Dark current		Collector breakdown	Emitter breakdown	Saturation voltage	Light current rise time	Angular response
Test condition		V_{CE} = 5 V H as shown			H=0 V_{CE} as shown		I_C = 100 μA	I_C = 100 μA	I_C = 0.4 mA	R_L = 1000 Ω V_{CC} = 5 V, I_L = 1 mA	3
Symbol		I_L			I_D		BV_{CEO}	BV_{ECO}	V_{CE} (sat)	t_r	Ø
Units		mA			nA		V	V	V	μs	degrees
		min.	max.	H*	max.	V_{CE}	min.	min.	typ.	typ.	typ.
SDP 8405-1	plastic	1.0		5	100	10	30	7	0.3	8	40
SDP 8405-2	plastic	7.0	14.0	5	100	10	30	7	0.3	10	40
SDP 8405-3	plastic	12.0	24.0	5	100	10	30	7	0.3	12	40
SDP 8405-4	plastic	20.0		5	100	10	30	7	0.3	16	40
SDP 8406-1	plastic	.15	1.9	1(a)	100	10	30	7	0.4(c)	8	50
SDP 8406-2	plastic	1.8	3.6	1(a)	100	10	30	7	0.4(c)	8	50
SDP 8406-3	plastic	3.4	6.5	1(a)	100	10	30	7	0.4(c)	8	50
SDP 8406-4	plastic	6.4	12.0	1(a)	100	10	30	7	0.4(c)	8	50

Optoschmitts

- TTL, LSTTL, CMOS compatible.
- Fan out of 10.
- Operate over 4.5 to 16 V_{CC} supply.

Characteristics	Package	Output voltage (low)	Output voltage (high)	Operate point	Release point	Rise time		Fall time		Propagation delay (low)		Propagation delay (high)		Clock freq.
Symbol		V_{OL}	V_{OH}	O_P	R_P	t_r		t_f		T_{DLH}		T_{DHL}		
Units		V	V	mW/cm²	mW/cm²	ns		ns		μs		μs		kHz
		max.	typ.(d)	max.(a)	max.(a)	typ.	max.	typ.	max.	typ.	max.	typ.	max.	max.
SD 3600	hermetic	0.4	V_{CC}	0.5	0.47	60	150	6	15	1	5	2.5	5	100
SD 5600	hermetic	0.4	V_{CC}	0.5	0.47	60	150	6	15	1	5	2.5	5	100
SDP 8600*	plastic	0.4	V_{CC}	2.5	2.35	60	150	6	15	1	5	2.5	5	100
SDP 8601*	plastic	0.4	V_{CC}	2.5	2.35	60	150	6	15	1	5	2.5	5	100
SDP 8602*	plastic	0.4	V_{CC}	2.5	2.35	60	150	6	15	1	5	2.5	5	100

*See Fig. 17 FOR MECHANICAL DIFFERENCES

Notes:

(1) Storage temperature −65°C to +150°C (hermetic)
−40°C to +85°C (plastic)

(2) Operating temperature −65°C to +125°C (hermetic)
−40°C to +80°C (plastic)

(3) Angular response is defined to be the total included angle between half sensitivity points.

(a) Light source is 940nm LED.
(b) R_L = 100Ω
(c) I_C = 25μA
(d) An internal load resistor of 10kΩ is tied between V_{CC} and V_O.

Specifications indicated are for 25°C ambient temperature.

See individual data sheets for temperature derating information.

*The value of H is measured in mW/cm² from a tungsten source @ a color temperature of 2870°K.

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Photodarlingtons

Characteristics	Package	Light current		Dark current	Collector breakdown	Emitter breakdown	Saturation voltage	Light current rise time	Angular response
Test condition		V_{CE} = 5 V H as shown		V_{CE} = 10 V H = 0	I_C = 100 μA	I_C = 100 μA	I_C = 1 mA	R_L = 1000 Ω V_{CC} = 5 V, I_L = 1 mA	
Symbol		I_L		I_D	BV_{CEO}	BV_{ECO}	V_{CE} (sat)	t_r	Ø
Units		mA		nA	V	V	V	μs	degrees
		min.	H*	max.	min.	min.	max.	typ.	typ.
SD 1410-1	hermetic	0.6	0.2	250	15	7	1.1	15	24
SD 1410-2	hermetic	2.0	0.2	250	15	7	1.1	25	24
SD 1410-3	hermetic	4.0	0.2	250	15	7	1.1	75	24
SD 1410-4	hermetic	8.0	0.2	250	15	7	1.1	125	24
SD 1410-1L	hermetic	0.6	0.2	250	15	7	1.1	15	24
SD 1410-2L	hermetic	2.0	0.2	250	15	7	1.1	25	24
SD 1410-3L	hermetic	4.0	0.2	250	15	7	1.1	75	24
SD 1410-4L	hermetic	8.0	0.2	250	15	7	1.1	125	24
SD 2410-1	hermetic	1.0	1.0	250	15	7	1.1	15	48
SD 2410-2	hermetic	3.0	1.0	250	15	7	1.1	25	48
SD 2410-3	hermetic	6.0	1.0	250	15	7	1.1	75	48
SD 3410-1	hermetic	0.6	2.0	250	15	7	1.1	15	90
SD 3410-2	hermetic	2.0	2.0	250	15	7	1.1	25	90
SD 3410-3	hermetic	4.0	2.0	250	15	7	1.1	75	90
SD 3410-4	hermetic	8.0	2.0	250	15	7	1.1	125	90
SD 5410-1	hermetic	2.0	0.2	250	15	7	1.1	15	6
SD 5410-2	hermetic	4.0	0.2	250	15	7	1.1	25	6
SD 5410-3	hermetic	8.0	0.2	250	15	7	1.1	75	6
SDP 8106-1	plastic	1.0	1.0(a)	250	15	7	1.1(b)	75	50

Notes:

(1) Storage temperature −65°C to +150°C (hermetic)
−40°C to +85°C (plastic)

(2) Operating temperature −65°C to +125°C (hermetic)
−40°C to +80°C (plastic)

(3) Angular response is defined to be the total included angle between half sensitivity points.

(a) Light source is a 940nm LED.

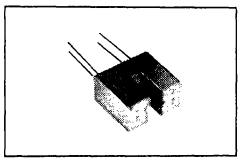
(b) I_C = 250μA

*The value of H is measured in mW/cm^2 from a tungsten source @ a color temperature of 2870°K.

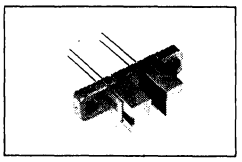
Specifications indicated are for 25°C ambient temperature.
See individual data sheets for temperature derating information.

OPTEK
345 Industrial Blvd.
McKinney, Texas 75069
(214) 542-9461

A DIVISION OF CROWN SEMICONDUCTOR



K-8105



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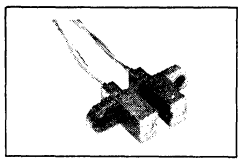

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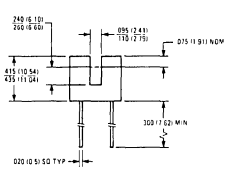
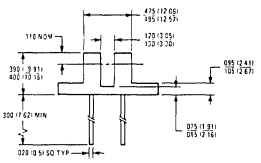
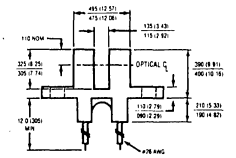


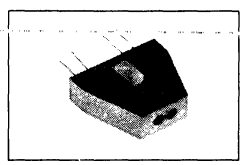




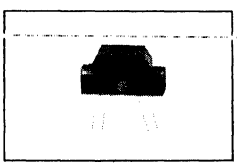
Coupled Electrical Characteristics

Device	On State Output Current I_F = 20mA, V_{CE} = 10.0V		
	MIN	TYPICAL	UNIT
K-8105	500	1300	μA
K-8102	500	1400	μA
K-8170	200	1500	μA

Available with wires attached and various apertures on sensor.



K-8710



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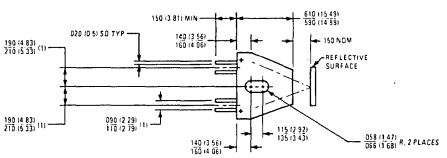
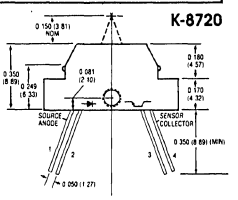
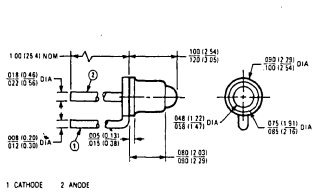




Coupled Electrical Characteristics

Device	On State Output Current I_F = 40mA V_{CE} = 5.0V, d = 0.15"		
	MIN	TYPICAL	UNIT
K-8710	200	500	μA
K-8720	100	350	μA

Available with wires attached.



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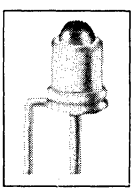
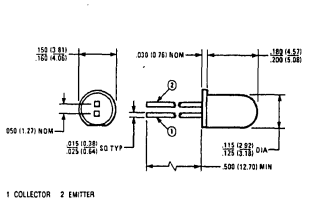


K-6100 K-5100



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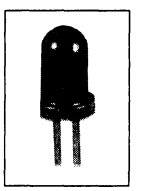
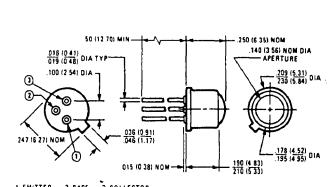


K-6500 K-5500

Phototransistors

Device	Light Current	@V_{CE} = 5.0V
	MIN	H = mW/cm²
K-5100	1.5mA	5
K-5250	4.0 mA	5
K-5500	0.5 mA	20
K-5550	1.0 mA	20



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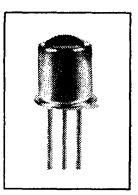
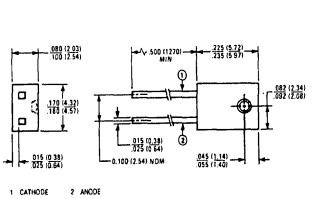


K-5250



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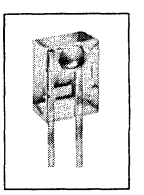
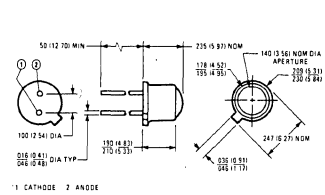


K-6550 K-5550

Infrared Light Emitting Diodes

Device	Output Power	Forward Current
	MIN	I_F
K-6100	0.35mW	50mA
K-6250	3.00 mW	100 mA
K-6500	0.5 mW	20 mA
K-6550	0.5 mW	40 mA



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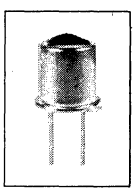


K-6250

Other electrical and mechanical devices available as standard products from Optek. Write for the Optek catalog for other standard products.

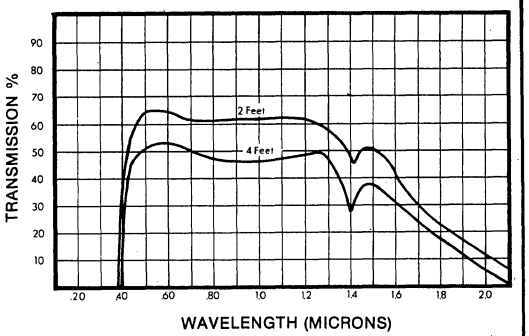
Rehlander Associates
363 RANTOUL STREET
BEVERLY, MASSACHUSETTS 01915
(617) 922-5961

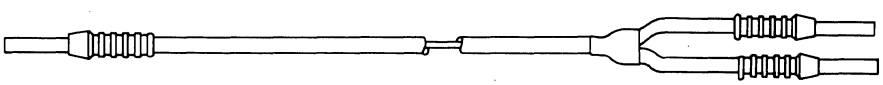
FIBER OPTIC PHOTOELECTRIC SENSOR CABLES

New line of fiber optic sensor cables allow photoelectric sensing in confined areas where space prohibits conventional emitters and detectors. Electrical isolation is provided for access into explosive or wet environments. Fiber optic sensor cables are compatible to standard PC board active device mounts and bulkhead receptacles allowing all electronic components to be mounted on the PC board. Proximity type sensors combine emitter and detector into a homogenous .032″ or .062″ active diameter.

Specifications:
Transmission: 600 to 700 dB/Km
Numerical Aperture: 0.56NA
Acceptance Angle: 68°
Operating Temperature:
-40°F to +225°F
Outside Diameter of Cable: .125″
Minimum Bend Radius: .25″

TRANSMISSION VS WAVELENGTH



	Common Bundle Diameter	Part Number (length)
REFLECTIVE TYPE		
	.032	P032-XX-PSC
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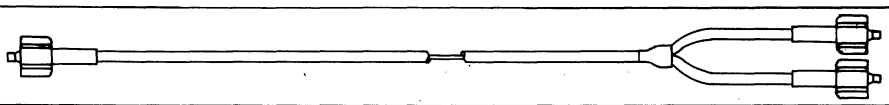	.032	S032-XX-SASC
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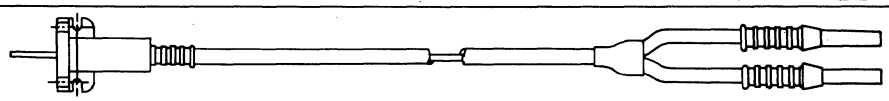	.032	HM032-XX-PSC
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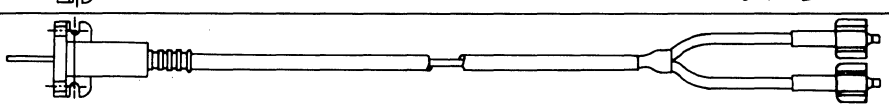	.032	HM032-XX-SASC
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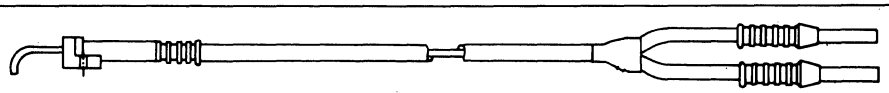	.032	HLM032-XX-PSC
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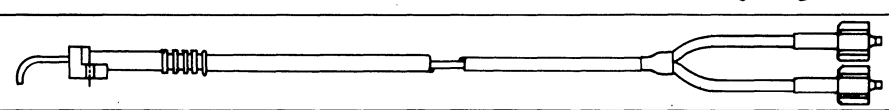	.032	HLM032-XX-SASC
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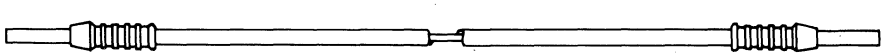	.032	P032-XX-P
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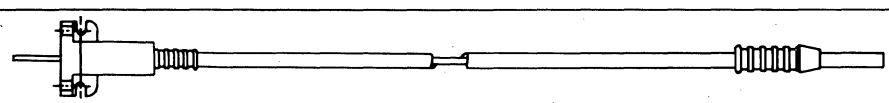	.032	HM032-XX-P
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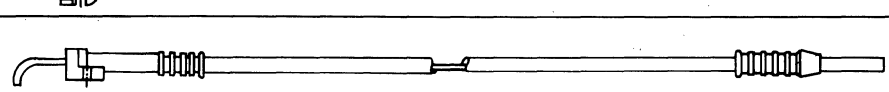	.032	HLM032-XX-P
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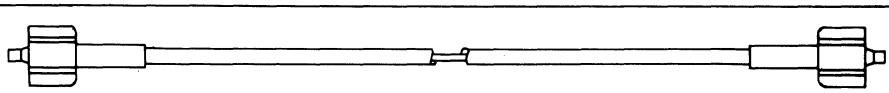	.032	S032-XX-SA
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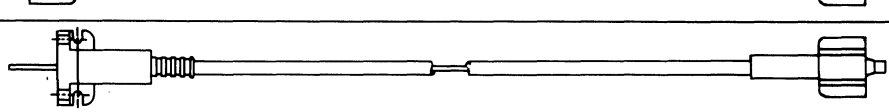	.032	HM032-XX-SA
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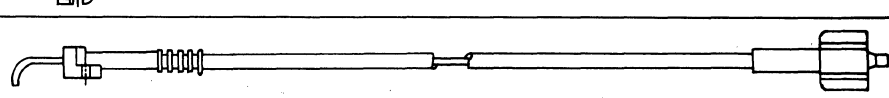	.032	HLM032-XX-SA
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SILONEX inc
FORMERLY NATIONAL SEMICONDUCTORS LTD.

PHOTOCELLS • PHOTODIODES • PHOTOVOLTAIC CELLS, PANELS AND POWER SYSTEMS • OPTICALLY COUPLED ISOLATORS • OPTOELECTRONIC ARRAYS • UV SENSITIVE LDRs

CdS & CdSe PHOTOCELLS

Cell Type No.	Typical 1.0 Ftc Res. KΩ	Min. Dark Res. MΩ	Max. Peak Volt.	Max. Power MW.	Description
NSL-312	75	100	70	50	CdSe Photoconductive Cell in Hermetic Glass and Metal TO-18. Plastic coated "Open pill" versions also available.
NSL-313	30	100	70	50	
NSL-314	14	100	70	50	
NSL-315	550	1000	250	50	
NSL-316	260	1000	250	50	
NSL-317	110	1000	250	50	
NSL-318	50	500	120	50	
NSL-4122	75	1	80	50	TO-18 CdS Photoconductive Cell in plastic coated "open pill" package. Hermetic Package also available.
NSL-4132	30	0.2	80	50	
NSL-4142	14	0.1	80	50	
NSL-4152	550	10	320	50	
NSL-4162	260	10	320	50	
NSL-4172	110	5	320	50	
NSL-4182	50	1	160	50	
NSL-444	120	50	1000	1000	1" CdS Photoconductive Cell in Hermetic Glass and Metal case 1.25" diameter.
NSL-445	26.0	15	1000	1000	
NSL-446	11.4	5	1000	1000	
NSL-447	5.5	0.5	1000	1000	
NSL-4442	120	10	1000	500	1" CdS Photoconductive Cell in plastic coated "open pill" package.
NSL-4452	26	1.5	1000	500	
NSL-4462	11.4	0.5	1000	500	
NSL-4472	5.5	0.2	1000	500	
NSL-461	65	80	80	100	CdS Photoconductive Cell in Hermetic Glass and Metal ¼" dia. case. Hermetic CdSe versions also available.
NSL-462	28	20	80	100	
NSL-463	12	2.7	80	100	
NSL-464	5.2	0.7	80	100	
NSL-465	550	160	250	100	
NSL-466	230	20	250	100	
NSL-467	100	4	250	100	
NSL-481	43.0	65	120	200	CdS Photoconductive Cell in Hermetic Glass and Metal TO-5. Plastic coated "open pill" versions also available.
NSL-482	18.6	15	120	200	
NSL-483	8	1.8	120	200	
NSL-484	3.5	0.25	120	200	
NSL-485	330	200	250	200	
NSL-486	155	130	250	200	
NSL-487	66	20	250	200	
NSL-293	1.7	0.4	80	500	TO-8 Hermetic CdS/Se Photoconductive Cell.
NSL-294	.75	50	80	500	
NSL-297	7.5	1.0	250	500	
NSL-3921	4.0	2	80	200	TO-8 CdSe Photoconductive Cell in Plastic Case, Glass Lens and Plastic Coated "open pill" and CdS versions also available.
NSL-3931	1.7	2	80	200	
NSL-3941	0.75	2	80	200	
NSL-3951	40.0	5	320	200	
NSL-3961	17.0	5	320	200	
NSL-3971	7.5	5	320	200	
NSL-492	4.0	2.0	80	500	CdS Photoconductive Cell in Hermetic Glass and Metal TO-8. Hermetic CdSe version also available.
NSL-493	1.7	0.4	80	500	
NSL-494	0.75	0.05	80	500	
NSL-495	40	30	320	500	
NSL-496	17	4.0	320	500	
NSL-497	7.5	0.5	320	500	
NORP-11	20	2.5	320	250	CdS Photocell in 0.5" lensed Plastic case.
NORP-12	9	1	320	250	
NORP-13	4	0.5	320	250	

UV SENSITIVE LDRs

Cell Type No.	Typical 1.0 Ftc Res. KΩ	Min. Dark Res. MΩ	Max. Peak Volt	Max. Power MW	Description
NSL-2129/3	1.7	0.2	80	200	0.5" Plastic Case with Phosphor-Coated Quartz Window
NSL-2129/6	17.0	1	320	200	

PIN PHOTODIODES

NSL Type No.	Light Current* MA	Dark Current nA	Rise Time nS	Fall Time nS	Description
NSL-530	0.3	10	3	6	TO-18 Package
NSL-580	1.5	30	5	8	TO-5

* At 500 Ftc (25 MW/cm²) 2870°K Source

PHOTOVOLTAIC MODULES

NSL Type No.	Typical Short Ct. Current	Typical Open Ct. Voltage	Peak Power	Mechanical Description
NSL-5925	2.2A	20.5V	32W	40.2" x 15.8" x 1.74"
NSL-5950	1.25A	19.5V	18W	21.2" x 17.6" x 1.74"
NSL-5978	680mA	19.5V	9W	17.56" x 12.32" x 1.74"

PHOTODETECTOR LAMP/LED ASSEMBLIES

CdSe Photodetector

Module Type No.	Emitter Volts	Emitter Current MA	Detector Max. ON Res. Ω	Detector Min. OFF Res. MΩ	Detector Max. Volts	Detector Max. Power	Description
PL-1033-1	10	15	100	10	80	250	Phenolic .75" x .75" x 625" Pin Leads for P.C. Board Mounting, (Matched, Multi-Detector Configurations available.)
PL-1036-1	10	15	400	50	320	250	
PL-2H33-1	200	2	100	10	80	250	
PL-2H36-1	200	2	400	50	320	250	
PL-5S33-1		25	250	10	80	250	
PL-5S36-1		25	2000	50	320	250	
PLT-10384	10	15	250	10	80	100	Standard tube; Axial leads.
PLT-10387	10	15	3000	100	320	100	
PLT-2H384	200	2	500	10	80	100	
PLT-2H387	200	2	10000	100	320	100	
PLS-5S380		25	250	10	80	100	Small tube; Axial leads.
PLS-5S387		25	4000	100	320	100	
PLM-5S310		25	500	10	80	50	Miniature Tube; Axial leads.
PLM-5S317		25	5000	100	320	50	

SILICON PHOTODIODES

Cell Type No.	Min. Short Ct.* Curr. MA	Min. Open Ct.* Volt.	Dark Curr. μA @ 1V @ 25°C	Reverse Voltage Recom. Max.	Description
NSL-701-1	0.30	0.35	3	5	.1" x .2" Chip. Wire Leads
NSL-801-1	0.325	0.275	1.5	10	
NSL-701-9	0.30	0.35	3	5	9 Element Cell, 0.1" Spacing
NSL-702	0.6	0.35	5	5	.2" x .2" Chip.
NSL-802	0.65	0.275	2.5	10	Wire Leads
NSL-703	1.4	0.35	15	5	.2" x .4" Chip. Wire Leads
NSL-803	1.5	0.275	7.5	10	
NSL-705	4.5	0.35	25	5	.76" x .354" Chip. Wire Leads
NSL-805	4.77	0.275	12.5	10	
NSL-706	2.9	0.35	20	5	.4" x .4" Chip. Wire Leads
NSL-806	3.0	0.275	10	10	
NSL-707	3.3	0.35	25	5	.2" x 1" Chip. Wire Leads
NSL-807	3.5	0.275	12.5	10	
NSL-708	1.3	0.35	15	5	.1" x 1" Chip. Wire Leads
NSL-808	1.4	0.275	7.5	10	
NSL-710	0.125	0.4	1	5	TO-18 Package
NSL-810	0.150	0.275	0.5	10	
NSL-751	1.4	0.35	2.0	5	0.5" dia. Epoxy Package
NSL-851	1.5	0.275	10	10	
NSL-781	0.28	0.35	5	5	Hermetic TO-5 Case
NSL-881	0.3	0.275	2.5	10	
NSL-782	0.42	0.35	5	5	
NSL-791	0.60	0.35	5	5	Hermetic TO-8 Case
NSL-792	1.1	0.35	15	5	
NSL-8932	0.65	0.275	0.5	10	0.5" dia. Ceramic

* At 500 Ftc (25 MW/cm²) 2870°K Source

SILICON PLANAR PHOTODETECTORS

Cell Type No.	Min. Short Ct.* Curr. μA	Min. Open Ct.* Volt.	Dark Curr. NA @ 5V @ 25°C	Break-down Voltage (V)	Description
NSL-811	100	0.4	5	40	TO-18, Flat Window
NSL-812	310	0.4	5	40	TO-18, Low Lens
NSL-813	220	0.4	5	40	TO-18, High Lens
NSL-814	90	0.4	5	40	TO-52, Flat Window
NSL-815	240	0.4	5	40	TO-52, Low Lens
NSL-883	360	0.4	10	20	TO-5, Flat Window
NSL-893	800	0.4	20	10	TO-8, Flat Window

* At 500 Ftc, 2870°K Source

SILICON BLUE SENSITIVE PHOTODIODES

Cell Type No.	Sensi-tivity @ 500 nM (A/W)	Min. Short Ct.* Curr. μA	Dark Curr. μA @ 1V @ 25°C	Break-down Voltage	Description
NSL-710BG	0.17	18	1.0	5	TO-18, BG Filter
NSL-810BG	0.17	18	0.5	10	TO-18, BG Filter
NSL-811BG	0.20	18	0.005	40	TO-18, BG Filter
NSL-780BG	0.17	35	5.0	5	TO-5, BG Filter
NSL-880BG	0.17	35	2.5	10	TO-5, BG Filter
NSL-883BG	0.20	40	0.01	20	TO-5, BG Filter

* At 500 Ftc, 2870°K Source

SILONEX inc

TWX 610-421-3362
TLX 51 669 663

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ALTRINCHAM, CHESHIRE, WA14 4NX TEL: (061) 928-3417

MINIGLOSSARY OPTO SEMICONDUCTORS

Avalanche Photodiode: A photodiode that takes advantage of avalanche multiplication of photocurrent. It is particularly suited to low noise and/or high speed applications.

Contrast: A noticeable difference in color, brightness, or other characteristics in a side-by-side comparison.

Chrominance Contrast: The color contrast between two adjacent surfaces of identical area, shape, texture, and luminance. The human eye is more sensitive to differences in color than it is to differences in brightness.

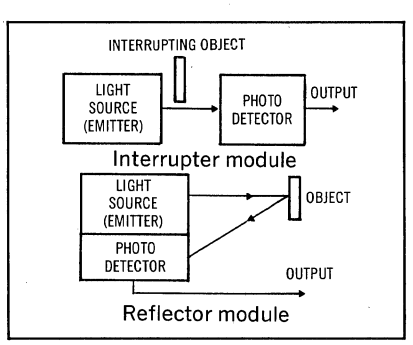
Current Transfer Ratio: The ratio of an optocoupler's output current to input current at a specified bias.

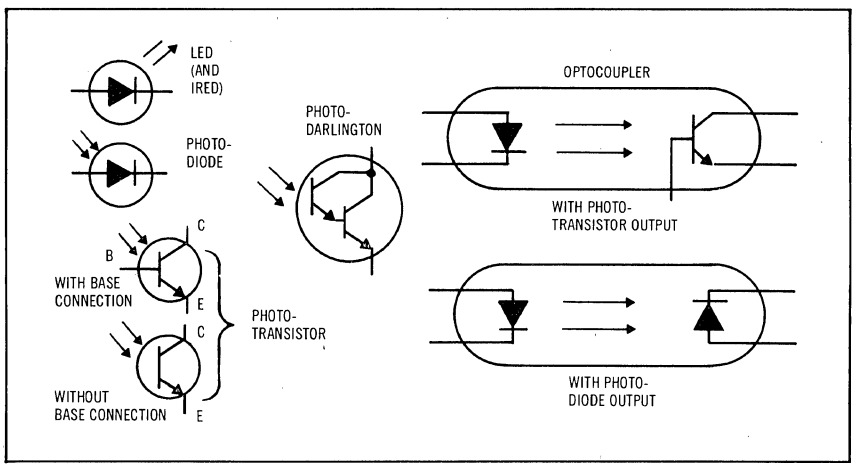
Dark Current: The leakage current of a photodetector with no incident light.

Dominant Wavelength: The wavelength that is a quantitative measure of apparent color of light as perceived by the human eye.

Infrared Radiation: The electromagnetic wavelength region between approximately 0.75 and 100 micrometers longer than the wavelength of visible light.

Interrupter (module): A device that produces an electrical output signal when an object breaks the light (visible or invisible) between a light source and a photodetector.





IRED: An infrared-emitting diode. See light-emitting diode.

Light Current: The current that flows through a photodetector when it is exposed to radiant energy.

Light-Emitting Diode (LED): A semiconductor diode that emits incoherent light at its PN junction when forward biased. The light can be in the visible or invisible (infrared) wavelength region.

Luminance Contrast: The observed brightness of a light-emitting element compared to the brightness of the "surround," an integral part of the device and inseparable from it.

Optocoupler: A device that transmits electrical signals, without electrical connection, between a light source (input) and the receiver (output). The input is generally an LED; the output might be a photodiode, phototransistor, a photo–Darlington, etc. Sometimes referred to as optoisolator.

Peak Wavelength: The wavelength at the peak of the radiated spectrum of an emitter.

Photo–Darlington: A light-sensitive Darlington-connected transistor pair. The photo–Darlington has a very high sensitivity to illumination or radiation.

Photodetector: A device that provides an electrical output signal when subjected to radiation in the visible, infrared, or ultraviolet regions of the electromagnetic spectrum. Photodiodes, phototransistors, and photo–Darlingtons are the most common type of photodetectors.

Photodiode: A junction diode that is responsive to radiant energy. Photodiodes have a high degree of linearity between the input radiation and the output current, and faster switching speeds than phototransistors.

Photothyristor: A thyristor whose switching action is controlled by light applied to the thyristor gate.

Phototransistor: A light-sensitive transister that delivers an electrical output proportional to the light intensity at its input. The low-level photocurrent that is generated is amplified by the current gain of the transistor. The base region (or gate in a FET) may or may not be brought out as an external terminal.

Point Source: A source with a maximum dimension less than one-tenth the distance between sources and detector.

Reflector (module): A device containing a light source and a photodetector that detects any object that reflects light produced by the source back to the detector.

- Photoconductive Cells
- Interrupter Switches
- Phototransistors and Photodarlingtons
- Retroreflective Switches
- Light Activated Switches

VACTEC

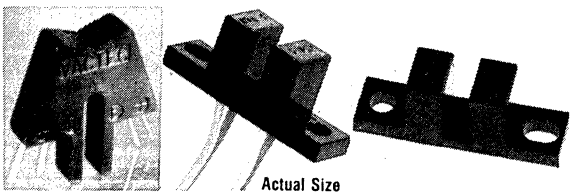
- Selenium Photovoltaic Cells
- Vactrols (Opto-Isolators)
- Infrared Emitters

INDUSTRY'S BROADEST OPTOELECTRONIC LINE

- Standard Silicon and Blue-Enhanced Photovoltaic Cells, Blue-Enhanced Photodiodes, and PIN Photodiodes

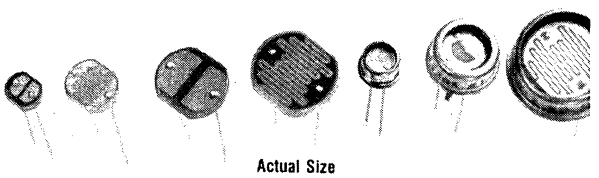
RETROREFLECTIVE & INTERRUPTER SWITCHES (Slotted)

Standard and custom optical switches—infrared GaAs LED and silicon phototransistor in an I-R transmitting housing. No openings or seams to collect dirt—available completely sealed for submersion during board cleaning—interchangeable with industry standard sizes. Request bulletins RPS-1 and SPS-1. New slotted switch with Schmitt Trigger output, bulletin SPS-2.



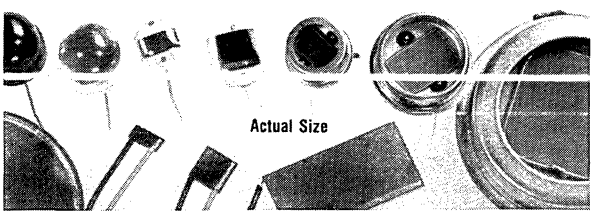
PHOTOCONDUCTIVE CELLS

Vactec light dependent resistors (LDR's) are available in three hermetic enclosures (TO-18, TO-5, TO-8) and 4 ceramic types. Ceramic types have automatically inserted wires which insure perfect contact integrity. Six materials of CdS, CdSe and CdSeS-CdS mixtures with spectral response peaks from 565-735 nm. Each material has a variety of sensitivities to satisfy all requirements. Request bulletin PCD-6.



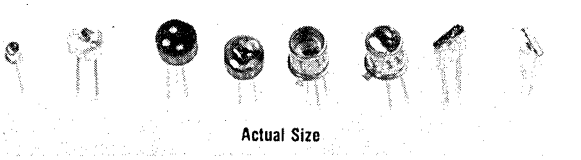
SILICON PHOTOVOLTAIC CELLS

Three processes: BLUE ENHANCED, LOW CAPACITANCE, STANDARD SOLAR. All available in a variety of hermetic, ceramic, as chips, or with flying leads. The BLUE ENHANCED cells are unique large area detectors with high U-V sensitivity to as low as 200 nm. Almost non-existent U-V enhancement effect with stability equivalent to high quality photodiodes. Request bulletin VTS3A. LOW CAPACITANCE cells have fast response less than 15μS with 10KΩ load. The high shunt impedance is desirable for driving amplifiers. Request bulletin VTS-2. SOLAR cells have high V_{OC} at low illumination (typ 200mV at .05mW/cm²). Linear over wide illumination range—request bulletin VTD-1.



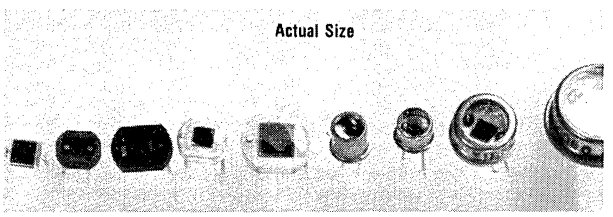
PHOTOTRANSISTORS — LED'S — PHOTODARLINGTONS — LIGHT ACTIVATED SWITCHES (LAS)

Phototransistors and photodarlingtons are NPN passivated—4 chip sizes of 25, 40, 50, and 60, mil square in TO-18, ceramic, coaxial, and lateral (side looking) packages. High light current at very low drive current ideal for instrumentation applications. Request bulletin VTTA-3A. GaAs I-R LED's with excellent stability in TO-18, T-1, T-1¾, lateral packages. Bulletin VTE-1. LAS (light activated switches) have high sensitivity with Schmitt Trigger output. Bulletin LAS-1, LAS-2.



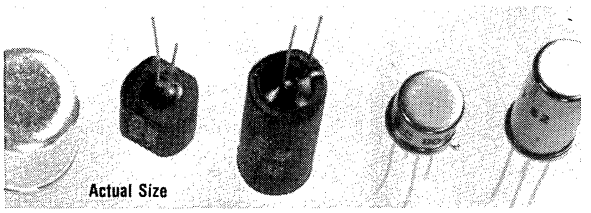
PHOTODIODES

BLUE ENHANCED photodiodes are extremely low dark current devices with excellent response in the U-V. Less than 10pA (I_D) for small chips. Large area diodes (VTB5051) 14.8mm² active area with 1.2A/(W/cm²) at 365nm and I_D of 250pA max. Request bulletin VTB-1B. FAST photodiodes have low capacitance. Use with reverse bias for fast response time and excellent linearity. Ideal for remote I-R sensor digital controls. Request bulletin VTD-1.



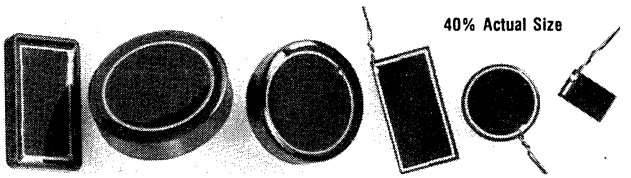
VACTROLS

Optical couplers using LED's, neons, or incandescent lamps as the emitter and Vactec photoconductive cells (LDR's) as the detector. For noiseless switching and signal monitors for audio. Neon types to sense telephone ring. LED types for triac gate control. Incandescent types for low cost true RMS sensor as voltage regulator or control of constant wattage heater. Five package types include 2 hermetic. Request bulletins VTL1, VTL2C, VTL3, VTL5CA, VTL5C8 and VTL9.



SELENIUM PHOTOVOLTAIC CELLS

Large area detectors for direct meter drive or in conjunction with amplifier. Spectral response peaks at 575 nm and is close to visible response. Available with integral #102 filter to match standard observer curve (CIE). Available in many flat or round cells with or without leads—also in 9 package styles including 2 hermetic. Request bulletin SPV-5A.



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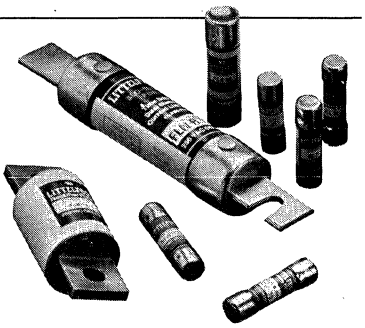
NEW FROM LITTELFUSE

The right industrial fuse for the right place. At the right price. Right on time.



We've been manufacturing small dimension fuses for over half a century, giving you state-of-the-art performance, reliability and service.

Now we can offer the same advantages in our new line of top quality industrial fuses: midget, semi-conductor rectifier, general purpose, hi-interrupting, one-time and renewable fuses. All backed by Littelfuse. And all available at competitive prices and ready for quick delivery. So when the time comes to replace your industrial fuses, we hope you'll save this handy guide and think of Littelfuse...the company that can meet all of your fuse requirements...big or small.

When Replacing These Series	Replace With Littelfuse Series
A2D-R	LLNRK
A4BT	KLP-C
A6D-R	LLSRK
A6Y TYPE 2	KLK
A13X	KLA
A13Z	KLA
A25X	KLB
A25Z	KLB
A50P	KLH
A60C	KLC
BAF	BLF
BAN	BLN
BBS	BLS
CLL	KLP-C
CM	BLF
CMF	BLN
CNM	FLM
CRNR	FLNR
CRSR	FLSR
CTK	KLK
EBS	BLS
ECNR	FLNR
ECSR	FLSR
EON	NLN
ERN	RLN
FNA	FLA
FNM	FLM
FNQ	FLQ
FRNR	FLNR
FRSR	FLSR
KAA	KLA
KAB	KLB
KAC	KLC
KAW	KLW
KBH	KLH
KRP-C	KLP-C
KTK	KLK
LCL	KLP-C
LENR	LLNRK
LESR	LLSRK
LOSR	LLSRK
LOWR	LLNRK
LPNR	LLNRK
LPSR	LLSRK
MCL	KLK
MEN	FLM
MEQ	FLQ
MID	FLA
MOF	BLN
MOL	BLF
MRL	KLW
NON	NLN
OTM	BLF
OTN	NLN
REN	RLN
RF	RLN
RFA	KLA
RFC	KLC
RFN	KLB
RFV	KLH
TR-R	FLNR
TR-SR	FLSR
TRM	FLM

	Fuse Symbol	Ampere Rating	AC Volts	U.L. Class	Interrupting Rating	General Fuse Applications
MIDGET FUSES	BLF BLN BLS FLA FLM FLQ	1/2-30 1-30 2/10-10 1/10-30 1/10-30 1/10-30	250 250 600 250/125 250 500	"Micro miniature miscellaneous fuses"	10,000	• Electronic devices • Control circuit transformers • Motor controls • Switchboards • Panels
MIDGET FUSES	KLK	1/10-30	600	Miscellaneous	200,000	• Pilot circuit wiring or switchboards • Electronic devices • Control circuitry • CT applications
SEMICONDUCTOR RECTIFIER FUSES	KLA KLB KLC KLW KLH	1/2-1000 1/2-1000 1-1000 1-30 10-1000	130 250 600 130 500	"Special purpose fuses"	30,000 200,000 200,000 10,000 200,000	• Variable speed drives • Motor controllers for conveyers & rotative machines • U.P.S. systems • D.C. drives • AC or DC semiconductor rectifiers • S.C.R. drives • Inverters • Mine power supplies
GENERAL PURPOSE FUSES	LLNRK LLSRK	1/10-60 70-600 1/10-60 70-600	250 250 600 600	RK5 RK1 RK5 RK1	200,000 200,000 200,000 200,000	• Motor branch circuits • C/B back-up protection • Branch feeders • Transformers • Protection distribution
GENERAL PURPOSE FUSES	FLNR FLSR	1/10-600 1/10-600	250 600	K5 & RK5 K5 & RK5	200,000	• Motor controllers & overcurrent protection • Motor protection • Coordinated systems & thermal sensitivity • Protect mains & feeders • Heating & air conditioning coils & transformers • Thermal protection in panels & switches
HI-INTERRUPTING CLASS-L FUSES	KLP-C	601-6000	600	L	200,000	• Switchgear • Air circuit breakers • Safety switches • Bolted pressure switches • Service entrance equipment
ONE-TIME & RENEWABLE FUSE	NLN RLN	1-600 1-600	250 250	H H	10,000 10,000	• Service entrance equipment • Low cost circuit protection • Fusible equipment • Lighting & heating loads

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eem protective components selection guide

Protective Components... Most electronic equipment needs some sort of protection against catastrophic overloads from either external or internal sources. Fuses and circuit breakers are widely used to provide this protection, but there are other electronic products which can provide certain kinds of circuit protection.

That's the purpose of this EEM Product Selection Guide. It is designed to help you find the kinds of products you need for your specific design problem. Use this Guide as a quick directory to a specific page.

After you've found a product which seems to be the best answer to your problem, you'll probably want to talk to a local sales office or distributor. You'll find these listed in EEM's "Yellow Pages" in the front of this Volume. Or, you may wish to call the manufacturer directly. Before you do, get your thoughts and questions organized. Be prepared to talk to a telephone operator at the other end who may (or may not) have any technical knowledge. If you need technical assistance, state that as clearly as possible.

After you've reached the knowledgeable person, ask your questions in a realistic and rational manner. After all, you've had hours or days to come up with the questions, the other person needs to be brought up to your speed. It's helpful if you can tell the person you are looking at a specific page in EEM. Chances are the other person will have a copy of EEM nearby and can refer to the same page. This will help in your communications.

Remember, the overwhelming majority of manufacturers want to help you. That's why they put the data pages in EEM. They want you to see the pages, decide what you need and make that call for additional information, quotations or other data. Helping them to answer your questions helps you.

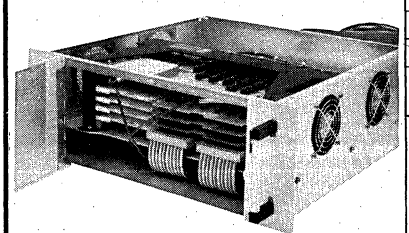
	Aatlee of Delaware	Atlantic Scientific	Control Concepts	FIC Corp.	Heinemann	Littelfuse/ Tracor	MCG Electronics	Belfuse	Littelfuse
Circuit Breakers					1•1712				
Fuses						1•1702		1•1706	1•1714
Fault Indicating Fuses								1•1708	1•1717
Rectifier Fuses						1•1702			1•1715
Limiters, Current		1•1704					1•1722		
Limiters, Surge		1•1704					1•1722		
Suppresors, Transient Voltage		1•1704	1•1709				1•1722		
Protectors, Surge			1•1709				1•1722		
Fuse Clips & Holders	1•1705			1•1711				1•1708	1•1717
Fuses, UL, CSA Listed								1•1706	
Fuses, Slow-Blowing								1•1706	
Fuses, Fast-Acting								1•1707	1•1714
Fuses, Miniature & Subminiature								1•1707	1•1714

Page numbers indicate the first EEM page on which each manufacturer lists this product. Additional references may follow on succeeding pages.

STATE-OF-THE-ART PROTECTION FOR POWER LINES AND DATA LINES

PROTECT YOUR SENSITIVE ELECTRONIC EQUIPMENT AGAINST ALL HAZARDS — FROM RANDOM TRANSIENTS TO LIGHTNING INDUCED SURGES

FIBER OPTIC TECHNOLOGY



FIBER OPTIC MULTIPLEXER

APPLICATION:

Computer to computer links

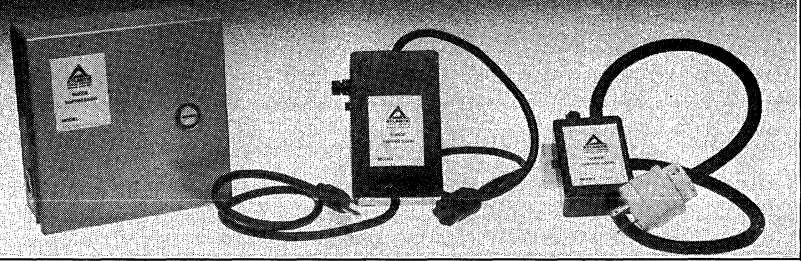
Secure communication links

Error free operation in high electrical noise environment

MULTIPLEXER FEATURES

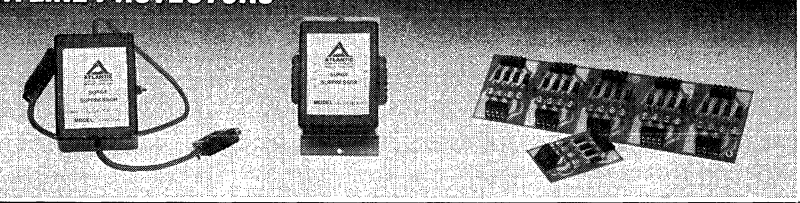
- Synchronous or Asynchronous operation
- 32 channel modular construction expandable to 128 channels/chassis
- Selectable channel/data rate configuration from 128 channels at 9.6 KBPS to 8 channels at 153.6 KBPS
- RS232-C electrical interface standard
- High density modular packaging and local/remote loop back provides easy maintenance and fault isolation
- Synchronous clocks provided at all standard rates at or below 9.6 KBPS

POWER LINE PROTECTORS



FEATURES:	M B SERIES	R B SERIES	H P B SERIES
Protection from surges	Up to 65,000A	Up to 25,000A	Up to 250A
Response time	50 nanoseconds	<10 nanoseconds	<10 nanoseconds
Holdover current	None	None	None
Failure indicator light	Yes	Yes	Yes
Solid state	100%	100%	100%
For protection of:	-power lines at service entrance and circuit breaker panels, against high current line surges and lightning induced effects	-solid state equipment control systems, and computers, where high energy powerline surge protection is required	-secondary power insertion applications to semiconductor equipment, such as computer, CATV, and control systems
Models available (VAC)	120, 240, 277, 350, 480, 600 split-phase or 3-phase	120, 240, 277 1-phase or split-phase	120, 240 1-phase, split-phase or 3-phase
Recovery time	Instant	Instant	Instant
Life of unit	500A>5000 times	500A>5000 times	250A>1500 times
Fail safe	Short	Short	Short
Other features	Wall or knockout mounting, metal enclosures	Completely self contained in phenolic enclosure with line cord and connectors as specified	

DATA LINE PROTECTORS



FEATURES:	RS 232 SERIES	D L SERIES	D L(E) SERIES
Protection from surges	Up to 6500A surges	Up to 6500A surges	Up to 6500A surges
Response time	5 nanoseconds	5 nanoseconds	5 nanoseconds
Holdover current	None	None	None
Recovery time	Instant	Instant	Instant
For protection of:	-the EIA (RS-232-C) digital interface of computers, terminals, and modems from surge and transient voltages caused by lightning, inductive load switching and static electricity	-low energy, low voltage DC data, telephone, or signal lines from surge and transient voltages caused by lightning, inductive load switching and static electricity	
Solid state	100%	100%	100%
Number of wires protected	1, 2, 3 and 7 standard additional wires available	2 to 8	4 to 20 each card
Other features	Plug-in protection for RS-232	Protection for RS-232, RS-422, 20 ma loop, etc.	

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LIGHTNING WARNING • LOCATION • PROTECTION

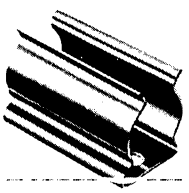
ATLEE COMPONENT HOLDERS

Atlee component clips are made of spring steel and beryllium copper because they afford the most generally desirable combination of properties. Specific selection of material will depend on conditions of the application.

Atlee offers a complete line of MS and NAS component clips. In addition clips can be manufactured to your specification for a variety of uses. Please contact the factory with your questions and special requirements.

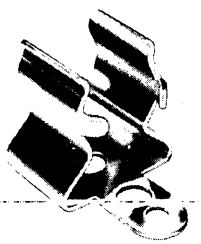
FEATURES

- The design of our component holders, from raw material through the finished product, ensures maximum performance and reliability under extreme usage, insertion, withdrawal force, and shock and vibration.
- Holding power increases as shock and vibration increase, measured by force required to remove component.
- Special contour design acquires closer set to component during shock and vibration, increasing security without localized pressure.
- Slotted design assures firm retention for fragile components without risk of injury.
- As an indication of the spring characteristics of Atlee's component holders, all of which are heat treated after forming, the following data is supplied; beryllium copper will withstand over 500 and spring steel 100 insertion-withdrawals of a slug 1/32" larger than nominal diameter, without metal fatigue.



Beryllium Copper, QQ-C-533a

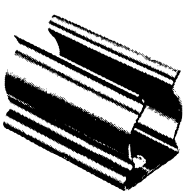
PLATING: cadmium CQ-P-416a; silver, QQ-S-365a; zinc, QQ-Z-325; tin, QQ-T-425; nickel, QQ-U-290; black matte, MIL-F-495A.
Various finishes available.
Designed to hold resistors, capacitors and small cylindrical devices. Fastened by means of rivets, eyelets, screws or similar fasteners.



Fuse and Resistor Holders

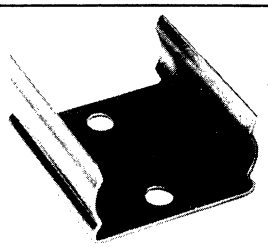
MATERIAL: phosphor bronze, QQ-B-750; beryllium copper, QQ-C-533a.

PLATING: silver, QQ-S-365a.
Finishes available silver plate.
Designed to hold fuses and ferrule-type resistors, plus reduce heating by providing high contact pressure.



Spring Steel, QQ-S-777a

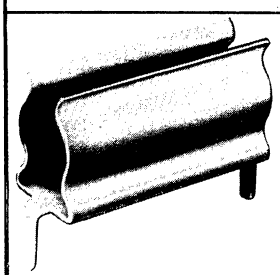
PLATING: cadmium CQ-P-416a; silver, QQ-S-365a; zinc, QQ-Z-325; tin, QQ-T-425; nickel, QQ-N-290; black matte, MIL-F-495A.
Various finishes available.
Designed to hold resistors, capacitors and small cylindrical devices. Fastened by means of rivets, eyelets, screws or similar fasteners.



Crystal Clips

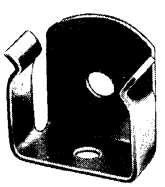
MATERIAL: spring steel, QQ-S-777a, spring steel S.A.E. 1065.

PLATING: cadmium, QQ-P-416a; silver, QQ-S-365a; zinc QQ-Z-325; tin, QQ-M-151; nickel, QQ-N-290; black matte, MIL-F-495A.
Various finishes available.
Designed to provide secure mounting for flattened elliptical components.



Tab Mounted Clips

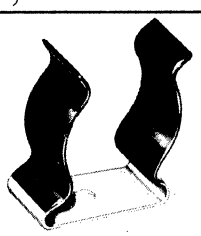
MATERIAL: beryllium copper, QQ-C-533a.
PLATING: cadmium, QQ-P-416a; silver, QQ-S-365a; zinc, QQ-Z-325; tin, QQ-M-151; nickel, QQ-N-290; black matte, MIL-F-495A.
Various finishes available.
Designed to hold resistors, capacitors, relays and similar cylindrical components. Fastened to a circuit board by tabs.



Transistor Clips

MATERIAL: beryllium copper, QQ-C-533a.

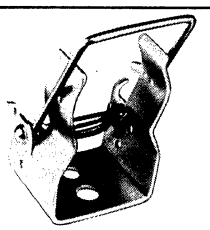
PLATING: cadmium, QQ-P-416a; silver, QQ-S-365a; tin, QQ-M-151; nickel, QQ-N-290; black matte, MIL-F-495A.
Various finishes available.
Designed to hold transistors without depending on soldered leads and at the same time act as a heat sink.



Industrial Component Holders

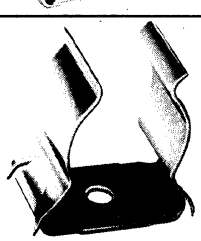
MATERIAL: spring steel S.A.E. 1065, .020 thick.

PLATING: commercial nickel, commercial nickel and vinyl coating
Designed for use in industrial and commercial applications.



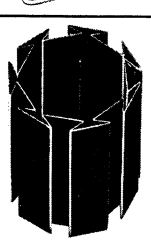
Locking Clips

MATERIAL: spring temper phosphor bronze, QQ-B-750.
PLATING: silver, QQ-S-365a; cadmium, QQ-P-416a; nickel, QQ-N-290; Class II, Type VI.
Various finishes available.
Designed to hold a fuse, ferrule-type resistor or similar component against the most severe shock and vibration.



No-Twist Clips

MATERIAL: spring steel, QQ-S-777a.
PLATING: cadmium, QQ-P-416a; silver, QQ-S-365a; zinc, QQ-Z-325; tin, QQ-M-151; nickel, QQ-N-290; black matte, MIL-F-495A.
Various finishes available.
Designed for holding capacitors and similar cylindrical components, without twisting.



Heat Dissipating Liners

MATERIAL: beryllium copper, .002 thick per QQ-C-533a, heat treated.

FINISH: black matte
Designed to cool many types of components combined with different types of cooling methods.

atlee, INC.
1 GILL STREET, WOBURN, MA 01801 • (617) 933-3510 • TELEX 949407

FUSES/UL, CSA 1-1/4" x 1/4" & 1" x 1/4"

TYPE 3AG NORMAL BLOW GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, maximum

MECHANICAL DIMENSIONS

Dimensions	Inches (mm)
Diameter	.250 (6.35)
Length	1.250 (31.75)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
3AG010	1/100	250	3AG1	1	250
3AG031	1/32	250	3AG1.25	1-1/4	250
3AG062	1/16	250	3AG1.5	1-1/2	250
3AG100	1/10	250	3AG1.6	1-6/10	250
3AG125	1/8	250	3AG1.75	1-3/4	250
3AG150	15/100	250	3AG2	2	250
3AG175	.175	250	3AG2.3	2-3/10	250
3AG187	3/16	250	3AG2.5	2-1/2	250
3AG200	2/10	250	3AG3	3	250
3AG250	1/4	250	3AG3.5	3-1/2	250
3AG300	3/10	250	3AG4	4	250
3AG375	3/8	250	3AG4.5	4-1/2	250
3AG400	4/10	250	3AG5	5	250
3AG500	1/2	250	3AG6	6	125
3AG600	6/10	250	3AG7	7	125
3AG750	3/4	250	3AG8	8	125
3AG800	8/10	250	3AG10	10	125

Listed by Underwriters' Laboratories through 8 amperes. Certified by Canadian Standards Association through 8 amperes.

Type 3AG fuses, described as normal blow, are medium to quick acting protectors for use in general circuit applications. Suitable for most circuits where high surges or transients are not anticipated.

TYPE 3AP NORMAL BLOW PIGTAIL GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, maximum

MECHANICAL DIMENSIONS

Dimensions	Inches (mm)
Diameter	.270 (6.86)
Length	1.290 (32.77)

Pigtail Leads	Inches (mm)
Diameter	.032 (.813)
Length	1.5 (38.1)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
3AP010	1/100	250	3AP1	1	250
3AP031	1/32	250	3AP1.25	1-1/4	250
3AP062	1/16	250	3AP1.5	1-1/2	250
3AP100	1/10	250	3AP1.6	1-6/10	250
3AP125	1/8	250	3AP1.75	1-3/4	250
3AP150	15/100	250	3AP2	2	250
3AP175	.175	250	3AP2.3	2-3/10	250
3AP187	3/16	250	3AP2.5	2-1/2	250
3AP200	2/10	250	3AP3	3	250
3AP250	1/4	250	3AP3.5	3-1/2	250
3AP300	3/10	250	3AP4	4	250
3AP375	3/8	250	3AP4.5	4-1/2	250
3AP400	4/10	250	3AP5	5	250
3AP500	1/2	250	3AP6	6	125
3AP600	6/10	250	3AP7	7	125
3AP750	3/4	250	3AP8	8	125
3AP800	8/10	250	3AP10	10	125

Listed by Underwriters' Laboratories through 8 amperes. Certified by Canadian Standards Association through 7 amperes.

Type 3AP fuses are medium to quick blowing fuses with the same electrical characteristics as Type 3AG. They are supplied with pigtail leads so that the fuse can be wired directly to the circuit.

TYPE 3SB SLOW BLOW GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, minimum

MECHANICAL DIMENSIONS

Dimensions	Inches (mm)
Diameter	.250 (6.35)
Length	1.250 (31.75)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
3SB010	1/100	250	3SB1	1	250
3SB031	1/32	250	3SB1.2	1-2/10	250
3SB040	4/100	250	3SB1.25	1-1/4	250
3SB062	1/16	250	3SB1.5	1-1/2	250
3SB100	1/10	250	3SB1.6	1-6/10	250
3SB125	1/8	250	3SB1.8	1-8/10	250
3SB150	15/100	250	3SB2	2	250
3SB175	.175	250	3SB2.25	2-1/4	250
3SB187	3/16	250	3SB2.5	2-1/2	250
3SB200	2/10	250	3SB2.8	2-8/10	250
3SB250	1/4	250	3SB3	3	250
3SB300	3/10	250	3SB3.2	3-2/10	250
3SB375	3/8	250	3SB3.5	3-1/2	250
3SB400	4/10	250	3SB4	4	250
3SB500	1/2	250	3SB4.5	4-1/2	250
3SB600	6/10	250	3SB5	5	250
3SB700	7/10	250	3SB6	6	250
3SB750	3/4	250			
3SB800	8/10	250			

Listed by Underwriters' Laboratories through 6 amperes. Certified by Canadian Standards Association through 5 amperes.

Type 3SB fuses, described as slow blow, are designed to prevent unnecessary blowing in circuits where transient surges are anticipated. Protection against short circuit or continued overload is still maintained.

TYPE 3SBP SLOW BLOW PIGTAIL GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, minimum

MECHANICAL DIMENSIONS

Dimensions	Inches (mm)
Diameter	.270 (6.86)
Length	1.290 (32.77)

Pigtail Leads	Inches (mm)
Diameter	.032 (.813)
Length	1.5 (38.1)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Rating Voltage
3SBP010	1.100	250	3SBP1	1	250
3SBP031	1/32	250	3SBP1.2	1-2/10	250
3SBP040	4/100	250	3SBP1.25	1-1/4	250
3SBP062	1/16	250	3SBP1.5	1-1/2	250
3SBP100	1/10	250	3SBP1.6	1-6/10	250
3SBP125	1/8	250	3SBP1.8	1-8/10	250
3SBP150	15/100	250	3SBP2	2	250
3SBP175	.175	250	3SBP2.25	2-1/4	250
3SBP187	3/16	250	3SBP2.5	2-1/2	250
3SBP200	2/10	250	3SBP2.8	2-8/10	250
3SBP250	1/4	250	3SBP3	3	250
3SBP300	3/10	250	3SBP3.2	3-2/10	250
3SBP375	3/8	250	3SBP3.5	3-1/2	250
3SBP400	4/10	250	3SBP4	4	250
3SBP500	1/2	250	3SBP4.5	4-1/2	250
3SBP600	6/10	250	3SBP5	5	250
3SBP700	7/10	250	3SBP6	6	250
3SBP750	3/4	250			
3SBP800	8/10	250			

Listed by Underwriters' Laboratories through 6 amperes. Certified by Canadian Standards Association through 5 amperes.

Type 3SBP fuses, designated as slow blow, prevent unnecessary blowing from sudden current surges. Normal protection is still maintained against continued overload and short circuits. Similar electrically to the 3SB series, but supplied with pigtail leads.

TYPE 8AG/8AP NORMAL BLOW GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, maximum

MECHANICAL DIMENSIONS

Dimensions	8AG Inches (mm)	8AP Inches (mm)	Pigtail Leads Inches (mm)
Diameter	.250 (6.35)	.275 (6.99)	.032 (.813)
Length	1.00 (25.4)	1.025 (26.04)	1.5 (38.1)

Catalog Number		Ampere Rating	Voltage Rating
8AG100	8AP100*	1/10	250
8AG125	8AP125	1/8	250
8AG250	8AP250	1/4	250
8AG375	8AP375	3/8	250
8AG500	8AP500	1/2	250
8AG750	8AP750	3/4	250
8AG1	8AP1	1	250
8AG1.5	8AP1.5	1-1/2	250
8AG2	8AP2	2	250
8AG2.5	8AP2.5	2-1/2	125
8AG3	8AP3	3	125
8AG4	8AP4	4	125
8AG5	8AP5	5	125
8AG6	A8P6	6	125
8AG7	8AP7	7	125

*Pigtail (AP)

Listed by Underwriters' Laboratories through 7 amperes. Certified by Canadian Standards Association through 5 amperes.

Type 8AG is designated as a normal blow fuse for use in general circuit protection. Their smaller size permits use where space limitations prevent use of Type 3AG. Pigtail leads (Type 8AP) are available when direct soldering into circuits is desired.

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FUSES/UL, CSA & SEMKO 5mm x 20mm

TYPE 5MF FAST ACTING GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
200%	5 seconds, maximum

MECHANICAL DIMENSIONS

Dimensions	Millimeters (Inches)
Diameter	5 (0.197)
Length	20 (0.787)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
5MF100	1/10	250	5MF1	1	250
5MF125	1/8	250	5MF1.25	1-1/4	250
5MF200	2/10	250	5MF1.6	1-6/10	250
5MF250	1/4	250	5MF2	2	250
5MF300	3/10	250	5MF2.5	2-1/2	250
5MF400	4/10	250	5MF3	3	250
5MF500	1/2	250	5MF4	4	125
5MF600	6/10	250	5MF5	5	125
5MF700	7/10	250	5MF6	6	125
5MF800	8/10	250	5MF7	7	125

Listed by Underwriters' Laboratories from 700 mA to 5 amperes. Certified by Canadian Standards Association through 5 amperes.

Type 5MF fuses, described as fast acting are manufactured to meet the requirements of UL 198.6 and CSA 22.2. They permit European manufacturers of original equipment to substitute a fuse listed or certified by UL/CSA when exporting their equipment to the United States or Canada without making costly changes in mountings and printed circuit board layouts. Since fusing characteristics are different than those specified by IEC 127 for specific ratings, a careful analysis of the blowing curves should be made before determining the proper substitution. The small size of these fuses also offer the American/Canadian designer a protective device where space limitations are an important consideration. **Pigtail leads (5MFP) are available when direct soldering into circuits is desired.**

TYPE 5MT TIME LAG GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rating	Blow Time
110%	4 hours, minimum
135%	1 hour, maximum
1000%	10 milliseconds, minimum

MECHANICAL DIMENSIONS

Dimensions	Millimeters (Inches)
Diameter	5 (0.197)
Length	20 (0.797)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
5MT100	1/10	250	5MT1	1	125
5MT125	1/8	250	5MT1.25	1-1/4	125
5MT200	2/10	250	5MT1.6	1-6/10	125
5MT250	1/4	250	5MT2	2	125
5MT300	3/10	250	5MT2.5	2-1/2	125
5MT400	4/10	250	5MT3	3	125
5MT500	1/2	250	5MT4	4	125
5MT600	6/10	250	5MT5	5	125
5MT700	7/10	250	5MT6	6	125
5MT800	8/10	250	5MT7	7	125

Listed by Underwriters' Laboratories from 250mA to 5 amperes. Certified by Canadian Standards Association through 5 amperes.

Type 5MT fuses, described as time lag offer additional surge protection for circuits where momentary transients are anticipated. They are built to meet the specifications of UL 198.6 and CSA 22.2. They permit the European manufacturers of original equipment to substitute a fuse listed or certified by UL/CSA when exporting their equipment to the United States or Canada without making costly changes in mountings and printed circuit board layouts. Since fusing characteristics are different than those specified by IEC 127 for specific ratings, a careful analysis of the blowing curves should be made before determining the proper substitution. The small size of these fuses also offer the American/Canadian designer a protective device where space limitations are an important consideration. **Pigtail leads (5MTP) are available when direct soldering into circuits is desired.**

TYPE 5SF QUICK ACTING GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rated Current	2.1 I_n Max.	2.75 I_n Min.	2.75 I_n Max.	4 I_n Min.	4 I_n Max.	10 I_n Max.
32 to 100 mA inclusive	30 min	10 ms	500 ms	3 ms	100 ms	20 ms
Above 100 mA to 6.3A	30 min	50 ms	2 s	10 ms	300 ms	20 ms

MECHANICAL DIMENSIONS

Dimensions	Millimeters (Inches)
Diameter	5 (0.197)
Length	20 (0.787)

Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
5SF032	.032	250	5SF500	1/2	250
5SF040	.040	250	5SF630	.630	250
5SF050	1/20	250	5SF800	8/10	250
5SF063	1/16	250	5SF1	1	250
5SF080	.080	250	5SF1.25	1-1/4	250
5SF100	1/10	250	5SF1.6	1-6/10	250
5SF125	1/8	250	5SF2	2	250
5SF160	.160	250	5SF2.5	2-1/2	250
5SF200	2/10	250	5SF3.15	3.15	250
5SF250	1/4	250	5SF4	4	250
5SF315	.315	250	5SF5	5	250
5SF400	4/10	250	5SF6.3	6-3/10	250

Approved by SEMKO for 80 mA, 125 mA, and from 250 mA through 6.3A.

Type 5SF fuses, described as quick acting, low breaking capacity, are manufactured to the specifications of IEC 127, CEE 4, Standard Sheet II (Type F). Used throughout Europe, they carry the SEMKO mark in the ratings indicated. They are used for general circuit protection in electrical and electronic equipment where momentary transients are not anticipated. **Pigtail leads (5SFP) are available when direct soldering into circuits is desired.**

TYPE 5ST TIME LAG GLASS TUBE FUSE SERIES

ELECTRICAL CHARACTERISTICS

Rated Current	2.1 I_n Max.	2.75 I_n Min.	2.75 I_n Max.	4 I_n Min.	4 I_n Max.	10 I_n Min.	10 I_n Max.
32 to 100 mA inclusive	2 min	200 ms	10 s	40 ms	3 s	10 ms	300 ms
Above 100 mA to 6.3A	2 min	600 ms	10 s	150 ms	3 s	20 ms	300 ms

MECHANICAL DIMENSIONS

Dimensions	Millimeters (Inches)
Diameter	5 (0.197)
Length	20 (0.787)

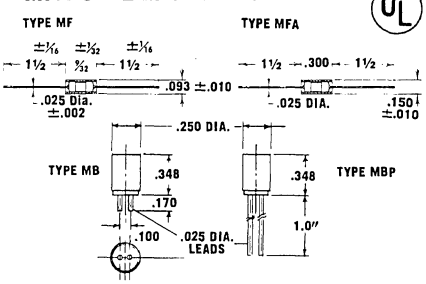
Catalog Number	Ampere Rating	Voltage Rating	Catalog Number	Ampere Rating	Voltage Rating
5ST032	.032	250	5ST500	1/2	250
5ST040	.040	250	5ST630	.630	250
5ST050	1/20	250	5ST800	8/10	250
5ST063	1/16	250	5ST1	1	250
5ST080	.080	250	5ST1.25	1-1/4	250
5ST100	1/10	250	5ST1.6	1-6/10	250
5ST125	1/8	250	5ST2	2	250
5ST160	.160	250	5ST2.5	2-1/2	250
5ST200	2/10	250	5ST3.15	3.15	250
5ST250	1/4	250	5ST4	4	250
5ST315	.315	250	5ST5	5	250
5ST400	4/10	250	5ST6.3	6-3/10	250

Approved by SEMKO from 160 mA through 6.3A.

Type 5ST fuses, described as time lag, low breaking capacity, are manufactured to the specifications of IEC 127, CEE 4, Standard Sheet III (Type T). They carry the SEMKO mark in the ratings indicated. They are used for general circuit protection in electrical and electronic equipment where momentary transients are anticipated. Pigtail leads (5STP) are available when direct soldering into circuits is desired.

MICRO FUSES

TYPE MF/MFE/MB/MBP/MFA MICROBEL MICRO FUSE SERIES



ELECTRICAL CHARACTERISTICS

Rating	Blow Time
100%	4 hours, minimum
150%	10 minutes, maximum
200%	1 minute, maximum

Catalog Number				Ampere Rating	Voltage Rating
MF125	MB125	MBP125	MFA125	1/8	125
MF250	MB250	MBP250	MFA250	1/4	125
MF375	MB375	MBP375	MFA375	3/8	125
MF500	MB500	MBP500	MFA500	1/2	125
MF750	MB750	MBP750	MFA750	3/4	125
MF1	MB1	MBP1	MFA1	1	125
MF1.5	MB1.5	MBP1.5	MFA1.5	1-1/2	125
MF2	MB2	MBP2	MFA2	2	125
MF2.5	MB2.5	MBP2.5	MFA2.5	2-1/2	125
MF3	MB3	MBP3	MFA3	3	125
MF3.5	MB3.5	MBP3.5	MFA3.5	3-1/2	125
MF4	MB4	MBP4	MFA4	4	125
MF5	MB5	MBP5	MFA5	5	125
MF7	MB7	MBP7	MFA7	7	125

Microbel Type Micro Fuses are subminiature fuses for use in circuits where space requirements are an important factor. Built to meet the requirements of UL 198.6 for micro-fuses, they are supplied in the four different mechanical configurations illustrated below.

Type MF is supplied with Kynar sleeve. Type MFE* is supplied with epoxy coating. Marked with or without color coding, MF fuses are available with radial or axial leads with the axial construction packaged either bulk or taped and reeled.

* UL Pending.

Listed by Underwriters' Laboratories through 7 amperes.

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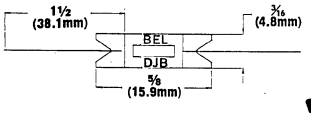
SPECIAL FUSES

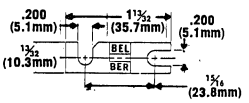
TYPE DJB FLAT PACK FUSE



ELECTRICAL CHARACTERISTICS

Rating	Blow Time
100%	4 hours, minimum
160%	20 seconds, maximum

TYPE BER FLAT PACK FUSE



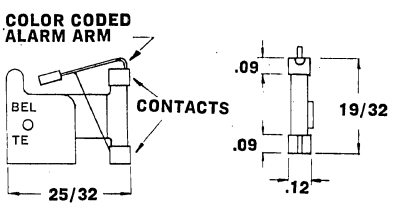
ELECTRICAL CHARACTERISTICS

Rating	Blow Time
100%	4 hours, minimum
135%	1 hour, maximum
200%	1 minute, maximum

Catalog Number		Ampere Rating	Catalog Number		Ampere Rating
DJB250	BER250	1/4	DJB2	BER2	2
DJB300	BER300	3/10	DJB2.25	BER2.25	2-1/4
DJB400	BER400	4/10	DJB2.5	BER2.5	2-1/2
DJB500	BER500	1/2	DJB2.75	BER2.75	2-3/4
DJB600	BER600	6/10	DJB3	BER3	3
DJB750	BER750	3/4	DJB3.5	BER3.5	3-1/2
DJB875	BER875	7/8	DJB4	BER4	4
DJB1	BER1	1	DJB5	BER5	5
DJB1.25	BER1.25	1-1/4	DJB8	BER8	8
DJB1.5	BER1.5	1-1/2	DJB10	BER10	10

Flat pack fuses, TYPE DJB with pigtails for direct soldering and TYPE BER for mounting with #10 screws, find broad application in telecommunication circuits and in low energy circuits where cost and space are important considerations. They are recognized under the component program of Underwriters' Laboratories and may be used in those circuits where the suitability of application has been investigated.

TYPE TE INDICATING FUSE



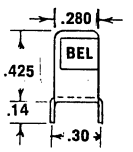
ELECTRICAL CHARACTERISTICS

Rating	Blow Time
80%	4 hours, minimum
100%	10 minutes, minimum
150%	5 minutes, maximum

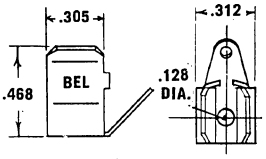
Catalog Number	Ampere Rating	Color Code	Catalog Number	Ampere Rating	Color Code
TE180	18/100	Y	TE2	2	OR
TE250	1/4	V	TE3	3	BLU
TE500	1/2	R	TE3.5	3-1/2	W/BLU
TE650	65/100	BK	TE4	4	W/BRN
TE750	3/4	BRN	TE5	5	GRN
TE1	1	6RY	TE7.5	7½	BK/W
TE1.3	1-1/3	W	TE10	10	R/W
TE1.5	1-1/2	W/Y			

Type TE fuses find extensive use in telecommunication circuits and other applications where both electrical and visual fuse failure indication is required. The alarm spring is color coded to give quick current rating identification.

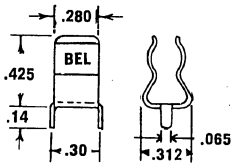
FUSE CLIPS AND FUSE MOUNTINGS



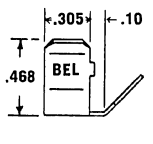
TYPE FC-101
3AG Clip
PC Board Mount
(Ear Stops)

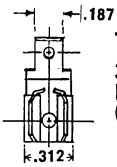


TYPE FC-105
3AG Clip
Hole Mount
(Solder Lug)

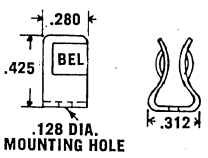


TYPE FC-102
3AG Clips
PC Board Mount
(Earless)

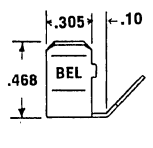


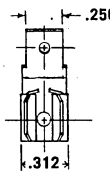


TYPE FC-106
3AG Clip
Hole Mount
(.187 Quick Connect)

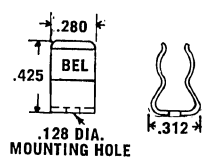


TYPE FC-103
3AG Clip
Hole Mount
(Ear Stops)

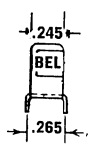


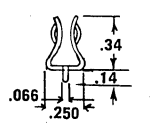


TYPE FC-107
3AG Clip
Hole Mount
(.250 Quick Connect)



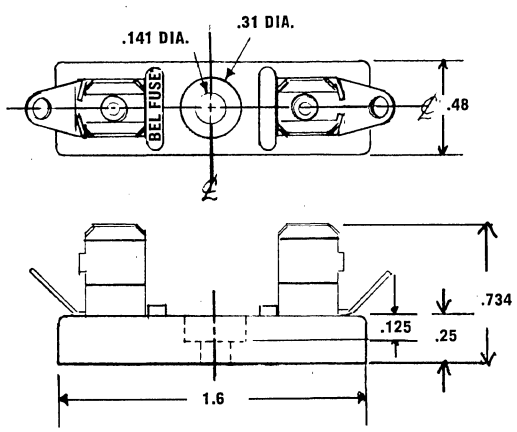
TYPE FC-104
3AG Clip
Hole Mount
(Earless)





TYPE FC-201
5mm Clip
PC Board Mount
(Ear Stops)

Mountings



All Bel Fuse clips are manufactured from .020 phosphor bronze stock and specially hardened to assure long life and minimum contact resistance. They are bright tin plated to facilitate soldering and prevent oxidation. In addition to the stock designs illustrated, clips can be quickly tooled to meet customer specifications.

The bases on mountings illustrated above are molded from a polyamid modified nylon rated by Underwriters' Laboratories at 94V-0. Clips are riveted to the base for maximum strength and are butted against a barrier to prevent rotation and assure alginment. The fuse mounts illustrated use Type FC-105 clips. Fuse mounts can be supplied with any combination of hole mount type clips.

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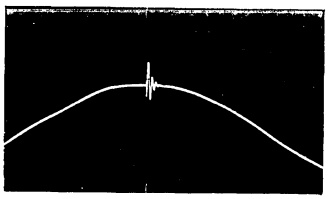
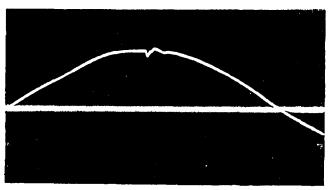
ISLATROL®

ACTIVE TRACKING SPIKE & TRANSIENT SUPPRESSORS THAT WORK

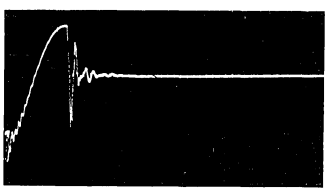
Why Islatrol is Different. These patented solid state units uniquely track the incoming sinusoid, will detect transients at any point on the sinusoid and, within 10 nanoseconds, become a low pass brute force active filter. No other device works like Islatrol, no other device protects like Islatrol.



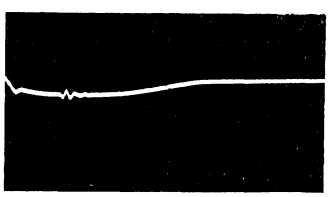
Input to Islatrol 700V transient



Output after Islatrol



Input to Islatrol 800V transient



Output after Islatrol

Suppression Performance:

Destructive or spurious transients, present at any point on the input sine wave of the AC power line, are clamped to within several volts, both above and below the instantaneous value of a filtered input sinusoid. For example, a two joule, 1000V spike (peak to peak) is suppressed to 10V (peak to peak). The above is accompanied with minimal power line loss.

control concepts
CORPORATION

Specifications

General Description:

A solid state, active tracking voltage suppressor which protects against transients, spikes, short-term outages and noise on incoming AC power lines to functional equipment.

Standard Voltage Inputs:

120V, 240V, 480V

Load Current:

Single Phase .5A - 100.0A
Three Phase 15.0A - 2000.0A

Power Line Frequency:

50-60 Hz. (400 Hz available)

Response Time:

5-10 Nanoseconds

Transient Reduction:

Minimum of 40 db, from the midband audio range through 50 MHz. The active filter improves the quality of the input line. Attenuation is greater than 50 db to IEEE surge withstand capability test No. 472-1974.

Preset Switch Level: ± 2V

Load Regulation:

Better than 1% from no load through full load.

Leakage:

Leakage to case less than 50 micro-amperes. Voltage isolation to case 5000V RMS.

Operating Temperature Range:

—40°C to 85°C

Reliability/Test Criteria:

Each ISLATROL® unit is 100% fully tested at an input energy level of two joules for approximately 1000 strikes, superimposed at the peak of the input sinusoid at main power line distribution impedance.

Standard Available Models:

Amperes	Model Numbers 120 Volt	208/240 Volt	480 Volt	Size	Weight
Single-Phase Models:					
0.5	I-100			2¼" x 1½" x ½"	⅓ lb.
1.0	I-101			3" x 2" x 1½"	1 lb.
2.5	I-102			4" x 3" x 1¾"	1½ lb.
5.0	I-105			4" x 3" x 1¾"	2 lb.
7.5	I-107	I-207		5" x 4¼" x 1¾"	3 lb.
15.0	I-115	I-215	I-415	6⅞" x 5¼" x 2¼"	5 lb.
30.0	I-130	I-230	I-430	8½" x 7½" x 3"	10 lb.
50.0	I-150	I-250	I-450	20" x 16" x 8"	75 lb.
100.0	I-1100	I-2100	I-4100	20" x 16" x 8"	100 lb.
Three-Phase Models:					
15.0		I-3-215	I-3-415	10" x 8" x 6"	30 lb.
30.0		I-3-230	I-3-430	10" x 8" x 6"	50 lb.
50.0		I-3-250	I-3-450	20" x 16" x 8"	75 lb.
100.0		I-3-2100	I-3-4100	20" x 16" x 8"	105 lb.
200.0		I-3-2200	I-3-4200	24" x 20" x 10"	170 lb.
400.0		I-3-2400	I-3-4400	60" x 36" x 10"	500 lb.
600.0		I-3-2600	I-3-4600	60" x 36" x 10"	550 lb.
1000.0		I-3-21000	I-3-41000	90" x 46" x 20"	700 lb.
1200.0		I-3-21200	I-3-41200	90" x 46" x 20"	700 lb.

FSCM #60508

Pat. #4095163, #4156838 and other Pat. pending.

Design it in. Or add it on. Choose ISLATROL variations for O.E.M. needs or for troublesome equipment already in use. We invite your inquiries for custom applications and requirements.

FULL 5 YEAR WARRANTY

Dept. EEM, 333 Front St., P.O. Box 1380, Binghamton, NY 13902, (607) 724-2484

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

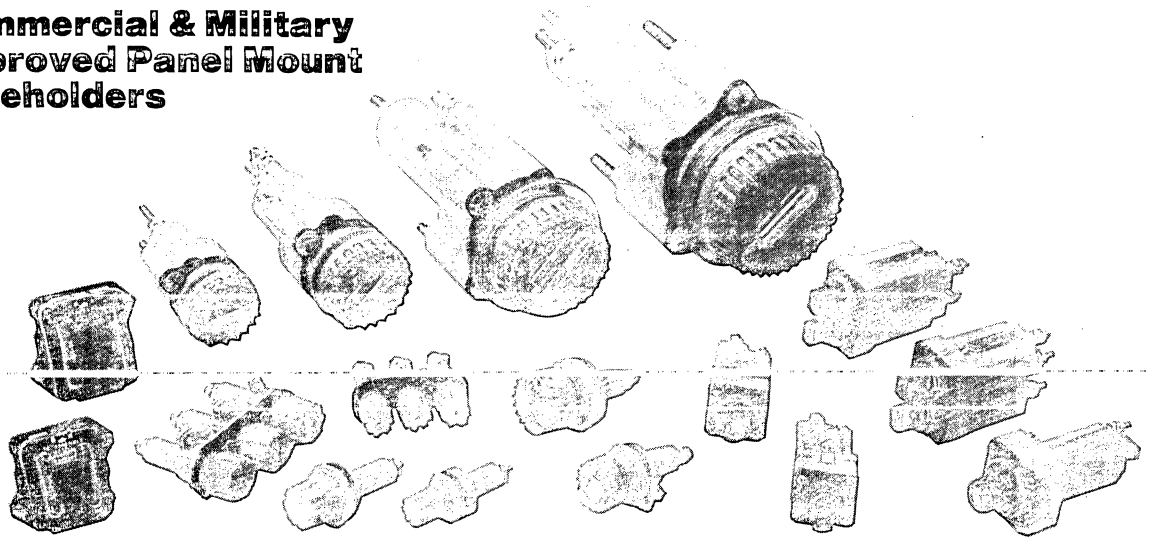
WPS word processing software

Y

YIG yttrium iron garnet

fic ·Fuseholders·Fuse Clips ·Blown Fuse Indicators

Commercial & Military Approved Panel Mount Fuseholders



- Superior Clip Design for Solid Fuse Contact
- UL Recognized & C.S.A. Certified
- Most Commercial Models are recognized under the Marine Electrical and Fuel System (PEQZ2) as "Ignition Protected Devices"
- Blown Fuse Indicating & Non-Indicating
- High Impact Plastic for Superior Strength
- Dead-Front, Watertight
- Military Versions Meet MIL-F-19207

Commercial Fuseholders

All Recognized by Underwriters Laboratories

Model	Fuse Size	Qty	Indicating (I) or Non-Indicating (N)	Voltage AC/DC	UL Recognized Amps	UL Recognized Voltage
5000+	¼x1¼"	1	N	250	0-30	250 max
5100+	¼x1¼"	3	N	250	0-30	250 max
5200+	¼x1¼"	1	N or I	250	0-30	250 max
*5300+	¼x1¼"	2	N or I	250	0-30	250 max
*5400+	13/32x1½"	1	N	600	0-30	600 max
*5500+	13/32x1½"	3	N	600	0-30	600 max
*5600+	13/32x1½"	1	N or I	600	0-30	600 max
*5700+	13/32x1½"	2	N or I	600	0-30	600 max
*5800	9/16x2"	1	N or I	600	0-30	250 max
*5900	13/16x3"	1	N or I	600	31-60	250 max

*CSA Certified
+Ignition Protected Devices

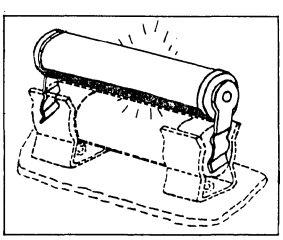
Indicating models can be modified for use in low voltage applications.

Military Fuseholders

MIL-SPEC	Type	Fuse Size	Qty	Indicating (I) or Non-Indicating (N)	Amps	Volts	Moisture Protection
19207/1	FHL10U	¼x1¼"	2	I	0-30	90-250	Unsealed
19207/2	FHL11U	¼x1¼"	1	I	0-30	90-250	Unsealed
19207/3	FHL12U	13/32x1½"	1	I	0-30	90-500	Unsealed
19207/4	FHL13G	9/16x2"	1	I	0-30	90-500	Dripproof
19207/5	FHL14G	13/16x3"	1	I	31-60	90-500	Dripproof
19207/6	FHL15G	1 1/16x5⅛"	1	I	61-100	90-500	Dripproof
19207/7	FHL16G	1⅝x7⅛"	1	I	101-200	90-500	Dripproof
19207/17	FHN28WB	¼x1¼"	1	N	0-30	250 Max	Watertight Body Sealed
19207/18	FHL29G	¼x1¼"	2	I	0-30	12-90	Dripproof
19207/19	FHL30G	¼x1¼"	1	I	0-30	12-90	Dripproof
19207/21	FHL32W	¼x1¼"	1	I	0-30	90-250	Watertight
19207/22	FHL33W	¼x1¼"	2	I	0-30	90-250	Watertight
19207/23	FHL34W	13/32x1½"	2	I	0-30	90-500	Watertight
19207/24	FHL35W	13/32x1½"	1	I	0-30	90-500	Watertight
19207/25	FHN41WB	13/32x1½"	1	N	0-30	500 Max	Watertight Body Sealed
19207/30	FHN46WB	¼x1¼"	3	N	0-30	250 Max	Watertight Body Sealed
19207/31	FHN47WB	13/32x1½"	3	N	0-30	500 Max	Watertight Body Sealed

Blown Fuse Indicators

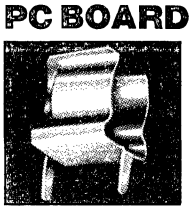
When A Fuse Blows, A Light Glows!®

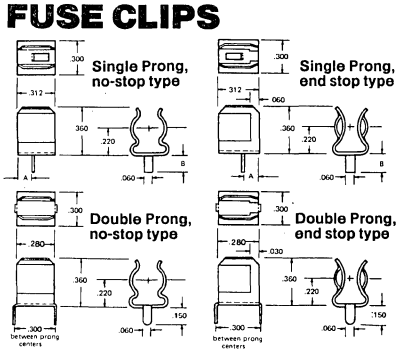


Several Models To Choose From

- Bolt Down for Rectifier Fuses
- Snap On for Ferrule Fuses
- Top Mounting for Knife Blade Fuses

PC BOARD FUSE CLIPS





Low profile clips (.360" high) are soldered to printed circuit boards eliminating eyeletting or riveting. Available in Spring brass, beryllium copper or spring bronze with various platings.

FIC CORPORATION
P.O. Box 2046
12216 Parklawn Drive
Rockville, MD 20852
TOLL FREE: 800/638-6594
IN MD: 301/881-8124
TWX: 710-828-9809

HEINEMANN

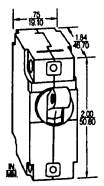
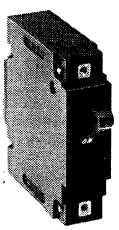
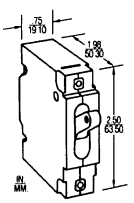
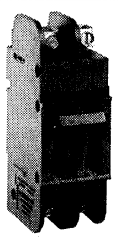
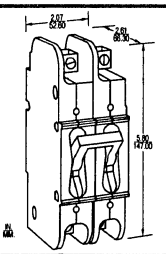
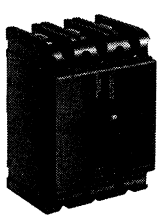
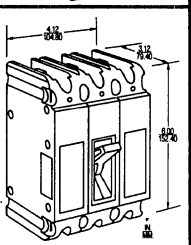
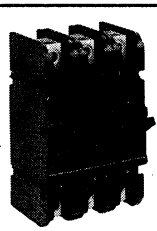
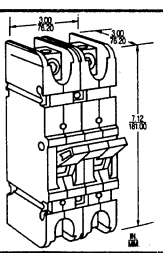
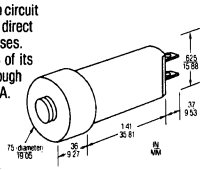
CIRCUIT PROTECTORS

Heinemann Electric Company
Trenton, NJ 08650
(609) 882-4800 • Telex 843431

Heinemann offers the widest range of styles and current ratings available in high-quality, reliable circuit protectors. From miniature, environmentally-sealed devices operating in the 0.020 A to 30 A range to industrial devices rated to 250 A and capable of safely interrupting a 25,000 A overload, Heinemann has the circuit protector to do the job.

Hydraulic-magnetic operation.

Heinemann hydraulic-magnetic circuit protectors will hold at their rated capacity regardless of ambient temperature, allowing sure, precise control. Through hydraulic damping of the sensing-coil core, a variety of time-delay

			APPLICATIONS	NO. OF POLES	CURRENT RATINGS	MAX. VOLTAGE
TYPE J		The Series J is an exceptionally compact, lightweight, and moderately-priced breaker for single or multipole OEM applications. Snap-in mounting, rocker handles, sealed-mount, and push-button models are available. Color-coded caps serve as panel accents and for circuit identification. 	OEM (power supplies, medical-electronic equipment, control systems, office and EDP equipment), control panels, marine equipment, field instrumentation.	1 to 4	0.020 — 30A	277V, 50/60 Hz 240V, 400 Hz 415V, 50/60 Hz, 3-phase "Y" 65Vdc
SERIES AM		A low-cost, lightweight breaker available in single or multipole configurations, the Series AM features rear-connection studs, a high level of moisture resistance, and a current range up to 100A ac or 60A dc. Qualified under Mil-C-55629 to 50A dc and ac. 	OEM (data-processing equipment, mobile applications, humid environments)	1 to 4	0.020-60A (ac) 0.020-100A (dc)	250V, 50/60 or 400 Hz 277V, 50/60 Hz, 1-phase 480V, 50/60 Hz, 3-phase "Y" 65Vdc
SERIES CF E-FRAME		Priced considerably lower than competitive E-frame breakers, the Series CF is the most compact and versatile circuit breaker available for equipment and branch-circuit protection. Single and multipole models are stocked in a wide range of standard ratings for fast, off-the-shelf delivery. 	Panelboards, switchboards, branch circuits, EDP equipment, machine tools, environmental systems, single- and three-phase applications.	1 to 6	0.01 — 100A (ac) 0.04 — 100A (dc)	240V, 50/60 or 400 Hz 480V, 1- and 3-phase 125Vdc
SERIES GH EH-FRAME		This rugged new EH-frame breaker offers all the advantages of a completely magnetic three-pole breaker with 14,000A interrupting capacity for less than most thermal units. Compact, environmentally stable to 100A at 480Vac and 250Vdc. 	Motor controls, air conditioning, electric heating, computer main frames, transportation, indoor or outdoor installations.	3	10 — 100A (ac) 10 — 100A (dc)	480V, 50/60 Hz 250Vdc
SERIES GJ		Where space is at a premium and current capacity up to 250A is called for, the Series GJ is the answer. Available in one-, two-, or three-pole models, it is especially suitable for panelboards, service-entrances, and electric vehicles. 	Commercial, industrial, and residential service—entrance or panelboard applications; lighting, appliance, transformer, electric vehicles, EDP power supplies, heating, air conditioning, and electronic circuit protection.	1 to 3	100 — 250A	240V, 50/60 Hz 125/250Vdc
RE-CIRK-IT® SERIES KD		The UL-recognized Re-Cirk-It® is a low-cost, pushbutton circuit protector, designed as a direct replacement for glass fuses. Resettable up to 1000% of its current rating at 2.5 through 15A, 500% at 0.25 to 2A. 	Consumer products, appliances, replacement for conventional fuse assemblies (5/8" diameter fuseholders).	1	0.25—15A	250V, 50/60 Hz 32Vdc

© Heinemann

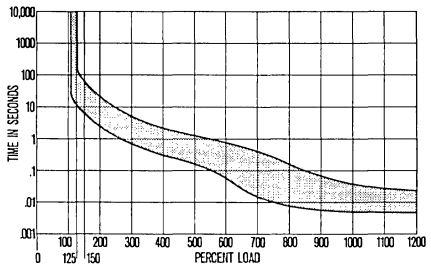
characteristics can be introduced to match circuit requirements.

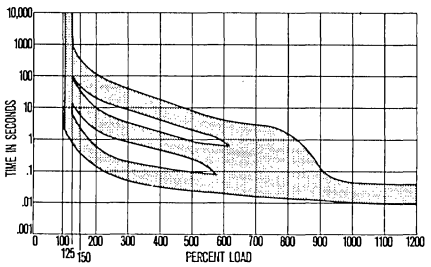
Heinemann invented and pioneered the hydraulic-magnetic breaker, now a specified standard where critical hold and trip operation must depend solely on current, and where breaker derating cannot be tolerated.

INTERRUPTING CAPACITY	UL/CSA RECOGNIZED OR LISTED
1000A 5000A with proper backup protection	Recognized, Component Recognition Program
1000A 5000A with proper backup protection	Recognized, Component Recognition Program
Up to 7500A (ac) 5000A (dc)	240V, 50/60 Hz and 125Vdc: Listed Others: Recognized
14,000A (ac) 10,000A (dc)	Listed (ac)
18,000A @ 240V, 50/60 Hz 10,000A @ 125/250Vdc 14,000A @ 160Vdc 25,000A @ 65Vdc	240V, 50/60 Hz and 125/250Vdc: Listed
1000A @ 250V, 50/60 Hz 200A @ 32Vdc	Recognized, Component Recognition Program

Typical Time-Delay Curves

Below are some typical time delay curves and characteristics of Heinemann circuit breakers. The graph on the left illustrates the curve for a Type J breaker suitable for long delay motor-start applications at 50/60 Hz. The one on the right shows the three curves available for the Series CF at 50/60 Hz. Other special application curves, including high-inrush, dc, and non-time-delay, are also available.

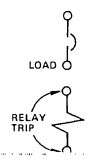




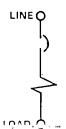
Special-Function Circuits for Protection and Control

Because of the flexibility of hydraulic-magnetic design, Heinemann breakers (except KD and TX) can be furnished with a number of different special-function internal circuits, as shown below. These circuits are highly useful for out-of-the-ordinary protective and control applications. Often, a single breaker with a special-function circuit can perform the duties of several components.

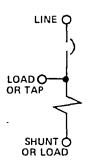
RELAY-TRIP
Provides for remote actuation using separate control circuit. Electrical isolation permits use of a different current or voltage from contact circuit. Both time-delay and non-time-delay constructions are available.



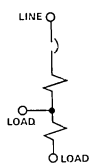
SERIES-TRIP (Standard internal circuit)
Ideal for use as both power switch and overload protector. Usually installed in series with line and load terminals to provide circuit interruption in the protected circuit.



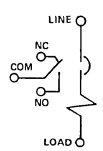
SHUNT/TAP
Use of third terminal permits remote tripping by utilizing line voltage with or without a time-delay response. On breakers rated up to 1A, the trip point may be raised by shunting with an external resistor on the shunt/tap terminal.



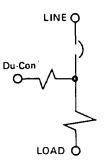
DUAL RATING
Two concentrically-wound sensing coils provide two discrete current ratings in the same breaker. Protects equipment designed to operate at two different current levels or supply voltages within certain limitations.



AUXILIARY SWITCH
Used for logic functions, alarms, lights, and other circuits. Miniature snap-action SPDT or DPDT switch is mounted on back of breaker, mechanically connected to switching mechanism. Contact capacity: 10A at 125/250V, 50/60 Hz; 4A resistive at 30Vdc; 2.5A inductive at 30Vdc. Minimum operating voltage: 6Vdc or ac, at 3VA dc or ac.



DU-CON™ (DUAL-CONTROL)
Provides sensing of both overcurrent and separate voltage signals in a single-pole breaker through a small, non-continuous-duty voltage sensing coil. DU-CON overload and voltage coils must be specified separately.

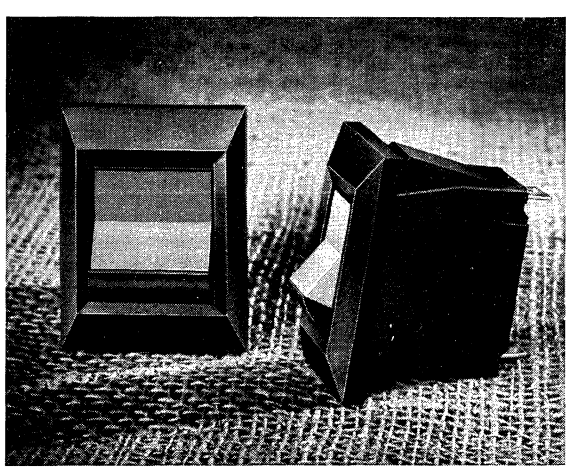


NEW!

Heinemann Series TX protector

Economical, attractive, one- or two-pole circuit protectors that provide on/off switching and add style with a variety of rocker handle colors. Available with optional rocker lighting, Series TX comes in ratings from 2 to 20 A at 125 Vac, 50/60 Hz or 32 Vdc, and 2 to 10 A at 250 Vac, 50/60 Hz. UL-recognized, CSA-certified, designed to meet requirements of VDE. Two-pole version may be specified with different ratings for each pole.

Request Bulletin TX-4020



7499

LITTELFUSE CIRCUIT PROTECTION DEVICES

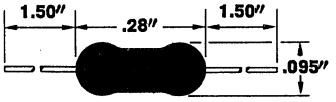
PICO II™ SUBMINIATURE FUSES

- World's smallest fuse for use in micro electronic circuits including computer and aerospace applications.
- Short circuit current of up to 300A.
- Low resistance values.
- Hi-speed action.
- Epoxy coated body for protection against environmental conditions.
- Withstand axial pull of 7 lbs.
- Available with or without color-coding per I.E.C. standards.

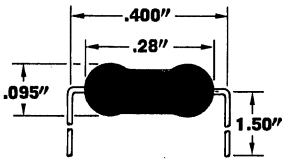
ENVIRONMENTAL CHARACTERISTICS

- Operating ambient temperature range: —55°C to 125°C
- Current carrying capacity: —55°C = 110% of rating; 25°C = 100% of rating; 125°C = 80% of rating
- Withstand vibrations of 10 to 2000 cps at 20 G's per method 204 test condition D of MIL-STD-202.
- Withstand shock of 100 G's for 6 milliseconds per method 213 test condition I of MIL-STD-202.

255 Series - Axial Leads



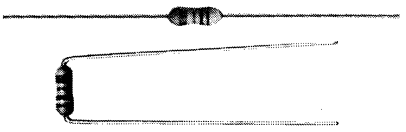
256 Series - Radial Leads



Note: Leads are solder-coated copper, .025" diameter for 1/16-10A, .032" diameter for 12-15A.

Blow Time: 100%, 4 hrs. min.; 200%, 5 sec. max. (1/16-10A) 10 sec. max. (12-15A)

U.L. Recognized through 10 amps.



L.F. Number Axial Leads	L.F. Number Radial Leads	Amp Rating	Voltage Rating
255.062	256-062	1/16	125
255.100	256.100	1/10	125
255.125	256.125	1/8	125
255.250	256.250	1/4	125
255.375	256.375	3/8	125
255.500	256.500	1/2	125
255.750	256.750	3/4	125
255001	256001	1	125
25501.5	25601.5	1-1/2	125
255002	256002	2	125
25502.5	25602.5	2-1/2	125
255003	256003	3	125
25503.5	25603.5	3-1/2	125
255004	256004	4	125
255005	256005	5	125
255007	256007	7	125
255010	256010	10	125
255012	256012	12	32
255015	256015	15	32

Note: To order axial lead PICO II fuses without color-coding, change **255** to **251**. To order radial lead type without color-coding, change **256** to **252**.

MICROFUSE SUBMINIATURE FUSES (125V)

Designed for applications where space is a critical factor. Ideal for installation on printed circuit boards. Short-circuit interrupting capacity — 125 volts at 10,000 amperes A.C.

Blow Time: 100%, 4 hour min.; 200%, 5 sec. max.

Size: 1/4" dia. x 11/32" (fuse body).

U.L. Recognized.

Plug-in, transparent cap type listed. Use prefix **272** for plug-in, metal cap; prefix **279** for pigtail, transparent cap; prefix **278** for pigtail, metal cap.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
273.002	1/500	273.125	1/8	273.750	3/4
273.005	1/200	273.200	2/10	273.800	8/10
273.010	1/100	273.250	1/4	273001	1
273.015	1/64	273.300	3/10	27301.5	1-1/2
273.031	1/32	273.400	4/10	273002	2
273.050	1/20	273.500	1/2	273003	3
273.062	1/16	273.600	6/10	273004	4
273.100	1/10	273.700	7/10	273005	5

SUBMINIATURE FUSES (250V) 5 x 20mm

For original installations and replacements in foreign-made equipment, such as home and car radios, amplifiers, tape recorders, etc. and in other applications where space is a factor. Available in medium-acting, fast-acting and slo-blo types.

MEDIUM ACTING (250V) TYPE M

Blow Time: 1/50 thru 1/10 amp — 100%, life; 210%, 2 min. max.; 400%, 0.04 to 0.50 sec. **1/8 thru 1-1/4 amp** — 100%, life; 210%, 2 min. max.; 400%, 0.06 to 2.00 sec. **1/6 thru 5 amps** — 100%, life; 210%, 30 min. max.; 400%, 0.06 to 2.0 sec.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
211.020	1/50	211.400	4/10	21101.6	1-6/10
211.031	1/32	211.500	1/2	211002	2
211.100	1/10	211.630	.630	2113.15	3.15
211.200	2/10	211.800	8/10	211004	4
211.250	1/4	211001	1	211005	5
211.315	.315	2111.25	1-1/4		

FAST ACTING (250V) TYPE F

Blow Time: 100%, life; 210%, 30 min. max.; 400%, 0.3 sec. max.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
212.100	1/10	212.630	.630	21202.5	2-1/2
212.125	1/8	212.700	7/10	2123.15	3.15
212.200	2/10	212.800	8/10	212004	4
212.250	1/4	212001*	1	212005	5
212.315	.315	2121.25	1-1/4	21206.3	6.3
212.400	4/10	21201.6	1-6/10	212008*	8
212.500	1/2	212002	2	212010*	10

212 Series SEMKO approved except (*) as indicated

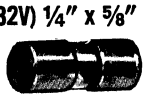
SLO BLO® FUSES (250V) TYPE T

Blow Time: 1/10 thru 1-1/4 amp — 100%, life; 210%, 2 min. max.; 400%, 0.3 to 2 sec. **1-6/10 thru 6 amps** — 100%, life; 210%, 30 min. max.; 400%, 0.3 to 3 sec.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
213.100	1/10	213.630	.63	2133.15	3.15
213.125	1/8	213.800	8/10	213004	4
213.200	2/10	213001	1	213005	5
213.250	1/4	2131.25	1-1/4	21306.3	6.3
213.315	.315	21301.6	1-6/10	213008*	8
213.400	4/10	213002	2	213010*	10
213.500	1/2	21302.5	2-1/2		

213 Series SEMKO and BEAB approved except (*) as indicated

1AG FUSES (32V) 1/4" x 5/8"



Medium-acting fuses for low-voltage applications: home and car radios, amplifiers, heaters, lighting circuits, cigar lighters.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 10 sec. max.

U.L. Listed (1-1/2 amps).

U.L. Recognized (2-10 amps).

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
301001	1	301005	5	301020	20
30101.5	1-1/2	301006	6	301025	25
301002	2	30107.5	7-1/2	301030	30
30102.5	2-1/2	301010	10		
301003	3	301015	15		

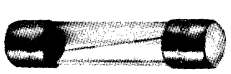
7AG FUSES (32V) 1/4" x 7/8"

Quick to medium acting with characteristics and applications similar to 301 series above.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 10 sec. max.

L.F. No.	Amp Rtg.	No. L.F.	Amp Rtg.	L.F. No.	Amp Rtg.
303001	1	303004	4	303020	20
30301.5	1-1/2	303005	5	303030	30
30302.5	2-1/2	303006	6		
303003	3	303015	15		

SFE AUTO FUSES (32V)



Medium-acting, made to sizes specified by SAE — graduated in length according to current rating.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 150%, **20 amps or less** — 0-15 sec; **30 amps** — 0-30 sec.

Size: 1/4" dia.

Length: See chart

U.L. Listed Under U.L. STD 275.

L.F. No.	Amp Rating	Length In.
307004	4	5/8
307006	6	3/4
30707.5	7-1/2	7/8
307009	9	7/8
307014	14	1-1/16
307020	20	1-1/4
307030	30	1-7/16

LITTELFUSE® CIRCUIT PROTECTION DEVICES

3AG FUSES (32V) 1/4" x 1 1/4"

Medium-acting fuses for use in cars, radios, amplifiers, etc.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 10 sec. max.
U.L. Listed under U.L. STD 275 through 30 amps.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
311004	4	311007.5	7-1/2	311015	15
311005	5	311008	8	311025	25
311006	6	311010	10	311030	30
311007	7	311012	12	311035	35

3AG FUSES (250V or less) 1/4" x 1 1/4"

Quick-acting, normal-blo fuses for general circuit protection.

3AG PIGTAIL FUSES

Same as above but with pigtails for direct wiring into chassis. Leads are 1-1/2" long, copper wire.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 5 sec. max.
U.L. Listed and Certified by CSA through 8 amps.

Note: Internal construction may vary depending on ampere rating.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
312.010	1/100	312.300	3/10	31202.5	2-1/2
312.031	1/32	312.375	3/8	312003	3
312.062	1/16	312.500	1/2	312004	4
312.100	1/10	312.600	6/10	312005	5
312.125	1/8	312.750	3/4	312006	6
312.150	15/100	312001	1	312007	7*
312.175	.175	3121.25	1-1/4	312008	8*
312.187	3/16	31201.5	1-1/2	312010	10*
312.200	2/10	31201.6	1-6/10		
312.250	1/4	312002	2		

* 125 volt. Note: To order fuses with pigtali leads, change **312** series number to **318.**

3AG SLO BLO® FUSES (250V or less) 1/4" x 1 1/4"

Designed to withstand momentary high current surges but still blow quickly on shorts. Provide protection for equipment with high reactive current surges or heavy starting currents such as solenoids, motors and lamp circuits.

3AG SLO BLO® PIGTAIL FUSES

Same as above but with pigtails for direct wiring into chassis. Leads are 1-1/2" long, copper wire.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max., 200%, 5 sec. min.
U.L. Listed and certified by CSA through 7 amps. U.L. Recognized from 8-30 amps.
Note: Internal construction may vary depending on ampere rating.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
313.010	1/100	313.700	7/10	313005	5
313.031	1/32	313.750	3/4	3136.25	6-1/4
313.040	4/100	313.800	8/10	313007	7
313.062	1/16	313001	1	313008	8*
313.100	1/10	31301.2	1-2/10	313010	10*
313.125	1/8	3131.25	1-1/4	313012	12*
313.150	15/100	31301.5	1-1/2	313015	15*
313.175	.175	31301.6	1-6/10	313020	20*
313.187	3/16	31301.8	1-8/10	313025	25*
313.200	2/10	313002	2	313030	30*
313.250	1/4	3132.25	2-1/4		
313.300	3/10	31302.5	2-1/2		
313.375	3/8	31302.8	2-8/10		
313.400	4/10	313003	3		
313.500	1/2	31303.2	3-2/10		
313.600	6/10	313004	4		

* 32 volt. Note: For pigtail leads, change **313** to **315.**

3AB CERAMIC SLO BLO® FUSES (250V or less) 1/4" x 1 1/4"

Similar to 313(000) series above, but have higher interrupting capacity.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 5 sec. min.
U.L. Listed 1/100 - 10 amps.
***U.L. Recognized** 15 - 30 amps.
C.S.A. Certified 1/4 - 3-2/10 amps.

*Note: 15 and 20 amp ratings are U.L. Recognized at 250V but meet all requirements for listing at 125V.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
326.010	1/100	326.600	6/10	326004	4
326.031	1/32	326.700	7/10	326005	5
326.062	1/16	326.750	3/4	3266.25	6-1/4
326.100	1/10	326.800	8/10	326007	7
326.125	1/8	326001	1	326008	8
326.150	15/100	32601.2	1-2/10	326010	10
326.175	.175	3261.25	1-1/4	326015	15
326.187	3/16	32601.5	1-1/2	326020	20
326.200	2/10	32601.6	1-6/10	326025	25*
326.250	1/4	326002	2	326030	30*
326.300	3/10	32602.5	2-1/2		
326.375	3/8	32602.8	2-8/10		
326.400	4/10	326003	3		
326.500	1/2	32603.2	3-2/10		

* 125 volt.

3AB CERAMIC BODY FUSES (250V or less) 1/4" x 1 1/4"

Ceramic body and arc-quenching filler in higher amperages provide high interrupting capacity.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 15 sec. max.
U.L. Listed through 15 amps.
Certified by CSA through 15 amps.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
314.125	1/8	314003	3	314012	12
314.250	1/4	314004	4	314015	15
314.375	3/8	314005	5	314020	20
314.500	1/2	314006	6	314025	25*
314.750	3/4	314007	7	314030	30*
314001	1	314008	8		
314002	2	314010	10		

* 125 volt.

3AB CERAMIC BODY RECTIFIER FUSES (250V or less) 1/4" x 1 1/4"

Extremely fast-acting fuses for protection of silicon controlled rectifiers and similar solid state devices.

Blow Time: 1-30 amps: 100%, 4 hour min.; **1-10 amps:** 250%, .2 sec. max. (pre-arcing); **12-30 amps:** 250%, 1 sec. max. (pre-arcing).
U.L. Recognized

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
322001	1	322006	6	322012	12*
3221.25	1-1/4	322007	7	322015	15*
322002	2	322008	8	322020	20*
322003	3	322009	9	322025	25*
322004	4	322010	10	322030	30*
322005	5				

* 65V. All others 250V.

LITTELFUSE® CIRCUIT PROTECTION DEVICES

8AG INSTRUMENT FUSES (250V or less) ¼" x 1"

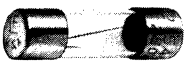
Very fast-acting fuses for protection of delicate equipment such as microammeters, galvanometers, voltmeters and other instruments.

Blow Time: 100%, 4 hour min.; 200%, 5 sec. max.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
361.002	1/500	361.125	1/8	361.750	3/4
361.005	1/200	361.187	3/16	361001	1
361.010	1/100	361.200	2/10	36101.5	1-1/2
361.015	1/64	361.250	1/4	361002	2
361.031	1/32	361.375	3/8	361003	3*
361.062	1/16	361.400	4/10	361004	4*
361.100	1/10	361.500	1/2	361005	5*

* 125 volt.

8AG NORMAL BLO FUSES ¼" x 1"



Normal blo fuses designed to standard N.E.C. specs. Used when space limitations prevent use of 3AG fuses. **For pigtail leads, change series number to 368.**

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 10 sec. max.

U.L. Listed through 5 amps. Certified by CSA 1/4-5 amps.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
362.125	1/8	362002	2*	362010	10†
362.250	1/4	36202.5	2-1/2*	362012	12†
362.375	3/8	362003	3*	362015	15†
362.500	1/2	362004	4*	362020	20†
362.750	3/4	362005	5*	362025	25†
362001	1	362006	6*	362030	30†
36201.5	1-1/2*	362008	8†		

* 125V. † 32V.

5AG FUSES (32V) 13/32" x 1½"

Medium-acting, rugged construction. For use in low-voltage applications such as aircraft and mobile communication equipment.

Blow Time: 10-30 amps: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 10 seconds max.
35-60 amps: 100%, 4 hour min.; 300%, 2-4 sec.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
511010	10	511025	25	511040	40
511015	15	511030	30	511050	50
511020	20	511035	35	511060	60

5AG QUICK-ACTING FUSES (250V or less) 13/32" x 1½"

Normal blo fuses for general circuit protection requiring larger fuse with more rugged construction.

Blow Time: 110%, 4 hour min.; 135%, 1 hour max.; 200%, 5 sec. max.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
512001	1	512003	3	512005	5
512002	2	512004	4	512008	8*

* 125 volt.

BLF FUSES (250V or less) 13/32" x 1½"

For low-cost, non-time delay use in control circuits.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 10,000 Amperes AC.
U.L. Listed 1/2 - 15 amperes

L.F. No.	L.F. No.	L.F. No.	L.F. No.
BLF 1/2	BLF 3	BLF 7	BLF 15
BLF 1	BLF 4	BLF 8	BLF 20
BLF 1-1/2	BLF 5	BLF 9	BLF 25
BLF 2	BLF 6	BLF 10	BLF 30
BLF 2-1/2	BLF 6-1/4	BLF 12	

Note: Numerals indicate amperage ratings.

BLN FUSES (250V or less) 13/32" x 1½"

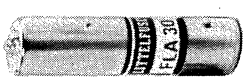
For low-cost, non-time delay use in control circuits and military applications.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 10,000 Amperes AC.
U.L. Listed 1 - 30 amperes.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
BLN 1	BLN 5	BLN 10	BLN 20
BLN 2	BLN 6	BLN 12	BLN 25
BLN 3	BLN 8	BLN 15	BLN 30
BLN 4			

Note: Numerals indicate amperage ratings.

FLA FUSES (250/125V or less) 13/32" x 1½"



Time delay fuses. Indicating pin protrudes when fuse blows.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 10,000 Amperes AC.
U.L. Listed 1/10 - 15 amperes.
C.S.A. Certified 1/10 - 10 amperes.

* 250V. All others 125V.
Note: Numerals indicate amperage ratings.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
FLA 1/10*	FLA 1	FLA 3	FLA 7
FLA 15/100*	FLA 1-1/8	FLA 3-2/10	FLA 8
FLA 2/10*	FLA 1-1/4	FLA 3-1/2	FLA 10
FLA 1/4*	FLA 1-1/2	FLA 4	FLA 12
FLA 3/10*	FLA 1-6/10	FLA 4-1/2	FLA 15
FLA 4/10*	FLA 1-8/10	FLA 5	FLA 20
FLA 1/2*	FLA 2	FLA 5-6/10	FLA 25
FLA 6/10*	FLA 2-1/4	FLA 6	FLA 30
FLA 8/10*	FLA 2-8/10	FLA 6-1/4	

FLM FUSES (250V or less) 13/32" x 1½"

Dual element, time delay fuses for use in circuits with high in-rush currents.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 10,000 Amperes AC.
U.L. Listed 1/10 - 20 amperes.
C.S.A. Certified 2/10 - 25 amperes.

Note: Numerals indicate amperage ratings.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
FLM 1/10	FLM 1-1/8	FLM 3	FLM 8
FLM 15/100	FLM 1-1/4	FLM 3-2/10	FLM 9
FLM 2/10	FLM 1-4/10	FLM 3-1/2	FLM 10
FLM 1/4	FLM 1-1/2	FLM 4	FLM 12
FLM 3/10	FLM 1-6/10	FLM 4-1/2	FLM 15
FLM 4/10	FLM 1-8/10	FLM 5	FLM 20
FLM 1/2	FLM 2	FLM 5-6/10	FLM 25
FLM 6/10	FLM 2-1/4	FLM 6	FLM 30
FLM 8/10	FLM 2-1/2	FLM 6-1/4	
FLM 1	FLM 2-8/10	FLM 7	

FLQ FUSES (500V or less) 13/32" x 1½"

Dual element, time delay fuses for circuits with high in-rush currents.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 10,000 Amperes AC.
U.L. Listed 1/10 - 30 amperes.
C.S.A. Certified 1/10 - 15 amperes.

Note: Numerals indicate amperage ratings.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
FLQ 1/10	FLQ 8/10	FLQ 3-2/10	FLQ 9
FLQ 1/8	FLQ 1	FLQ 3-1/2	FLQ 10
FLQ 15/100	FLQ 1-1/8	FLQ 4	FLQ 12
FLQ 3/16	FLQ 1-1/4	FLQ 4-1/2	FLQ 14
FLQ 2/10	FLQ 1-1/2	FLQ 5	FLQ 15
FLQ 1/4	FLQ 1-6/10	FLQ 5-6/10	FLQ 20
FLQ 3/10	FLQ 2	FLQ 6	FLQ 25
FLQ 4/10	FLQ 2-1/4	FLQ 6-1/4	FLQ 30
FLQ 1/2	FLQ 2-1/2	FLQ 7	
FLQ 6/10	FLQ 3	FLQ 8	

LITTELFUSE® CIRCUIT PROTECTION DEVICES

BLS FUSES (600V or less) 13/32" x 1 3/8"

Fast clearing, space-saving fuses for street lighting, control and electronic circuits.

Blow Time: 110%, 4 hrs. min., 135%, 1 hr. max.
Short Circuit Rating: 100,000 amperes AC.
U.L. Listed 2/10 - 5 amperes.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
BLS 2/10	BLS 1	BLS 2	BLS 6
BLS 4/10	BLS 1-1/2	BLS 3	BLS 7
BLS 1/2	BLS 1-6/10	BLS 4	BLS 8
BLS 3/4	BLS 1-8/10	BLS 5	BLS 10
BLS 8/10			

Note: Numerals indicate amperage ratings.

KLK FUSES (600V or less) 13/32" x 1 1/2"

Fast-acting, current limiting fuses for use in control, electronic and other circuits with high fault current capacity.

Blow Time: 110%, 4 hrs. min.; 135%, 1 hr. max.
Short Circuit Rating: 200,000 amperes AC.
U.L. Listed 3/10 - 30 amperes.
C.S.A. Certified 3/10 - 30 amperes.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
KLK 1/10	KLK 1/3	KLK 3	KLK 10
KLK 1/8	KLK 3/4	KLK 4	KLK 15
KLK 2/10	KLK 1	KLK 5	KLK 20
KLK 1/4	KLK 1-1/2	KLK 6	KLK 25
KLK 3/10	KLK 2	KLK 8	KLK 30

Note: Numerals indicate amperage ratings.

KLW RECTIFIER FUSES (130V or less) 13/32" x 1 1/2"

Fast-acting fuses for protection of rectifiers, S.C.R.'s, thyristors, solid state devices.

Blow Time: 100%, 4 hrs. min.; 120% - 180%, 1000 sec. max.; 250%, 1 sec. max.
Interrupting Rating: 10,000 amperes AC.

L.F. No.	L.F. No.	L.F. No.	L.F. No.
KLW 1	KLW 5	KLW 9	KLW 20
KLW 2	KLW 6	KLW 10	KLW 25
KLW 3	KLW 7	KLW 12	KLW 30
KLW 4	KLW 8	KLW 15	

Note: Numerals indicate amperage ratings.

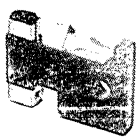
BLADE TYPE TERMINAL FUSES (32V)

Low voltage plug-in fuses. Color-coded for amperage identification.

Blow Time: 110%, 100 hours min.; 135%, 1500 sec. max.; 200%, 5 sec. max. 350%, .080 sec. min. **Size:** .76" wide x .75" high x .207" deep.
U.L. Listed 3 - 30 amps.

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
257003	3	25707.5	7.5	257020	20
257004	4	257010	10	257025	25
257005	5	257015	15	257030	30

ALARM INDICATING FUSES (125 VAC, 60 VDC)

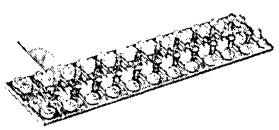


Plug-in fuses for telecommunications and similar applications. Blown fuse indicating flag can also activate alarm circuit. Flag is color-coded by ampere rating.

Blow Time: 100%, 10 minutes min.; 150%, 5 minutes max.

L.F. No.	Amp Rtg.	Color Code	L.F. No.	Amp Rtg.	Color Code
401.180	18/100	Yellow	401002	2	Orange
401.250	1/4	Violet	401003	3	Blue
401.500	1/2	Red	401005	5	Green
401.600	65/100	Black	40107.5	7-1/2	Black/
401.750	3/4	Brown			White
401001	1	Gray	401010	10	Red/
4011.33	1-1/3	White			White

TYPE T FUSE BLOCKS WITH SCREW TERMINAL CLIPS



Open type blocks available for 3AG and 5AG fuse sizes from one to twelve poles. Bases are of grade X black laminate with 1/32" insulator sheet cemented to underside. Screw terminal clips.

Mounting Hole: 3AG — .142"/.147" dia. with .295"/.302" by 82°CS. **5AG** — .171"/.176" dia. with .342"/.349" x 82°CS.
Clip Material: 356 Series—Nickel Plated Spring Brass. **359** and **556** Series—Silver Plated Beryllium Copper.
Size: Width: 2-3/8" (3AG), 2-3/4" (5AG). See chart for length dimensions. **356 Series is Recognized under the Components Program of Underwriters Laboratories.**

No. of Poles	For 3AG Fuses Length (In.)	For 3AG Fuses Part No.	For 5AG Fuses Length (In.)	For 5AG Fuses Part No.
1	25/32	356001	27/32	556001
2	1-11/16	356002	1-13/16	556002
3	2-19/32	356003	2-25/32	556003
4	3-1/2	356004	3-3/4	556004
5	4-13/32	356005	4-23/32	556005
6	5-5/16	356006	5-11/16	556006
7	6-7/32	356007	6-21/32	556007
8	7-1/8	356008	7-5/8	556008
9	8-1/32	356009	8-19/32	556009
10	8-15/16	356010	9-9/16	556010
11	9-27/32	356011	10-17/32	556011
12	10-3/4	356012	11-1/2	556012

For 3AG block with silver plated beryllium copper, change series number to **359.**

TYPE S BLOCKS WITH SOLDER LUG CLIPS

Similar to Type T blocks above but with solder terminals which are an integral part of the clip. For 3AG and 8AG fuses.

Mounting Hole: .142"/.147" dia.

Clip Material: 357 and **387** Series — Tin Plated Spring Brass. **357(200)** Series — Silver Plated Beryllium Copper.

Size: Width: 1-5/8" (3AG), 1-3/8" (8AG). See chart for length dimensions.

Recognized under the Components Program of Underwriters Laboratories.

No. of Poles	Length (Inches)	For 3AG Fuses Catalog No.	For 8AG Fuses Catalog No.
1	1/2	350231*	357201	387001
2	1-1/8	350277*	357202	387002
3	1-3/4	357003	357203	387003
4	2-3/8	357004	357204	387004
5	3	357005	357205	387005
6	3-5/8	357006	357206	387006
7	4-1/4	357007	357207	387007
8	4-7/8	357008	357208	387008
9	5-1/2	357009	357209	387009
10	6-1/8	357010	357210	387010
11	6-3/4	357011	357211	387011
12	7-3/8	357012	357212	387012

* Note: #357001 and #357002 are provided with a molded black phenolic base as shown below.

No. of Poles	Catalog No.	Width
1	357001	1/2"
2	357002	1-1/8" 2 mtg. holes on 5/8" centers

TYPE Q BLOCKS WITH Q.C. TERMINALS

Type Q Blocks with Q.C. Terminals. For 3AG fuses. Mounting Hole: .142"/.147" dia.

Clips: Nickel Plated Spring Brass.

Terminals: Plated Brass.

Width: 1-5/8".

Recognized under the Components Program of Underwriters Laboratories.

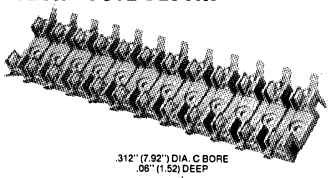
No. of Poles	Length (Inches)	Catalog Number With 1/4" Terminals	Catalog Number With 3/16" Terminals
1	1/2	351101	351601
2	1-1/8	351102	351602
3	1-3/4	351103	351603
4	2-3/8	351104	351604
5	3	351105	351605
6	3-5/8	351106	351606
7	4-1/4	351107	351607
8	4-7/8	351108	351608
9	5-1/2	351109	351609
10	6-1/8	351110	351610
11	6-3/4	351111	351611
12	7-3/8	351112	351612

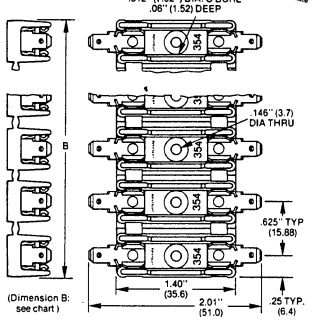
Note: The qick-connect fuse blocks shown below are supplied with a molded black phenolic base.

No. of Poles	Width	Catalog Number 1/4" Terminals	Catalog Number 3/16" Terminals
1	1/2"	350329	350327
2	1-1/8" - 2 mtg. holes on 5/8" centers	350330	350328

LITTELFUSE CIRCUIT PROTECTION DEVICES

OMNI-BLOK™ FUSE BLOCKS





For 3AG fuses. New, low profile fuse blocks with "break-away" pole feature . . . 12 pole units may be broken apart as needed to obtain desired number of poles. One piece-high amperage clip/terminal eliminates resistance build-up and allows operation at higher current levels than previous designs.

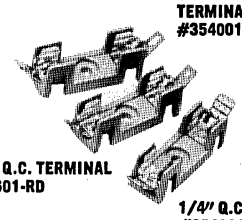
Specifications: 354 (000) Series (Solder type terminals); 30 amps, 300V. 354 (600) Series (3/16" Q.C. terminals); 20 amps, 300V. 354 (800) Series (1/4" Q.C. terminals); 30 amps, 300V.

Materials: Clip/terminal; High tensile spring brass, electro-tin plated. Base; Grey Polyester, glass reinforced. UL-94V0 flammability rating.

Special Options: Standard color is gray. Contact factory for special colors. Single pole units can be supplied with anti-rotation boss. Contact factory.

U.L. Recognized up to 30 amperes, 300V

SOLDER TYPE TERMINALS #354001-BU

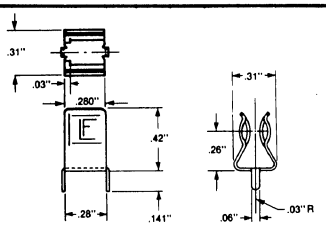


3/16" Q.C. TERMINAL #354601-RD

1/4" Q.C. TERMINALS #354801-GY

Standard Part Numbers			Number of Poles	Dimension "B"	
Solder Type Terminals	3/16" Q.C. Terminals	1/4" Q.C. Terminals		Inches	mm
354001-GY	354601-GY	354801-GY	1	.50"	12.7
354002-GY	354602-GY	354802-GY	2	1.12"	28.4
354003-GY	354603-GY	354803-GY	3	1.75"	44.5
354004-GY	354604-GY	354804-GY	4	2.38"	60.5
354005-GY	354605-GY	354805-GY	5	3.00"	76.2
354006-GY	354606-GY	354806-GY	6	3.63"	92.2
354007-GY	354607-GY	354807-GY	7	4.25"	108
354008-GY	354608-GY	354808-GY	8	4.88"	124
354009-GY	354609-GY	354809-GY	9	5.50"	139.7
354010-GY	354610-GY	354810-GY	10	6.13"	155.7
354011-GY	354611-GY	354811-GY	11	6.75"	171.5
354012-GY	354612-GY	354812-GY	12	7.38"	187.5

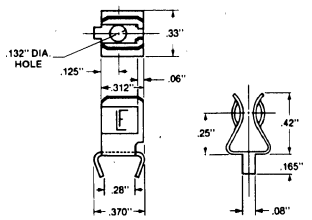
P.C. BOARD FUSE CLIPS
FOR 1/4" DIAMETER FUSES



Cat. No.	Clip Material	Finish	Style
102071	Spring Brass	Tin Plated	Ear
102074	Spring Brass	Tin Plated	Earless
122083	Beryllium Copper	Silver Plated	Ear
122088	Beryllium Copper	Tin Plated	Ear
122087	Beryllium Copper	Silver Plated	Earless

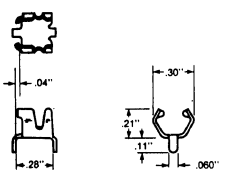
Note: Spring brass clips are suitable for current levels up to 15 amperes; beryllium copper clips up to 30 amps.

P.C. BOARD FUSE CLIPS
BOWED TAB TYPE FOR 1/4" DIAMETER FUSES



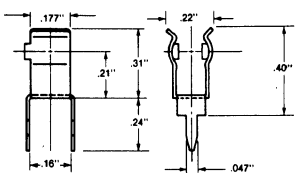
Cat. No.	Clip Material	Finish	Style
102078	Spring Brass	Tin Plated	Earless
102079	Spring Brass	Tin Plated	Ear

P.C. BOARD FUSE CLIPS
LOW PROFILE TYPE FOR 1/4" DIAMETER FUSES



Cat. No.	Clip Material	Finish	Style
122090	Beryllium Copper	Silver Plated	Low Profile
102080	Spring Brass	Tin Plated	Low Profile

P.C. BOARD FUSE CLIPS
FOR 5mm DIAMETER FUSES



Cat. No.	Clip Material	Finish	Style
100054	Spring Brass	Silver Plated	Ear
100056	Spring Brass	Tin Plated	Ear

RIVET MOUNT FUSE CLIPS

EAR TYPE

EARLESS TYPE

LUG TYPE

Be Cu*	Spring Brass†	Style	Fuse Div.
121001	101001		1/4"
123001	103001		9/32"
125001	105001	Ear	13/32"
127001	107001		9/16"
129001	109001		13/16"
121002	101002		1/4"
123002	104002		9/32"
125002	105002	Earless	13/32"
127002	107002		9/16"
129002	109002		13/16"
121004	101003‡	Lug	1/4"

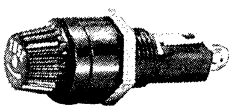
* Silver Plated. † Nickel Plated. ‡ Tin Plated.

LITTELFUSE® CIRCUIT PROTECTION DEVICES

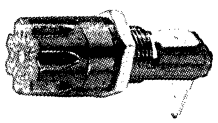
3AG FUSEHOLDERS WITH SOLDER TYPE, 3/16" OR 1/4" QUICK-CONNECT TERMINALS

Extend only 1" behind panel. **UL Recognized and Certified by CSA.**

KNURLED KNOB



FLUTED KNOB



SPECIFICATIONS

Electrical: Rated at 20 amperes for any voltage up to 250V. Dielectric withstanding voltage exceeds 2400 volts.

Mounting: Withstands 15 pound/inch (1.69Nm) mounting torque. Maximum panel thickness .18" (4.8)

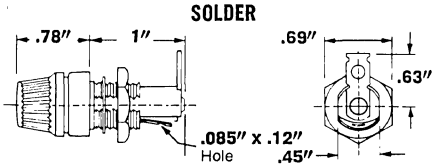
Molded Parts: Black thermoset

Knob: Bayonet style with white lettering

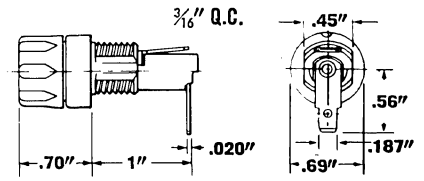
Brass Terminals: Tin plated except 1/4" quick connect terminals are nickel plated.

Hardware: Standard fuseholders supplied with a neoprene washer and a hex nut unassembled. Lockwasher (L) and drip-proof seal (P) variations available by adding appropriate suffix letters (L, P or PL) to catalog number.

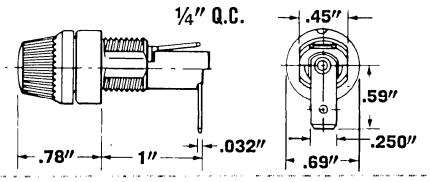
Right Angle Terminal
SOLDER



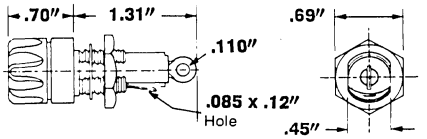
3/16" Q.C.



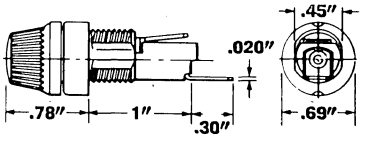
1/4" Q.C.



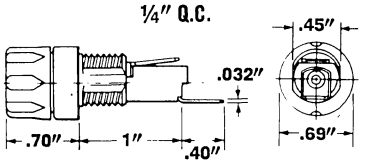
Straight Bottom Terminal
SOLDER



3/16" Q.C.



1/4" Q.C.



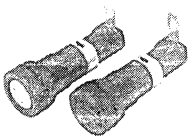
RIGHT ANGLE TERMINAL

Fluted Knob	Knurled Knob	Type of Terminal
342004	342022	Solder
342028	342048	3/16" Q.C.
342828	342848	1/4" Q.C.

STRAIGHT BOTTOM TERMINAL

Fluted Knob	Knurled Knob	Type of Terminal
342014	342012	Solder
342038	342058	3/16" Q.C.
342838	342858	1/4" Q.C.

SHOCK-SAFE FUSEHOLDERS FOR 3AG OR 5 x 20mm FUSES



- Designed to meet IEC (International Electrotechnical Commission) specifications 65 and 257.
- Eliminate possibility of electrical shock.
- Bodies accept 1/4" x 1 1/4" or 5 x 20mm fuses with use of appropriate knob.
- **U.L. Recognized. Certified by C.S.A.**

SPECIFICATIONS

MOLDED PARTS
Body material: black phenolic
Knob material: grey or black polyester
Hex nut material: glass filled polycarbonate

KNOB
Finger grip or screwdriver slot types
Spring loaded, bayonet style
Fuse extractor
Nickel plated brass insert

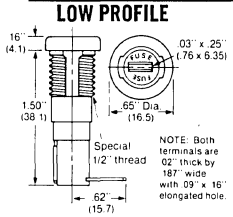
TERMINALS
Electro tin plated brass
Accept solder or 3/16" female connector

MOUNTING
Withstands 15 pound/inch mounting torque
Maximum panel thickness: 5/16"

ELECTRICAL CHARACTERISTICS
300 volt rating 20 amperes max.
Insulation resistance: 10,000 megohm minimum at 500 VDC
Contact Resistance: .005 ohms average at 20 millivolts
Dielectric strength: 4000 volts minimum

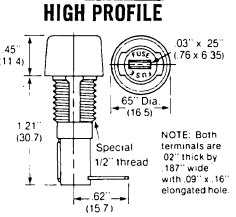
ENVIRONMENTAL
Ambient temperature: −40°C to +85°C
Vibration: 10-500 Hz, .03" constant amplitude or 10 G's constant acceleration

LOW PROFILE



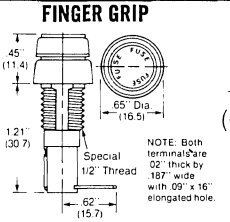
Metric dimensions shown in parentheses

HIGH PROFILE



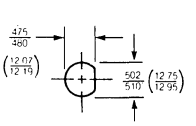
Metric dimensions shown in parentheses

FINGER GRIP

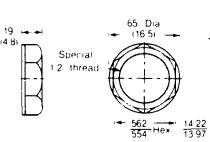


Metric dimensions shown in parentheses

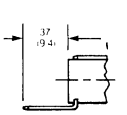
Suggested Mounting Hole



Plastic Hex Nut with Flange



Optional Straight Bottom Terminal



LOW PROFILE BODY (with screwdriver slot knob)

L.F. No.		Bottom Terminal	
1/4" x 1-1/4" Fuses	5mm x 20mm Fuses	Right Angle	Straight
345601	345621	X	
345611	345631		X

Body only: #345601-010 (Rt. Angle) #345611-010 (Straight)
Knob only: #345601-020 (1/4" x 1 1/4") #345621-020 (5 x 20mm)

HIGH PROFILE BODY (with screwdriver slot knob)

L.F. No.		Bottom Terminal	
1/4" x 1-1/4" Fuses	5mm x 20mm Fuses	Right Angle	Straight
345602	345622	X	
345612	345632		X

Body only: #345602-010 (Rt. Angle) #345612-010 (Straight)
Knob only: #345601-020 (1/4" x 1 1/4") #345621-020 (5 x 20mm)

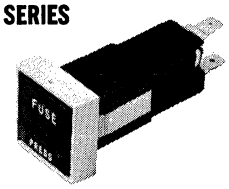
FINGER GRIP BODY (with finger grip knob)

L.F. No.		Bottom Terminal	
1/4" x 1-1/4" Fuses	5mm x 20mm Fuses	Right Angle	Straight
345603	345623	X	
345613	345633		X

Body only: #345603-010 (Rt. Angle) #345613-101 (Straight)
Knob only: #345603-020 (1/4" x 1 1/4") #345623-202 (5 x 20mm)

LITTELFUSE CIRCUIT PROTECTION DEVICES

LOW PROFILE FUSEHOLDERS 348 (000) SERIES



Snap into panel. Eliminate need for mounting hardware. Square cap design and choice of cap and bezel colors. 3/16″ or 1/4″ Q.C. terminals. Indicating Type has standard body and bezel in black — other bezel colors to special order. **U.L. Recognized and Certified by CSA.**

SPECIFICATIONS

Molded Parts: Body - Phenolic Resin. Cap - High temperature thermoplastic.

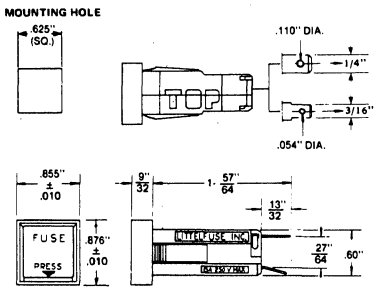
Terminals: One piece-brass-Electro-tin plated.

Electrical Characteristics: **348** series; Rated at 15 amps for any voltage to 250. **344** Series: Rated at 15 amps to maximum lamp voltage. Dielectric withstanding voltage between terminals and terminals to ground at room temperature and 90% R.H. exceeds 1,500 volts.

Vibration: Withstands 10-55 Hz at .06″ double amplitude.

Mechanical Shock: Withstands 50G for 11 milliseconds duration.

Mounting: .625″ sq. hole in 1/32″ through 1/8″ thick chassis panel.



HOW TO ORDER LOW PROFILE FUSEHOLDERS

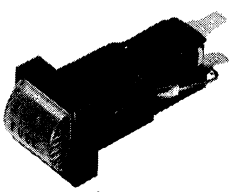
The six digit catalog number is a coded description of the finished unit. To specify type required, select appropriate code numbers from chart below. To order a cap assembly only for 3AG fuses, use **348** series numbers and insert a "0" in the terminal style and bezel color locations. To order a body assembly only, use **348** series number and insert a "0" in the cap color location.

SIX DIGIT CATALOG NUMBERS CONSIST OF

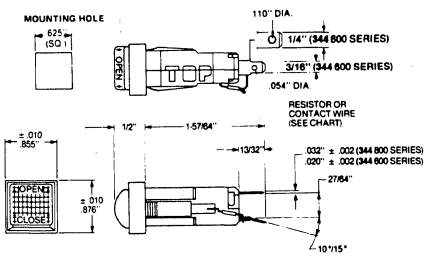
Series No.	Terminal Style	Bezel Color	Cap Color
348 For 3AG Fuses		1 Red	1
		2 Green	2
		3 Yellow	3
		4 Blue	4
	6 3/16″ Wide Terminals	5 White	5
	8 1/4″ Wide Terminals	7 Black	7
		9 Grey	9

For example: 348615 is a holder with 3/16″ terminals, red bezel and white cap.

INDICATING LOW PROFILE FUSEHOLDER (344 600 AND 344 800 SERIES)



Specifications: See above.



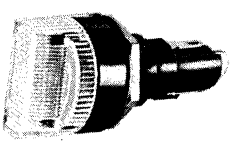
HOW TO ORDER LOW PROFILE INDICATING FUSEHOLDERS

With 3/16″ terminals

Catalog Number	Lamp Type	Lamp Voltage	Lamp Current	Resistor	Lens Color
344601	Incandescent	6	40 mA	No	Amber
344602	Incandescent	14	80 mA	No	Amber
344603	Incandescent	28	40 mA	No	Amber
344604	Neon	120	1.2 mA	Yes	Clear
344605	Neon	240	.3 mA	Yes	Clear

Note: To order holder with 1/4″ terminals, change the 6 to 8. Example: **344 801.**

3AG INDICATING FUSEHOLDERS



For visual indication of blown fuse. Two lens styles available. U.L. Recognized.

SPECIFICATIONS

Molded Parts: Black phenolic.

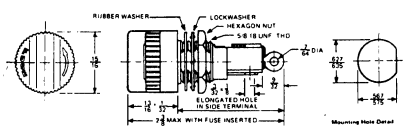
Hardware: Hexagon Nut; Steel, zinc chromate conversion coated. Washer; oil resistant rubber.

Knob: Extractor type, bayonet lock, knob of transparent high density styrene.

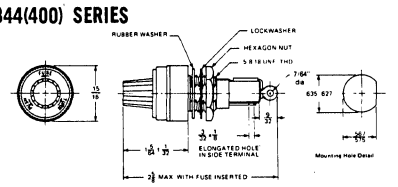
Terminals: Brass, electro tin-plated.

Electrical Characteristics: 20 amp-250V.

344(000) SERIES



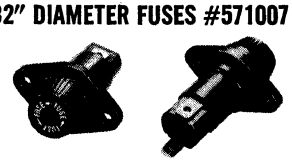
344(400) SERIES



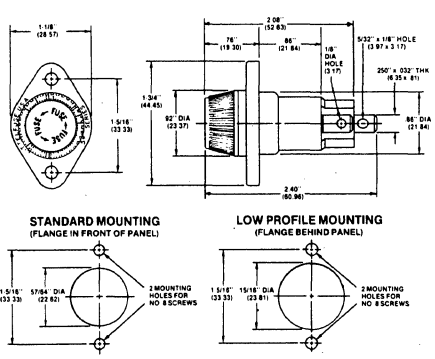
200 to 250V	100 to 125V	16 to 32V	7 to 16V	2.5 to 7V
Neon	Neon	Incandescent 28V	Incandescent 14V	Incandescent 6V
.002 Amp	.002 Amp	.04 Amp	.08 Amp	.20 Amp
Clear Knob	Clear Knob	Amber Knob	Amber Knob	Amber Knob
344 (600) SERIES				
344 250 344 250A	344 125 344 125A	344 024 344 024A	344 012 344 012A	344 006 344 006A
344 (400) SERIES				
344 405 344 405A	344 404 344 404A	344 403 344 403A	344 402 344 402A	344 401 344 401A

Note: All holders furnished with rubber washer, hex nut, lock-washer, and O-Ring (for drip-proof application, if required). Part numbers with suffix A are packaged in individual bags. All others are shipped bulk. Resistor is furnished with lamp.

PANEL FUSEHOLDER FOR 13/32″ DIAMETER FUSES #571007



Versatile fuseholder for 13/32″ diameter fuses with lengths from 1-3/8″ to 1-1/2″. Minimum rear panel projection, 3/4″ spacing between mounting flange and terminals to accommodate even the thickest panels. Recessed side terminal for additional shock-safe characteristics. For watertight version, order #571007P. **U.L. Recognized and Certified by CSA.**



SPECIFICATIONS

Molded Parts: Black Phenolic.

Knob: Spring-loaded, extractor type, knurled for finger grip. Threaded nickel-plated, brass insert. Watertight O-ring seal provided with model 571007P. White markings.

Terminals: Side terminal, electro tin-plated brass. End terminal electro tin-plated brass with elongated 1/8″ hole (5/32″ long). Terminals will accept solder or 1/4″ female connector.

Electrical Characteristics: Rated at 30 amps for any voltage up to 600. Dielectric withstanding voltage greater than 2400V. Contact resistance less than 0.004 ohms when checked in accordance with MIL-STD-202, method 307.

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

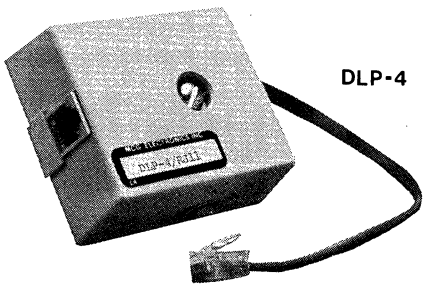
Protection For Signal/Data/ Telephone Lines

RS-232, RS-422, RS-423, 20ma loops, Modems

DLP-3

DLP-3: RS232 Protection

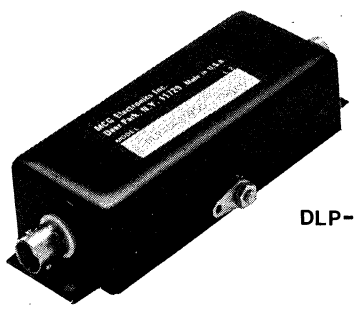
Designed to provide complete protection for computers and terminals. RS232 connectors make installation easy, taking minutes for non-technical personnel. Pins 2, 3, 7, and 20 are protected.



DLP-4

DLP-4: Modem Protection

Dial-up protection unit puts an end to downtime and costly equipment failure for dial-up modems and CPU's. Compatible with RJ11 and RJ45 telephone jacks.



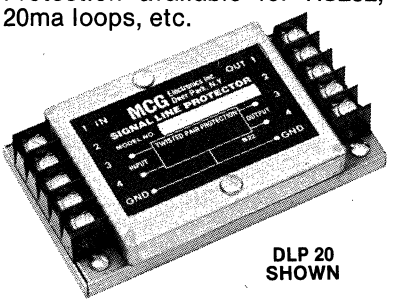
DLP-5

DLP-5: Video Cable Protector

Prevents coaxial cable from transmitting damaging transients to sensitive loads. Using isolated BNC connectors, the DLP-5 shunts damaging transients from the cable shield and center conductor to earth ground. Ideal for communications protection where wide baud width (to 20 mhz) is desired. The DLP-5 protects one circuit.

DLP-10: Multiple Protection

Gives protection for 2 wires or 1 twisted pair circuit. Case or last terminal provides ground point. Protection available for RS232, 20ma loops, etc.



DLP 20 SHOWN

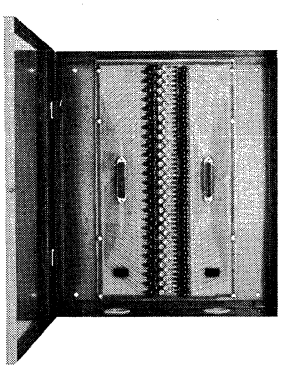
DLP-20:
Protects 4 wires or 2 pairs.

DLP-30:
Protects 8 wires or 4 pairs.

DLP-33:
Open pc board, protects 24 wires or 12 pairs. Not sold with case or cover.

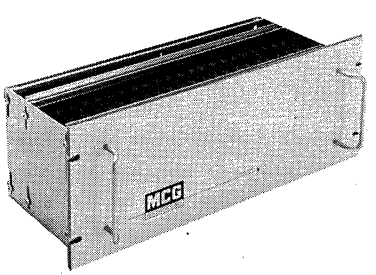
DLP-36: PABX Protection

Provides protection for PABX, modems, micro processors, CPU's, and terminals when many data lines are involved. Can protect up to 50 individual wires or 25 circuit pairs. Protection for RS232, 20ma loops, etc.



DLP-40: Rack Mounted Protection

Independent protection for up to 20 terminals or printers per system.
Plug-in protection cards for all applications, such as RS-232, -422, -423, 20ma loops, etc.
Can protect up to 100 individual lines per system.
Ideal for data logging, monitoring complex instrumentation.
Protects computer main frames.



MCG
ELECTRONICS, INC.
160 BROOK AVENUE
DEPT. 30809
DEER PARK, NEW YORK 11729
(516) 586-5125 • TELEX 645518

Protecting industry since 1967

Protection For AC Power Lines

Facility Protection

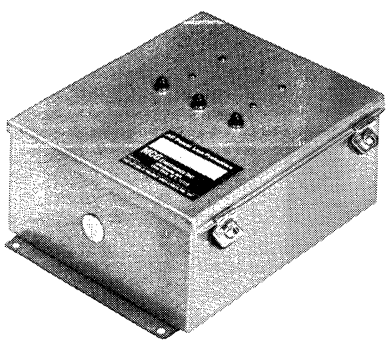
Surge-Master Heavy Duty Power Line Protectors give complete protection against all transients.

All computers and computer-based systems are vulnerable to transients on AC power lines caused by heavy motors starting up, power company load adjustments, welding operations–and, of course, lightning. Even if your equipment operates from batteries charged by a UPS, you're not safe. If lightning knocked out your UPS, how long could you keep going?

The MCG Surge-Master offers two stage protection. The first reacts in nanoseconds to absorb lesser transients and the leading edges of major ones. The second stage absorbs the big ones and has three modules on each line. So, in the unlikely event that one module should be knocked out, there are still two protecting you. And a system of indicator lights tells you not only when a fault has occurred, but exactly where it is. Modular construction makes replacement of damaged modules quick and easy. Initial installation requires minimal power interruption.

Available with capabilities from 100 to 3000 amps, for 120, 240, and 480 VAC, and for single, 3 phase, wye and delta power systems.

Computer Grade Protection



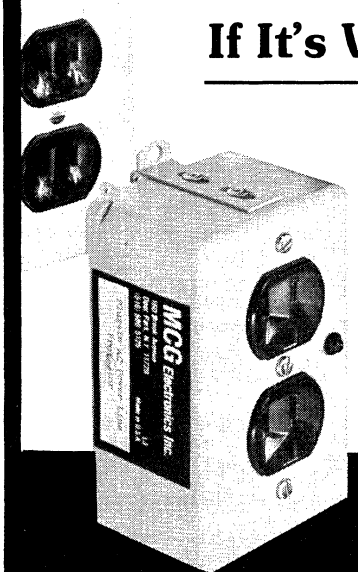
The MCG 5000 Series keeps "transients" and "noise" from damaging sensitive electronic equipment.

The 5000 Series offers moderate cost, high performance protection for computers, mini-computers, and other sensitive electronic equipment against power line noise and destructive high voltage surges, spikes, and transients.

"Transients" are caused by lightning, heavy machinery, elevators, even electric office equipment or fluorescent lights being turned on or off. ("Noise is a rapid series of small transients caused by radio-frequency or electromagnetic interference.") Strong transients can knock your equipment out, lesser ones make it lose data and give garbled information. Even those having no noticeable effect damage the IC's in your equipment, ultimately causing it to fail.

The 5000 Series combines filtering (50db/500kz) and substantial suppression of high energy transients in a variety of protectors that respond in less than 5 nanoseconds, and have 320 joule energy handling capability. These units are suitable for operation on 120VAC to 480VAC,to 40 Amps.

If It's Worth Protecting, It's Worth A P210



- **A lot of protectors look like the P210**
- **Many claim to protect like the P210**
- **None, in fact, *are* like the P210**

Designed to keep "transients and noise" from damaging sensitive electronic equipment, the Line-Master™, Model P210 employs a sophisticated combination of brute force surge protection and impulse filtering. The P210 reacts in 5 nanoseconds, has an energy absorption capability of 160 joules, and resets automatically when the transient has passed. In use, it is simply plugged into any AC outlet, and the equipment plugged into it. Rated at 117VAC and 10Amps, the P210 converts your AC wall outlet into a "dedicated line". The P210 sells for $147 each, delivery is stock to 2 weeks.

Other models are available for installation in cabinets or equipment racks to protect one piece or multiple equipment simultaneously.

Protecting Industry Since 1967.

ELECTRONICS, INC.
160 BROOK AVENUE
DEPT. 30909
DEER PARK, NEW YORK 11729
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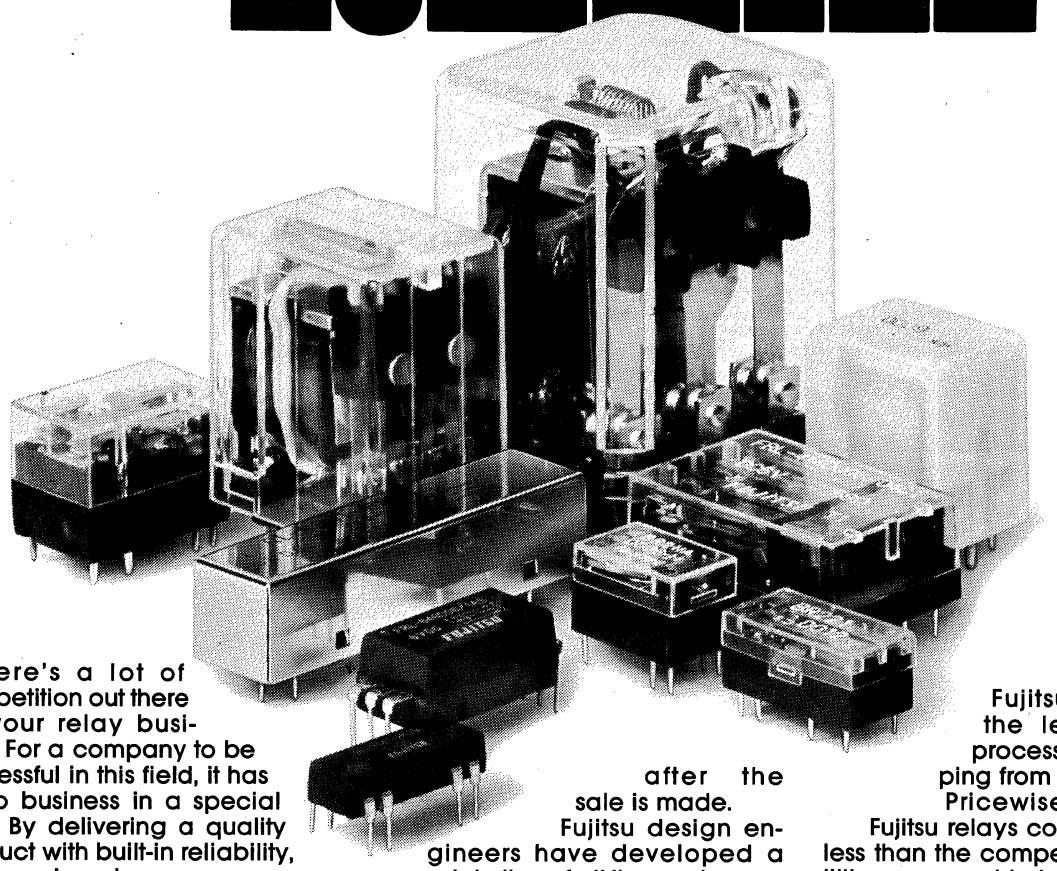
MCG

FUJITSU: RELAYS



There's a lot of competition out there for your relay business. For a company to be successful in this field, it has to do business in a special way. By delivering a quality product with built-in reliability, price and service.

Fujitsu relays have it all. Our relays meet or surpass the quality of those made by the competition. They're built to do a job and do it right. And Fujitsu relays are compatible with most relays on the market.

As far as service, Fujitsu considers it a point of pride, as well as good business to cater to your company's needs before, during and after the sale is made.

Fujitsu design engineers have developed a complete line of all the most popular relays in use today. A supply of these standard relays is always readily available. We also offer a customizing service where we work with your engineers to design relays tailored specifically to your needs.

Our warehouse is stocked to supply your company with samples of our fine products. Quantity orders come directly from the factory. And Fujitsu can match the lead time for processing and shipping from any source.

Pricewise, you'll find Fujitsu relays cost the same or less than the competition, leaving little reason not to try us.

For general purpose to flat package relays, for Mercury-wetted contacts to molded inline package (regular reed) and DIPs (latched reed), it pays to switch to Fujitsu where quality, reliability, price and service are part of our product.

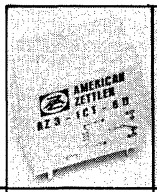
For more information on our superior components, call or write us today.

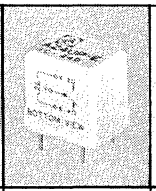
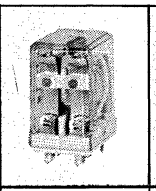
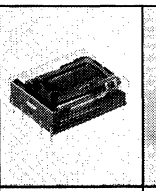
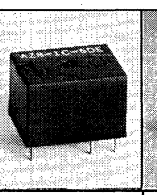
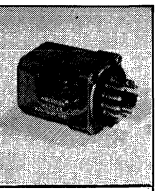
FUJITSU AMERICA, INC.
FUJITSU Component Sales Division
918 Sherwood Drive, Lake Bluff, IL 60044
(312) 295-2610, Telex: 206196, TWX 910-651-2259

Manufacturer	Electro Mechanical	Mercury Wetted Contacts	REED	Mercury Wetted Reed	Solid State	Hybrid	General Purpose	Latching	Power	RF	High Voltage	Sensitive	Voltage Sensing	Current Sensing	Thermal	Time Delay	Vacuum	MIL	Printed Circuit Mount	Plug-in	Crystal Can	Low Profile	I/O Module	Sealed Relays
American Zettler							1•1726		1•1726			1•1726							1•1726					1•1726
AET (Applied Electro Technology)					1•1733		1•1733												1•1733	1•1733				
Aromat	1•1734		1•1738				1•1735	1•1734	1•1741			1•1734							1•1734	1•1746		1•1738		1•1735
Robert Bosch	1•1750						1•1750												1•1750	1•1750				
Clare/General Inst.	1•1754	1•1752	1•1753				1•1752		1•1752			1•1752							1•1752	1•1752				
Communications Instruments							1•1757	1•1756	1•1757	1•1756		1•1756						1•1756	1•1756	1•1757				1•1756
Computer Components			1•1758								1•1758							1•1758	1•1758	1•1758				1•1758
Coto Corp.			1•1759	1•1759						1•1759	1•1759	1•1759			1•1759				1•1759					1•1759
Crouzet																1•1760				1•1760				
Deltrol	1•1762						1•1762		1•1762							1•1763				1•1762				
Diversified Electronics																1•1764								1•1764
Douglas Randall		1•1767	1•1765		1•1770			1•1766	1•1768		1•1765			1•1765					1•1765			1•1769		1•1765
EI&S (Electronic Instrument & Specialty)			1•1774	1•1774	1•1775	1•1775			1•1775						1•1774				1•1774					
Electronic Specialty	1•1776							1•1776	1•1776	1•1777		1•1776								1•1778	1•1776			1•1778
Elec-Trol			1•1779	1•1779	1•1782			1•1779											1•1779					1•1779
Essex Control/Stancor							1•1784		1•1784			1•1784												
Fifth Dimension																			1•1785					
Fujitsu	1•1786	1•1800	1•1797				1•1786		1•1793			1•1786							1•1786	1•1794		1•1789		1•1797
General Electric						1•1804		1•1804		1•1804		1•1804	1•1804	1•1804				1•1804	1•1804	1•1805	1•1804			1•1804
Gordos Arkansas			1•1814	1•1814	1•1806	1•1812	1•1808		1•1806		1•1814								1•1808			1•1810		1•1814
Gould	1•1824					1•1824	1•1824	1•1826	1•1827			1•1824				1•1828		1•1831	1•1826	1•1827	1•1831			1•1833
Grayhill					1•1834		1•1834		1•1834										1•1834	1•1834		1•1834	1•1834	
Guardian California					1•1835	1•1835	1•1835		1•1835										1•1835	1•1835				
Hamlin		1•1837	1•1836	1•1836	1•1837				1•1837		1•1837								1•1836	1•1837				
Hasco	1•1840		1•1838		1•1844		1•1840	1•1842	1•1841		1•1839			1•1844					1•1838			1•1842		1•1838
Iskra	1•1845						1•1845													1•1845				
ITT Components	1•1850				1•1851	1•1851	1•1850	1•1847	1•1849			1•1846		1•1850					1•1846			1•1847	1•1851	
ITT Jennings								1•1852	1•1852	1•1852	1•1852						1.1852							
Kilovac									1•1856	1•1856	1•1856						1•1856							1•1857
Leach	1•1860				1•1866		1•1860	1•1860	1•1860							1•1866		1•1861						
Logitek																1•1871								
Magnecraft	1•1872		1•1872	1•1872	1•1872	1•1872	1•1872		1•1872		1•1872					1•1872			1•1872	1•1872				
Midtex (Midland Ross)							1•1873												1•1873	1•1873				
Omron							1•1874		1•1875			1•1874							1•1874					1•1874
Opto 22					1•1876				1•1877										1•1877				1•1876	
Ross Eng.									1•1878		1•1878						1•1878							
Standex			1•1879																					
Wabash			1•1880																	1•1880				

GENERAL PURPOSE RELAYS

On the following pages you'll find summary specifications for our most popular relays. For additional technical information on these relays, or those marked (*), which are not covered here, call (800) 854-8474. In California call (714) 540-4190. For ordering information, call our local sales office listed in the eem yellow section.



SERIES			AZ 3	AZ 4	AZ 6*	AZ 7	AZ 8	AZ 9*
CONTACTS	FORM		SPDT	SPDT	1-4 PDT	2-6 PDT	SPDT	1-3 PDT
	AMPS		3/5/10	5/3	10	0 to 2/0.5	3/6	10
	VOLTS		28 VDC 120 VAC	24 VDC 115 VAC	30 VDC 115 VAC	30 VDC 115 VAC	28 VDC 120/300 VAC	28 VDC 120 VAC
NOMINAL OPERATING VOLTAGES AND DC COIL RESISTANCE IN OHMS	A C	6			19			5.3
		12			77			21
		24	N/A	N/A	300	N/A	N/A	82
		115			7,210			2,250
	D C	3	—	25	—	—	—	—
		6	350	100	47	115	80	30
		12	1,400	400	188	430	320	120
		24	5,600	1600	750	1650	1,280	472
		48	21,500	6400	2,660	6000	3,800	1,800
		115	—	—	11,000	—	—	10,000
TERMINALS								
SOLDER/PLUG-IN			—	—	X	—	—	X
PC			X	X	X	X	X	—
OCTAL PLUG-IN			—	—	—	—	—	X
QUICK CONNECT			—	—	X	—	—	—
TYPICAL LIFE (OPERATIONS)			200,000	100,000	500,000	1,000,000	100,000	100,000
DIELECTRIC STRENGTH (VRMS)			1500	1000	2000	1500	750	2,500
OPERATING TEMPERATURE RANGE			−20°C to +60°C	−20°C to +60°C	−45°C to +40°C	−55°C to +65°C	−20°C to +70°C	−55°C to +80°C
WEIGHT			30 grams	10 grams	24-74 grams	13-20 grams	8 grams	30 grams
SEALED			Available	Available	No	Available	Available	No
MAXIMUM SIZE IN INCHES		L	1.21	0.866	1.084	1.200	0.825	2.57
		X	X	X	X	X	X	X
		W	0.75	0.635	0.552	0.826	0.625	1.45
		X	X	X	X	X	X	X
		H	1.16	0.640	1.403	0.458	0.561	1.38
U/L RECOGNIZED			Yes	Yes	Yes	Yes	Yes	Yes
CSA CERTIFIED			Pending	No	Yes	Yes	Yes	Yes
VDE			Yes	Yes	Yes	Yes	No	Yes

All listed data are for the type with the minimum number of contacts.
For more detailed information, request individual data sheets.

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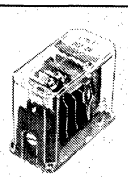
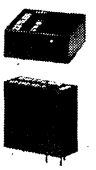
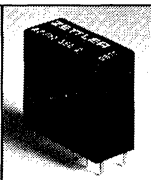
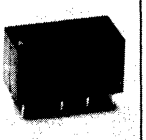
FROM AMERICAN ZETTLER

							
AZ 230/* AZ 231	**AZ 420/ AZ 421**	**AZ 430**	**AZ 530/ AZ 2530**	**AZ 531* AZ 2531**	**AZ 690**	**AZ 730**	**AZ 820**
1-2 PDT 16 26 VDC 115 VAC	1-4 PDT 0 to 5/3 26 VDC 115 VAC	6 PDT 0 to 5/3 26 VDC 115 VAC	SPDT Low to 2/1 26 VDC 115 VAC	DPDT Low to 2/1 26 VDC 115 VAC	SPDT 10 24 VDC 115 VAC	DPDT 8 24 VDC 115 VAC	DPDT Low to 2/0.5 30 VDC 120 VAC
N/A	75 300 835 3,800	N/A	N/A	N/A	N/A	N/A	N/A
— 52 190 950 2,700 13,000	14* 52* 185* 700* 2,500* 15,000	— 25* 90* 430* 1800* 9000	— 90* 310* 950* 4,500* 14,000	— 80 260 670 3,800 19,000	— 56 215 740 3,200 —	— 56 215 740 3,200 —	— 66 280 1,070 4,000 —
— X — —	X X — —	X X — —	— X — —	— X — —	— X — —	— X — —	— X — —
100,000	1,000,000	1,000,000	100,000	100,000	200,000	200,000	200,000
2500	1000	1000	500	500	4000	4000	1200
−55°C to +80°C	−55°C to +80°C	−55°C to +65°C	−55°C to +55°C	−55°C to +65°C	−55°C to +65°C	−55°C to +65°C	−55°C to +75°C
30 grams	28 grams	30 grams	11 grams	14 grams	17 grams	17 grams	5 grams
No	Available	No	Available	Available	Available	Available	Yes
1.375 X 0.735 X 1.187	0.940 X 0.735 X 1.187	1.375 X 0.735 X 1.187	1.090 X 0.593 X 0.445	1.090 X 0.888 X 0.445	SLIMPAK THINPAK 1.100 1.100 X X 0.480 1.024 X X 1.040 0.441	1.230 X 0.535 X 1.040	0.820 X 0.420 X 0.455
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Pending
Yes	Yes	Yes	Yes	Yes	Pending	Pending	Pending
Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

* Higher coil resistances or sensitive version available.

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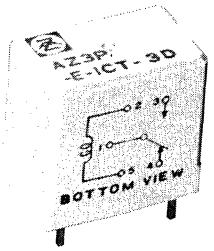
SERIES AZ 3

SPDT Contacts to 10 Amps



L: 1.21″
W: 0.75″
H: 1.16″

FEATURES

- Compact Size
- Coils to 48 VDC
- Contacts Rated at 3, 5, or 10 Amps
- Life Expectancy 200,000 Operations
- PC Board Mounting
- UL File #E43203

Contact Arrangement: SPDT (1 Form C)

Contact Rating: Noninductive load

Light Duty: Max. switched power: 90 W or 360 VA
Max. switched current: 3 Amps
Max. switched voltage: 150 VDC or VAC

Medium Duty: Max. switched power: 150 W or 600 VA
Max. switched current: 5 Amps
Max. switched voltage: 150 VDC or VAC

Heavy Duty: Max. switched power: 280 W or 1200 VA
Max. switched current: 10 Amps
Max. switched voltage: 150 VDC or VAC

Contact Material: Light Duty: Silver-Nickel, gold plated
Medium Duty: Silver-Nickel alloy
Heavy Duty: Silver-Nickel alloy

Operate Time: 20 ms at nominal coil voltage (typical)

Release Time: 20 ms at nominal coil voltage (typical)

Dielectric Strength: 1500 Vrms; 750 Vrms contact to contact

Coil Power

At Pick Up Voltage (typical): Light and Medium Duty: 70 mW
Heavy Duty: 150 mW

Max. Continuous Dissipation: 2 W at 20°C (68°F) ambient

Life Expectancy: Mechanical: 5 million operation
Electrical:
Light Duty: $2x10^5$ @ 3 A, 28 VDC/120 VAC
Medium Duty: $2x10^5$ @ 5 A, 28 VDC/120 VAC
Heavy Duty: $2x10^5$ @ 10 A, 28 VDC/120 VAC

RELAY ORDERING DATA

STANDARD RELAYS: LIGHT DUTY TYPE (3 Amp Contact)

COIL SPECIFICATIONS					
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
6	20	350	4.8	AZ 3-1-C-6D	2.50
12	40	1,400	9.6	AZ 3-1C-12D	2.50
24	80	5,600	19.2	AZ 3-1C-24D	2.60
48	157	21,500	38.4	AZ 3-1C-48D	2.95

STANDARD RELAYS: MEDIUM DUTY TYPE (5 Amp Contact)

COIL SPECIFICATIONS					
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
6	20	350	4.8	AZ 3-1CH-6D	2.70
12	40	1,400	9.6	AZ 3-1CH-12D	2.70
24	80	5,600	19.2	AZ 3-1CH-24D	2.80
48	157	21,500	38.4	AZ 3-1CH-48D	3.15

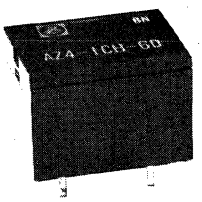
STANDARD RELAYS: HEAVY DUTY TYPE (10 Amp Contact)

COIL SPECIFICATIONS					
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
6	14	164	4.8	AZ 3-1CT-6D	2.90
12	28	660	9.6	AZ 3-1CT-12D	2.90
24	54	2,500	19.2	AZ 3-1CT-24D	3.00
48	107	9,900	38.4	AZ 3-1CT-48D	3.35

1. All values at 20°C

SERIES AZ 4

SPDT Up to 5 Amp Contacts



L: 0.866″
W: 0.635″
H: 0.640″

FEATURES

- Subminiature Size
- DC Coils to 48 VDC
- PC Board Terminals
- Extremely Low Cost
- 3 and 5 Amp Contacts
- Rugged Construction for High Reliability
- UL File #E44211; CSA File #LR36664

Contact Arrangement: SPDT (1 Form C)

Contact Rating: Noninductive load

Light Duty: Max. switched power: 90 W or 360 VA
Max. switched current: 3 Amps
Max. switched voltage: 60 VDC or 250 VAC

Heavy Duty: Max. switched power: 150 W or 600 VA
Max. switched current: 5 Amps
Max. switched voltage: 60 VDC or 250 VAC

Contact Material: Light Duty: Silver Alloy
Heavy Duty: Silver cadmium oxide

Life Expectancy: Mechanical: 10 million operations
Electrical: 10^5 operations at rated load

Contact Resistance (typical): 50 milliohms initially

Operate Time: 6 ms at nominal coil voltage (typical)

Release Time: 2 ms at nominal coil voltage (typical)

Dielectric Strength: Contact to contact: 750 Vrms
Contact to coil: 1500 Vrms

Coil Power

At Pick Up Voltage (typical): 230 mW

Max. Continuous Dissipation: 1.6 W @ 20°C (68°F) ambient

RELAY ORDERING DATA

LIGHT DUTY (3 Amp Contact)

COIL SPECIFICATIONS					
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
5	6.5	70	4.0	AZ 4-1C-5D	1.90
6	7.8	100	4.8	AZ 4-1C-6D	1.90
12	15.6	400	9.6	AZ 4-1C-12D	1.90
24	31.2	1,600	19.2	AZ 4-1C-24D	1.90
48	62.4	6,400	38.4	AZ 4-1C-48D	2.30

HEAVY DUTY (5 Amp Contact)

COIL SPECIFICATIONS					
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
5	6.5	70	4.0	AZ 4-1CH-5D	2.10
6	7.8	100	4.8	AZ 4-1CH-6D	2.10
12	15.6	400	9.6	AZ 4-1CH-12D	2.10
24	31.2	1,600	19.2	AZ 4-1CH-24D	2.10
48	62.4	6,400	38.4	AZ 4-1CH-48D	2.50

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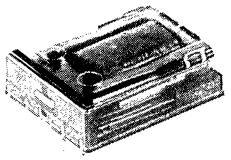
SERIES AZ 7

DPDT, 4PDT Dry Circuit to 2 Amp Contacts

2 POLE
L: 1.200″
W: 0.826″
H: 0.458″
4 POLE
L: 1.200″
W: 0.965″
H: 0.458″



FEATURES

- Low Profile For Compact Board Spacing
- DC Coils to 48 VDC
- Life Expectancy to 100 Million Operations
- Standard PC 0.2″ Grid Spacing
- Contact Resistance Less Than 50 Millioms
- Welded Bifurcated Contacts
- Both Form C and Form D Contacts Available
- Epoxy Sealed "Process-Proof" Version Available
- UL File #E43203; CSA File #LR36664
- Meets FCC 1500V Surge Requirement

Contact Arrangement: DPDT (2 Form C) bifurcated
4PDT (4 Form C) bifurcated
Form D also available

Contact Rating: Noninductive load — Form C contact
2 Amp @ 30 VDC
0.5 Amp @ 125 VAC

Contact Material: Fine silver, gold-clad
Other material available upon request

Life Expectancy: Mechanical: 100 million operations

Electrical:	Unsealed	Sealed
1 A @ 26 VDC	$5x10^5$ ops	10^6 ops
2 A @ 26 VDC	10^6 ops	$2x10^5$ ops

Contact Resistance: 50 milliohms initially
200 milliohms at end of life

Operate Time: 10 ms at nominal coil voltage (typical)

Release Time: 4 ms at nominal coil voltage (typical)

Dielectric Strength (initial): 1000 Vrms; 1000 Vrms across contact gap; 1500 Vrms contact to coil

Coil Power

At Pick Up Voltage (typical): 2 pole: 190 mW
4 pole: 310 mW

Max. Continuous Dissipation: 1.6 W @ 20°C (68°F) ambient
1.2 W @ 40°C (105°F) ambient

RELAY ORDERING DATA

Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
STANDARD RELAYS: 2 FORM C (DPDT) CONTACTS (Unsealed)					
5	11	90	3.6	AZ 7-2C-5D	4.40
6	13	137	4.2	AZ 7-2C-6D	4.40
12	26	500	8.4	AZ 7-2C-12D	4.40
24	52	2,000	16.8	AZ 7-2C-24D	4.40
48	97	7,000	33.6	AZ 7-2C-48D	4.90
STANDARD RELAYS: 2 FORM C (DPDT) CONTACTS (Sealed)					
5	11	90	4.0	AZ 7-2C-5DE	5.00
6	13	137	4.8	AZ 7-2C-5DE	5.00
12	26	500	9.6	AZ 7-2C-12DE	5.00
24	52	2,000	19.2	AZ 7-2C-24DE	5.00
48	97	7,000	38.4	AZ 7-2C-48DE	5.55
STANDARD RELAYS: 4 FORM C (4PDT) CONTACTS (Unsealed)					
5	8	53	3.6	AZ 7-4C-5D	5.30
6	11	90	4.2	AZ 7-4C-6D	5.30
12	21	330	8.4	AZ 7-4C-12D	5.30
24	40	1,200	16.8	AZ 7-4C-24D	5.30
48	72	4,200	33.6	AZ 7-4C-48D	5.90
STANDARD RELAYS: 4 FORM C (4PDT) CONTACTS (Sealed)					
5	8	53	4.0	AZ 7-4C-5DE	5.90
6	11	90	4.8	AZ 7-4C-6DE	5.90
12	21	330	9.6	AZ 7-4C-12DE	5.90
24	40	1,200	19.2	AZ 7-4C-24DE	5.90
48	72	4,200	38.4	AZ 7-4C-48DE	6.55

SERIES AZ 820

DPDT, Up to 2 Amps Bifurcated Contact

DIP PACKAGE
L: 0.820″
W: 0.420″
H: 0.455″

FEATURES

- Low Profile for Compact Board Spacing
- DC Coils to 48 VDC
- Life Expectancy to 10 Million Operations
- Standard PC 0.1″ Grid Terminal Spacing
- Fits Standard 16 Pin IC Socket
- Epoxy Sealed for Automatic Wave Soldering and Cleaning

Contact Arrangement: DPDT (2 Form C)
Bifurcated Contact

Contact Rating: Noninductive load
Max. switched power: 30 W or 60 VA
Max. switched current: 2 Amps
Max. switched voltage: 150 VDC or VAC

Contact Material: Silver alloy, gold plated
Silver palladium, gold plated upon request

Life Expectancy: Mechanical: 10 million operations
Electrical: $5x10^5$ @ 1 A, 30 VDC
$2x10^5$ @ 0.5 A, 120 VAC

Dielectric Strength (initial): 1200 Vrms; 500 Vrms between open contacts

Contact Resistance (typical): 50 milliohms initially
200 milliohms at end of life

Operate Time: 5 ms at nominal coil voltage (typical)

Release Time: 2 ms at nominal coil voltage (typical with no coil suppression)

Coil Power

At Pick Up Voltage (typical): 250 mW

Max. Continuous Dissipation: 1.05 mW @ 20°C (68°F) ambient
0.84 W @ 40°C (105°F) ambient

Temperature Rise: 95°C per Watt (typical)

RELAY ORDERING DATA

Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
STANDARD RELAYS: 2 FORM C (DPDT)					
5	6.8	45	3.7	AZ 820-2C-5DE	3.30
6	8.2	66	4.5	AZ 820-2C-6DE	3.30
12	16.4	280	9.0	AZ 820-2C-12DE	3.30
24	32.4	1,070	18.0	AZ 820-2C-24DE	3.30
48	61.5	4,000	36.0	AZ 820-2C-48DE	3.55

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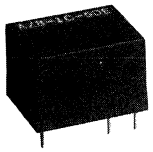
SERIES AZ 8

Epoxy Sealed SPDT Up to 6 Amps

L: 0.83″
W: 0.63″
H: 0.56″



FEATURES

- Subminiature Size
- Coils to 48 VDC
- Epoxy Sealed for Automatic Wave Soldering
- Contacts Rated at 3 or 6 Amps
- Life Expectancy to 20 Million Operations
- Extremely Low Cost
- UL File #E44211; CSA File #LR36664
- Suitable for Class B Applications

Contact Arrangement: SPDT (1 Form C)

Contact Rating: Resistive load

Light Duty: Max. switched power: 100 W or 600 VA
Max. switched current: 3 Amps
Max. switched voltage: 30 VDC/300 VAC
U.L. Rating: 2 A @ 28 VDC or 120/300 VAC; ⅛ HP @ 120 VAC; Standard Pilot Duty @ 120/240 VAC

Heavy Duty: Max. switched power: 170 W or 1800 VA
Max. switched current: 6 amps
Max. switched voltage: 30 VDC/300 VAC
U.L. Rating: 6 A @ 28 VDC or 120/300 VAC; ⅛ HP @ 120 VAC; Standard Pilot Duty @ 120/240 VAC

Contact Material: Light Duty: Fine silver, gold plated
Heavy Duty: Silver nickel, gold plated

Life Expectancy: Mechanical: 20 million operations
Electrical:
Light Duty: $1x10^5$ — 3 A 120 VAC
$5x10^5$ — 3 A 24 VDC
Heavy Duty: $1x10^5$ — 6 A 24 VDC or 120 VAC

Operate Time: 5 ms at nominal coil voltage (typical)

Release Time: 3 ms at nominal coil voltage (typical with no coil suppression)

Dielectric Strength: 750 Vrms contact to contact
2000 Vrms contact to coil

Coil Power
At Pick Up Voltage (typical): 210 mW
Max. Continuous Dissipation: 1.5 W @ 20°C (68°F) ambient
Temperature Rise: 75°C per Watt (typical)

RELAY ORDERING DATA

STANDARD RELAYS: LIGHT DUTY (3 Amp Contact)							
COIL SPECIFICATIONS				Unsealed		Epoxy Sealed	
Nom. Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price	Order Number	List Price
5	8.3	56	3.25	AZ 8-1C-5D	2.20	AZ 8-1C-5DE	2.50
6	9.9	80	3.90	AZ 8-1C-6D	2.20	AZ 8-1C-6DE	2.50
12	19.8	320	7.80	AZ 8-1C-12D	2.20	AZ 8-1C-12DE	2.50
24	39.6	1280	15.60	AZ 8-1C-24D	2.30	AZ 8-1C-24DE	2.60
48	79.2	3800	28.80	AZ 8-1C-48D	2.70	AZ 8-1C-48DE	3.00
STANDARD RELAYS: HEAVY DUTY (6 Amp Contact)							
5	8.3	56	3.25	AZ 8-1CH-5D	2.35	AZ 8-1CH-5DE	2.65
6	9.9	80	3.90	AZ 8-1CH-6D	2.35	AZ 8-1CH-6DE	2.65
12	19.8	320	7.80	AZ 8-1CH-12D	2.35	AZ 8-1CH-12DE	2.65
24	39.6	1280	15.60	AZ 8-1CH-24D	2.45	AZ 8-1CH-24DE	2.75
48	79.2	3800	28.80	AZ 8-1CH-48D	2.85	AZ 8-1CH-48DE	3.15
SENSITIVE RELAYS: LIGHT DUTY (3 Amp Contact)							
5	9.8	80	3.25	AZ 8-1C-5DS	2.40	AZ 8-1C-5DSE	2.70
6	11.7	110	3.90	AZ 8-1C-6DS	2.40	AZ 8-1C-6DSE	2.70
12	23.4	440	7.80	AZ 8-1C-12DS	2.40	AZ 8-1C-12DSE	2.70
24	46.8	1780	15.60	AZ 8-1C-24DS	2.50	AZ 8-1C-24DSE	2.80
SENSITIVE RELAYS: HEAVY DUTY (6 Amp Contact)							
5	9.8	80	3.25	AZ 8-1CH-5DS	2.55	AZ 8-1CH-5DSE	2.85
6	11.7	110	3.90	AZ 8-1CH-6DS	2.55	AZ 8-1CH-6DSE	2.85
12	23.4	440	7.80	AZ 8-1CH-12DS	2.55	AZ 8-1CH-12DSE	2.85
24	46.8	1780	15.60	AZ 8-1CH-24DS	2.65	AZ 8-1CH-24DSE	2.95

SERIES AZ 2530

Epoxy Sealed Dry Nitrogen Filled SPDT
Low Level to 2 Amp Contacts

L: 1.090″
W: 0.593″
H: 0.445″

FEATURES

- Airtight Seal for Automatic Wave Soldering and Cleaning
- Punch Out Tab Provides "breathing" Hole After Cleaning
- Welded Return Spring Stabilizes Contact Resistance
- Low Profile for Compact Board Spacing
- DC Coils to 48 VDC
- Life Expectancy to 10 Million Operations
- Standard PC 0.1″ Grid Terminal Spacing
- UL File #E43203; CSA File #LR36664

Contact Arrangement: SPDT (1 Form C)

Contact Rating: Noninductive load

Light Duty: Fine silver gold plated
1 Amp @ 26 VDC
0.5 Amp @ 115 VAC

Medium Duty: Silver cadmium oxide
2 Amp @ 26 VDC
1 Amp @ 115 VAC

Life Expectancy: Mechanical: 10 million operations
Electrical: $1x10^6$ — 1 A 26 VDC

Contact Resistance: 50 milliohms max. initially

Operate Time: 5 ms at nominal coil voltage (typical)

Release Time: 6 ms at nominal coil voltage (typical)

Dielectric Strength: Contact to contact: 500 Vrms
Contact to coil: 500 Vrms

Coil Power
Sensitive type: 80 mW
At Pick Up Voltage (typical): Light duty type: 125 mW
Medium duty type: 250 mW
Max. Continuous Dissipation: 1.6 W @ 20°C (68°F) ambient
1.2 W @ 40°C (105°F) ambient
Temperature Rise: 55°C (130°F) per watt (typical)

RELAY ORDERING DATA

STANDARD RELAYS: LIGHT DUTY TYPE (1 Amp Contact)					
COIL SPECIFICATIONS				Epoxy Sealed	
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
5	9.5	64	3.75	AZ 2530-12-1	3.75
6	11.0	90	4.5	AZ 2530-11-1	3.75
12	21.0	310	9.0	AZ 2530-08-1	3.75
24	37.0	950	18.0	AZ 2530-06-1	4.00
48	80.0	4,500	36.0	AZ 2530-04-1	4.60
STANDARD RELAYS: MEDIUM DUTY TYPE (2 Amp Contacts)					
COIL SPECIFICATIONS				Epoxy Sealed	
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	List Price
5	7.1	35	3.75	AZ 2530-14-2	3.85
6	9.5	47	4.5	AZ 2430-13-2	3.85
12	17.0	200	9.0	AZ 2530-09-2	3.85
24	37.0	950	18.0	AZ 2530-06-2	4.15
48	66.0	3,000	36.0	AZ 2530-045-2	4.75
SENSITIVE RELAYS: 1 Amp Contacts					
COIL SPECIFICATIONS				Epoxy Sealed	
Nominal Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate Current (mA)	Order Number	List Price
5	21	310	16.0	AZ 2530-08-52	6.00
12	42	1,250	8.9	AZ 2530-56-52	6.15
24	66	3,000	6.1	AZ 2530-45-52	6.80
48	143	14,000	2.7	AZ 2530-03-52	8.20

Other coil resistances, sensitivities, and contact material available upon request. Please consult factory for additional information.

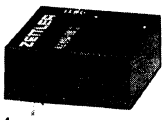
"It's a better relay"

AMERICAN ZETTLER, INC.
16881 Hale Avenue, Irvine, California 92714 (714) 540-4190 • Telex 67-8472

SERIES AZ 690

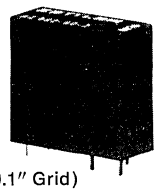
Single Pole — 10 Amp
High Dielectric — 4000 Vrms
Complete International Approvals

L: 1.100″
W: 1.024″
H: 0.441″



AZ 694

L: 1.100″
W: 0.480″
H: 1.040″



AZ 692
AZ 693 (0.1″ Grid)

FEATURES

- Isolation Spacing Greater Than 8mm
- Dielectric Strength 4000 Vrms Coil to Contact
- Approvals/Standards Include UL, CSA, VDE, IEC, CEE, SEMKO
- Single Pole — Forms A, B, C Available
- 10 Amp Switching
- Life Expectancy to 30 Million Operations
- Thinpak Version Less Than .500″ High
- Slimpak™ Version Saves Board Space
- Epoxy Sealed Version for Automatic Wave Soldering and Cleaning
- UL File #E44211; CSA File #LR36664; VDE4120-4940-4001/A1

Contact Arrangement: SPDT (1 Form C); other forms optional

Contact Rating: Resistive load
Max. switched power: 300 W or 2000 VA
Max. switched current: 10 Amp, 64 Amp for 2 msec
Max. switched voltage: 150 VDC or 250 VAC
U.L. Rating: 10 Amp @ 24 VDC or 115 VAC
¼ HP 120 VAC Motor Load

Contact Material: Silver cadmium oxide

Life Expectancy: Mechanical: 30 million operations
Electrical: 10^5 @ 10 Amp, 30 VDC
$2x10^5$ @ 10 Amp, 115 VAC or 8 Amp 220 VAC

Contact Resistance: 100 milliohms max. initially
200 milliohms at end of life

Operate Time: 6 ms at nominal coil voltage (typical)

Release Time: 4 ms at nominal coil voltage (typical wtih no coil suppression)

Coil Power
At Pick Up Voltage (typical): 350 mW
Max. Continuous Dissipation: 1.9 W @ 20°C (68°F) ambient
1.45 W @ 40°C (105°F) ambient
Temperature Rise: 42°C (108°F) per Watt (typical)
Coil Temperature: Max. 105°C (220°F)

Dielectric Strength (initial): 4000 Vrms Coil to Contact
1000 Vrms between open contact

STANDARD ORDERING DATA

Nom. Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Order Number	Order Number	Order Number	List Price
STANDARD COILS							
5	8	38	3.5	AZ 692-125-2	AZ 693-125-2	AZ 694-125-2	4.00
6	10	58	4.2	AZ 692-112-2	AZ 693-112-2	AZ 694-112-2	4.00
12	19	215	8.4	AZ 692-08-2	AZ 693-08-2	AZ 694-08-2	4.00
24	35	740	16.8	AZ 692-560-2	AZ 693-560-2	AZ 694-560-2	4.00
48	74	3200	33.6	AZ 692-04-2	AZ 693-04-2	AZ 694-04-2	4.50
SENSITIVE COILS							
5	9	47	3.5	AZ 692-118-52	AZ 693-118-52	AZ 694-118-52	4.50
6	12	80	4.2	AZ 692-010-52	AZ 693-010-52	AZ 694-010-52	4.50
12	24	330	8.4	AZ 692-071-52	AZ 693-071-52	AZ 694-071-52	4.50
24	45	1200	16.8	AZ 692-052-52	AZ 693-052-52	AZ 694-052-52	4.50
48	89	4700	33.6	AZ 692-518-52	AZ 693-518-52	AZ 694-518-52	5.00

Epoxy Sealed versions available

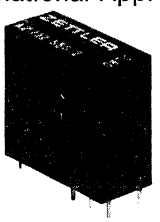
HARDWARE

Relay Type	Socket	Retaining Clip
AZ 692	ST 682-U1	ST 482-2
AZ 693	ST 483-U1	ST 482-2

SERIES AZ 730

Double Pole — 8 Amp
High Dielectric — 4000 Vrms
Complete International Approvals

L: 1.230″
W: 0.535″
H: 1.040″



FEATURES

- Dielectric Strength 4000 Vrms Coil to Contact
- Isolation Spacing Greater Than 8mm
- Approvals/Standards Include UL, CSA, VDE, IEC, CEE, SEMKO
- Double Pole — Forms A, B, C Available
- 8 Amp Switching
- Life Expectancy to 30 Million Operations
- Slimpak™ Version Saves Board Space
- Epoxy Sealed Version for Automatic Wave Soldering and cleaning
- UL File #E44211; CSA File #LR36664; VDE4120-4940-4002/A1

Contact Arrangement: DPDT (2 Form C); other forms optional

Contact Rating: Resistive load
Max. switched power: 240 W or 1500 VA
Max. switched current: 8 Amp, 51 Amp for 2 ms
Max. switched voltage: 150 VDC or 250 VAC
U.L. Rating: 8 Amp @ 24 VDC or 115 VAC
⅛ HP 120 VAC Motor Load

Contact Material: Silver cadmium oxide

Life Expectancy: Mechanical: 30 million operations
Electrical: 10^5 @ 8 Amp 30 VDC
$2x10^5$ @ 8 Amp 115 VAC or 6 Amp 220 VAC

Contact Resistance: 100 milliohms max. initially
200 milliohms at end of life

Operate Time: 8 ms at nominal coil voltage (typical)

Release Time: 4 ms at nominal coil voltage (typical with no coil suppression)

Dielectric Strength: 4000 Vrms contacts to coil
2500 Vrms contact to contact
1000 Vrms between open contact

Coil Power
At Pick Up Voltage (typical): 350 mW
Max. Continuous Dissipation: 1.9 W @ 20°C (68°F) ambient
1.45 W @ 40°C (105°F) ambient
Temperature Rise: 42°C (108°F) per Watt (typical)
Coil Temperature: Max. 105°C (220°F)

STANDARD ORDERING DATA

Nom. Coil VDC	Max. Continuous VDC	Coil Resistance ±10%	Must Operate VDC	Unsealed Order Number	Unsealed List Price	Sealed Order Number	Sealed List Price
STANDARD COILS							
5	8	38	3.5	AZ 732-125-2	4.80	AZ 2732-125-2	5.60
6	10	58	4.2	AZ 732-112-2	4.80	AZ 2732-112-2	5.60
12	19	215	8.4	AZ 732-08-2	4.80	AZ 2732-08-2	5.60
24	35	740	16.8	AZ 732-560-2	4.80	AZ 2732-560-2	5.60
48	74	3200	33.6	AZ 732-04-2	5.30	AZ 2732-04-2	6.10
SENSITIVE COILS							
5	9	47	3.5	AZ 732-118-52	5.30	AZ 2732-118-52	6.10
6	11	70	4.2	AZ 732-509-52	5.30	AZ 2732-509-52	6.10
12	21	270	8.4	AZ 732-521-52	5.30	AZ 2732-521-52	6.10
24	43	1100	16.8	AZ 732-053-52	5.30	AZ 2732-053-52	6.10
48	86	4400	33.6	AZ 732-510-52	5.80	AZ 2732-510-52	6.60

HARDWARE

Socket	Retaining Clip
ST 484-U1	ST 482-2

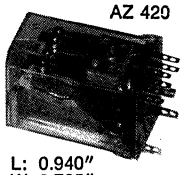
"It's a better relay"

AMERICAN ZETTLER, INC.
16881 Hale Avenue, Irvine, California 92714 (714) 540-4190 • Telex 67-8472

SERIES AZ 420

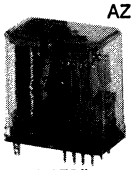
Up to 6 PDT or 8 PST
Dry Circuit thru 10 Amp Contacts

AZ 420



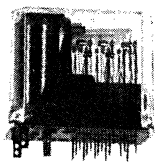
L: 0.940″
W: 0.735″
H: 1.230″

AZ 421



L: 1.172″
W: 0.735″
H: 1.230″

AZ 431



L: 1.395″
W: 0.735″
H: 1.230″

FEATURES

- International Standard Type
- Occupies Less Than One Cubic Inch of Space
- Life Expectancy More Than 100 Million Operations
- Coils to 115V — DC or AC
- Current and Voltage Sensitive Coils Available
- Dry Circuit, 2 Amp, 5 Amp, or 10 Amp Contacts
- Form A, B, C and D Contacts Available
- Solder/plug in or PC Terminals
- Hydrogen Annealed Iron Magnetic Circuit
- Molded Comb Eliminates Phenolic Dust Inside Relay
- Balanced Spring-held Armature Allows Dependable Operation in Any Position
- Round Core and Larger Coil Volume Provide More Pull Force
- UL File #E43203; CSA File #LR36664; VDE 0110 Gr. A

Contact Arrangement:	2, 4, or 6 Form C; 6 or 8 Form A or B; 2 or 4 Form D available
Contact Rating:	Noninductive load — U.L. Rating
Code: WL	Fine silver, gold plated 3 Amp at 26 VDC or 115 VAC
Code: WH	Silver cadmium oxide, gold plated 7.5 Amp at 26 VDC or 115 VAC
Code: 10L, 40L	Fine silver, gold plated 2 Amp at 26 VDC; 1 Amp at 115 VAC
Life Expectancy:	Mechanical operations: 100 million Electrical: $1x10^6$ at 2 A, 30 VDC or 120 VAC (Code WL) $1x10^5$ at 5 A, 30 VDC or 120 VAC (Code WH)
Contact Resistance:	50 milliohms initially (typical)
Operate Time (typical):	10 ms at nom. coil voltage
Release Time (typical):	3 ms at nom. coil voltage with no coil suppression
Dielectric Strength (initial):	1000 Vrms between all points 1500 Vrms versions available
Coil Power	
At Pick Up Power (typical):	40 mW per pole (sensitive version) 25 mW per pole available
Max. Continuous Dissipation:	2.6 W @ 20°C (68°F) ambient 2.0 W @ 40°C (105°F) ambient
Temperature Rise:	30°C (86°F) per Watt (typical)

CONTACTS RATED 2 AMPS — FINE SILVER GOLD PLATED

COIL SPECIFICATONS						
Nom. Voltage (Volts)	Must Operate (VDC)	Resistance (Ohms)	Contacts	Solder Plug-in Terminals Order Number	PC Terminals Order Number	List Price
6 DC	4.5	52	DPDT	AZ 420-15-4WL	AZ 428-15-4WL	5.25
12 DC	9.0	185	DPDT	AZ 420-1011-4WL	AZ 428-1011-4WL	5.25
24 DC	18.0	700	DPDT	AZ 420-70-4WL	AZ 428-70-4WL	5.25
48 DC	36.0	2.5K	DPDT	AZ 420-56-4WL	AZ 428-56-4WL	5.25
115 DC	86.0	15K	DPDT	AZ 420-035-4WL	AZ 428-035-4WL	7.25
6 DC	4.5	52	4PDT	AZ 421-15-1WL	AZ 429-15-1WL	6.15
12 DC	9.0	185	4PDT	AZ 421-1011-1WL	AZ 429-1011-1WL	6.15
24 DC	18.0	700	4PDT	AZ 421-70-1WL	AZ 429-70-1WL	6.15
48 DC	36.0	2.5K	4PDT	AZ 421-56-1WL	AZ 429-56-1WL	6.15
115 DC	86.0	15K	4PDT	AZ 421-035-1WL	AZ 429-035-1WL	8.15
6 DC	4.5	25	6PDT	AZ 431-18-1WL	AZ 439-18-1WL	9.35
12 DC	9.0	90	6PDT	AZ 431-13-1WL	AZ 439-13-1WL	9.35
24 DC	18.0	430	6PDT	AZ 431-80-1WL	AZ 439-80-1WL	9.35
48 DC	36.0	1.8K	6PDT	AZ 431-06-1WL	AZ 439-06-1WL	9.35
115 DC	86.0	9K	6PDT	AZ 431-04-1WL	AZ 439-04-1WL	10.85

CONTACTS RATED 5 AMPS — SILVER CADMIUM

COIL SPECIFICATIONS					
Nominal Voltage (Volts)	Must Operate (VDC)	Resistance (Ohms)	Contacts	Solder Plug-In Terminals Order Number	List Price
6 DC	4.5	52	DPDT	AZ 420-15-4WH	5.55
12 DC	9.0	185	DPDT	AZ 420-1011-4WH	5.55
24 DC	18.0	700	DPDT	AZ 420-70-4WH	5.55
48 DC	36.0	2.5K	DPDT	AZ 420-56-4WH	5.55
115 DC	86.0	15K	DPDT	AZ 420-035-4WH	7.55
6 DC	4.5	52	4PDT	AZ 421-15-1WH	6.75
12 DC	9.0	185	4PDT	AZ 421-1011-1WH	6.75
24 DC	18.0	700	4PDT	AZ 421-70-1WH	6.75
48 DC	36.0	2.5K	4PDT	AZ 421-56-1WH	6.75
115 DC	86.0	15K	4PDT	AZ 421-035-1WH	8.75
6 DC	4.5	25	6PDT	AZ 431-18-1WH	10.25
12 DC	9.0	90	6PDT	AZ 431-13-1WH	10.25
24 DC	18.0	430	6PDT	AZ 431-80-1WH	10.25
48 DC	36.0	1.8K	6PDT	AZ 431-06-1WH	10.25
115 DC	86.0	9K	6PDT	AZ 431-04-1WH	12.65

Epoxy Sealed Versions Available

BIFURCATED CONTACTS RATED 2 AMPS — FINE SILVER GOLD PLATED

COIL SPECIFICATONS						
Nom. Voltage (Volts)	Must Operate (VDC)	Resistance (Ohms)	Contacts	Solder Plug-in Terminals Order Number	PC Terminals Order Number	List Price
6 DC	4.5	52	DPDT	AZ 420-15-40L	AZ 428-15-40L	6.15
12 DC	9.0	185	DPDT	AZ 420-1011-40L	AZ 428-1011-40L	6.15
24 DC	18.0	700	DPDT	AZ 420-70-40L	AZ 428-70-40L	6.15
48 DC	36.0	2.5K	DPDT	AZ 420-56-40L	AZ 428-56-40L	6.15
115 DC	86.0	15K	DPDT	AZ 420-035-40L	AZ 428-035-40L	8.15
6 DC	4.5	52	4PDT	AZ 421-15-10L	AZ 429-15-10L	7.75
12 DC	9.0	185	4PDT	AZ 421-1011-10L	AZ 429-1011-10L	7.75
24 DC	18.0	700	4PDT	AZ 421-70-10L	AZ 429-70-10L	7.75
48 DC	36.0	2.5K	4PDT	AZ 421-56-10L	AZ 429-56-10L	7.75
115 DC	86.0	15K	4PDT	AZ 421-035-10L	AZ 429-035-10L	9.75
6 DC	4.5	25	6PDT	AZ 431-18-10L	AZ 439-18-10L	11.65
12 DC	9.0	90	6PDT	AZ 431-13-10L	AZ 439-13-10L	11.65
24 DC	18.0	430	6PDT	AZ 431-80-10L	AZ 439-80-10L	11.65
48 DC	36.0	1.8K	6PDT	AZ 431-06-10L	AZ 439-06-10L	11.15
115 DC	86.0	9	6PDT	AZ 431-04-10L	AZ 439-04-10L	13.15

CONTACTS RATED 5 AMPS — SILVER CADMIUM

COIL SPECIFICATIONS					
Nominal Voltage (Volts)	Must Operate (VDC)	Resistance (Ohms)	Contacts	PC Terminals Order Number	List Price
6 DC	4.5	52	DPDT	AZ 428-15-4WH	5.35
12 DC	9.0	185	DPDT	AZ 428-1011-4WH	5.35
24 DC	18.0	700	DPDT	AZ 428-70-4WH	5.35
48 DC	36.0	2.5K	DPDT	AZ 428-56-4WH	5.35
115 DC	86.0	15K	DPDT	AZ 428-035-4WH	7.35
6 DC	4.5	52	4PDT	AZ 429-15-1WH	6.75
12 DC	9.0	185	4PDT	AZ 429-1011-1WH	6.75
24 DC	18.0	700	4PDT	AZ 429-70-1WH	6.75
48 DC	36.0	2.5K	4PDT	AZ 429-56-1WH	6.75
115 DC	86.0	15K	4PDT	AZ 429-035-1WH	8.75
6 DC	4.5	25	6PDT	AZ 439-18-1WH	10.25
12 DC	9.0	90	6PDT	AZ 439-13-1WH	10.25
24 DC	18.0	430	6PDT	AZ 439-80-1WH	10.25
48 DC	36.0	1.8K	6PDT	AZ 439-06-1WH	10.25
115 DC	86.0	9K	6PDT	AZ 439-04-1WH	12.65

HARDWARE

Poles	Socket	Retaining Clip	Ground Clip
2	ST 140-A1	ST 140-1	ST 140-2
4	ST 141-A1	ST 141-1	ST 140-2
6	ST 345-A1	ST 345-1	ST 140-2

Gold Plating Available Upon Request

"It's a better relay"

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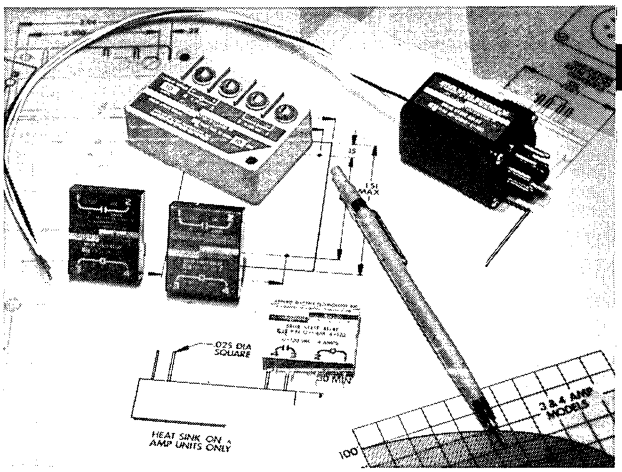
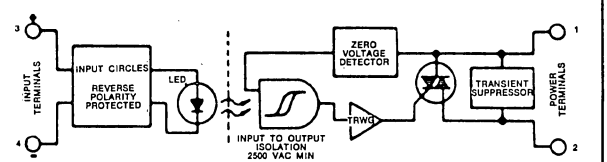


Optoswitch™

GENERAL PURPOSE AC SOLID STATE RELAYS OPTO-ISOLATED

SCHEMATIC DIAGRAM



SOLID STATE RELAY SPECIFICATIONS:

1. POWER CIRCUIT SPECIFICATION — Isolation: Input to output and input to base plate 2500 vrms, 10^{10} ohms DC. **Peak Repetitive Voltage:** 250 V. **Operating Voltage Range:** 24-140 VAC. **Contact Voltage Drop:** 1.3 vrms nominal, 1-6 vrms max. over temperature range: **Turn On Time:** ½ cycle maximum, zero voltage. **Turn Off Time:** ½ cycle maximum: zero current. **DV/DT Off State:** 200 v/microsecond. **DV/DT Commutating.** Snubbed for motor starting loads. **Off State Leakage:** 6 ma. maximum over operating temperature range. I^2t rating for period of 8.3 ms (for fusing purpose).

2. DC CONTROL VOLTAGE SPECIFICATION — Maximum Control Input: 32 V. **Turn On Voltage:** 4 V maximum over operating temperature range. **Turn On Current:** 3.5 ma. maximum over temperature range. **Turn Off Voltage:** 1 V minimum. **Maximum Reverse Polarity Voltage:** 60 V.

3. TEMPERATURE RATING — Operating Temperature Range: −40° to 100°C. **Maximum Base Plate Temperature at Rated Current:** OTM Series; 60°C. **Maximum Case Temperature at Rated Current:** ALL OTHERS; 75°C.

4. MECHANICAL — Physical Configuration: See inside date sheet. **Case:** Epoxy encapsulated for environmental protection.

amp model	I^2t (amp². sec.)	amp model	I^2t (amp². sec.)
3	2.5	10	50
4	6	15	85
6	15	25	250

The OPTOSWITCH™ general purpose AC solid state relays have been specifically designed to meet or exceed commercial requirements. Applied Electro Technology Int. has a long history of manufacturing aerospace and military high reliability solid state relays and this high quality experience has influenced a new design in solid state relays with stringent manufacturing and testing.

Use these relays in all your commercial applications such as copiers, instruments, controls, gas pumps, microprocessor controllers, automated machinery, etc.

The OPTOSWITCH™ totally solid state AC relays are total encapsulated and especially recommended for harsh industrial environments where high shock or severe temperature excursions are encountered. All inputs are opto-isolated and turn-on is synchronized with load voltage zero crossing to minimize radio frequency interference.

- Optical isolation between control and load circuits.
- Logic compatible input current level.
- Zero voltage turn-on for reduced EMI.
- High transient immunity.
- Integrated heat-sinks for greater load capacity.

ORDERING INFORMATION

PART NO. BREAKDOWN 12-OPC SERIES

12 - OPC - 4 - 120

- PRODUCT IDENT NO.
- OPTOSWITCH™ PRINTED CIRCUIT MOUNTING
- CURRENT RATING IN AMPS
- SWITCHING VOLTAGE

PART NO. BREAKDOWN 12-OEM SERIES

12 - OEM - 4 - 120

- PRODUCT IDENT NO.
- OPTOSWITCH™ PRINTED CIRCUIT EDGE MOUNTING
- CURRENT RATING IN AMPS
- SWITCHING VOLTAGE

PART NO. BREAKDOWN 12-OTM SERIES

12 - OTM - 25 - 120

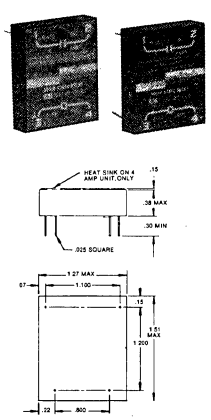
- PRODUCT IDENT NO.
- OPTOSWITCH™ TERMINAL MOUNTING
- CURRENT RATING IN AMPS
- SWITCHING VOLTAGE

PART NO. BREAKDOWN 12-OSM SERIES

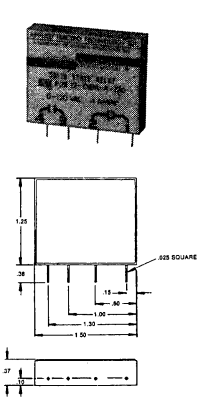
12 - OSM - 1 - 120

- PRODUCT IDENT NO.
- OPTOSWITCH™ SOCKET MOUNTING
- CURRENT RATING IN AMPS
- SWITCHING VOLTAGE

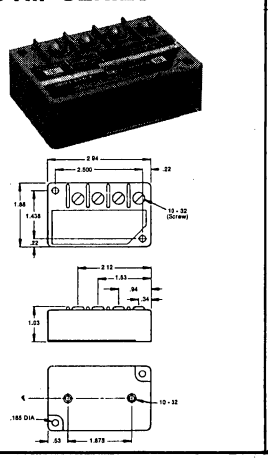
12-OPC SERIES



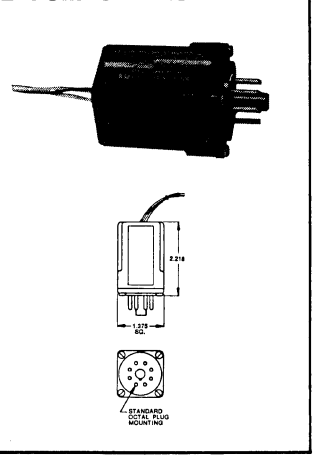
12-OEM SERIES



12-OTM SERIES



12-OSM SERIES



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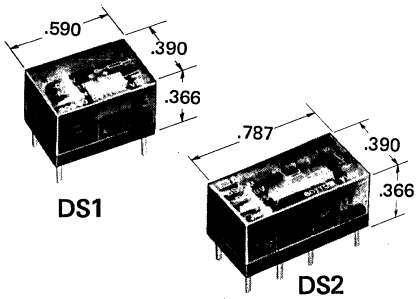
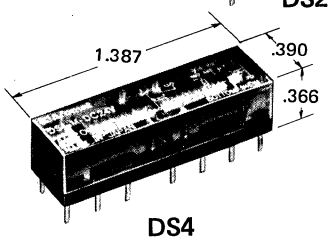
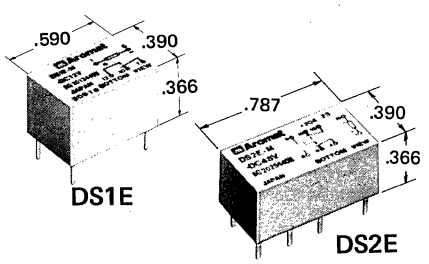
NEW Highly Sensitive 1,500 V FCC Surge Withstanding Miniature Relays DS-RELAYS

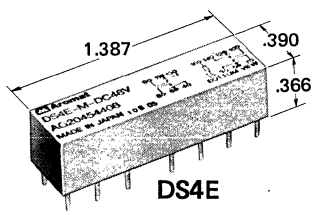
Relay Efficiency





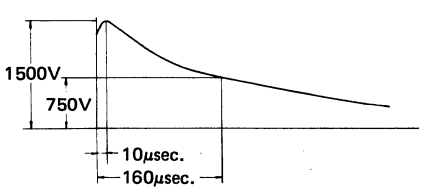
DSE Amber Relays





- High sensitivity
- High switching capacity
- High breakdown voltage —1,500V FCC surge between open contacts, 1,000VAC between open contacts
- DIP terminal arrangement
- Latching types available

* FCC (Federal Communication Commission) requests following standard as Breakdown Voltage specification



Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
Single side stable	DC5V	5VDC	62.5			
DS1–M–	DC6V	6	90			
DS1E–M–	DC9V	9	203	400	1C	2
	DC12V	12	360			
	DC24V	24	1440			
	DC48V	48	5760			
2 coil latching	DC5V	5VDC	69.4			
DS1–ML2–	DC6V	6	100			
DS1E–ML2–	DC9V	9	225	360	1C	2
	DC12V	12	400			
	DC24V	24	1600			
Single side stable	DC5V	5VDC	62.5			
DS2–M–	DC6V	6	90			
DS2E–M–	DC9V	9	203	400	2C	2
	DC12V	12	360			
	DC24V	24	1440			
	DC48V	48	5760			
2 coil latching	DC5V	5VDC	69.4			
DS2–ML2–	DC6V	6	100			
DS2E–ML2–	DC9V	9	225			
	DC12V	12	400	360	2C	2
	DC24V	24	1600			
	DC48V	48	6400			
Single side stable	DC5V	5VDC	125			
DS2–S–	DC6V	6	180			
DS2E–S–	DC9V	9	405			
	DC12V	12	720	200	2C	2
	DC24V	24	2880			
	DC48V	48	11520			
2 coil latching	DC5C	5VDC	139			
DS2–SL2–	DC6V	6	200			
DS2E–SL2–	DC9V	9	450			
	DC12V	12	800	180	2C	2
	DC24V	24	3200			
	DC48V	48	12800			
Single side stable	DC5V	5VDC	62.5			
DS4–M–	DC6V	6	90			
DS4E–M–	DC9V	9	203			
	DC12V	12	360	400	4C	2
	DC24V	24	1440			
	DC48V	48	5760			
2 coil latching	DC5V	5VDC	69.4			
DS4–ML2–	DC6V	6	100			
DS4E–ML2–	DC9V	9	225			
	DC12V	12	400	360	4C	2
	DC24V	24	1600			
	DC48V	48	6400			
Single site stable	DC5V	5VDC	125			
DS4–S–	DC6V	6	180			
DS4E–S–	DC9V	9	405			
	DC12V	12	720	200	4C	2
	DC24V	24	2880			
	DC48V	48	11520			
2 coil latching	DC5V	5VDC	139			
DS4–SL2–	DC6V	6	200			
DS4E–SL2–	DC9V	9	450			
	DC12V	12	800	180	4C	2
	DC24V	24	3200			
	DC48V	48	12800			

Note: 1. Reverse polarity types available
2. Gold capped silver pallarium contacts available
3. For UL/CSA recognized types : 2 Form C and 4 form C, add suffix UL/CSA.
4. Standard packing → Carton : 50 pcs./Case: 500 pcs.

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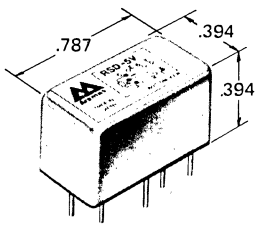
Half Size Amber Relays
More than 50 Million Units around the World

R-RELAYS

Relay Efficiency



- Amber sealed construction
- High sensitivity
- High speed: 1 msec. max.
- Wide switching range and high welding resistance
- Small size
- High reliability and long life
- Latching types available

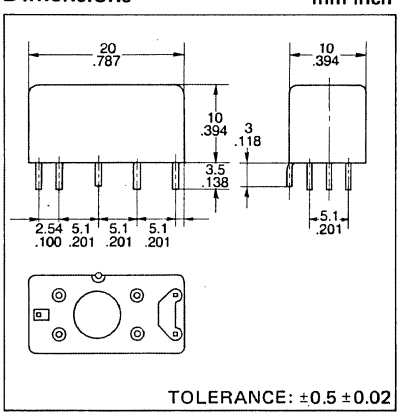
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
Single side stable RSD–	DC5V	5VDC	170	147	1C	1
	DC6V	6	220	164		
	DC12V	12	890	162		
	DC24V	24	2,000	288		
	DC48V	48	8,000	221		
1-coil latching RSLD–	DC5V	5VDC	340	74	1C	1
	DC6V	6	450	80		
	DC12V	12	1,500	96		
	DC24V	24	6,000	96		
	DC48V	48	12,000	147		
2-coil latching RSL2D–	DC5V	5VDC	170	147	1C	1
	DC6V	6	225	160		
	DC12V	12	650	230		
	DC24V	24	2,700	213		
	DC48V	48	6,500	321		

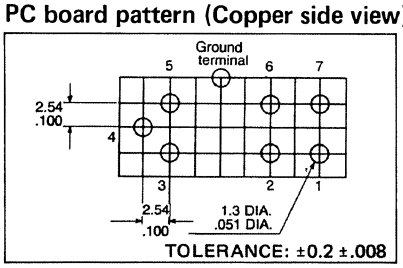
Note: 1. R1a (1 Form a contact) types available
2. Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

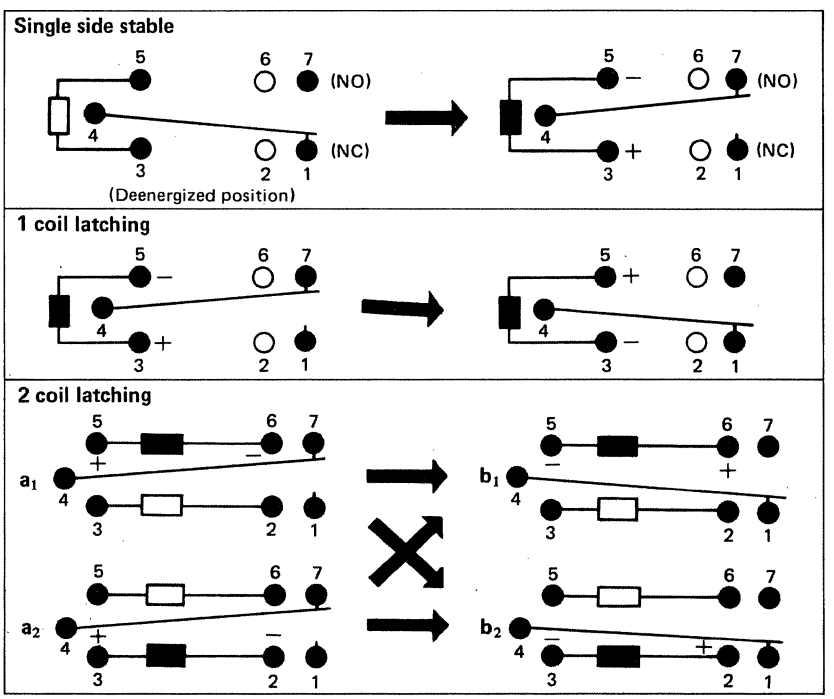
mm inch



PC board pattern (Copper side view)

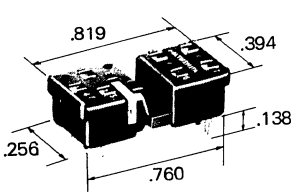


Schematic (Bottom view)



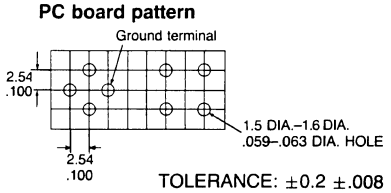
R Socket

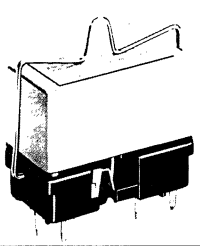
R–PS	PC terminal



R-PS

PC board pattern





The R-Relay with R-PS attached

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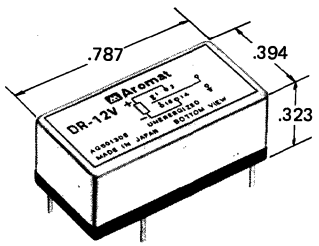
Highly Reliable Miniature DIP Relays

DR-RELAYS

Relay Efficiency



- High breakdown voltage: 750 Vrms between open contacts
- High sensitivity
- High sticking resistance
- Miniature size and flat form
- High speed – Operate time: Approx. 1 msec.
- DIP terminal arrangement
- Latching types available

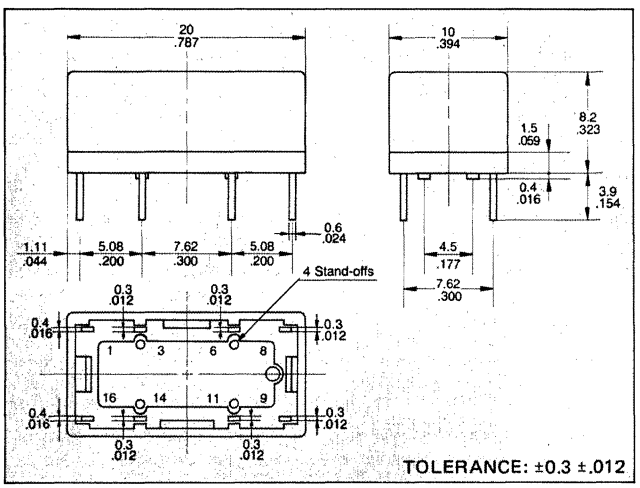
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
Single side stable DR–	5V	5VDC	240	104	1C	1
	6V	6	330	109		
	12V	12	1,400	103		
	24V	24	3,600	160		
	48V	48	11,000	209		
1-coil latching DR–L–	5V	5VDC	420	59	1C	1
	6V	6	610	59		
	12V	12	2,300	62		
	24V	24	5,800	99		
	48V	48	21,100	109		
2-coil latching DR–L2–	5V	5VDC	225	111	1C	1
	6V	6	290	124		
	12V	12	1,210	119		
	24V	24	3,840	150		
	48V	48	7,950	290		

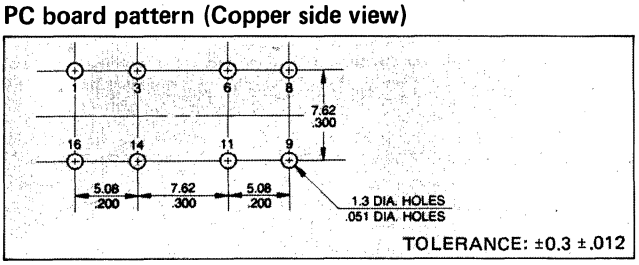
Note: Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

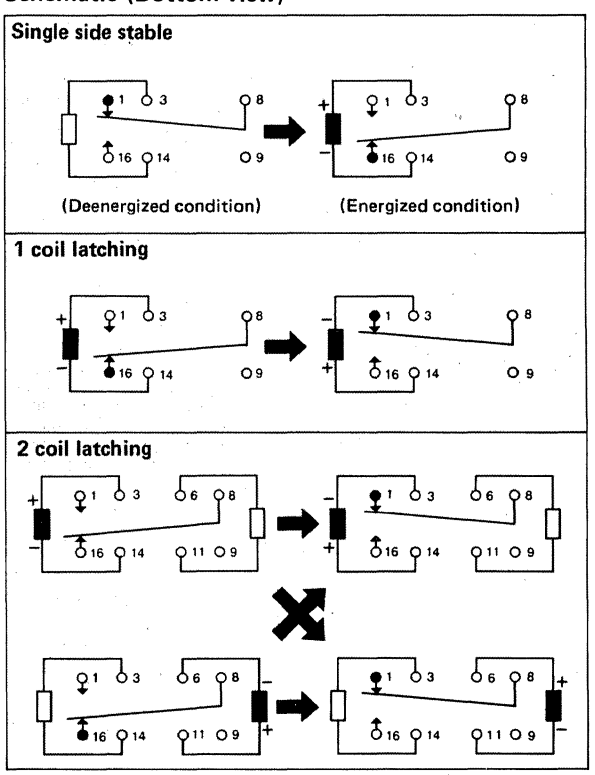
mm inch



PC board pattern (Copper side view)



Schematic (Bottom view)



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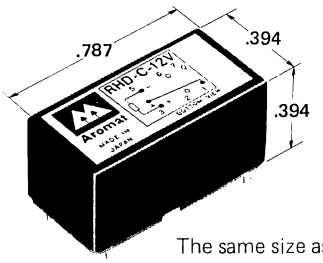
NEW IC Built-in Power Saving Relays for Battery Devices R-C UNIT RELAYS

Relay Efficiency



The same size as R relay.

- Ultra low operating power
- Little heat generation
- Wider operating voltage range
- Low bounce

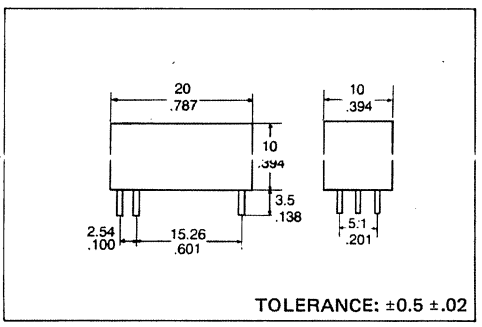
Types and Data

Type	Coils		Contacts	
	Voltage	Nom. Power (mW)	Arrange-ment	Rating (A)
RHD–C– 5V	5	0.3 to 0.78	1C	1
RHD–C–12V	12	1.56 to 3.12		

Note: Standard packing → Carton : 50 pcs./Case : 500 pcs.

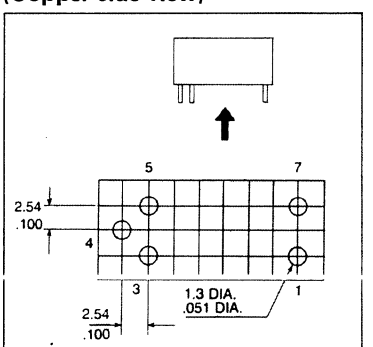
Dimensions

mm inch



TOLERANCE: ±0.5 ±.02

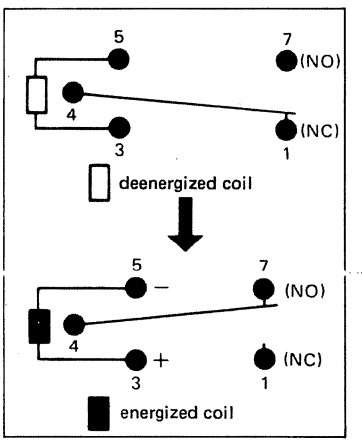
P/C board pattern (Copper side view)



TOLERANCE: ±0.2 ±0.08

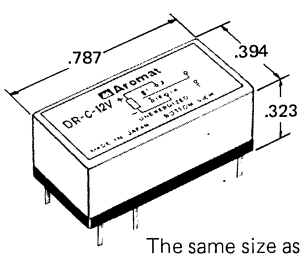
Note: A standard pattern: P/C board with a pitch of .100 inch is suitable for mounting RHD-C relays.

Schematic (Bottom view)



NEW IC Built-in Power Saving Relays for Battery Devices DR-C UNIT RELAYS

Relay Efficiency



The same size as DR relay.

- Ultra low operating power
- Little heat generation
- Wider operating voltage range
- Low bounce

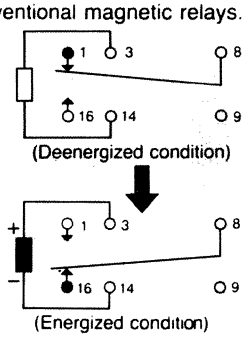
Types and Data

Type	Coils		Contacts	
	Voltage	Nom. Power (mW)	Arrange-ment	Rating (A)
DR–C– 5V	5	0.175 to 0.245	1C	1
DR–C–12V	12	1.56 to 3.38		

Note: Standard packing → Carton: 50 pcs./Case : 500 pcs.

Schematic (Bottom view)

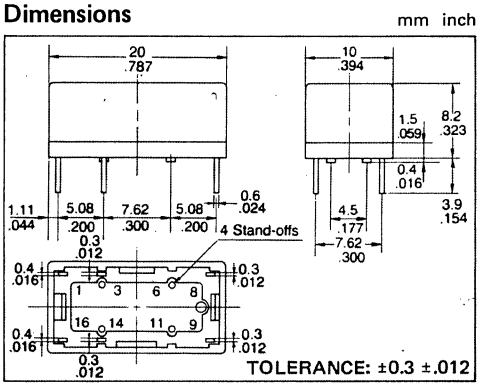
Same operations as the conventional magnetic relays.



Note: Energization with an opposite polarity does not switch the contact. The reverse polarity may damage the built-in IC. Apply proper polarity to switch the contact.

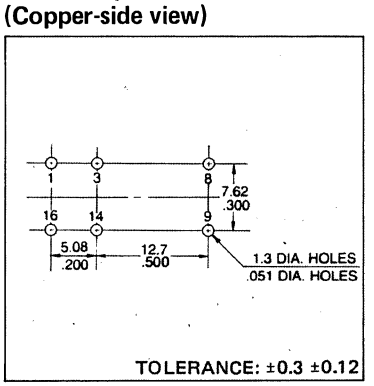
Dimensions

mm inch



TOLERANCE: ±0.3 ±.012

PC board pattern (Copper-side view)



TOLERANCE: ±0.3 ±0.12

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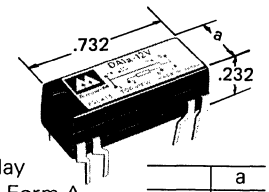
Thin-Line Low Profile DIP Reed Relays — DA-RELAYS



- High contact reliability
- Sensitive relay – 89mW (1 Form A 5V) low operating power.
- DIP terminal arrangement
- Magnetically shield

	a
DA1a	.283
DA2a	.362

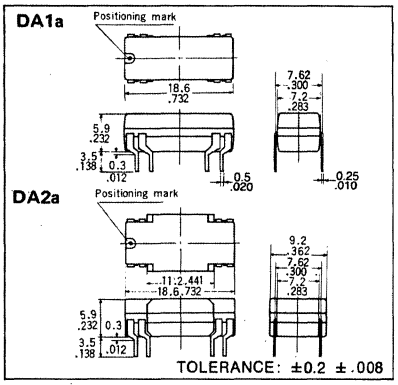
Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
DA1a–	5V	5VDC	280	89	1a	0.2
	6V	6	280	129		
	12V	12	720	200		
	24V	24	2,500	230		
DA2a–	5V	5VDC	150	167	2a	
	6V	6	150	240		
	12V	12	510	282		
	24V	24	1,770	325		

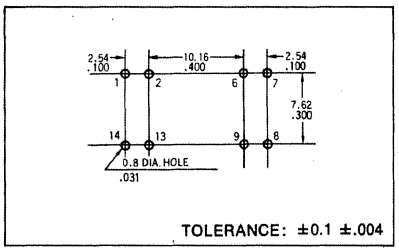
Notes: 1. Diode enclosed type available as –D
2. High sensitive coils for 5V and 6V available
3. Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

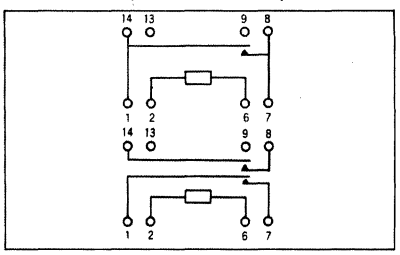
mm inch



PC board pattern (Copper side view)

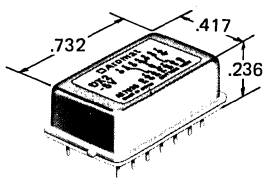


Schematic (Bottom view)



Hermetically Sealed Small DIP Relays — DX-RELAYS

Relay Efficiency



- High radio frequency characteristics
- High sensitivity to be IC drivable: 60mW pick-up only
- High insulation resistance
- High shock/vibration resistance: 50G/30G (10 to 55 Hz at double amplitude of 5 mm)
- Latching types available

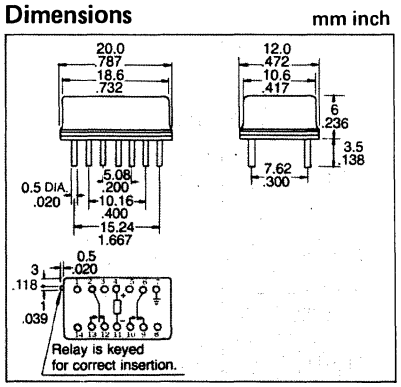
Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
Single side stable DX2–	3V	3VDC	70	128	2C	1
	5V	5	200	125		
	6V	6	280	128		
	12V	12	1,000	144		
	24V	24	4,000	144		
1-coil latching DX2–L–	3V	3VDC	70	128	2C	1
	5V	5	200	125		
	6V	6	280	128		
	12V	12	1,000	144		
	24V	24	4,000	144		
2-coil latching DX2–L2–	3V	3VDC	35	257	2C	1
	5V	5	100	250		
	6V	6	140	257		
	12V	12	500	288		
	14V	24	2,000	288		

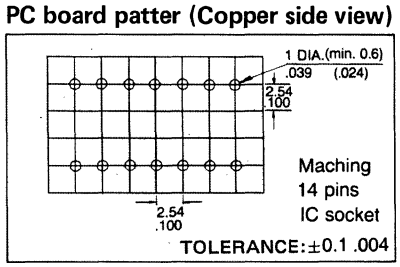
Note: Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

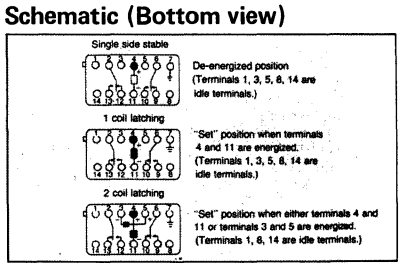
mm inch



PC board patter (Copper side view)



Schematic (Bottom view)



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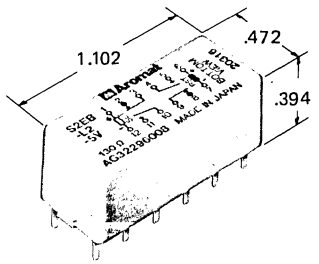
4 Amp Polarized High Density Relays with High Sensistivity

SEB-RELAYS

Relay Efficiency



- Amber sealed construction
- High sensitivity in small size
- Wide switching range: 100μA to 4A
- High shock/vibration resistance: 50G/18G (10 to 55 Hz at double amplitude of 3 mm)
- A variety of contact arrangement
- Low thermal electromotive force: Approx. 3μV
- DIL terminal arrangement
- Multiple latching

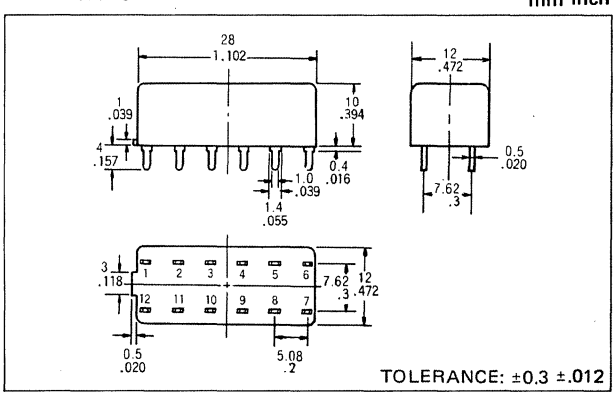
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrangement	Rating (A)
Single side stable S2EB–	5V	5V,DC	130	192	2a2b	4
	6V	6	180	200		
	12V	12	720	200		
	24V	24	2,850	202		
	48V	48	8,500	271		
2 coil latching S2EB–L2–	5V	5VDC	130	192	2a2b	4
	6V	6	180	200		
	12V	12	720	200		
	24V	24	2,850	202		
	48V	48	6,500	355		
Single side stable S4EB–	5V	5VDC	130	192	4a	4
	6V	6	180	200		
	12V	12	720	200		
	24V	24	2,850	202		
	48V	48	8,500	271		
2 coil latching S4EB–L2–	5V	5VDC	130	192	4a	4
	6V	6	180	200		
	12V	12	720	200		
	24V	24	2,850	202		
	48V	48	6,500	355		

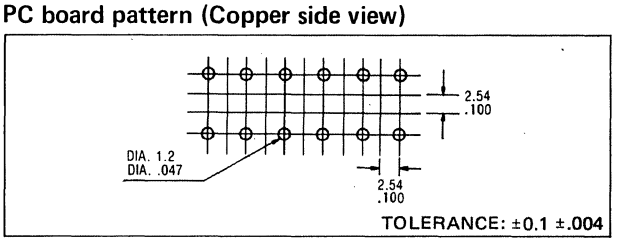
Note: Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

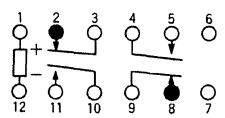
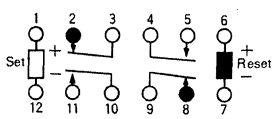
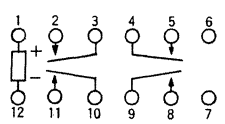
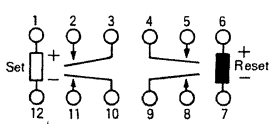
mm inch

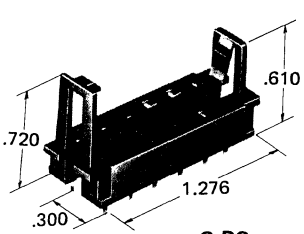


PC board pattern (Copper side view)



Schematic (Bottom view)

	Single side stable (De-energized position)	2 coil latching "Reset" position when reset coil is energized with indicated polarity..
2a2b		
4a		



S-PS

S Socket

S–PS	PC terminal

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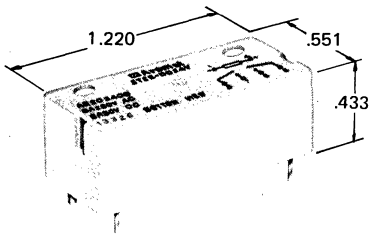
IC Drivable PC Board Relays for Field Load Switching

STE-RELAYS

Relay Efficiency



- Amber sealed construction
- High switching capacity—8A
- High sensitivity
- Miniature size
- High shock/vibration resistance — 20G/12G (10 to 55 Hz at double amplitude of 2 mm)
- Latching types available

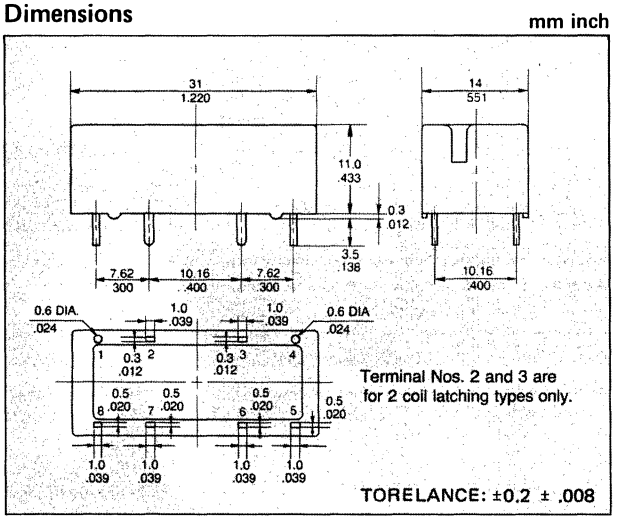
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
Single side stable ST1E—	DC 5V	5VDC	110	240	1a1b	8
	DC 6V	6	150			
	DC 9V	9	360			
	DC12V	12	640			
	DC24V	24	2,400			
	DC48V	48	9,000			
2 coil latching ST1E—L2—	DC 5V	5VDC	110	240	1a1b	8
	DC 6V	6	160			
	DC 9V	9	360			
	DC12V	12	640			
	DC24V	24	2,440			
	DC48V	48	10,200			
Single side stable ST2E—	DC 5V	5VDC	110	240	2a	8
	DC 6V	6	150			
	DC 9V	9	360			
	DC12V	12	640			
	DC24V	24	2,400			
	DC48V	48	9,000			
2 coil latching ST2E—L2—	DC 5V	5VDC	110	240	2a	8
	DC 6V	6	160			
	DC 9V	9	360			
	DC12V	12	640			
	DC24V	24	2,440			
	DC48V	48	10,200			

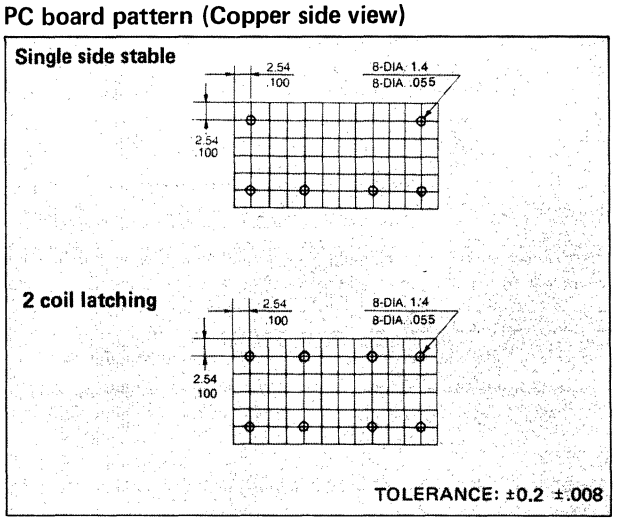
Note: Standard packing→Carton: 50 pcs./Case: 500 pcs.

Dimensions

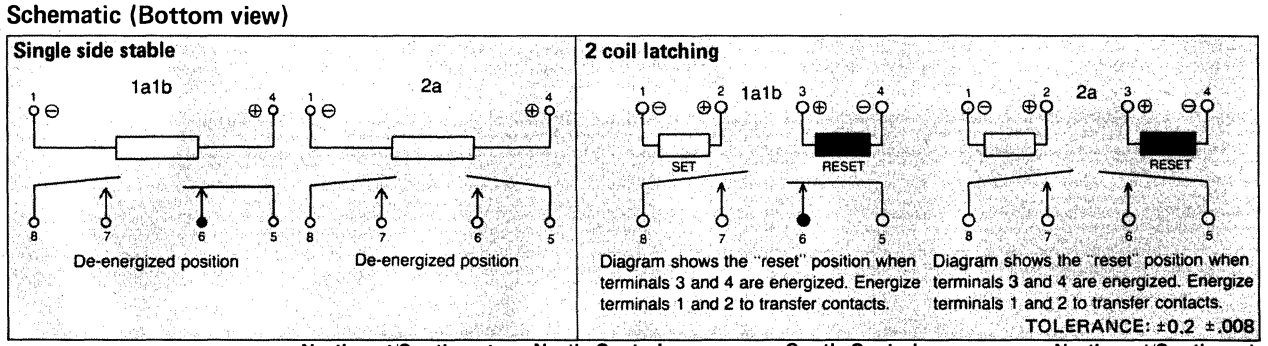
mm inch



PC board pattern (Copper side view)



Schematic (Bottom view)



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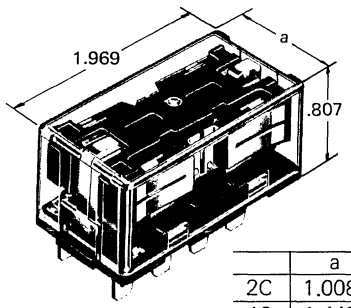
Compact Power Relays with High Sensitivity

SP-RELAYS

Relay Efficiency



	a
2C	1.008
4C	1.449

- High sensitivity
- High switching capacity in compact size
- High shock/vibration resistance: 40G/18G (10 to 55 Hz at double amplitude of 3 mm)
- Multiple latching
- High reliability and long life
- Latching types available

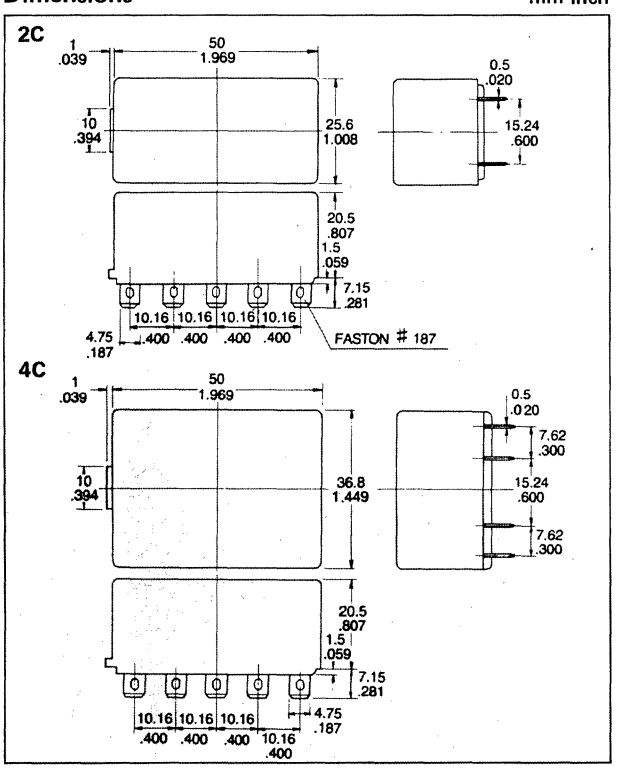
Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
Single side stable SP2–	5V	5VDC	83	300	2C	15
	6V	6	120			
	12V	12	480			
	24V	24	1,920			
	48V	48	7,700			
2 coil latching SP2–L2–	5V	5VDC	83	300	2C	15
	6V	6	120			
	12V	12	480			
	24V	24	1,920			
	48V	48	7,700			
Single side stable SP4–	5V	5VDC	83	300	4C	10
	6V	6	120			
	12V	12	480			
	24V	24	1,920			
	48V	48	7,700			
2 coil latching SP4–L2–	5V	5VDC	83	300	4C	10
	6V	6	120			
	12V	12	480			
	24V	24	1,920			
	48V	48	7,700			

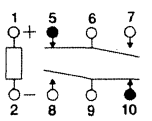
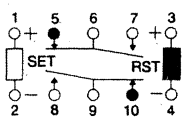
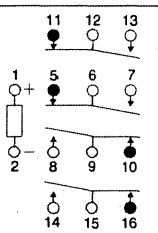
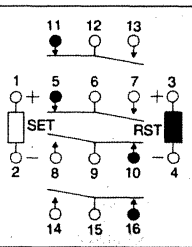
Note: Standard packing → SP2, SP2-L2 Carton: 20 pcs./Case: 200 pcs.
SP4, SP4-L2 Carton: 10 pcs./Case: 100 pcs.

Dimensions

mm inch



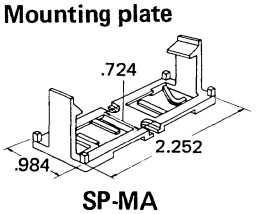
Schematic (Bottom view)

	Single side stable (De-energized position)	2-coil latching ("Reset" position when reset coil is energized with indicated polarity.)
2C		
4C		

SP Sockets

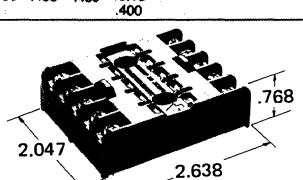
SP2–SF	Screw terminal socket
SP4–SF	Screw terminal socket
SP–MA	Mounting plate

Mounting plate



SP-MA

The SP-Relay with SP-MA attached



SP2–SF

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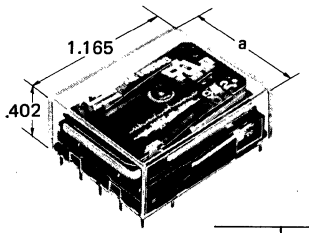
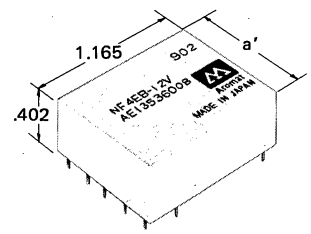
High Sensitivity Flatpack Relays with High Reliability

NF-RELAYS



	a
NF2	.764
NF4	.945

NFEB Amber Relays



	a'
NF2EB	.772
NF4EB	.953

More than 30,000,000 pcs. in use all over the world

- Low profile – stands only .402 inches high
  Ideal for high packaging density
- High sensitivity – minimum operating power
  NF2/150mW, NF4/240mW
- Variety of available lines –
  Amber Sealed types
  MBB (Form D) contact types
  High breakdown voltage types for transient protection – 1,000V rms between open contacts, contact sets
- Gold capped silver palladium contacts available.

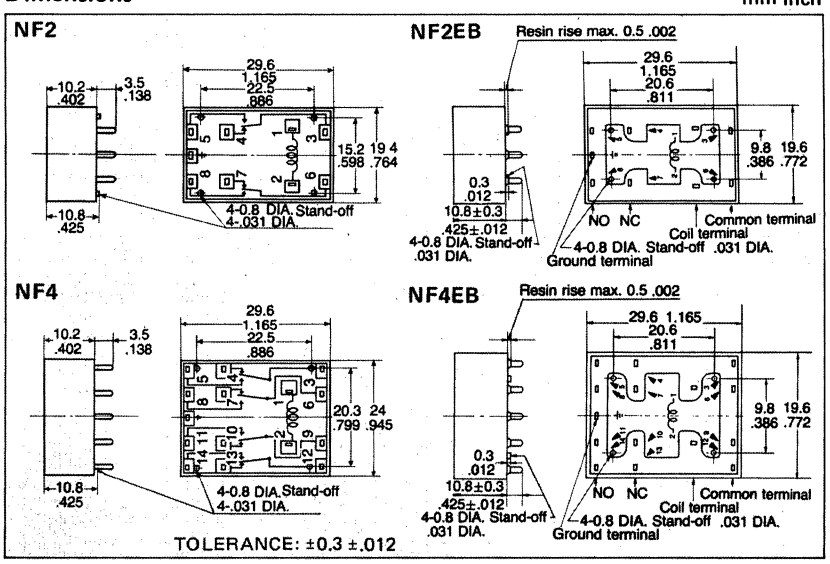
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
NF2–	5V	5VDC	90	278	2C	2
NF2EB–	6V	6	137	260		
	12V	12	500	290		
	24V	14	2,000	290		
	48V	48	7,000	330		
NF4–	5V	5VDC	53	472	4C	2
NF4EB–	6V	6	90	400		
	12V	12	330	440		
	24V	24	1,200	480		
	48V	48	4,200	550		

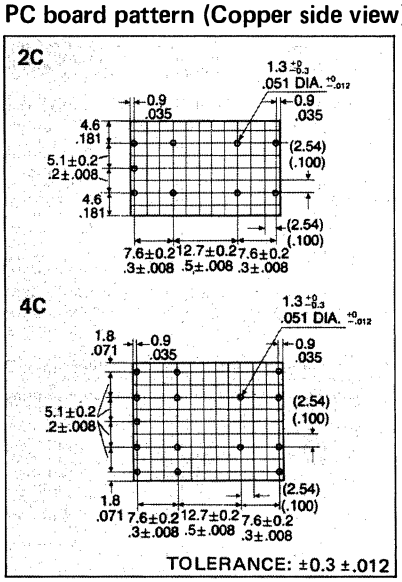
Notes: 1. MBB (Form D) contact types available.
2. Standard packing → Carton: 20 pcs./Case: 200 pcs.

Dimensions

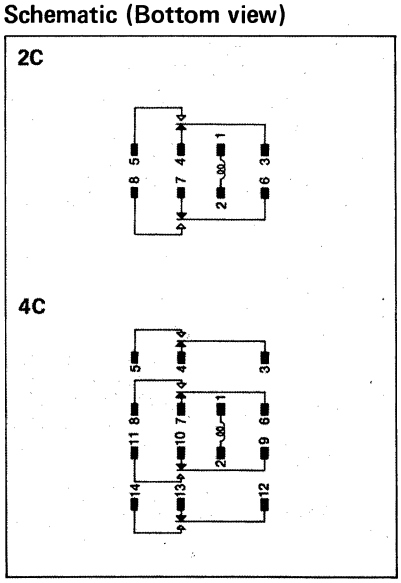
mm inch



PC board pattern (Copper side view)



Schematic (Bottom view)



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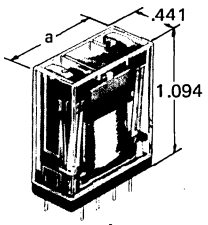
Flat/Lean Line High Power Bifurcated Contact Relays

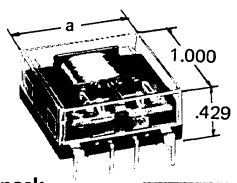
NC-RELAYS

Relay Efficiency



Lean line

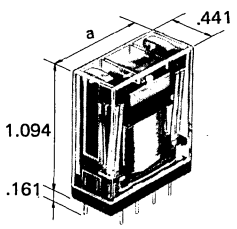
	a
2C	1.000
4C	1.500



Flatpack

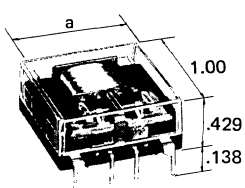
	a
2C	1.000
4C	1.500

NCED Amber Relays



Lean line (PC board)

	a
2C	1.000
4C	1.500



Flatpack

	a
2C	1.000
4C	1.500

- Space saver — Flatpack and Lean line
- High contact capacity—5A 250VAC(2C) 5A 125VAC(4C)
- Low operating power — 2C, 230 mW 4C, 460mW (single-side stable)
- Flux-resistant
- High breakdown voltage for transient protection — 1,000V rms between open contacts, sets
- Latching types available

Types and Data

	Type	Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A) Standard	Contacts: Rating (A) Amber
Flatpack	Single side stable NC2D–JP– NC2ED–JP–	DC5V	5VDC	69.4	360		
		DC6V	6	100	360		
		DC12V	12	400	360	2C	5	3
		DC24V	24	1,600	360		
		DC48V	48	6,400	360		
	2 coil latching NC2D–JPL2– NC2ED– JPL2–	DC5V	5VDC	31.3	800		
		DC6V	6	45	800		
		DC12V	12	180	800	2C	5	3
		DC24V	24	720	800		
		DC48V	48	2,880	800		
	Single side stable NC4D–JP– NC4ED–JP–	DC5V	5VDC	34.7	720		
		DC6V	6	50	720		
		DC12V	12	200	720	4C	.5	2
		DC24V	24	800	720		
		DC48V	48	3,200	720		
	2 coil latching NC4D–JPL2– NC4ED– JPL2–	DC5V	5VDC	15.6	1,600		
		DC6V	6	22.5	1,600		
		DC12V	12	90	1,600	4C	5	2
		DC24V	24	360	1,600		
		DC48V	48	1,440	1,600		
Lean line	Single side stable NC2D–P– NC2ED–P–	DC5V	5VDC	69.4	360		
		DC6V	6	100	360		
		DC12V	12	400	360	2C	5	3
		DC24V	24	1,600	360		
		DC48V	48	6,400	360		
	2 coil latching NC2D–PL2– NC2ED–PL2–	DC5V	5VDC	31.3	800		
		DC6V	6	45	800		
		DC12V	12	180	800	2C	5	3
		DC24V	24	720	800		
		DC48V	48	2,880	800		
	Single side stable NC4D–P– NC4ED–P–	DC5V	5VDC	34.7	720		
		DC6V	6	50	720		
		DC12V	12	200	720	4C	5	2
		DC24V	24	800	720		
		DC48V	48	3,200	720		
	2 coil latching NC4D–PL2– NC4ED–PL2–	DC5V	5VDC	15.6	1,600		
		DC6V	6	22.5	1,600		
		DC12V	12	90	1,600	4C	5	2
		DC24V	24	360	1,600		
		DC48V	48	1,440	1,600		

Note: Standard packing → Carton: 20 pcs./Case : 200 pcs.

NC Sockets

For Flat series

Catalog No.	Terminals	Mating relay
NC2-JPS	P/C board	NC2D-JP
NC4-JPS	P/C board	NC4D-JP
NC2-JPL2S	P/C board	NC2D-JPL2
NC4-JPL2S	P/C board	NC4D-JPL2

For Slim series

Catalog No.	Terminals	Mating relay
NC2-PS	P/C board	NC2D-P
NC4-PS	P/C board	NC4D-P
NC2-SS	Solder	NC2D
NC4-SS	Solder	NC4D
NC2-LP2S	P/C board	NC2D-PL2
NC4-L2PS	P/C board	NC4D-PL2
NC2-L2SS	Solder	NC2D-L2
NC4-L2SS	Solder	NC4D-L2

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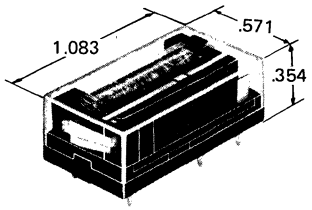
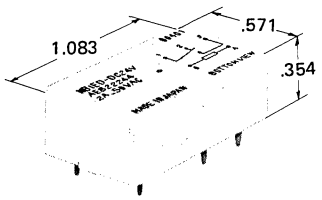
1 Form C Thin PC Board Relays

NB-RELAYS

Relay Efficiency



NBE Amber Relays



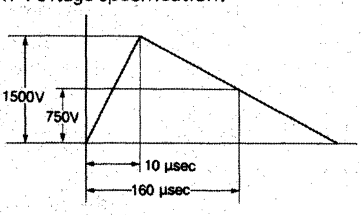
- Thin height
- 1,500VFCC surge between open contacts
- Hign dielectric strength —5,000V surge in 1x40 μsec. between coil and contact
- DIL terminal arrangement
- Single contact
- Amber Sealed types available
- Latching types available

Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A) Standard	Contacts: Rating (A) Amber
Single side stable NB1– NB1E–	DC 5V	5VDC	63	397	1C	5	3
	DC 6V	6	90	400			
	DC12V	12	360	400			
	DC24V	24	1,400	410			
	DC48V	48	4,500	514			
2 coil latching NB1–L2– NB1E–L2–	DC 5V	5VDC	12 42	2,083 595	1C	5	3
	DC 6V	6	17 60	2,118 600			
	DC12V	12	70 240	2,057 600			
	DC24V	24	270 960	2,133 600			
	DC48V	48	960 3,300	2,400 698			

Notes: 1. Coil resistance and nominal operating power of 2 coil latching types: The upper figure is for the set coil, and the lower for the reset coil.
2. Bifurcated contact types available.
3. Standard packing → Carton: 50 pcs./Case: 500 pcs.

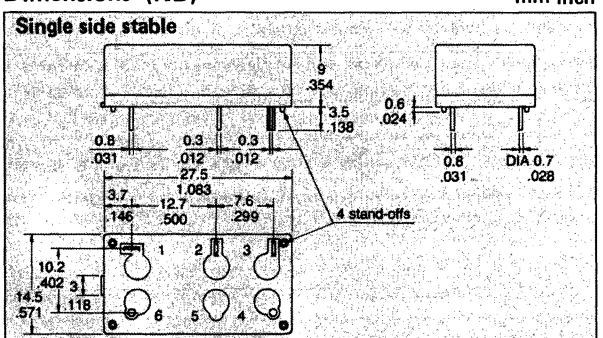
*FCC (Federal Communication Commission) requests following standard as Breakdown Voltage specification.



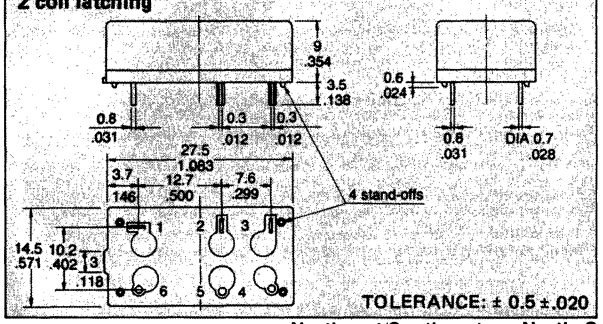
Dimensions (NB)

mm inch

Single side stable



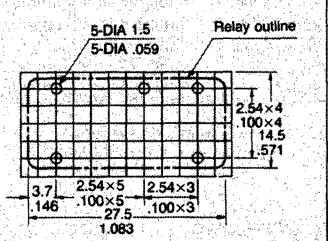
2 coil latching



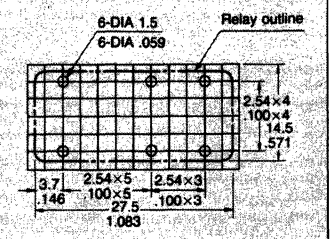
TOLERANCE: ± 0.5 ± .020

PC board pattern (Copper side view)

Single side stable



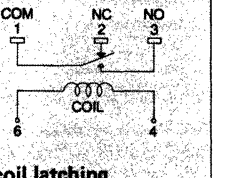
2 coil latching



TOLERANCE: ± 0.50 ± .004

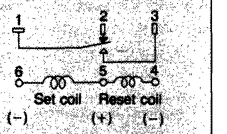
Schematic (Bottom view)

Single side stable



2 coil latching

(Shown as reset position)



Apply plus polarity to terminal 5 for latching operation when minus polarity is applied to terminals 6 and 4, with coil terminal 5 used as common terminal.
When plus polarity is applied to terminals 6 and 4, apply minus polarity to coil terminal 5 for latching operation.

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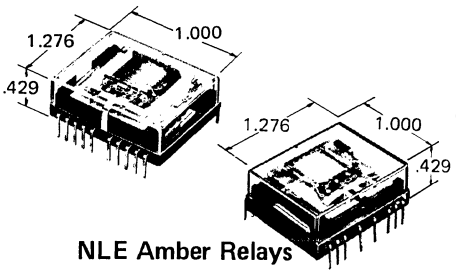
6PDT Flatpack 2 Amp DIL Relays — NL-RELAYS

Relay Efficiency



NLE Amber Relays

- Space saving dimensions — 25.4 mm x 32.4 mm x 10.9 mm (1.000) (1.276) (0.429)
- Low operating power — 400mW
- Latching types available
- High breakdown voltage for transient protection — 2,000V rms

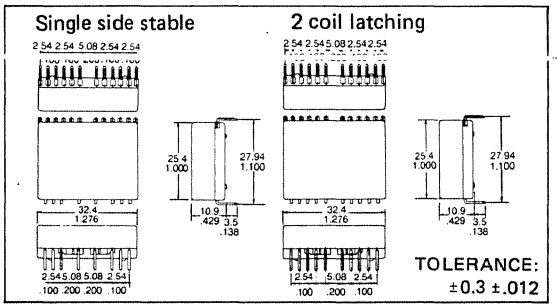
Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
Single side stable NL6X– NL6EX–	DC5V	5VDC	34.7	720	6C	2
	DC6V	6	50	720		
	DC12V	12	200	720		
	DC24V	24	800	720		
	DC48V	48	3,200	720		
2 coil latching NL6X–L2– NL6EX–L2–	DC5V	5VDC	15.6	1,600	6C	2
	DC6V	6	22.5	1,600		
	DC12V	12	90	1,600		
	DC24V	24	360	1,600		
	DC48V	48	1,440	1,600		

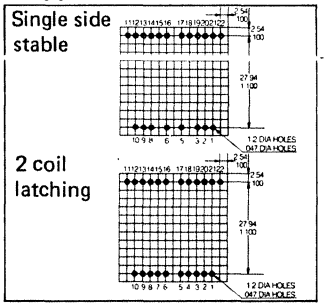
Notes: 1. Gold capped silver-palladium contacts available
2. MBB contact (Form D) types available
3. Standard packing → Carton: 20 pcs./Case: 200 pcs.

Dimensions (NL)

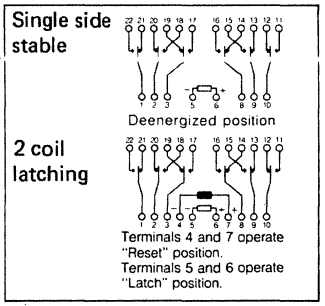
mm inch



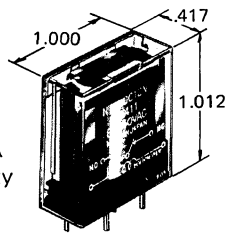
PC board pattern (Copper side view)



Schematic (Top view)



Lean Line Power Relays with High Sensitivity — NT-RELAYS



- High contact capacity — 8A
- High sensitivity
- Compact size
- Long life
- Standard terminal pitch —.1 inch

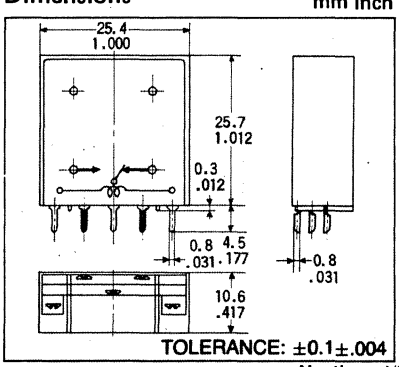
Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A)
NT1–	DC6V	6VDC	130	280	1C	8A
	DC12V	12	500	290		
	DC24V	24	2,000	290		
NT1–	AC6V	6VAC	—			
	AC12V	12	—			
	AC24V	24	—	0.75VA	1C	8A
	AC48V	48	—			
	AC115V	115	—			

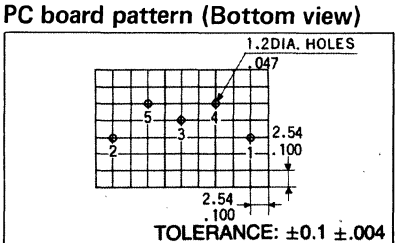
Note: Standard packing → Carton: 50 pcs./Case: 500 pcs.

Dimensions

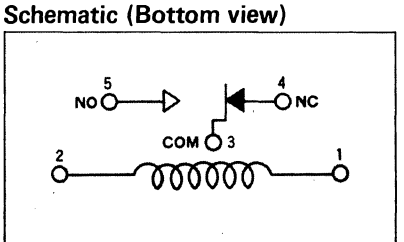
mm inch



PC board pattern (Bottom view)



Schematic (Bottom view)



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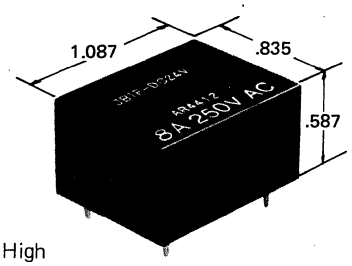
Compact Power Relays JB-RELAYS



- High dielectric strength —10,000V surge in 1×40 μsec. between coil and contact
- Flux resistant construction
- More than 0.3" terminal pitch

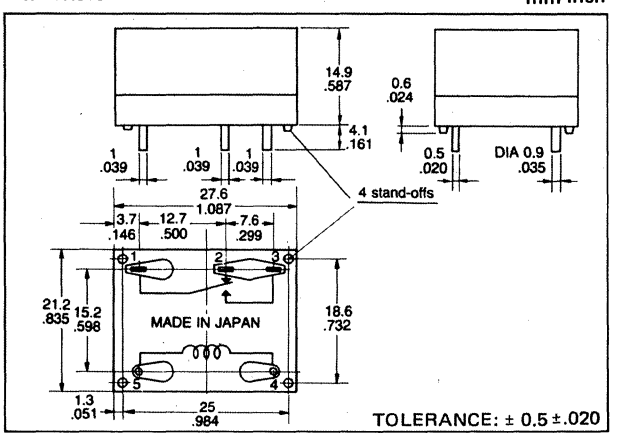
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
JB1F—	DC 5V	5VDC	52	480	1C	8
	DC 6V	6	75	480		
	DC12V	12	300	480		
	DC24V	24	1,200	480		
	DC48V	48	4,100	560		

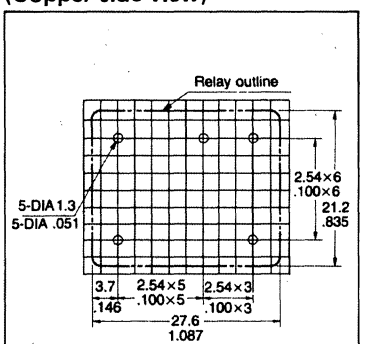
Note: Standard packing → Carton: 20 pcs./Case: 200 pcs.

Dimensions

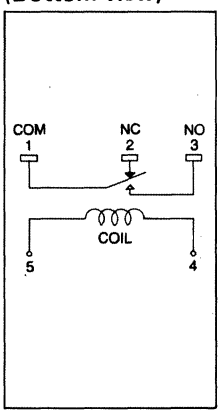
mm inch



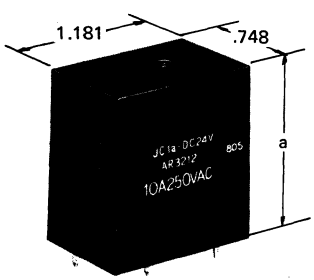
PC board pattern (Copper side view)



Schematic (Bottom view)



Compact Power Relays JC-RELAYS



	a
PC board type	1.181
Top mount type	1.201
Plug-in type	1.181

- High inrush current capacility.
  1a : 111A inrush (TV-5), 10A steady
  2a : 71A inrush (TV-3), 5A steady
- High dielectric withstanding for transient protection.
  JC can withstand 10,000V surge in 1 x 40 μsec. between coil and contact
- TV-rated types available

Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
JC1a—	DC 6V	6VDC	40	900	1a	10
(JC1a—S*)	12V	12	160			
(JC1a—TM*)	24V	24	640			
JC2a—	DC 6V	6VDC	36	1,000	2a	5
(JC2a—S*)	12V	12	144			
(JC2a—TM*)	24V	24	576			
JC1a1b—	DC 6V	6VDC	36	1,000	1a1b	5
(JC1a1b—S*)	12V	12	144			
(JC1a1b—TM*)	24V	24	576			

Notes:
1. S* : Denotes Plug-in terminal types.
2. TM*: Denotes Top mounting types.
3. Sockets for plug-in types also available
4. Upgraded rating types available as JC-F types.
   15A 250VAC 1 HP 125VAC (JC1aF)
   10A 250VAC 1/3 HP 125VAC (JC2aF)
   5A 250VAC 1/3 HP 125VAC (JC1a1bF)
5. Standard packing → Carton: 50 pcs./Case: 200 pcs.

JC Sockets

JC1-SS	PC terminal
JC2-SS	PC terminal
JC1-PS	Solder terminal
JC2-PS	Solder terminal

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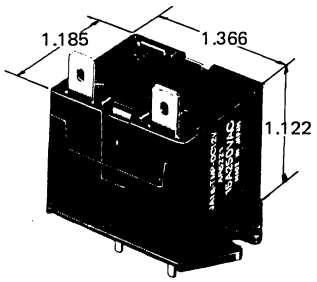
1 Horse Power Compact Power Relays

JA-RELAYS



- High switching capacity — 55A inrush, 15A steady state inductive load
- Particularly suitable for air conditioners, dish waters, copiers and other consumer and office equipment
- Two types available
  "TM" type for direct chassis mounting
  "TMP" types for PCB-mounting
- TV-rated types available

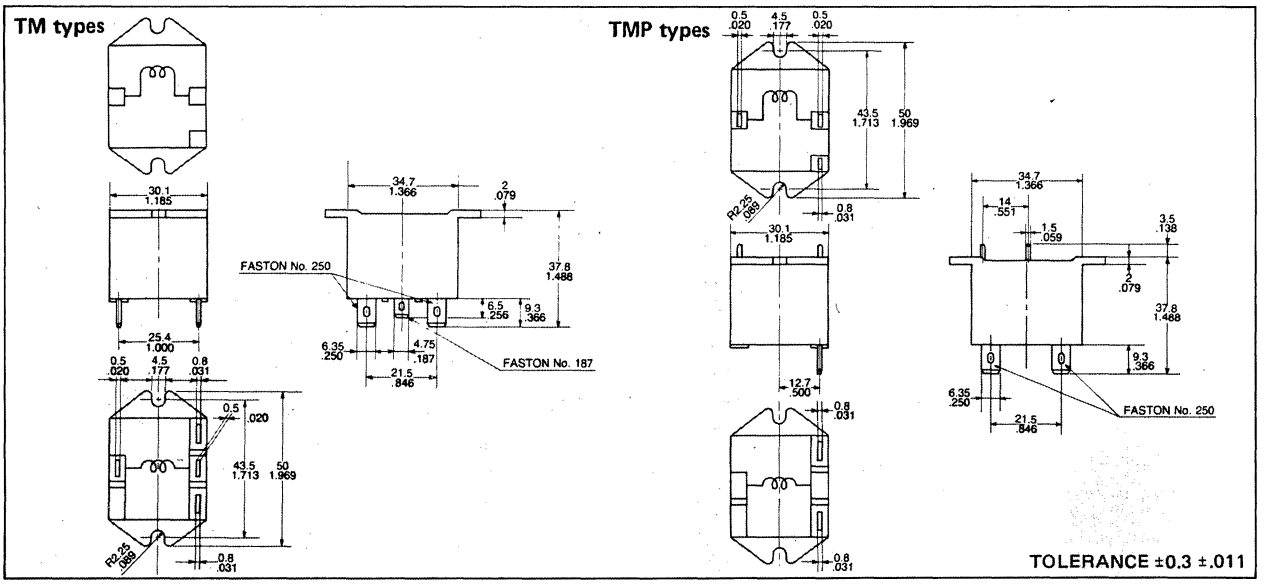
Types and Data

Type	Coils			Contacts	
	Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
JA1a–TM– DC 6V	6VDC	30	1.2W	1a	1 HP
DC12V	12	120	1.2		
DC24V	24	480	1.2		
JA1a–TM– AC24V	24VAC	–	*1.4VA	1a	1 HP
AC115V	115	–	1.4		
AC240V	240	–	1.4		
JA1a–TMP– DC 6V	6VDC	30	1.2W	1a	1 HP
DC12V	12	120	1.2		
DC24V	24	480	1.2		
JA1a–TMP– AC24V	24VAC	–	1.4VA	1a	1 HP
AC115V	115	–	1.4		
AC240V	240	–	1.4		

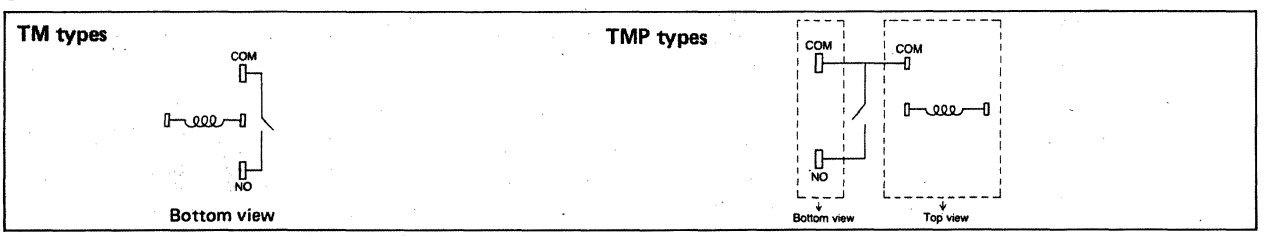
Notes: 1. *1.4VA is nominal operating power at 50Hz.
In case of 60Hz, nominal operating power is 1.3VA.
2. JA1b (1 Form B) and JA1C (1 Form C) versions are available.
3. Terminals
"TM" type : .187" quick-connect terminals for coil and .250" for contacts.
"TMP" type : PC board terminals for coils nd .250" quick connect terminals for contacts.
4. Upgraded rating types available as JA-P types.
(25A 250VAC 1HP 125, 250VAC)
5. Standard packing → Carton: 20 pcs./Case: 200 pcs.

Dimensions

mm inch



Schematic



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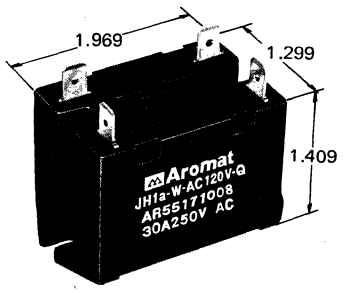
Power Relays with Space Saving Design

JH-RELAYS



- Many safety-oriented characteristics incorporated.
- High dielectric strength – 10,000V surge in μsec.
- High inrush resistance –
  1X : 117A (TV-8 equivalence)
  2X : 91A (TV-6 equivalence)

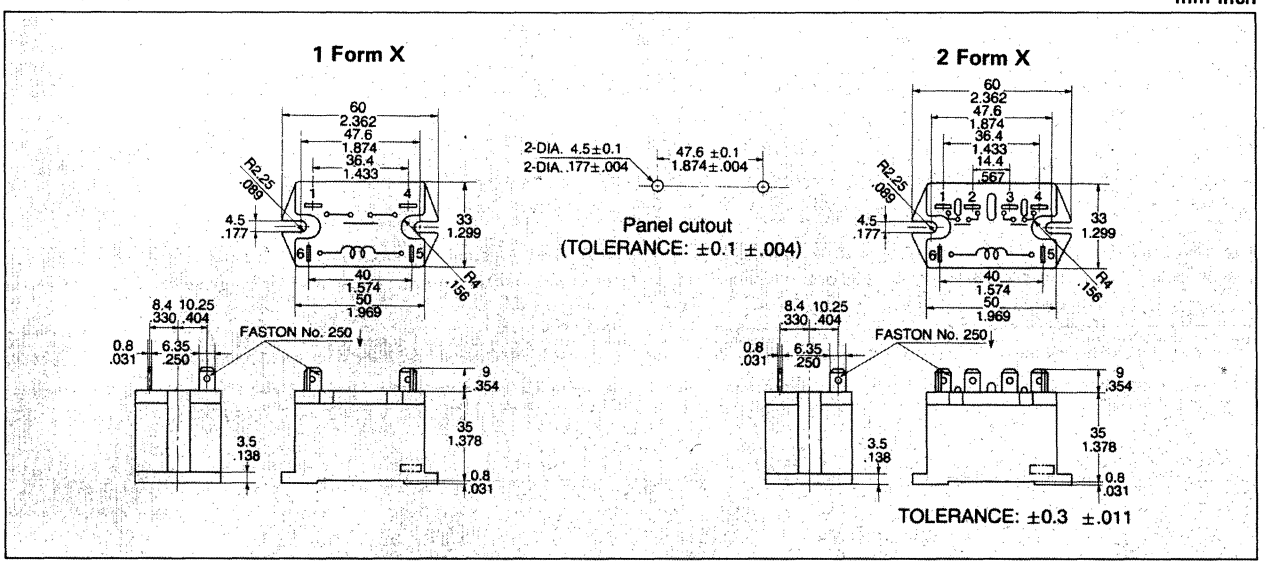
Types and Data

Type		Coils			Contacts	
		Voltage	Res. (Ω)	Nom. Power (mW)	Arrange-ment	Rating (A)
JH1a–W–	DC 6V-Q	6VDC	18.7	1.9 W	1X	30
	DC12V-Q	12	75			
	DC24V-Q	24	300			
	DC110V-Q	110	6,300			
JH1a–W–	AC 6V-Q	6	–	3.2 VA	1X	30
	AC12V-Q	12	–			
	AC24V-Q	24	–			
	AC120V-Q	120	–			
JH2a–W–	DC 6V-Q	6VDC	18.7	1.9 W	2X	20
	DC12V-Q	12	75			
	DC24V-Q	24	300			
	DC110V-Q	110	6,300			
JH2a–W–	AC 6V-Q	6VAC	–	3.2 VA	2X	20
	AC12V-Q	12	–			
	AC24V-Q	24	–			
	AC120V-Q	120	–			

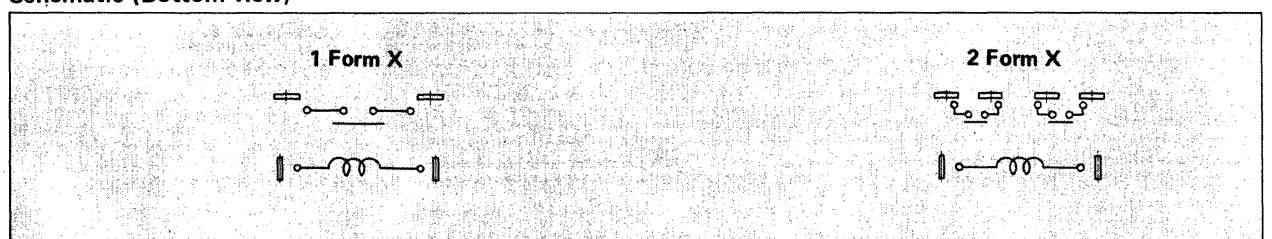
Note: Standard packing →Carton: 20 pcs./Case: 100 pcs.

Dimensions

mm inch



Schematic (Bottom view)



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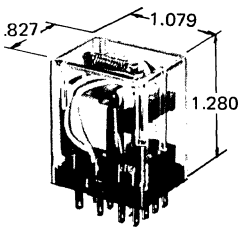
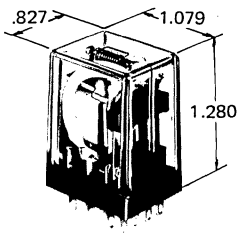
Highly Rated Relays for Wider Applications

HC-RELAYS

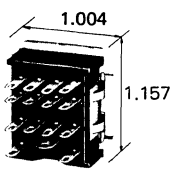


HCE Amber Relays

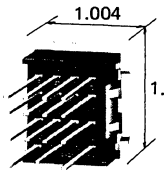


Versatile range

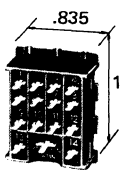
- Interchangeable with comparable relays.
- Extra long life — more than 10^8 mechanical operations.
- 4 types of contact arrangement — 4C (5A 250VAC), 3C (7A 250VAC), 2C (7A 250VAC), 1C (10A 250VAC)



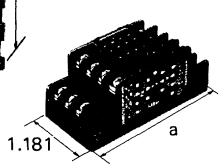
HC4-SS



HC4-WS

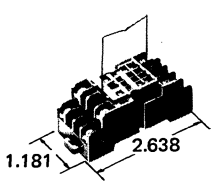


HC4-PS



HC-HSF

	a
HC-HSF	2.323
HC2-SF	1.575
HC3-HSF	2.638



HC2-SFD

Types and Data

Type		Coils: Voltage	Coils: Res. (Ω)	Coils: Nom. Power (mW)	Contacts: Arrangement	Contacts: Rating (A) Standard	Contacts: Rating (A) Amber
HC1– (HC1-P*)	DC6V	6VDC	40	approx. 900	1C	10	5
	DC12V	12	160				
	DC24V	24	650				
	DC48V	48	2,600				
	DC110V	110	11,000				
HC1– (HC1-P*)	AC6V	6VAC	–	approx. 1.2VA	1C	10	5
	AC12V	12	–				
	AC24V	24	–				
	AC48V	48	–				
	AC115V	115	–				
HC2– (HC2-P*)	DC6V	6VDC	40	approx. 900	2C	7	3
	DC12V	12	160				
	DC24V	24	650				
	DC48V	48	2,600				
	DC110V	110	11,000				
HC2– (HC2-P*)	AC6V	6VAC	–	approx. 1.2VA	2C	7	3
	AC12V	12	–				
	AC24V	24	–				
	AC48V	48	–				
	AC115V	115	–				
HC3– (HC3-P*)	DC6V	6VDC	40	approx. 900	3C	7	
	DC12V	12	160				
	DC24V	24	650				
	DC48V	48	2,600				
	DC110V	110	11,000				
HC3– (HC3-P*)	AC6V	6VAC	–	approx. 1.2VA	3C	7	
	AC12V	12	–				
	AC24V	24	–				
	AC48V	48	–				
	AC115V	115	–				
HC4– (HC4-P*)	DC6V	6VDC	40	approx. 900	4C	5	2
	DC12V	12	160				
	DC24V	24	650				
	DC48V	48	2,600				
	DC110V	110	11,000				
HC4– (HC4-P*)	AC6V	6VAC	–	approx. 1.2VA	4C	5	2
	AC12V	12	–				
	AC24V	24	–				
	AC48V	48	–				
	AC115V	115	–				

Notes: 1. P*: Denotes PC terminal relay.
2. Standard packing → Carbon: 20 pcs./Case: 200 pcs. or 800 pcs.
3. Top mounting (TM) types available.

HC Sockets

Solder Socket	Socket for PC board	Socket for Wrapping	Screw Terminal Socket
HC1-SS	HC1-PS	HC1-WS	HC-HSF
HC2-SS	HC2-PS	HC2-WS	HC2-SF
HC3-SS	HC3-PS	HC3-WS	HC3-HSF
HC4-SS	HC4-PS	HC4-WS	HC Bracket
			HC Mounting Strip
			HC2-SFD
			HC3-SFD
			HC4-SFD

Note: –SFD types are for DIN rail assembly.

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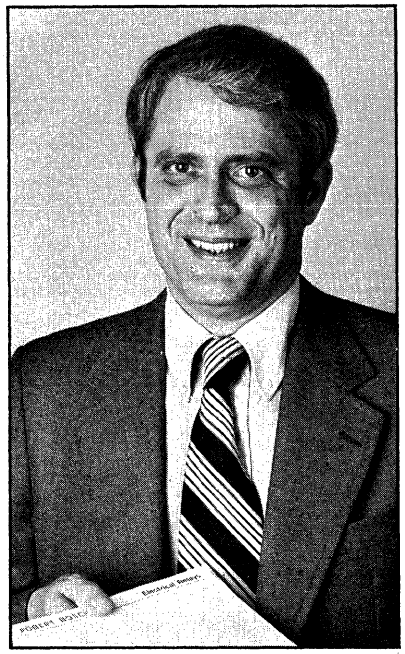

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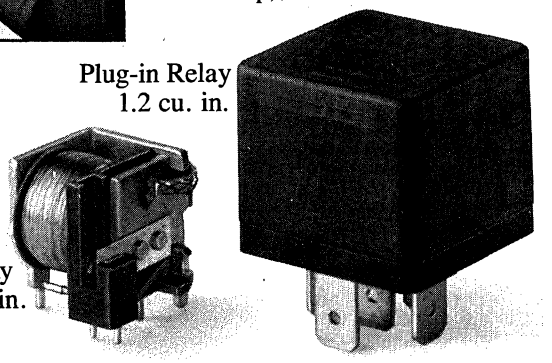
1.2 cu. in.

PCB Relay
0.56 cu. in.



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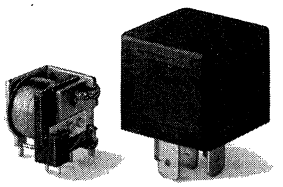
Bosch Mini-Giant® Relays

Technical Specifications

	LINE NO.	PART NUMBER	TYPE	VOLTAGE	CURRENT SWITCHING MAKE/BREAK CONTACT		SWITCHING CYCLE LIFE		COIL	
					RESISTIVE	LAMP, MOTOR LOAD	RESISTIVE	LAMP, MOTOR INDUCTIVE	RESISTANCE	OPERATING CURRENT
PLUG IN METAL CAP	1	0 332 014 101	SPST Flasher	12V		100W		5,000,000[1)]	85±5 Ω	140mA
	2	0 332 014 107	SPST Flasher/W.B.	12V		100W		5,000,000	85±5 Ω	140mA
	3	0 332 014 113	SPST	12V	30/A	24/A	250,000	100,000	85±5 Ω	140mA
	4	0 332 014 125	SPST with Bracket	12V	30/A	24/A	250,000	100,000	85±5 Ω	140mA
	5	0 332 014 213	SPST	24V	20/A	16/A	250,000	100,000	305±15Ω	80mA
	6	0 332 014 203	SPST with Bracket	24V	20/A	16/A	250,000	100,000	305±15Ω	80mA
	7	0 332 015 001	SPST Dual Make Cont.	12V	2x15/A	2x55/W	100,000	50,000	63±3 Ω	200mA
	8	0 332 015 002	SPST Dual Make Cont.	24V	2x10/A	2x70/W	100,000	50,000	210±12Ω	120mA
	9	0 332 015 006	SPST Dual Make Cont. w/o Bracket	12V	2x15/A	2x55/W	100,000	50,000	63±3 Ω	200mA
	10	0 332 204 001	SPDT with Bracket	6V	30/20A	24/16A	250,000	100,000	22±2 Ω	300mA
	11	0 332 204 101	SPDT	12V	30/20A	24/16A	250,000	100,000	85±5 Ω	140mA
	12	0 332 204 125	SPDT with Bracket	12V	30/20A	24/16A	250,000	100,000	85±5 Ω	140mA
	13	0 332 204 201	SPDT	24V	20/10A	16/8A	250,000	100,000	305±15Ω	80mA
	14	0 332 204 203	SPDT with Bracket	24V	20/10A	16/8A	250,000	100,000	305±15Ω	80mA
PLASTIC CAP	15	0 332 014 150	SPST with Bracket	12V	30A	24/A	100,000	50,000	85±5 Ω	140mA
	16	0 332 014 151	SPST	12V	30A	24/A	100,000	50,000	85±5 Ω	140mA
	17	0 332 204 150	SPDT with Bracket	12V	30/20A	24/16A	100,000	50,000	85±5 Ω	140mA
	18	0 332 204 151	SPDT	12V	30/20A	24/16A	100,000	50,000	85±5 Ω	140mA
PC BOARD	19	0 332 016 102	SPST	12V	15/A	12/A	250,000	100,000	85±5 Ω	140mA
	20	0 332 206 001	SPDT Emergency light	6V	15/10A	37/10A	250,000	6,000	32±4 Ω	200mA
	21	0 332 206 101	SPDT	12V	15/10A	12/8A	250,000	100,000	85±5 Ω	140mA
	22	0 332 206 102	SPDT High Resistance	12V	8/4A	6/3A	250,000	100,000	200±10Ω	60mA
	23	0 332 206 105	SPDT Flasher	12V		100W		5,000,000[1)]	85±5 Ω	140mA
	24	0 332 206 106	SPDT High Current	12V	30/10A	24/8A	50,000	50,000	85±10Ω	140mA
	25	0 332 206 201	SPDT	24V	10/7A	8/5A	250,000	100,000	305±15Ω	80mA



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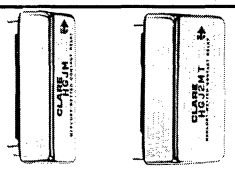
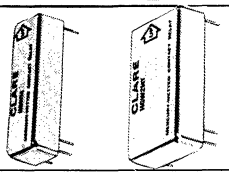
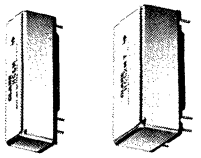
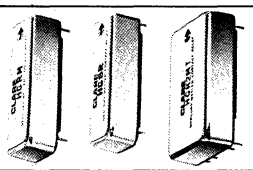
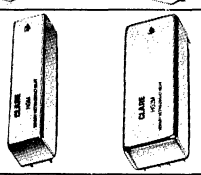
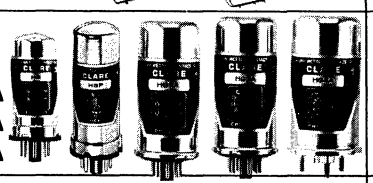
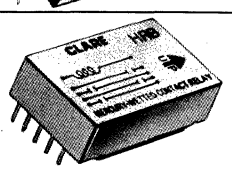
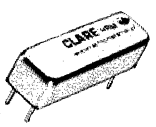
CLARE Mercury-Wetted Contact Relays

GENERAL INSTRUMENT

RELAY TYPE	TERMINAL TYPE/GRID	CONTACT FORMS AVAILABLE	DESCRIPTION
HGJM **HGJ2MT** 	1.400/1.200 x .100 staggered	1C 2C (Break-Before-Make)	Highest speed mercury-wetted contact relay. Life at 2A, 100VA rated load: 20 billion operations with contact protection. Low noise, high repetition rate. Stable at 200 Hz.
HGWM **HGW2MT** 	1.20 x .100	1C 2C	Compact package mercury-wetted relay. Life at rated load: 20 billion operations. Same characteristics as HGJM.
HGSM **HGS2MT** 	1.800/1.500 x .200 staggered	1C 1D 2C 2D	Sensitive mercury-wetted relay. Life at 2A rated load: 20 billion operations with contact protection. 120 Hz repetition rate.
HGRM **HGR2MT** **HGSR** 	1.400/1.200 x .100 staggered	1C 1D 2C 2D	Small mercury-wetted relay. Life at rated load: 20 billion operations with contact protection. Same contact characteristics of HGSM.
HGM **HG2M** 	3.000/2.400 x .200 staggered	1D 2D (Make-Before-Break)	High current (5.0A, 250VA) mercury-wetted module. Life at rated load: 20 billion operations with contact protection. 80 Hz maximum repetition rate.
HG **HGP** **HG2A** **HG3A** **HG4A** 	8, 11 and 14 Pin Plugs	1D 2D 3D 4D	Heavy duty (5.0A, 250VA) mercury-wetted plug-in relays. Life at rated load: 20 billion operations with contact protection.
HGS	8 Pin Octal Plug	1C 1D	Sensitive mercury-wetted plug-in relay. Life at rated load: 20 billion operations with contact protection. 2A, 100VA contact rating.
851	1.300 x .100	1A 2A 4A (Normally Open)	Mercury-wetted reed, epoxy molded. End lead construction. Life at rated load: 1 billion operations. .5A, 50VA contact rating.
HRB 	1.00 x .150	1A thru 5A	Mercury-wetted reed, metal cover. Standard grid spacing. Life at rated load: 1 billion operations. .5A, 50VA contact rating.
HRM 	.800 x .150	1A	Subminiature form A module for PCB mounting. Life at rated load: 1 billion operations with contact protection. .5A, 50VA contact rating.

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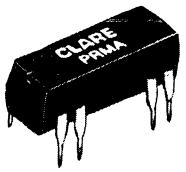
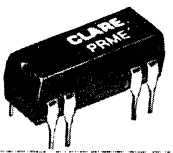
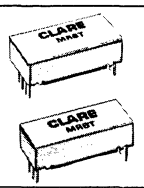
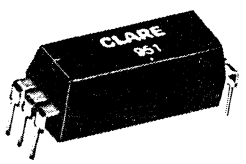
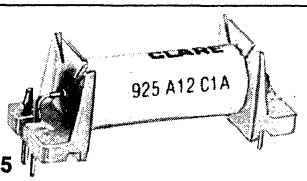
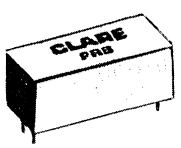
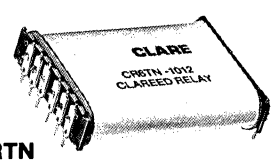
CLARE Dry Reed Relays

GENERAL INSTRUMENT

RELAY TYPE	TERMINAL TYPE/GRID	CONTACT FORMS AVAILABLE	NOMINAL VOLTAGE	DESCRIPTION
DYAD PRMA	.300 x .100 Dual-in-line Package (DIP)	Form A (1 & 2) Form B (1 only)	5 Vdc 12 Vdc 24 Vdc	The new bifurcated DYAD® series yields improvements in speed and contact life reliability. Life at signal load: 250 million operations.
 PRMA	.300 x .100 Dual-in-line Package (DIP)	Form A (1 & 2) Form B (1 only) Form C (1 only)	5 Vdc 12 Vdc 24 Vdc	Molded construction. Diode and electrostatic shield options. Life at rated load: 5 million operations.
 PRME	.300 x .100 Dual-In-Line Package (DIP)	Form A (1 only)	5 Vdc 12 Vdc 24 Vdc	Low profile molded construction. Available with diode and/or shield. Life rated load: 5 million operations.
MRB/922	1.00 x .100 1.00 x .150	Form A (1 to 6) Form B (1 & 2) Form A/B (1 & 2) Form C (1 to 4) Form AL (1 & 2)	5 Vdc 6 Vdc 12 Vdc 24 Vdc	Industry standard in "microreed" size reed relays. Metal cover and versatile design. Life at rated load: 10 million operations.
 MRBT	1.00 x 0.10	Form A (2 & 3)	5 Vdc 12 Vdc 15 Vdc	Microreed relay designed to minimize thermal voltage errors in low-level circuits. Life at rated load: 10 million operations.
 951	1.00 x .100	Form A (1, 2 & 4) 3-pole and 5-pole available.	5 Vdc 12 Vdc 24 Vdc	Epoxy molded equivalent of MRB metal covered relay. Rugged lead frame construction. Life at rated load: 5 million operations.
 925	1.00 x .100	Form A (1 & 2) Form B (1 only)	5/6 Vdc 12 Vdc 24 Vdc	Open construction. Life at rated load: 10 million operations.
 PRB	.700 x .100	Form A (1 & 2) Form B (1 only)	5 Vdc 6 Vdc 12 Vdc 24 Vdc	Magnetic shielding option with a ferrous cover in a high density package design. Life at rated load: 5 million operations.
 CRTN	2.50 x .218	Form A (1 to 6) 7 to 12 poles available Form B (1 & 2) Form A/B (1 & 2) Form AL (1 & 2)	6 Vdc 12 Vdc 24 Vdc 48 Vdc	Industry standard in large size reed relays. Life at rated load: 20 million operations.

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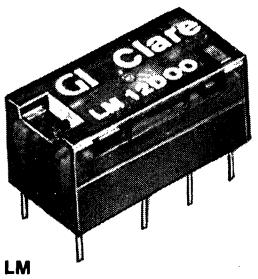
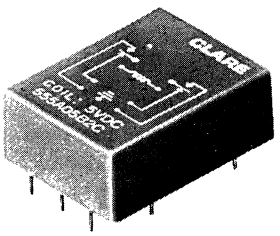
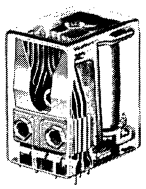
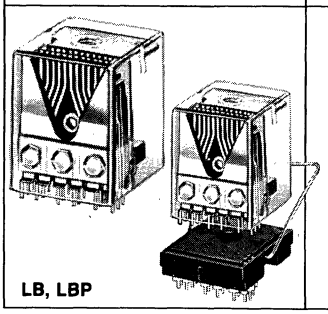
CLARE Electromechanical Relays

GENERAL INSTRUMENT

RELAY TYPE	TERMINAL TYPE/GRID	CONTACT FORMS AVAILABLE	NOMINAL VOLTAGE	DESCRIPTION
 LM	Dual-in-line Package (DIP)	(Break-Before-Make) 1 Form C 2 Form C	3 Vdc 5 Vdc 6 Vdc 12 Vdc 24 Vdc 48 Vdc	Dual-in-line subminiature package for automatic PCB insertion. Epoxy sealed construction for automatic wave soldering and cleaning. Breakaway breather hole allows lower relay operating temperature. Life at full rated load: 500 thousand operations.
 555	1.00 x .100	(Break-Before-Make) 2 Form C (Make-Before-Break) 2 Form D	5 Vdc 6 Vdc 12 Vdc 24 Vdc 48 Vdc	Bifurcated contacts insure reliable low level to 1 ampere switching. Typical coil power dissipation only 290 milliwatts. Submersible sealed construction simplifies wave soldering and cleaning operations. Breakaway breather hole allows lower relay operating temperature. Life at full rate load: 1 million operations.
 LA	.100 In Line	4 Form C	6 Vdc 12 Vdc 24 Vdc 30 Vdc 48 Vdc	Low cost miniature relays offer high switching capacity and versatility for their size. Bifurcated contacts switch from low level to 2 ampere full rated loads. Life at rated load: 100 thousand operations.
 LB, LBP	.100 In Line	6 Form C	6 Vdc 12 Vdc 15 Vdc 18 Vdc 24 Vdc 30 Vdc 36 Vdc 48 Vdc	Miniature relays offer high switching capacity and versatility at low cost. bifurcated contacts switch from low level to 2 ampere full rated loads. LB series are designed for direct plug into socket mounting. Life at rated load: 100 thousand operations.

CLARE CIRCUIT PROTECTION

Surge Arrester Selection Guide

PRODUCT	VOLTAGE RATINGS	APPROXIMATE SIZE AND MOUNTING METHOD	PHYSICAL CONSTRUCTION	SPECIAL FEATURES
Comgap (CG)	75V-1000V DC	.265" L x .380" Dia. Solder Leads .892" L P/C Mtg. Mtg. Clips for Units w/o Leads	Ceramic/Metal	Small Size Rugged Ceramic Construction Low Capacitance < 1.5 pF High Peak Current Capability > 10 kA
Uni-Imp® (UBD, UGT, UBT)	550V-20kV DC	2.20" L x .560" Dia. Solder Lugs	Glass/Metal	Ultra Fast Protection No Overshoot (DC to 200kV/μS) Life Thousands of Operations
Spark Gaps (SB & SG)	400V-40kV DC	3.562" L x 1.202" Dia. Solder Lugs Ferruled Ends for Clip Mtg.	Glass/Metal	Sub-Microsecond Responsive Time Electrical Energy Transfer DC Overvoltage Protection
Triggered Spark Gaps (TA & TB)	1.0kV-25kV DC	3/4" H x 21/22" Dia. Solder Lugs 2.10" H x 2.82" Dia. Stud Screw Mtg.	Ceramic/Metal	Command Energy Switching DC Overvoltage Protection Rugged Construction

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MINIGLOSSARY ELECTROMECHANICAL RELAYS

RELAYS

Hybrid: Isolated input and output either with a solid-state input and an electromechanical output or vice versa. Typically a reed switch is used to trigger a solid-state output or a solid-state amplifier is used to trigger an electromechanical relay.

Differential: Have multiple windings to function when voltage, current and/or power difference reaches a specific level or value.

Close-differential: The dropout value is specified close to the pickup value.

Frequency sensitive: Operates at a set frequency or within specific frequency bands. A resonant reed, for example.

Hermetically sealed: Totally sealed by glass-to-metal or metal-to-metal seals to ensure very low rates of gas leakage over long time periods.

Encapsulated: Imbedded in a suitable potting compound.

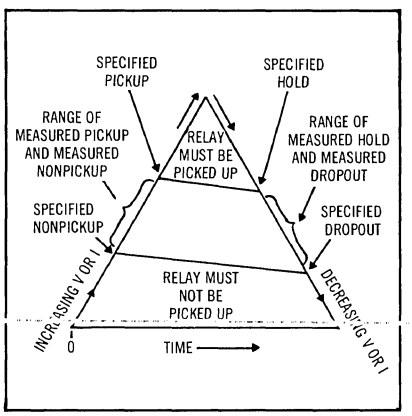
Sealed: Enclosed in a relatively air-tight cover. (Not the same as hermetically sealed.)

Covered: Unsealed metal or plastic enclosure or housing.

CONTACTS

Dry circuit: contacts that carry current but do not open or close during energizing of the load circuit. Often wrongly used in reference to low level contacts.

Low Level: Contacts controlling relatively low voltages and low currents. Generally below 5 Vdc and 10mA.



OPERATING CHARACTERISTICS

Measured dropout: The value at which all contacts restore to their unoperated position as current or voltage decreases.

Specified dropout: The value at or *above* which all contacts *must* restore to their unoperated position as voltage or current is decreased.

Specified hold: The value that *must* be reached before any contact change occurs as voltage or current is decreased on an operated relay.

Specified nonpickup: The value that *must* be reached before any contact change occurs as voltage or current decreases on an unoperated relay.

Measured pickup: The value at which all contacts function as voltage or current increases on an unoperated relay.

Specified pickup. The value at or *below* which all contacts *must* function as voltage or current increases on an unoperated relay.

Sensitivity: Specified pickup expressed in watts.

Normal bridging: The make-before-break action between adjacent contacts on relays designed for this purpose.

Abnormal bridging: The undesired closing of contacts caused by a metal bridge or protrusion developed by arcing.

Magnetic freezing: Sticking of the armature to the core as a result of residual magnetism.

TIME

Actuation: The interval from coil energization or de-energization to the functioning of a specified contact.

Initial actuation: The interval from coil energization or de-energization to the *first* closing or opening of a previously open or closed contact.

Final actuation: Sum of initial actuation *and* bounce intervals following an actuation.

Contact bounce: The interval from close or opening of a contact to the end of the bounce of "chatter."

Chatter: See bounce.

Operate: Normally taken as the interval between energization and the opening or closing of the last contact to function not including bounce.

Release: Normally taken as the interval between de-energization and the opening or closing of the last contact to function excluding bounce.

Transfer: The interval between opening a closed contact and closing an open contact of a break-before-make relay.

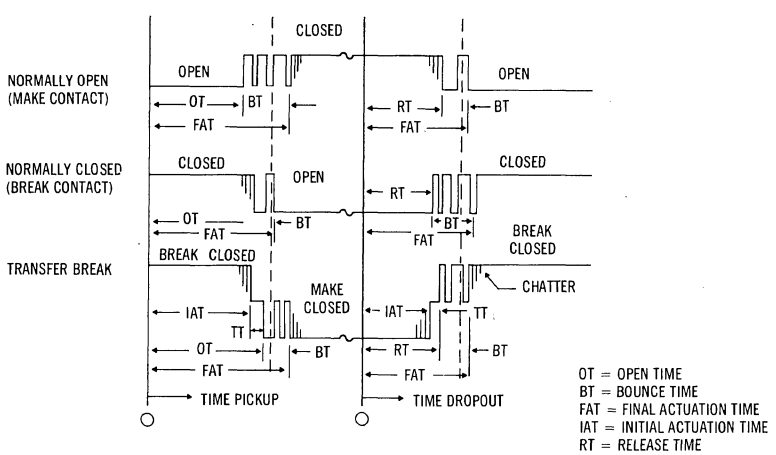
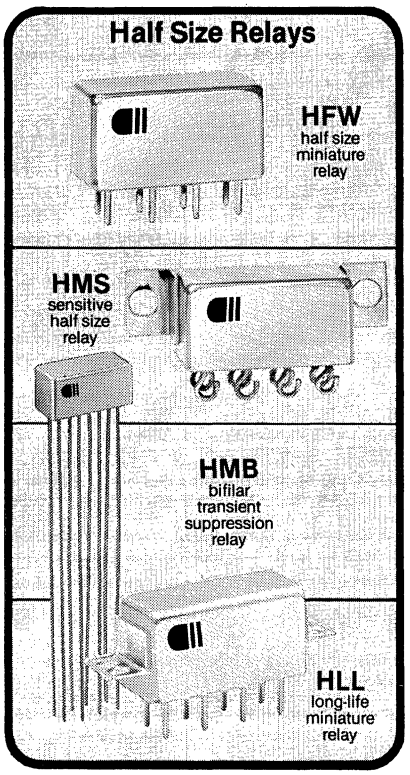


Fig. 2. Typical time vs. current (non-inductive load)

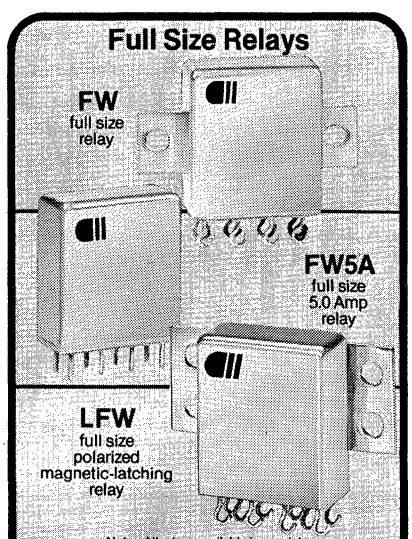
HIGH PERFORMANCE RELAYS from COMMUNICATIONS INSTRUMENTS, INC.

Half Size Relays



Contact Data	Coil Voltage	Features
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 4.0 Amps	5 to 48.0 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • Sensitive version available • Excellent RF switching • Ambient temp rating −65°C to +125°C • Qualified to MIL-R-39016/6 level L&M *(Request Data Sheet HFW-81)*
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 2.0 Amps	5 to 36.0 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • Energy-saving 100/125 milliwatt sensitivity • Excellent RF switching • Ambient temp rating −65°C to +125°C • Qualified to MIL-R-39016/44 level L&M *(Request Data Sheet HMS-83)*
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 3.0 Amps	6 to 32.0 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • Bifilar transient suppression • Excellent RF switching • Ambient temp rating −65°C to +125°C • Qualified to MIL-R-39016/22 level L&M *(Request Data Sheet HMB-83)*
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 2.0 Amps	6 to 26.5 VDC Life: 100 million operations at low level	• Welded, hermetically sealed enclosures • Low contact resistance • Sensitive version available • Excellent RF switching • Ambient temp rating −65°C to +125°C • Shock and vibration resistant *(Request Data Sheet HLL-83)*

Full Size Relays



Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 3.0 Amps	6.3 to 110 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • Sensitive version available • Excellent RF switching • Ambient temp rating −65°C to +125°C • Qualified to MIL-R-5757/10 *(Request Data Sheet FW-81)*
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 5.0 Amps	6.3 to 110 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • 5.0 Amp version of FW • Excellent RF switching • Ambient temp rating −65°C to +125°C • Designed to MIL-R-5757 *(Request Data Sheet FW5A-81)*
Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 3.0 Amps	3.2 to 110 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • One and two coil operation • Excellent RF switching • Ambient temp rating −65°C to +125°C • Designed to MIL-R-5757/53 *(Request Data Sheet LFW-81)*

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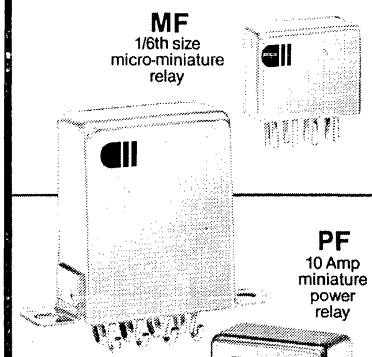
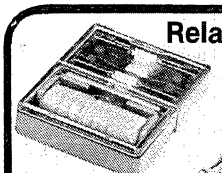
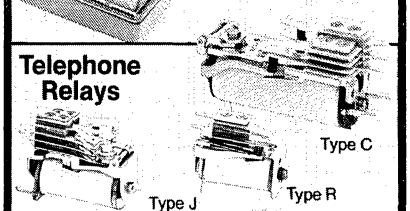
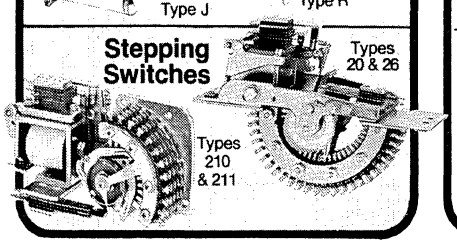
DAVE ARROWOOD
Product Manager for Crystal Can Relays

HIGH PERFORMANCE RELAYS from COMMUNICATIONS INSTRUMENTS, INC.

Relay	Contact Data	Coil Voltage	Features
MF 1/6th size micro-miniature relay 	Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 1.0 Amp	3.4 to 53.0 VDC	• Hermetically sealed enclosures • Low contact resistance • Total volume only .046 cubic inch • Excellent RF switching • Ambient temp rating −65°C to +125°C • Designed to MIL-R-39016/34 *(Request Data Sheet MF-81)*
PF 10 Amp miniature power relay	Contact Arrangements: 1 Form C, 2 Form B, 2 Form A. Contact rating: low level to 10.0 Amps	6.3 to 110 VDC	• Welded, hermetically sealed enclosures • Very low contact resistance • Package volume .72 cubic inch • Excellent RF switching • Ambient temp rating −65°C to +125°C • Designed to MIL-R-5757/23 & 28 *(Request Data Sheet PF-83)*
SF ultra-sensitive relay	Contact Arrangements: 1 Form C, 2 Form C, 2 Form B, 2 Form A. Contact rating: low level to 3.0 Amps	1.8 to 48.0 VDC	• Welded, hermetically sealed enclosures • Low contact resistance • 40 milliwatt sensitivity • Excellent RF switching • Ambient temp rating −65°C to +125°C • Designed to MIL-R-5757/13 *(Request Data Sheet SF-81)*
RD 4 and 6 pole relays	Contact Arrangements: 4 Form C 6 Form C Contact rating: low level to 2.0 Amps	18.0 to 36.0 VDC	• Hermetically sealed enclosures • Low contact resistance • Optional all-welded construction • 100 G shock • Ambient temp rating −65°C to +125°C • Qualified to MIL-R-5757/1 & 7 *(Request Data Sheet RD-83)*

Relay	Contact Data	Coil Voltage	Features
Type 511 GPQ general purpose RF relay 	Contact Arrangements: 2 Form C, 4 Form C, 2 Form D, 4 Form D. Contact rating: low level to 1.0 Amp	5 to 48.0 VDC	• Sealed enclosures • Designed for general purpose RF switching • Sensitive version available • Insulation resistance 50,000 MΩ at 500 VDC • Allows 0.5" center PC board spacing • Low profile. Only .35" height *(Request Data Sheet 511/GPQ-83)*
Telephone Relays Type C, Type J, Type R 	Contact Arrangements: Long frame: up to 8 Form C Med. frame: up to 8 Form C Short frame: up to 4 Form C Contact rating: low level to 10.0 Amps	6 to 250 VDC	• Optional hermetic sealing • Ac or dc operation • Fast operate and fast release • Variety of accessories • Ambient temp rating −55°C to +85°C • Custom designs available *(Request Catalog 502)*
Stepping Switches Types 20 & 26, Types 210 & 211 	Point variations: 10 to 52 point operation Contact rating: 0.1 Amp at 115 VAC or 30 VDC resistive Carry: 3.0 Amps	6 to 110 VDC	• Optional sealing • Insulation resistance $10^9\Omega$ at 500 VDC • Fast operate and release times • Variety of switch mounting accessories • Operating temperature −0°C to +85°C • Custom designed models available *(Request Catalog 601)*

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DAVE ARROWOOD: Product Manager for Crystal Can Relays
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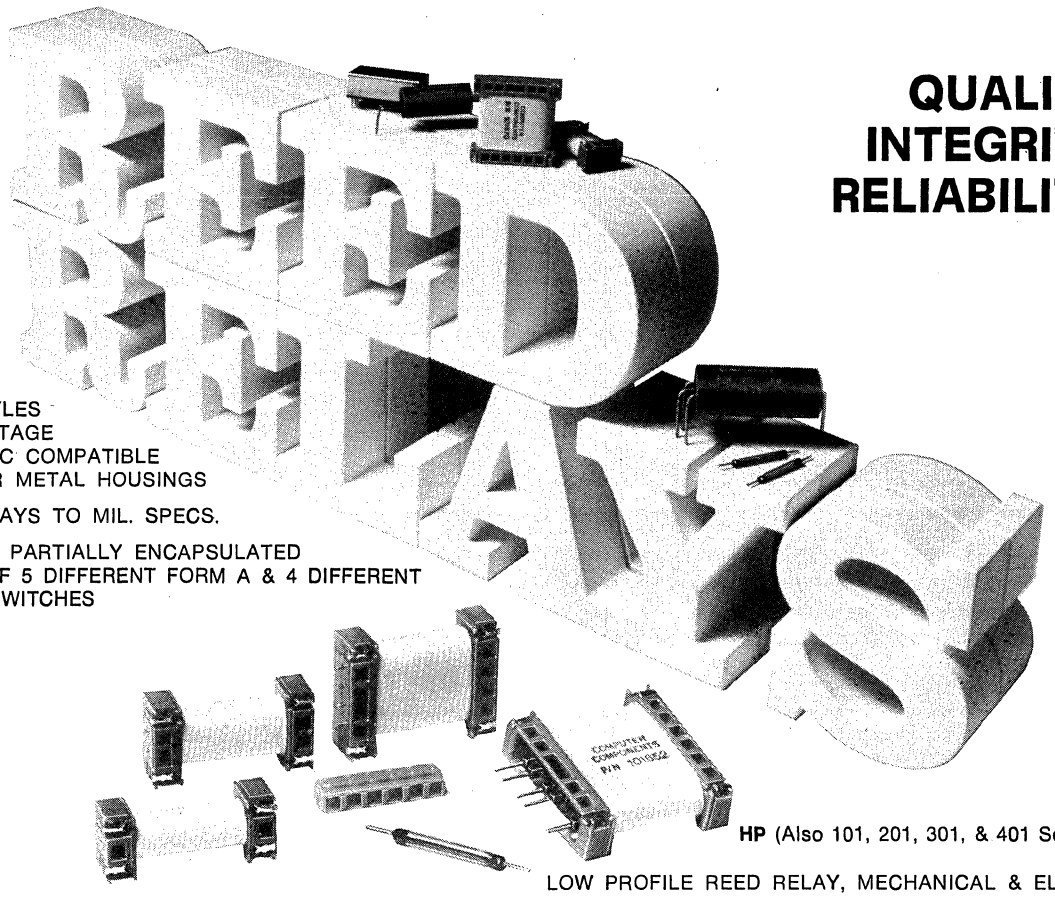
QUALITY INTEGRITY RELIABILITY

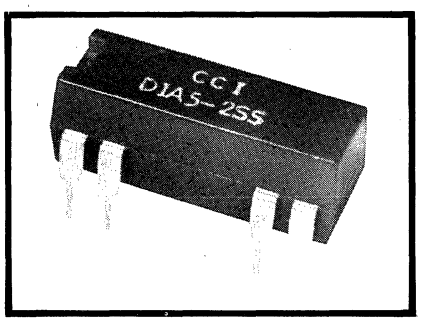


- OPEN STYLES
- HIGH VOLTAGE
- MOLDED IC COMPATIBLE
- EPOXY OR METAL HOUSINGS
- REED RELAYS TO MIL. SPECS.
- FULLY OR PARTIALLY ENCAPSULATED
- CHOICE OF 5 DIFFERENT FORM A & 4 DIFFERENT FORM C SWITCHES

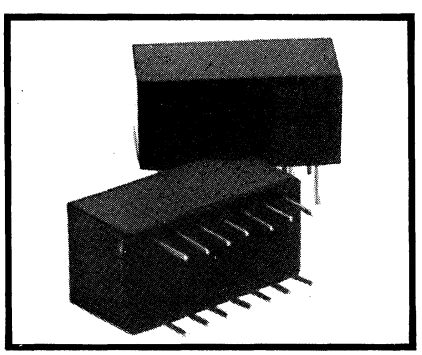
HP (Also 101, 201, 301, & 401 Series)

LOW PROFILE REED RELAY, MECHANICAL & ELECTRICAL REPLACEMENT FOR IBM 766 SERIES PLUG-IN, REPLACE REEDS, NO TOOLS-NO SOLDERING

"D" SERIES



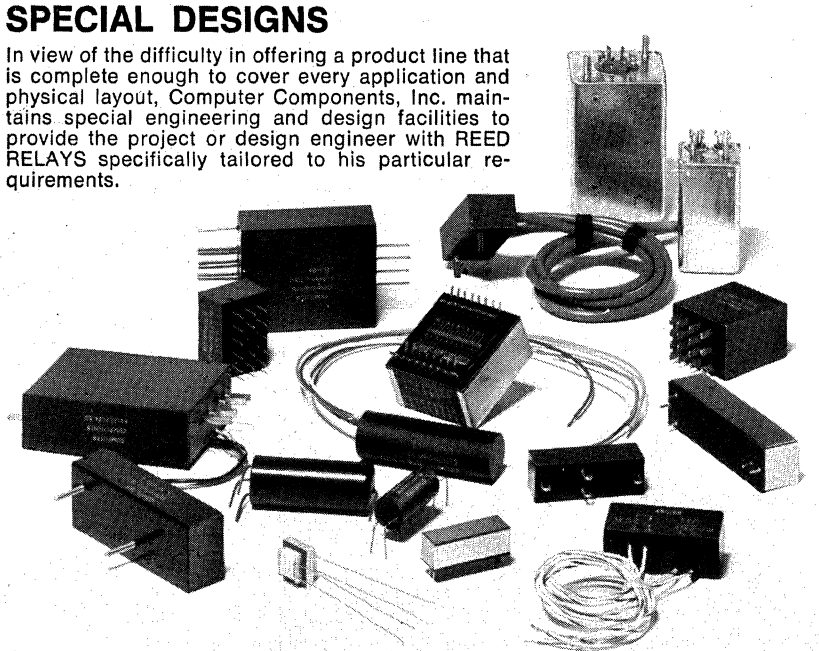
Introducing our "D" series, fully moulded D.I.P. compatible relay.



6 Form A, IC Compatible, .4W x .43H x .8L

SPECIAL DESIGNS

In view of the difficulty in offering a product line that is complete enough to cover every application and physical layout, Computer Components, Inc. maintains special engineering and design facilities to provide the project or design engineer with REED RELAYS specifically tailored to his particular requirements.



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MINIATURE, ULTRA-LOW THERMAL EMF AND

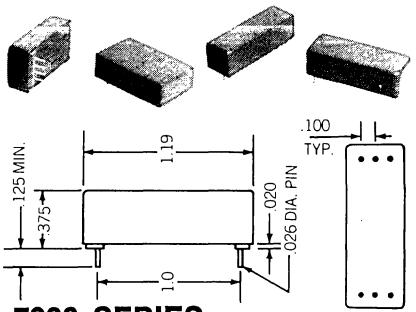
4500

ONE BILLION LIFETIMES!

COTO reed relays have been life tested up to 1,000,000 operations. This assures you of complete product integrity in your most critical designs.

Each and every COTO reed relay is triple-tested in all operating parameters prior to shipment. You can depend absolutely on COTO quality and reliability.

COTO offers a wide variety of reed relays to meet every requirement.

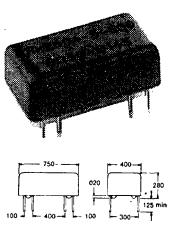


7000 SERIES

7000 — Miniature series available in three types: Dry Standard (7100); Mercury Wetted (7200) and High Voltage (7300). Encapsulated in a magnetically shielding steel shell, epoxy coated. 5, 12 or 24 VDC.

Dry Std.	HG Wet	High Volt	Contact Form	Package Width
7101	7201	7301	1A	.410
7102	7202	7302	2A	.500
7103	7203	7303	3A	.660
7104	7204	7304	4A	.760
7121			1B*	.500
7122			2B*	.660
7141			1C	.410
7142			2C	.660
7143			3C	.760
7150			1AL*	.500
7160			1A/1B†	.760

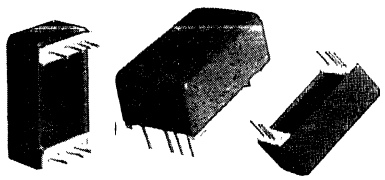
* Polarized. † Make before break not guaranteed.



2600 SERIES

2600 — Highly reliable DIP reed relays designed for versatility. Offered in a wide variety of contact types and coil resistances. Excellent for new designs or to retro-fit lesser quality molded DIP relays. Diode coil suppression available.

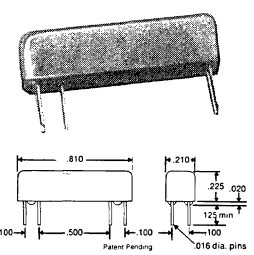
Model #	Contact Form	Switch Volt	Switch Current	E.S. Shield
2604	1A	200	0.5A	YES
2610	1C	100	0.2A	NO
2611	1C	100	0.25A	YES
2631	1A Hi-V	250	0.5A	NO
2653	2A	100	0.5A	YES



3200/3400 SERIES

3200/3400 — Low and ultra-low thermal EMF series. Feature 500 nanovolt thermals and 50 nanovolt stability. Fully encapsulated in magnetically shielding steel shell. For scanning low level analog and digital signals, multiplexing, data acquisition and automatic test equipment.

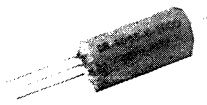
Model #	Contact Form	Thermal EMF Options (Max)
3201	1A	3μV, 1μV, 500nV
3202	2A	5μV, 3μV, 1μV, 500nV
3203	3A	5μV, 3μV, 1μV
3204	1B	5μV, 3μV, 1μV, 500nV
3205	2B	5μV, 3μV, 1μV
3206	1A/1B	5μV, 3μV, 1μV
3207	1A Latch	1μV, 200nV
3250	3A	5μV, 3μV, 1μV, 500nV
3221	1A Hi-V	5μV, 3μV
3222	2A Hi-V	5μV, 3μV
3402	2A	5μV, 3μV, 1μV, 500nV
3432	2A HG	10μV, 5 μV
3450	3A	5μV, 3μV, 1μV, 500nV
3460	3A	5μV, 3μV, 1μV, 500nV

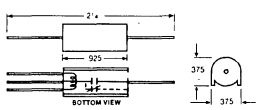


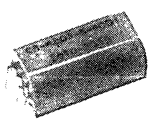
2200/2900 SERIES

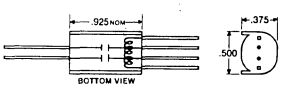
2200/2900 — Microminiature reed relays for maximum versatility and dependability. Encapsulated in epoxy coated magnetically-shielding steel shell. Ideal for switching high-frequency signals. Greater than 10^{12} ohms insulation resistance available.

Model #	Contact Form	Switch Volt	Switch Current	Carry Current
2204	1A Dry	200	0.5A	1.0A
2211	1C Dry	100	0.25A	0.5A
2231	1A Hi-V	200	0.5A	1.0A
2902	1A Dry	200	0.5A	1.5A
2904	1A Dry	200	0.5A	1.5A
2911	1C Dry	150	0.25A	1.0A
2920	1A HG	500	1.0A	2.0A









4000/4200 SERIES

4000/4200 — Totally encased and sealed reed relays. Manufactured to the highest standards and 100% tested prior to shipment. Available in a wide variety of contact types and terminal configurations. Optional electrostatic or magnetic shield.

Relay Contact Type 4000	Relay Contact Type 4200	Model #	Switch Volt DC Max	Switch Current Max Res
1A Std	2A Std	4003* 4203*	200	0.5
1A Hi-Rel	2A Hi-Rel	4004* 4204*	200	0.5
1A Hi-Pwr		4005	150	1.0
1C Std	2C Std	4011 4211	150	0.25
1A HG		4020	500	2.0
1A Hi-V Low Cost	Low Cost 2A Hi-V	4030 4230	300	0.5
1A Hi-V Std	Std 2A Hi-V	4031* 4231*	500	0.5
1B Std		4240	200	0.5

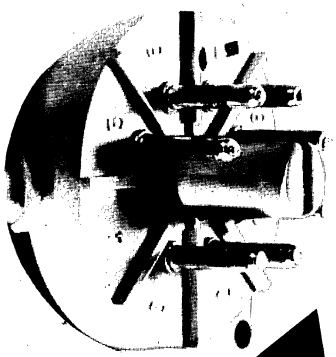
* Recognized under the component program of Underwriters' Laboratory.

WRITE FOR OUR COMPLETE CATALOG #CC-83E

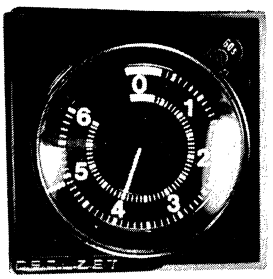
Contact nearest sales office listed in the Manufacturers' Directory of this EEM.

COTO CORPORATION, 55 DUPONT DR., PROVIDENCE, RI 02907 • (401) 943-2686 • TWX: 710-381-8016

octal Cycle Progress Timer



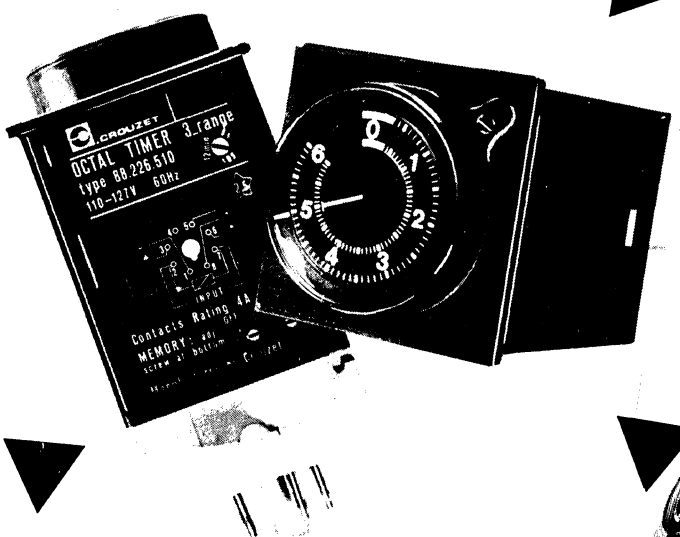
OCTAL PLUG-IN interchangeable with most octal timers



CYCLE PROGRESS shows time remaining in the cycle

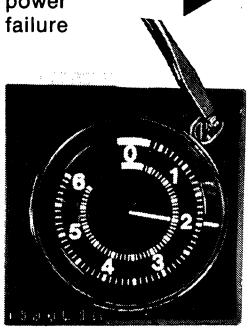
±2% SETTING ACCURACY

MEMORY holds setting during power failure



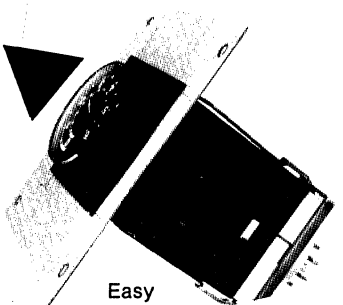
TRANSIENT IMMUNITY built-in

MULTI-FUNCTION on-delay, interval and single shot in one timer!



MULTI-RANGE 2 models cover from 0.3 sec. to 12 hours

OCTAL LOCK prevents module from vibrating out of its socket



Easy **PANEL MOUNT** with no additional hardware

HOW TO ORDER

OCTAL CYCLE PROGRESS TIMER - part no. 88 226.5
(Example - 88 226.5 - 115V 60Hz Model 1)

VOLTAGE	FREQUENCY	TIME RANGES
115V	60Hz	Model 1: 6 sec./60 sec./12 min.
24V	60Hz	Model 2: 6 min./60 min./12 hrs.
240V	60Hz	
220V	50Hz	

CERTIFICATIONS

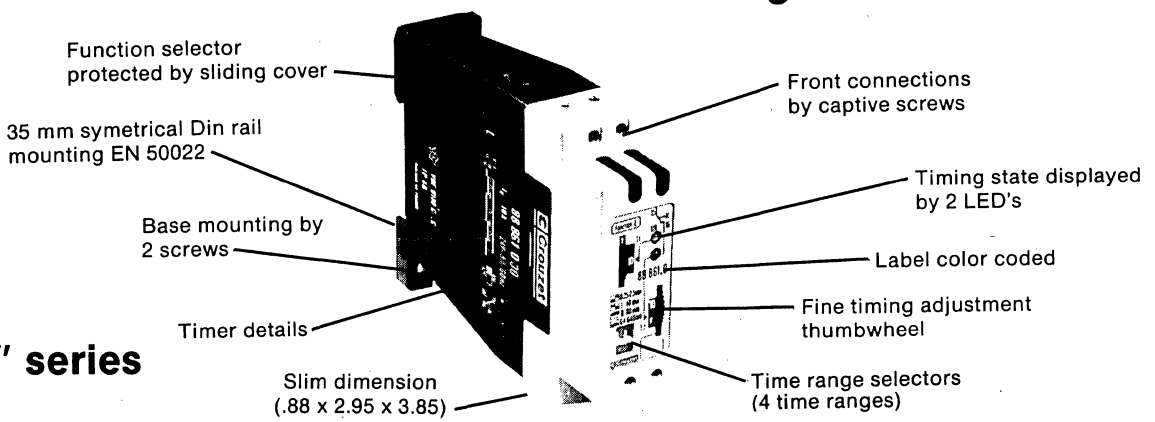
UL and CSA — Most European standards.

Crouzet

Crouzet Controls, Inc.
1029 State Parkway, Schaumburg, IL 60195
Tel: 1 312/843-2200 - Telex: Crouzet 206 297

Solid State Timers

Multifunction — Multirange



"M" series

Functions Available

MARKING	1 Red label		2 Yellow label		3 Green label	
SELECTABLE POSSIBLE FUNCTIONS	Pulse Generator (I) Pulse Change-over (F) Pulse Monitor (O)		On-delay (A) Interval (H) Repeat Cycle (D) Repeat Cycle (E)		Off-delay (C) Interval (B) Pulse Monitoring (N)	
PART NO.	88 860 01	88 860 03	88 860 21	88 860 23	88 860 81	88 860 83
RANGE OF SELECTABLE TIMES	0.06 to 160 s	0.25 to 640 min.	0.06 to 160 s	0.25 to 640 min.	0.06 to 160 s	0.25 to 640min.

4 Blue label		5 Orange label		6 Pink label	7 Lime green label	8 White label	
Repeat Cycle (L) (T_1 and T_2 Adjustable)		Percentage Timer (G) Setting in percentage Adjustable 3 - 97 %		Pulse Output (M) Ma Mb Mc T : 0,5 s ± 0,2 s	Wye-Delta Motor Start (S) t : 0,1 s or t : 0,035 s bridge B1 B2	Relay 88 863 0 SPDT 88 863 1 DPDT	
88 861 01	88 861 03	88 861 21	88 861 23	88 861 41	88 862 01	88 863 0	88 863 1
0.06 to 160 s	0.25 to 640 min.	0.6-2.5-20 and 160 s	2.5-10-80 & 640 min.		3 to 30 s - 6 to 60 s		

Standard supply voltages: 24 or 48V, DC and 50/60 Hz, 110V or 240V, 50/60 Hz, ± 15% nominal
Accuracy: ± 5% — Relay current rating: 10A~(1A —) — Max. admissible current: 15A< 10ms

Also available: "S" series timers: multivoltage (10 to 254V AC/DC) — multirange, single function
"SE" series timers: single range, single function, single voltage, custom built

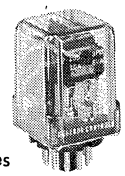
Crouzet
Crouzet Controls, Inc.
1029 State Parkway, Schaumburg, IL 60195
Tel: 1 312/843-2200 - Telex: Crouzet 206 297

DELTROL RELAYS

BZ Buzzer

L = 1-1/16
W = 1-1/4
H = 7/8

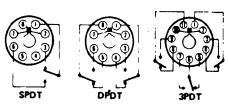
Continuous or intermittent duty buzzer which buzzes when coil is energized. Operated on 50/60 cycle AC voltage. Mounting: No. 6-32 tapped core. Recognized under the Components Program of Underwriters Laboratories, Inc. (File No. E37066). CSA listed (File No. 20690).



105 Series

L = 1-3/8
W = 1-3/8
H = 2

General purpose plug-in relay for continuous duty operation. Plastic cover. Recognized under the Components Program of Underwriters Laboratories, Inc. (File No. E37066).



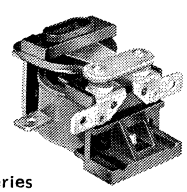
BASE DIAGRAMS FOR 105 SERIES

B-3 HOLD DOWN SPRING
S/N 20171-00

165/166 Series

L = 1-13/32
W = 1-1/2
H = 2-3/16

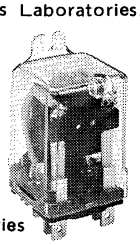
Plastic covered general purpose plug-in relay. Molded nylon coil. Continuous duty operation. Recognized under the Components Program of Underwriters Laboratories, Inc. (File No. E37066). Also CSA Recognized.



170 Series

L = 1-7/8
W = 1-5/8
H = 1-1/4

High current relays for industrial control applications. Molded nylon encapsulated coil is resistant to fungus and moisture. Recognized under the Components Program of Underwriters Laboratories, Inc. (File No. E37066).



275F Series

General purpose relays with plastic dust cover with flange mounting, barrier-type .250" quick-connect terminals and molded-nylon coil. Recognized under the Components Program of Underwriters Laboratories, Inc. (File No. E37066). CSA Recognized.

BZ BUZZER

Stock No.	Series	Contacts Arrang.	Contacts Rating (Amps)	Coil Input Voltages	Coil Resistance (Ohms)	Coil Nominal Power
20000-81	BZ			12VAC	32	3.0VA
20000-82	BZ			24VAC	132	3.0VA
20000-83	BZ			120VAC	2,250	3.0VA

105/105A SERIES (With Indicator Lamp)

20107-84	105	DPDT	5A	120VAC	1,800	2.2VA
20108-81	105	DPDT	10A	12VAC	19	2.0VA
20108-82	105	DPDT	10A	24VAC	74	2.0VA
20108-84	105	DPDT	10A	120VAC	1,800	2.0VA
20108-85	105	DPDT	10A	240VAC	6,800	2.0VA
20110-82	105	3PDT	10A	24VAC	74	2.2VA
20110-84	105	3PDT	10A	120VAC	1,800	2.2VA
20110-85	105	3PDT	10A	240VAC	6,800	2.2VA
20114-80	105	DPDT	10A	6VDC	30	1.2W
20114-81	105	DPDT	10A	12VDC	120	1.2W
20114-82	105	DPDT	10A	24VDC	472	1.2W
20114-83	105	DPDT	10A	48VDC	1,800	1.2W
20114-84	105	DPDT	10A	110VDC	10,000	1.2W
20117-81	105A	DPDT	10A	12VAC	19	2.2VA
20117-82	105A	DPDT	10A	24VAC	74	2.2VA
20117-84	105A	DPDT	10A	120VAC	1,800	2.2VA
20118-84	105A	3PDT	10A	120VAC	1,800	2.2VA

165/166 & 165F/166F SERIES (Flange-Mounted Stock Available)

20307-82	166	DPDT	10A	24VAC	74	2.2VA
20307-84	166	DPDT	10A	120VAC	1,800	2.2VA
20307-85	166	DPDT	10A	240VAC	6,800	2.2VA
20308-82	166	3PDT	10A	24VAC	74	2.2VA
20308-84	166	3PDT	10A	120VAC	1,800	2.2VA
20308-85	166	3PDT	10A	240VAC	6,800	2.2VA
20310-80	166	DPDT	10A	6VDC	30	1.2W
20310-81	166	DPDT	10A	12VDC	120	1.2W
20310-82	166	DPDT	10A	24VDC	472	1.2W
20325-84	165	3PDT	5A	120VAC	1,800	2.2VA
20328-82	165	3PDT	5A	24VDC	472	1.2W
20311-81	166	3PDT	10A	12VDC	120	1.2W
20311-82	166	3PDT	10A	24VDC	472	1.2W
20311-84	166	3PDT	10A	110VDC	9,500	1.2W
20381-83	166A	3PDT	10A	120VAC	1,800	2.2VA

170 SERIES

20392-82	170	SPST-	30A	24VAC	44	4.7VA
20392-83	170	NO-DM	30A	120VAC	1,100	4.7VA
20394-81	170	SPST-	30A	12VDC	72	2W
20394-82	170	NO-DM	30A	24VDC	288	2W

275F SERIES

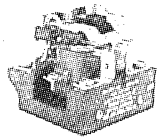
20844-84	275F	DPDT	20A	120VAC	1,670	2.4VA
20848-82	275F	SPST-NO-DM	30A	24VDC	320	1.8W
20852-82	275F	DPDT	20A	24VDC	320	1.8W

ALL DIMENSIONS ARE NOMINAL.

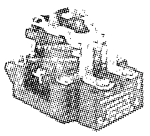
DELTROL controls DIVISION OF DELTROL CORP

2745 S. 19th Street, Milwaukee, Wisconsin 53215 Phone (414) 671-6800, Telex 2-6871

DELTROL RELAYS



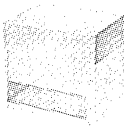
Single Pole
L = 2-1/2
W = 2-1/2
H = 2-3/16



Double Pole
L = 3-11/32
W = 2-1/2
H = 2-3/8

Heavy duty power relay for industrial control applications. Particularly suited for motor controls, heater loads, welder loads, and other power switching applications. Molded nylon coil resists fungus and moisture. Long life, rugged construction. Rating: 25 amps, 1-1/2 hp, 120/240 VAC. Heavy duty screw-type terminals. Mounting: two 3/16" holes on 1-7/8" centers. Listed under the Components Program of Underwriters Laboratories, Inc. (File No. E37066). CSA listed (File No. 20690).

B-5 DUST COVER



L = 5
W = 4
H = 3

S/N 20257-80

Sealed knock-out holes for standard conduit fittings. Relay mounts on pre-drilled base. Constructed of Aluminum. Snap action cover release. Accommodates relay series 900.

900 SERIES

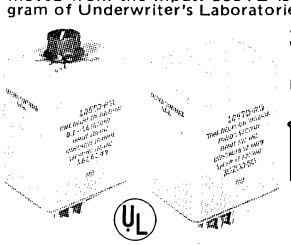
		Contacts		Coil		
Stock No.	Series	Arrang.	Rating (Amps)	Input Voltages	Resistance (Ohms)	Nominal Power
20237-82	900	SPST-NO	30A	24VAC	12	9.5VA
20237-83	900	SPST-NO	30A	120VAC	290	9.5VA
20238-82	900	SPST NO-DM	30A	24VAC	12	9.5VA
20238-83	900	SPST NO-DM	30A	120VAC	290	9.5VA
20239-82	900	SPDT	30A	24VAC	12	9.5VA
20239-83	900	SPDT	30A	120VAC	290	9.5VA
20240-82	900	DPST-NO	30A	24VAC	12	9.5VA
20240-83	900	DPST-NO	30A	120VAC	290	9.5VA
20241-83	900	DPDT	30A	24VAC	12	9.5VA
20241-83	900	DPDT	30A	120VAC	290	9.5VA
20243-81	900	SPDT	30A	12VDC	72	2W
20244-81	900	DPST-NO	30A	12VDC	72	2W
20244-82	900	DPST-NO	30A	24VDC	290	2W
20245-82	900	DPDT	30A	24VDC	290	2W
20245-84	900	DPDT	30A	110VDC	6,050	2W

ALL DIMENSIONS ARE NOMINAL.

DELTROL TIME DELAY RELAYS

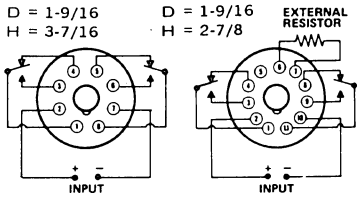
105TD and 105TD-R SERIES

Time delay relay utilizes a Deltrol DPDT relay combined in a compact, convenient package with electronic delay circuit. The circuit has been designed to provide instant reset if power is removed during the timing cycle without a momentary contact transfer. When rated voltage is applied to the input, the timing cycle begins. At the end of the timing cycle, the DPDT relay transfers and remains in that condition until power is removed from the input. 105TD is recognized under the components program of Underwriter's Laboratories, Inc., file no. E37066.



ADJUSTABLE
W = 2
D = 1-9/16
H = 3-7/16

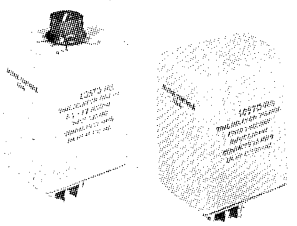
FIXED
W = 2
D = 1-9/16
H = 2-7/8



105TD DELAY ON OPERATE (Adjustable)

Stock No.	Time Cycle	Coil Voltage
30202-80	0.1 to 10 Sec.	120VAC
30203-80	0.1 to 10 Sec.	24VDC
30202-82	0.6 to 60 Sec.	120VAC
30203-82	0.6 to 60 Sec.	24VDC
30202-84	1.8 to 180 Sec.	120VAC
30203-84	1.8 to 180 Sec.	24VDC

105TD DELAY ON OPERATE (Fixed) AVAILABLE



105TD-R DELAY ON RELEASE (Adjustable)

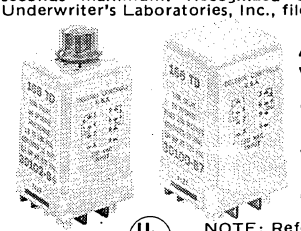
Stock No.	Time Cycle	Coil Voltage
30222-80	0.1 to 10 Sec.	120VAC
30223-80	0.1 to 10 Sec.	24VDC
30222-82	0.6 to 60 Sec.	120VAC
30223-82	0.6 to 60 Sec.	24VDC
30222-84	1.8 to 180 Sec.	120VAC
30223-84	1.8 to 180 Sec.	24VDC

105TD-R DELAY ON RELEASE (Fixed) AVAILABLE

OTHER VOLTAGES AVAILABLE

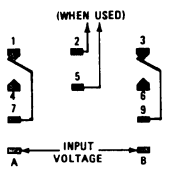
166TD and 166TD-R SERIES

Plug-in time delay relay that will not false trip upon interruption of time cycle. High-impact plastic dust cover. DPDT configuration rated 10 amps. Contact rating: 3/16" dia., 1/4 HP or 10 amps at 120 VAC; 1/2 HP at 240 VAC. Release and recycle time 100 milliseconds typical, 150 milliseconds maximum. Recognized under the components program of Underwriter's Laboratories, Inc., file no. E37066.



ADJUSTABLE
W = 1-1/2
D = 1-3/8
H = 3-1/8

FIXED
W = 1-1/2
D = 1-3/8
H = 2-9/16

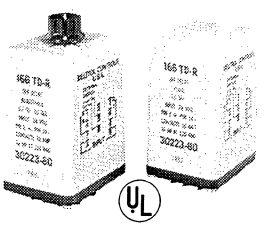


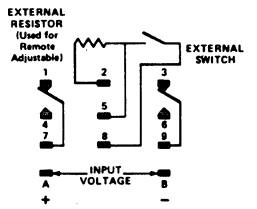
NOTE: Refer to Bulletin 1845-4 for complete engineering specifications, terms and definitions.

166TD DELAY ON OPERATE (Adjustable)

Stock No.	Time Cycle	Coil Voltage
30102-80	0.1 to 10 Sec.	120VAC
30103-80	0.1 to 10 Sec.	24VDC
30102-82	0.6 to 60 Sec.	120VAC
30103-82	0.6 to 60 Sec.	24VDC
30102-84	1.8 to 180 Sec.	120VAC
30103-84	1.8 to 180 Sec.	24VDC

166TD DELAY ON OPERATE (Fixed) AVAILABLE





166TD-R DELAY ON RELEASE (Adjustable)

Stock No.	Time Cycle	Coil Voltage
30122-80	0.1 to 10 Sec.	120VAC
30123-80	0.1 to 10 Sec.	24VDC
30122-82	0.6 to 60 Sec.	120VAC
30123-82	0.6 to 60 Sec.	24VDC
30122-84	1.8 to 180 Sec.	120VAC
30123-84	1.8 to 180 Sec.	24VDC

166TD-R DELAY ON RELEASE (Fixed) AVAILABLE

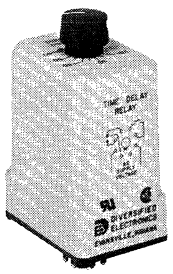
DIVERSIFIED ELECTRONICS, INC.
INDUSTRIAL CONTROL DIVISION

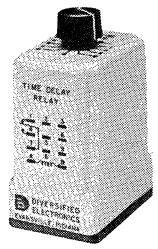
National & International Sales
P.O. Box 207
Leesburg, FL 32748
Toll Free (800) 874-0619
In Florida (904) 787-7259

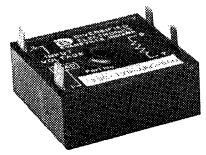
Corporate Headquarters
119 North Morton Avenue
Evansville, IN 47711
(812) 426-2806

TIME DELAYS

	OCTAL TYPE/PLUG IN TD SERIES	BLADE TYPE/PLUG IN TD SERIES	SOLID STATE TS SERIES	UNITIMER TDU SERIES
Delay on Operate	●	●	●	●
Interval on Operate	●	●	●	●
Delay on Release	●	●	●	●
Single Shot	●	●	●	
Repeat Cycle	●	●	●	
Delayed Interval	●	●	●	
Delayed Single Shot	●	●	●	
Delay on Operate/ Delay on Release	●	●		
Flasher	●	●	●	●
Energy Conservation	●	●		
Percentage Timer	●	●		







FEATURES

OCTAL TYPE/PLUG IN TD SERIES
- CMOS CIRCUITRY
- FAST RECYCLE TIME
- VIRTUALLY UNLIMITED DELAYS
- NO FALSE TRANSFER
- CONTINUOUS DUTY CYCLE
- MOST MODELS - UL & CSA
- OCTAL TYPE, PLUG IN BASE
- LEXAN DUST COVER
- FACTORY STOCK

BLADE TYPE/PLUG IN TD SERIES
- CMOS CIRCUITRY
- FAST RECYCLE TIME
- VIRTUALLY UNLIMITED DELAYS
- NO FALSE TRANSFER
- CONTINUOUS DUTY CYCLE
- BLADE TYPE, PLUG IN BASE
- LOW POWER CONSUMPTION
- BOTH AC OR DC TYPES
- FACTORY STOCK

SOLID STATE TS SERIES
- CMOS CIRCUITRY
- NINE (9) OPERATING MODES
- ALL MODELS UL
- TOTALLY SOLID STATE
- DELAYS UP TO 2 HOURS
- SMALL SIZE
- EASY INSTALLATION
- TOTALLY ENCAPSULATED
- FACTORY STOCK

UNITIMER TDU SERIES
- FIELD PROGRAMMABLE
- OPERATES ON AC OR DC VOLTAGES
- FOUR (4) TIMING RANGES
- FIVE (5) OPERATING MODES
- NO FALSE TRANSFER
- LED GLOWS WHEN RELAY IS ENERGIZED
- FACTORY STOCK

DESCRIPTION

OCTAL TYPE/PLUG IN TD SERIES
The TD Time Delay Relay series features a CMOS integrated circuit consisting of an RC oscillator, a binary counter and an output logic that operates an electro-mechanical relay. The delay period is adjustable by varying the oscillator frequency which is represented by the variable control on the enclosure. A dial is silk screened under the control providing a reference point. Extremely fast recycle times, along with high accuracy and repeatability make the TD series ideally suited for all applications encountered in the industry.

BLADE TYPE/PLUG IN TD SERIES
The TD series described here is electrically identical to the octal plug in types. The package and type of termination is the difference. This too features the CMOS integrated circuit providing extremely long delays, fast recycle times, high repeatability and accuracy. As with all other DEI timers, these will not false transfer when power is removed prior to completion of the timing cycle. They plug into standard blade type sockets. Specify QC-11.

SOLID STATE TS SERIES
The TS series offers a solid state addition to the existing broad line of DEI timers. Their small size and low cost provide an inexpensive alternative to the electro-mechanical types. Nine (9) different operations are offered. The totally encapsulated package features CMOS technology, allowing long timing ranges, 100% solid state circuitry, no moving parts to wear, and quick connect terminals for ease of installation. The same fast recycle times and accuracy employed in the other DEI timers make the TS series also ideally suited for all applications encountered in the industry. All models have UL

UNITIMER TDU SERIES
The TDU series Unitimer offers the most versatile single timer available today. 1 model replaces 40 standard devices. 4 wide range delays X 5 most common modes of operation X 2 supply voltages, since it will operate on both AC and DC. The CMOS digital circuitry provides high accuracy, repeatability and fast reset times. The long life, heavy duty relay output is rated to carry currents of 10 amps at 24VDC or 120VAC. All programming is easily accomplished externally by using one or more jumpers between designated base pins -no trap doors to open, no switches to set or disassembly required.

SPECIFICATIONS

	OCTAL TYPE/PLUG IN TD SERIES	BLADE TYPE/PLUG IN TD SERIES	SOLID STATE TS SERIES	UNITIMER TDU SERIES
SUPPLY VOLTAGE:	24 or 120 VAC, 50/60 Hz; 24 or 110 VDC	24 or 120 VAC, 50/60 Hz; 24 or 110 VDC	24 or 120 VAC, 50/60 Hz; Some Models Available in DC	24 or 120 VAC, 50/60 Hz; 24 or 110 VDC
TIME DELAYS:	Virtually Unlimited	Virtually Unlimited	Up to 2 Hours	Field Programmable to 1 Hour
TEMPERATURES Operate:	0°C to +55°C	0°C to +55°C	0°C to +55°C	0°C to +55°C
Storage:	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C
OUTPUT:	DPDT, 10 Amps Resistive; 211 VA Inductive, 1/6 HP @ 120 VAC or 24 VDC	DPDT, 10 Amps Resistive; 211 VA Inductive, 1/6 HP @ 120 VAC or 24 VDC	1 Amp Continuous; 10 Amps Inrush	SPDT, 10 Amps Resistive; 211 VA Inductive, 1/6 HP @ 120 VAC or 24 VDC
REPEATABILITY:	1% Including First Cycle	1% Including First Cycle	1% Including First Cycle	1% Including First Cycle
ACCURACY:	± 10%	± 10%	± 10%	± 10%
RESET TIMES Before Time Out:	100 Milliseconds	100 Milliseconds	100 Milliseconds	100 Milliseconds
After Time Out:	50 Milliseconds	50 Milliseconds	50 Milliseconds	50 Milliseconds
Recycle:	40 Milliseconds	40 Milliseconds	40 Milliseconds	40 Milliseconds
FALSE TRANSFER:	No	No	No	No
REVERSE POLARITY PROTECTED:	Yes	Yes	Yes	Yes
DUTY CYCLE:	Continuous	Continuous	Continuous	Continuous
POWER CONSUMPTION:	3 Watts (Approximately)	3 Watts (Approximately)	3 Watts (Approximately)	3 Watts (Approximately)
LIFE EXPECTANCY Mechanical:	10 Million Operations (Minimum)	10 Million Operations (Minimum)	N/A - No Moving Parts to Wear	10 Million Operations (Minimum)
Electrical	100,000 Operations @ Rated Load	100,000 Operations @ Rated Load	100,000 Operations @ Rated Load	100,000 Operations @ Rated Load
ENCLOSURE STYLE:	"A" Lexan Dust Cover	"B" Lexan Dust Cover	"C" Totally Encapsulated	"A" Lexan Dust Cover
TERMINATIONS:	8 or 11 Pin Octal Plug In; (Use RB-08 or RB-11 Relay Sockets)	11 Pin Blade Plug In; (Use QC-11 Relay Socket)	¼" Quick Disconnect Terminals	11 Pin Octal Plug In; (Use RB-11 Relay Socket)
UL:	Most Models Recognized, File #E55826, Consult Factory	Recognition Forthcoming; Consult Factory	All Models Recognized File #E55826	UL Recognized, File # E55826

DOUGLAS RANDALL REED RELAYS
Division of Kidde, Inc.
KIDDE
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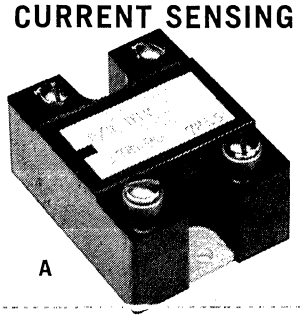
SPECIAL DESIGNS

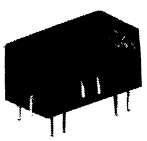
Douglas Randall makes custom designed relays to solve difficult problems. A few models are shown below to illustrate the variety available. Special molding techniques make it possible to manufacture unusual sizes, shapes and terminal arrangements with low tooling costs.

The electrical variations possible with Reed Relays are practically limitless.

Douglas Randall will gladly review your applications and offer rapid engineering and prototype service.

CURRENT SENSING RELAYS


A

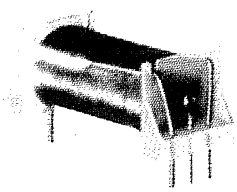

B

Douglas Randall offers a line of relays with coils capable of handling 25 Amperes DC. Contact arrangements can be Form 1A, Form 1B, or Form 1C.

Relay A has a Form B contact which opens at 1 ADC closes at .5 ADC and can operate continuously at 15 ADC coil current. It has screw terminals and can be bolted to a heat sink.

Relay B has standard DIP terminals. It has a Form B contact which opens at 2.3 ADC and closes at 1.7 ADC.

SENSITIVE RELAYS

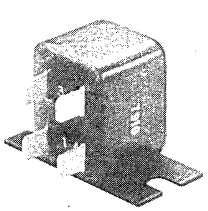


Proper switch selection and tight coil design result in relays operable at lowest coil power. The one shown operates at only 3.5 milliwatts.

VERTICAL MOUNTING

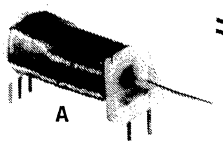
This relay is a miniature molded mercury wetted type .450″ Diameter x 1¼″. High designed for vertical mounting.

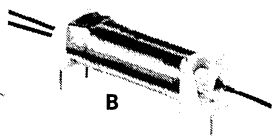
SPECIAL HOUSING



This relay is designed with spade terminals and epoxy molded into a steel case with welded mounting bracket.

HIGH INSULATION RESISTANCE RELAYS


A

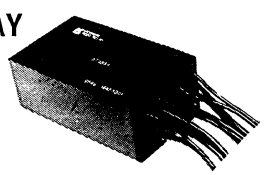

B

Two typical designs are shown above:

A — A miniature reed relay with a floating lead to maintain high IR.

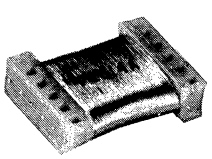
B — This is a relay using Form A and Form B switches timed to provide a Form C (break before make) function with flying leads to maintain 10^{13} ohms. Up to 5 Form A contacts are available @ 10^{13} ohms.

SPECIAL HIGH VOLTAGE RELAY



This relay has three separate coils, each containing a 5,000VDC and a 10,000VDC switch. The package is molded with a flame retardant epoxy and constructed to withstand 18,500VDC between the switches and all other conductors. The relay is 3⅞″ L x 2⅜″ W x 1½″ H.

SNAP-IN RELAYS



This 4 pole relay mounts in Berg-clips, like the Series SI on page 3 Douglas Randall can now duplicate the following discontinued IBM models:

1 — Position: 766040, 766042, 766059, 766060, 766065, 766068 and 766086

2 — Position: 766043, 766044, 766057, 766067, 766072 and 766087

4 — Position: 766046, 766047, 766066, 766071 and 766079

DOUBLE COIL RELAY

This is a special Form 2C relay with two coils. Either coil when energized at 90% nominal voltage must be able to cancel the other coil when energized at 110% nominal voltage. The relay must be able to withstand 600VRMS.

DOUGLAS RANDALL

Division of Kidde, Inc.

KIDDE

REED RELAYS

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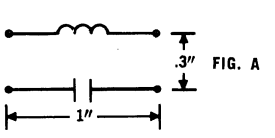
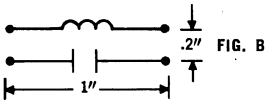
new

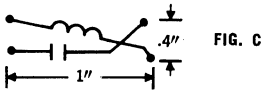
Form 1C (SPDT) and Form 2C (DPDT) UL RECOGNIZED REED RELAYS

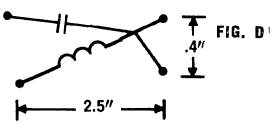
FILE NO. E/54552; C.C. NRNT2

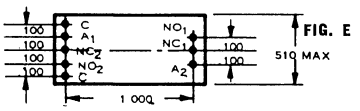
Fig.	Part No.	Nom. Volt.	DCR Ohms ±10%	Contact Rating
1 & A	377885 377455 377886	6 12-19 24	250 1200 4000	10W, .5A or 200VDC 120VAC @ .275 Amp Use for gating triacs @ 120VAC
1 & B	377472 375388 377471	6 12-19 24	250 1200 4000	
1 & C	377327 377806 377807	5 12 24	250 1000 4000	240VAC @ .040 Amp. Use for gating triacs @ 240VAC
2 & D	377307 (SP) 377410 377201	6 12 24	175 700 2880	3A @ 17VDC 1A @ 100VDC .3A @ 300VDC For inductive AC loads up to the ratings shown.
	CSA Certified — File LR 34149			
3	377808 377809 377810 373350	6 12 24 48	250 1000 2150 2150	20W, .5A or 500VDC 240VAC @ .040 Amp. Use for triac gating ± 240VAC
4 & B	378510 378511 378512	6 12 24	170 675 2700	10W, .5A or 200VDC 120VAC @ .275A Used for gating triacs @ 120VAC
4 & B	378513 378514 378515	6 12 24	170 675 2700	As above, supplied with dust cover
1 & E	378193 378194 378195	6 12 24	170 675 2700	Form 2C .05A @ 20VAC or VDC
5 & F	378196 378197 378198	6 12 24	250 1000 4000	Form 1C .05A @ 20VAC or VDC

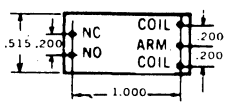


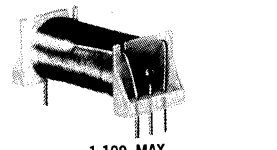


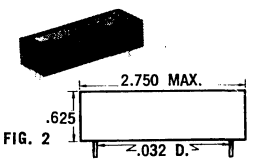


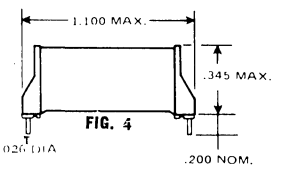








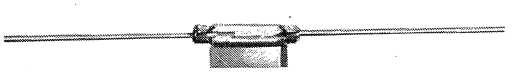




PROXIMITY SWITCHES

Douglas Randall manufactures standard and custom switches to meet many applications, a few of which are illustrated. All proximity switches are tested for operation by external magnets at specified distances.

MINIATURE LATCHING

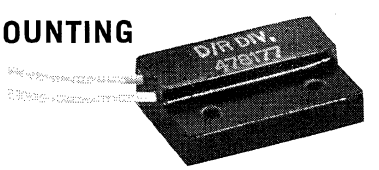


This is a switch and magnet combination shown 3 times actual size. The length, excluding leads is only .350″. This assembly will latch in either the open or closed state when approached by an external magnet.

FORM B

This is a Form B switch and magnet assembly, .7″ L x .150″ Sq. The normally closed switch opens, when approached by an ⅛″ Sq. steel rod.

STEP MOUNTING

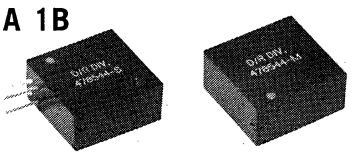


This encapsulated switch is available with Form 1A, Form 1B, Form 1C or Form 2A contacts. It can be supplied with dry reed, mercury wet, high voltage (to 1,000VDC) or high power (to 100VA) contacts. The one shown was designed for low contact resistance and low level switching.

HEAVY DUTY

The proximity switch shown above has heavy duty contacts rated at 100VA. This switch and matching magnet are epoxy encapsulated for heavy duty use on outdoor machinery.

FORM 1A 1B



This is a switch and magnet combination. The switch has Form 1A and Form 1B contacts designed so that one set of contacts is always open as the magnet approaches it.

DOUGLAS RANDALL
Division of Kidde, Inc.
KIDDE
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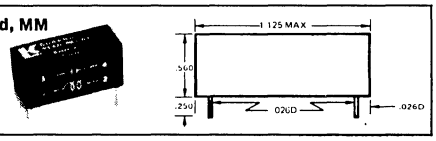
REED RELAYS

MINIATURE REED RELAYS

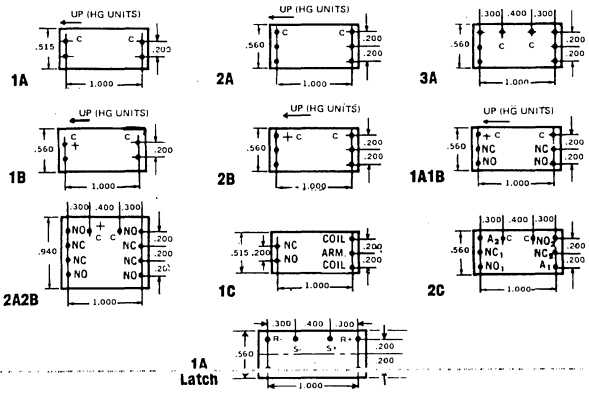
Molded — Series MM Dry, HgM Mercury Wet*
Open — Series MG Dry Reed, HgMG Mercury Wet*

Form	Nominal Voltage	DCR Ohms ±10%	MM Series Part Number	MG Series Part Number
1A	6	250	6MM1A	6MG1A
	12	1000	12MM1A	12MG1A
	24	4000	24MM1A	24MG1A
2A	6	170	6MM2A	6MG2A
	12	675	12MM2A	12MG2A
	24	2700	24MM2A	24MG2A
3A	6	110	6MM3A	6MG3A
	12	450	12MM3A	12MG3A
	24	1800	24MM3A	24MG3A
4A	6	60	—	6MG4A
	12	250	—	12MG4A
	24	1000	—	24MG4A
5A	6	50	—	6MG5A
	12	200	—	12MG5A
	24	800	—	24MG5A
6A	6	50	—	6MG6A
	12	200	—	12MG6A
	24	800	—	24MG6A
1B	6	170	6MM1B	6MG1B
	12	675	12MM1B	12MG1B
	24	2700	24MM1B	24MG1B
2B	6	110	6MM2B	6MG2B
	12	450	12MM2B	12MG2B
	24	1800	24MM2B	24MG2B
1A1B	6	110	6MM1A1B	6MG1A1B
	12	450	12MM1A1B	12MG1A1B
	24	1800	24MM1A1B	24MG1A1B
2A2B	6	50	6MM2A2B	6MG2A2B
	12	200	12MM2A2B	12MG2A2B
	24	800	24MM2A2B	24MG2A2B
1C	6	250	6MM1C	6MG1C
	12	1000	12MM1C	12MG1C
	24	4000	24MM1C	24MG1C
2C	6	170	6MM2C	6MG2C
	12	675	12MM2C	12MG2C
	24	2700	24MM2C	24MG2C
3C	6	60	—	6MG3C
	12	250	—	12MG3C
	24	1000	—	24MG3C
4C	6	50	—	6MG4C
	12	200	—	12MG4C
	24	800	—	24MG4C
1A Latch	6	85/85	6MML1A	6MGL1A
	12	340/340	12MML1A	12MGL1A
	24	1350/1350	24MML1A	24MGL1A

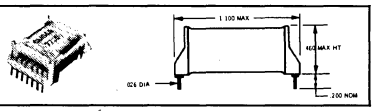
Miniature Molded, MM



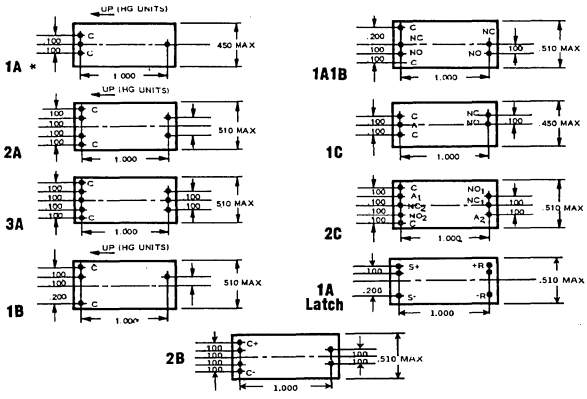
Terminal Layout Series MM (Bottom View)



Miniature Open, MG



Terminal Layout Series MG (Bottom View)



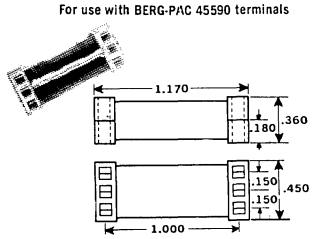
Contact Data — Series MM, SI, MG, XMG and Hg Versions

Contact Type	Contact Rating Form A	Form B	Form C
Dry	10W 12VA .5A 250VDC .15Ω*	10W 12VA .5A 250VDC .15Ω*	3W 3VA .25A 100VDC .2Ω*
Hg Wet	28W — 1A 1000VDC .05Ω*	28W — 1A 1000VDC .05Ω*	14W 14VA .5A 1000VDC .05Ω*
All Position Hg Wet	3W 2.5VA .25A 1000VDC .05Ω*	— — — — —	— — — — —

* Initial Resistance

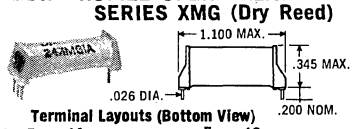
SNAP-IN RELAYS SERIES SI

For use with BERG-PAC 45590 terminals

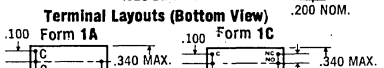


Form	Nominal Voltage	Part Number	DCR Ohms ±10%
1A	6	6SI1A	250
	12	12SI1A	1000
	24	24SI1A	4000

LOW PROFILE OPEN RELAYS SERIES XMG (Dry Reed)



Terminal Layouts (Bottom View)



Form	Nominal Voltage	Part Number	DCR Ohms ±10%
1A*	6	6XMG1A	168
	12	12XMG1A	675
	24	24XMG1A	2700
1C*	6	6XMG1C	168
	12	12XMG1C	675
	24	24XMG1C	2700

Note: Nylon Cover Available.
* Hg wet switches available.

NOTES

1. E/M shields std. all Series MM and all Form B and Form L.
2. E/S shields optional.
3. 1000VDC switches available all Form A and B relays.
4. Premium run-in switches available all models.
5. Ultra sensitive relays available.
6. Series MML/1A, have internal diodes.

***Hg Wet, Form C, & Non-Position Sensitive available**

OPERATING DATA — All Series

Must Operate — 70% Nominal
Must Release — 10% Nominal
Maximum Voltage —
Form A and C — 200% Nominal
Form B and Latching — 130% Nominal
Environmental Data: −20°C to +65°C; vibration 35g to 2000cps: shock, 30g.

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REED RELAYS

STANDARD SIZE REED RELAYS

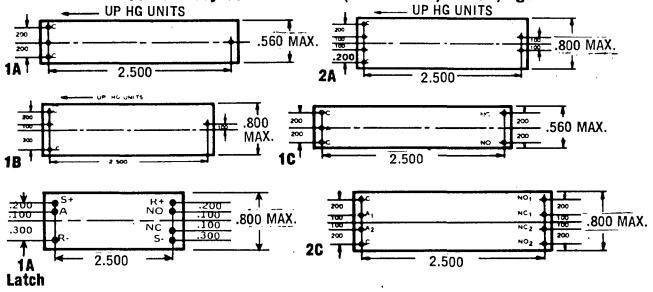
Molded — Series SM, HP*, Hg*
Open — Series SG, HPG*, HgG*

Form	Nominal Voltage	SM Series Part Number	Molded DCR Ohms ±10%	SG Series Part Number	Open DCR Ohms ±10%
1A	6	6SM1A	180	6SG1A	180
	12	12SM1A	725	12SG1A	720
	24	24SM1A	2900	24SG1A	2880
2A	6	6SM2A	175	6SG2A	110
	12	12SM2A	700	12SG2A	440
	24	24SM2A	2750	24SG2A	1760
1B	6	6SM1B	175	6SG1B	110
	12	12SM1B	700	12SG1B	440
	24	24SM1B	2750	24SG1B	1760
2B	6	6SM2B	140		
	12	12SM2B	550		
	24	24SM2B	2200		
1C	6	6SM1C	180	6SG1C	180
	12	12SM1C	725	12SG1C	720
	24	24SM1C	2900	24SG1C	2880
2C	6	6SM2C	175	6SG2C	110
	12	12SM2C	700	12SG2C	440
	24	24SM2C	2750	24SG2C	1760
1A Latch	6	6SML1A	85/85	6SGL1A	85/85
	12	12SML1A	340/340	12SGL1A	340/340
	24	24SML1A	1350/1350	24SGL1A	1350/1350

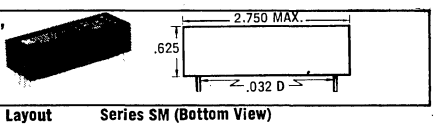
*For part numbers and DCR values contact factory. See specification table for contact ratings.

Standard Open, SG, HPG*, HgG*

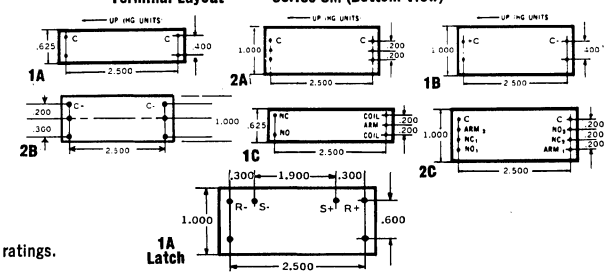
Terminal Layout — **Series SG (Bottom View) — HPG, HgG**



Standard Molded, SM, HP*, HG

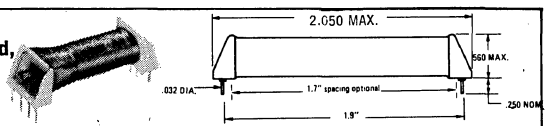


Terminal Layout — **Series SM (Bottom View)**



COMPACT OPEN REED RELAYS

CG Dry Reed, HPCG*, High Power



Form	Nom. Volt.	Part Number	DCR Ohms ±10%	Part Number	DCR Ohms ±10%	Terminal Layout (Bottom View)
1A	6	6CG1A	165	6HPCG1A	105	
	12	12CG1A	660	12HPCG1A	420	
	24	24CG1A	2640	24HPCG1A	1680	
2A	6	6CG2A	100	6HPCG2A	65	
	12	12CG2A	400	12HPCG2A	260	
	24	24CG2A	1600	24HPCG2A	1040	
1B	6	6CG1B	100	6HPCG1B	65	
	12	12CG1B	400	12HPCG1B	260	
	24	24CG1B	1600	24HPCG1B	1040	
1C	6	6CG1C	165	6HPCG1C	105	
	12	12CG1C	660	12HPCG1C	420	
	24	24CG1C	2640	24HPCG1C	1680	
2C	6	6CG2C	100	6HPCG2C	65	
	12	12CG2C	400	12HPCG2C	260	
	24	24CG2C	1600	24HPCG2C	1040	
1A Latch	6	6CGL1A	60/60			
	12	12CGL1A	250/250			
	24	24CGL1A	1000/1000			

Common Specifications, All Series

OPERATING DATA
Must Operate — 70% Nominal
Must Release — 10% Nominal
Max. Voltage — Form A & C — 200% Nominal
Form B & Latch — 130% Nominal

ENVIRONMENTAL DATA
Temperature — 20°C to +65°C
Shock — 30g
Vibration — 35g to 2000 Hz

CONTACT RATINGS
Series SM, SG, CG (Standard)

Form	Max. Res. Load	Initial Contact Resistance
A & B	15W, 1.0A, 400VDC	.100Ω
C	10W, .5A, 200VDC	.150Ω

Series HG*, HgG* (Mercury Wet)

A & B	50W, 3.0A, 400VDC	.050Ω

Series HP*, HPG*, HPCG*

Form	Suffix	Max. Res. Load	Initial Contact Resistance
A & B	−25	25W, 1.0A, 1000VDC	.100Ω
A & B	−50	50W, 3.0A, 1000VDC	.200Ω
A & B	−100	110VA, 3.0A, 110VAC	—
C	—	20W. 1.5A, 500VDC	.200Ω

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KIDDE

REED RELAYS

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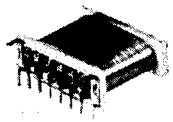
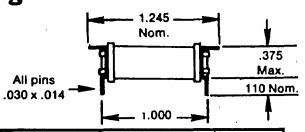
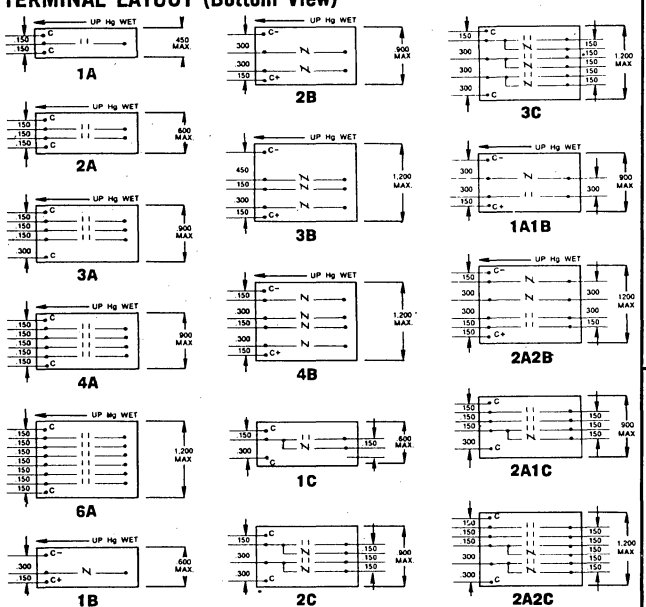
LOW PROFILE — LP, HgLP SERIES





Form	Nominal Voltage	Part Number	DCR Ohms ±10%	Form	Part Number	DCR Ohms ±10%
1A	6	6LP1A	240	4B	6LP4B	45
	12	12LP1A	950		12LP4B	180
	24	24LP1A	3800		24LP4B	700
2A	6	6LP2A	155	1C	6LP1C	155
	12	12LP2A	625		12LP1C	625
	24	24LP2A	2500		24LP1C	2500
3A	6	6LP3A	80	2C	6LP2C	80
	12	12LP3A	325		12LP2C	325
	24	24LP3A	1300		24LP2C	1300
4A	6	6LP4A	80	3C	6LP3C	45
	12	12LP4A	325		12LP3C	180
	24	24LP4A	1300		24LP3C	700
6A	6	6LP6A	45	1A1B	6LP1A1B	80
	12	12LP6A	180		12LP1A1B	325
	24	24LP6A	700		24LP1A1B	1300
1B	6	6LP1B	155	2A2B	6LP2A2B	45
	12	12LP1B	625		12LP2A2B	180
	24	24LP1B	2500		24LP2A2B	700
2B	6	6LP2B	80	2A1C	6LP2A1C	80
	12	12LP2B	325		12LP2A1C	325
	24	24LP2B	1300		24LP2A1C	1300
3B	6	6LP3B	45	2A2C	6LP2A2C	45
	12	12LP3B	180		12LP2A2C	180
	24	24LP3B	700		24LP2A2C	700

TERMINAL LAYOUT (Bottom View)

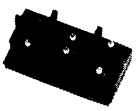


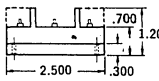
CONTACT DATA — Series LP, and Hg Versions

Contact Type	Contact Rating Form A	Form B	Form C
Dry	10W 12VA .5A 250VDC .15Ω*	10W 12VA .5A 250VDC .15Ω*	3W 4VA .25A 28VDC .2Ω*
Hg Wet	28W — 1A 1000VDC .05Ω*	28W — 1A 1000VDC .05Ω*	14W — .5A 1000VDC .05Ω*
All Position Hg Wet	3W 2.5VA .25A 1000VDC .05Ω*	— — — — —	— — — — —

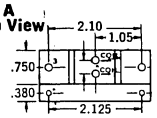
OPERATING DATA — Series LP, HgLP
Must Operate — 70% Nom. Must Release — 10% Nom.
Maximum Voltage — Form A & C — 200% Nominal
Form B — 130% Nominal

HIGH VOLTAGE RELAYS — HV SERIES

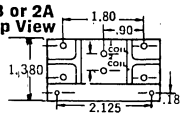




1A Top View



1B or 2A Top View



Form	Nom. Volt.	Part Number	DCR Ohms ±10%
1A (1B*)	6	6HV1A	25
	12	12HV1A	100
	24	24HV1A	400
2A	6	6HV2A	20
	12	12HV2A	80
	24	24HV2A	320

OPTION:
* Relays available in Form B up to 7,500V.

Note: To order, specify as follows: 6HV1A 35 is a 6HV1A relay with 3,500VDC switch.

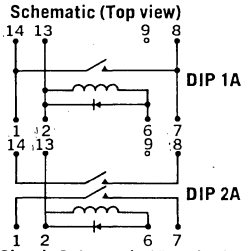
CONTACT DATA

Series	Maximum Resistive Rating			Breakdown Voltage (min.)	Initial Resistance
35	3,500VDC	3.0A	50W	5,000VDC	.100 Ohms
75	7,500VDC	3.0A	50W	10,000VDC	.100 Ohms
100	10,000VDC	3.0A	50W	12,500VDC	.100 Ohms

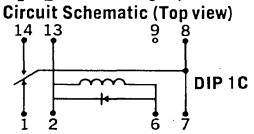
SERIES DIP RELAYS

Fit on standard DIP sockets.
Compatible with logic inputs.
Packaged for Automatic Insertion.

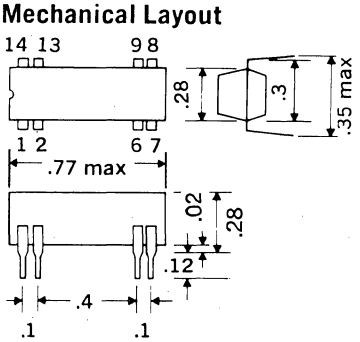
Schematic (Top view)



Circuit Schematic (Top view)



Mechanical Layout



SERIES DIP RELAYS

Contact Form	Nominal Voltage	DCR Ω±10%	*Part Number
1A	5 VDC	500	5 DIP 1A
	12 VDC	800	12 DIP 1A
	24 VDC	2000	24 DIP 1A
2A	5 VDC	140	5 DIP 2A
	12 VDC	400	12 DIP 2A
	24 VDC	1300	24 DIP 2A
1C	5 VDC	200	5 DIP 1C
	12 VDC	500	12 DIP 1C
	24 VDC	1500	24 DIP 1C

*Clamp Diode Available, add D to Part Number e.g. 5 DIP 1AD.

Contact Rating — 1A & 2A 10 VA @ .3A or 100 VDC
1C 3 VA @ .2A or 30 VDC
Initial Control Resistance — 1A & 2A .150Ω
1C .150Ω
Must Operate — 75% Nominal
Must Release — 10% Nominal

DOUGLAS RANDALL SOLID STATE COMPONENTS

Division of Kidde, Inc.
KIDDE
STOCKED FOR IMMEDIATE DELIVERY
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SOLID STATE RELAYS SERIES K
DC OUTPUT / DC CONTROL SIGNAL

NEW Output to 250 VDC

Douglas Randall Series K are SPST (NO) or (NC) relays which will switch loads of 4, 8 or 12 Amps to 250 VDC. They provide rapid switching and opto-isolation between input and output. The sensitive inputs are compatible with DTL or TTL logic. Arc-free switching makes these relays suitable for hazardous atmospheres.

MODEL NUMBERS

Output Voltage	Current	Model
2-32VDC	4 Amp	K04A
	8 Amp	K08A
	12 Amp	K12A
2-55VDC	4 Amp	K04B
	8 Amp	K08B
	12 Amp	K12B
2-50VDC	6 Amp	K06D

*Inductive loads must be diode suppressed.
† Normally closed add — (NC) K04A-NC.

INPUT SIGNAL DATA

Range	3-32VDC
Must Operate	3VDC
Must Release	1VDC
Input Impedance	1000Ω Min.
Isolation	
Signal to Load	1500V
Signal to Base	1500V
Temperature	−30°C to +80°C

MECHANICAL ARRANGEMENT

See AC output relays on page 7

OUTPUT DATA

Continuous Current	4A, 8A, or 12A
DC Line Voltage	2-32VDC or 2-55VDC
Off State Leakage	2mA DC
Turn On Time	50 Micro Sec.
Turn Off Time	500 Micro Sec.
Voltage Drop @ Rate Current	1.5VDC Max.
Isolation Load to Base	1500V

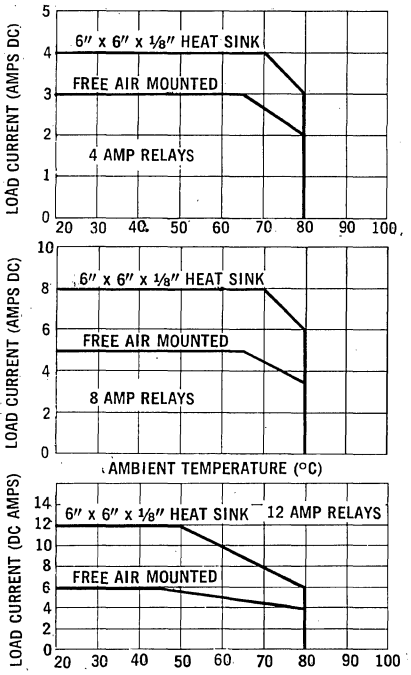
SIZE:
2¼L x 1¾W x 1⅛H Max.

WEIGHT:
4 Ounces Max.

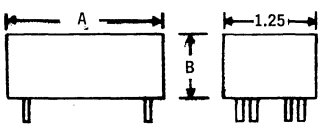
TERMINATION:
Standard Models —
Control Signal:
6-32 Screws
Output:
8-32 Screws

Special Models can be provided with lead wires or other types of termination in OEM quantities. Consult the factory & see pg.7 for mechanical details.

LOAD CURRENT VS TEMPERATURE



SOLID STATE RELAYS — SERIES CV
PC MOUNTED —



INPUT DATA			OUTPUT DATA	
	CV1	CV2		CV1 & CV2
Nominal Voltage	5.5VDC	28VDC	Current	3A RMS
Voltage Range	4-10VDC	10-32VDC	Surge Current	80A Peak
Must Operate	4VDC	10VDC	Minimum Current	50mA
Must Release	.4VDC	.4VDC	Off State Leakage	8mA
Impedance	1000Ω	4000Ω	Voltage	24 to 240VAC
Isolation (Input to Output)	1500V	1500V		@ 47 to 63 Hz
Capacitance	15pF	15pF	Voltage Drop	2.0VAC
			Offstate dv/dt	100V/μsec.
			Turn On Time	8.3msec.
			Turn Off Time	16 msec.

INPUT DATA			OUTPUT DATA	
	CV3	CV6		CV3 & CV6
Nominal Voltage	5.5VDC	28VDC	Maximum Current	3A DC
Voltage Range	4-10VDC	10-32VDC	Voltage Range	4-55VDC
Must Operate	4VDC	10VDC	Voltage Drop	1.6VDC
Must Release	.4VDC	.4VDC	Off State Leakage	10mA DC
Impedance	1000Ω	4000Ω	Turn On Time	500μsec.
			Turn Off Time	1.5msec.

INPUT DATA			OUTPUT DATA	
	CV4	CV5		CV4 & CV5
Voltage Range	10-55VDC	90-130VAC	Voltage	30VDC
Current	10mA	10mA	Current	16mA Max.
Must Not Operate	3mADC	.8mA RMS	Leakage	100μA
Isolation	1500V	1500V	Voltage Drop	.4VDC
Capacitance	10pF	10pF	Logic Supply Volt.	4-5-6VDC
Impedance	—	40KΩ	Logic Supply Cur.	10mA @ 6VDC

MODELS CV-1 & CV-2

3 Amp output @ 120/240 VAC
Zero crossover, Opto-isolation
Dim. A — 2.00" Max, B — .650" Max.

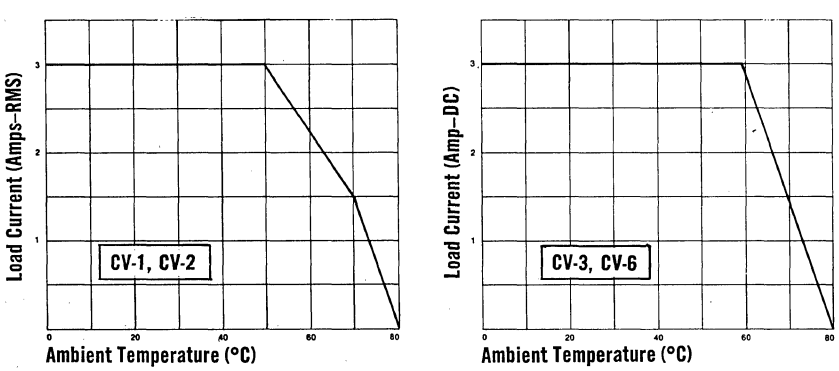
MODELS CV-3 & CV-6

3 Amp output @ 4 to 55 Volts DC
Opto-isolation
Dim. A — 2.00", B — .75"

MODELS CV-4 & CV-5

Convert 10-55 VDC (CV-4)
Convert 90-130 VAC (CV-5)
to Logic Level outputs
Opto-isolation
Dim. A — 1.25", B — .50"

LOAD CURRENT VS TEMPERATURE



AC Output CV-1 & CV-2 U/L Recognized, File E60556, C.C.NMFT2
CSA Certified File LR34149

DOUGLAS RANDALL SOLID STATE COMPONENTS

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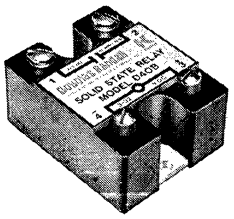
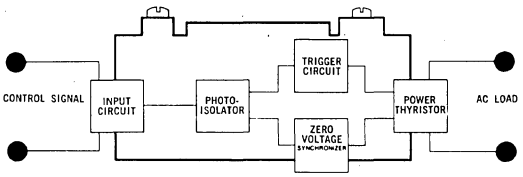
SOLID STATE RELAYS RATINGS TO 40 AMPS

AC OUTPUT / DC OR AC CONTROL UL RECOGNIZED / FILE NO. E60556 / C.C. NMFT2 CSA CERTIFIED FILE LR34149





Douglas Randall's line of solid state AC output relays are UL recognized for resistive, lamp and motor loads. Featuring opto-isolation and zero-voltage switching models are available to handle up to 40 Amp. DC or AC control signals can be specified and Form A or B output.

INPUT SIGNAL DATA (AC OR DC)

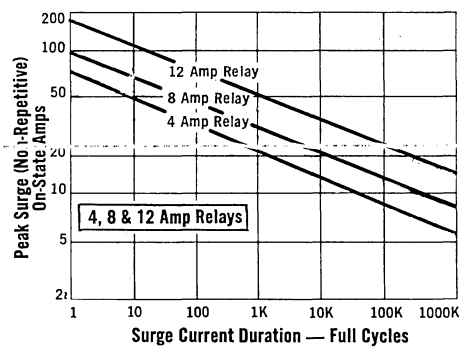
	DC	AC
Range	3-32V[5]	90-240VAC (80-140VDC)
Must Operate	3VDC	90VAC (80VDC)
Must Release	1VDC	10VAC (10VDC)
Input Impedance	1000Ω Min., 40KΩ Min.	
Isolation		
Signal to Load	1500V, 10^{10}Ω DC	
Signal to Base	1500V, 10^{10}Ω DC	
Capacitance	15 pF Signal to Load	
Temperature Range	−30°C to +80°C	

MODEL NUMBERS (NOTE 4)

Output Rating	Current	DC Signal	AC Signal
90-140VAC	4A	D04A	A04A
	8A	D08A	A08A
	12A	D12A	A12A
	25A	D25A	A25A
	40A	D40A	A40A
200-280VAC	4A	D04B	A04B
	8A	D08B	A08B
	12A	D12B	A12B
	25A	D25B	A25B
	40A	D40B	A40B
400-480VAC*	12A	D12D	A12D

* Not U/L Recognized Not CSA Certified
No Internal Snubber

SURGE CURRENT VS TIME



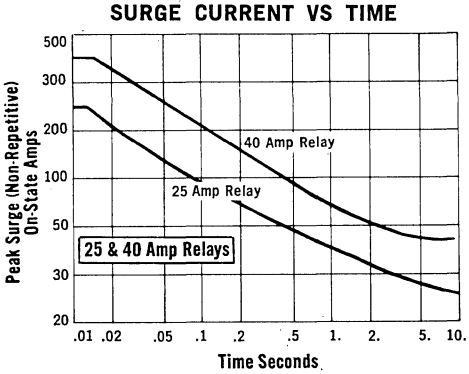
OUTPUT DATA (AC OUTPUT)

Maximum Current	4A	8A	12A	25A	40A
One Cycle Surge Current	75A	100A	150A	250A	400A
Overload (1 sec., RMS)	20A	30A	50A	40A	75A
Minimum Holding Current	50mA Typ.	50mA Typ.	50mA Typ.	50mA Typ.	50mA Typ.

AC Line Voltage: 90/140V or 200/280V[1] @ 47-63 Hz[2]
Voltage Drop @ Rated Current: 1.6V Max.
Typical Turn-on Voltage: 5V
Response Time (DC Signal): ½ Cycle Max.
dv/dt[6] Off State: 100V/μsec.
Commutating: 5V/μsec.

Off State Leakage Current:
90/140VAC — 4.5mA Typ.
200/280VAC — 5.5mA Typ.
400/480VAC — 1.5mA Typ.
Isolation Output to Base: 1500V, 10^{10}Ω DC[3]
Contact Form: SPST (NO)[4]

SURGE CURRENT VS TIME



NOTES AND OPTIONS

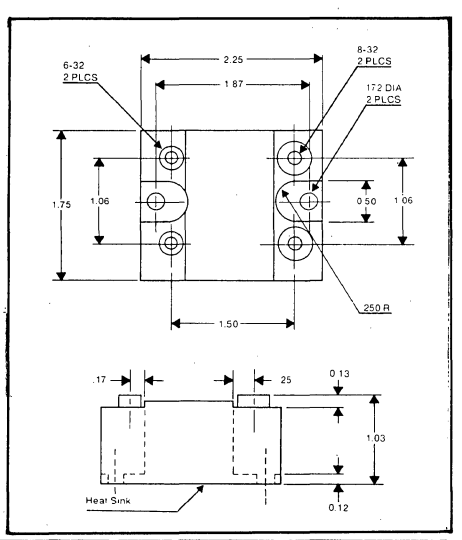
1. Special wide range models can be made which will switch loads from 18V to 140V. These relays can handle either 24VAC or 120VAC loads.
2. 2500VAC isolation between input and output.
3. Form A (SPST-NO) relays are standard. Form B (SPST-NC) switching is optional. Models incorporating this feature are designated by NC. e.g. A40B-NC.
4. All DC models are TTL compatible over the full operating temperature range.
5. All relays except 480VAC Models incorporate an RC snubber network which prevents false operation from transients up to the dv/dt level shown. More severe transients may require additional external protection. We will review your application and recommend the additional protection needed.

MECHANICAL SPECIFICATIONS

Size: 2¼"L x 1¾"W x 1⅛" maximum.

Weight: 4 ounces maximum.

Termination: Standard Models — Control Signal: 6-32 screws. Output: 8-32 screws.
Special Models can be provided with lead wires or other types of termination in OEM quantities. Consult the factory for details.



SPECIAL DESIGNS

Douglas Randall has designed many special solid state relays, such as a polarized, latching, SPDT unit which will switch 12A at 28VDC. We also have the capability of making special package sizes and terminal arrangements for our solid state relays at moderate tool cost. Your inquiries will be reviewed promptly.

DOUGLAS RANDALL SOLID STATE COMPONENTS

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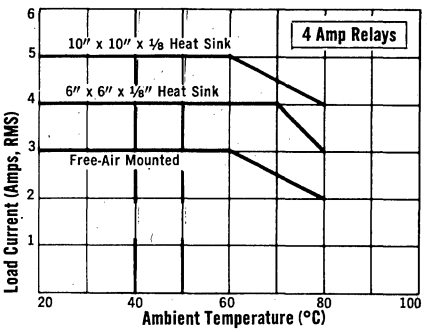
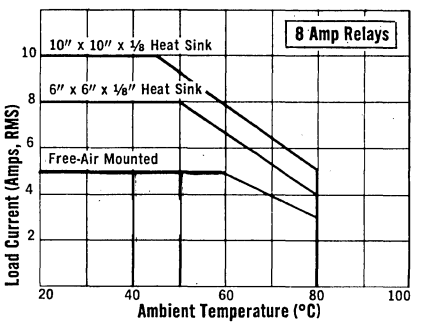
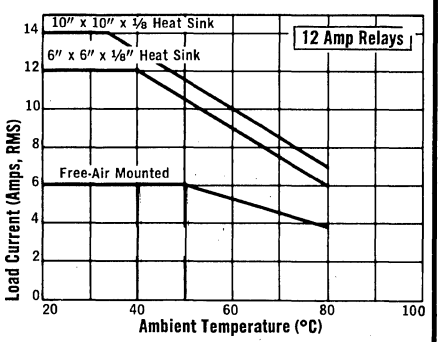
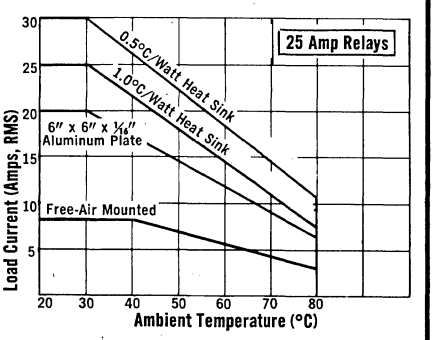
AC OUTPUT (Cont'd)

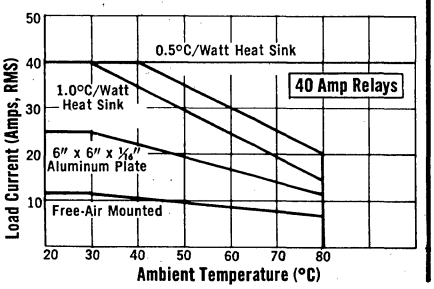
LOAD CURRENT VS TEMPERATURE











PROPORTIONAL CONTROLS

40 AMP @ 480 VDC

Douglas Randall Proportional Control vary loads up to 40 Amp @ 480 VAC from 0 to 99%.

SERIES R — RESISTOR CONTROLS

These controls operate by connecting a variable resistor to the input terminals. See Figs. 1 & 2.

Mechanical Specifications on page 7

INPUT*

Variable Resistor (150,000Ω, 1 watt) — For 120VAC
Variable Resistor (1 Megohm, ½ watt) — For 240VAC, 277VAC or 480VAC

Output Voltage		CURRENT 5A	10A	15A	25A	40A
90-130 VAC	Models	R05A	R10A	R15A	R25A	R40A
200-240 VAC	Models	R05B	R10B	R15B	R25B	R40B
400-480 VAC	Models*	R05D	R10D	R15D	R25D	R40D

OUTPUT DATA

Maximum Current	5A	10A	15A	25A	40A
One Cycle Surge Current	75A	100A	150A	225A	400A
Overload (1 Sec., RMS)	20A	30A	50A	70A	150A
Minimum Holding Current	.05A	.05A	.07A	.08A	.09A
AC Line: 90/130 VAC, 200/240 VAC, 250/300 VAC or 400/480 VAC					
Typical Leakage: 90/130 VAC — 10 mA; 200-240 VAC — 7 mA; 250-300 VAC — 6 mA; 400-480 VAC — 3 mA*					

* Models R05D, R10D, R15D, R25D and R40D have no snubbers.

SERIES RD / LOGIC INPUT CONTROL

Series RD provide full control from 0% to 99% when energized by 0-10 VDC or 0-15m ADC signals.

MODEL RD04A AND MODEL RD04B

INPUT SIGNAL	0-10 VDC or 0-15 ma DC[2]	
OUTPUT DATA	RD04A	RD04B
Maximum Current	4A	4A
One Cycle Surge Current	100A	100A
One Second Overload Current	40A	40A
Minimum Holding Current	.05A	.05A
AC Line Voltage	90-130 VAC @ 47-63 Hz	200-240 VAC
Off State Leakage	.01A (typical)	.01A (typical)
Response Time	150 m sec @ 10 VDC (typical)	300 m sec @ 10 VDC
Isolation (Input to Output)	500 VRMS	500 VRMS

Notes: 1. All data is measured at 25°C.
2. The input is not polarity sensitive, but **must be protected against voltages above 10 VDC.**

INPUT MODULES RDA, RDB & RDD

These modules accept 0-10 VDC signals. Their output is connected to the input terminals of Series R — Resistor Modules, which in turn controls loads up to 40 Amp @ 480 VAC. See Fig. 3.

NOMINAL PERCENTAGES OUTPUT VS INPUT RESISTANCE @ 25°C

Models R05 to R40A

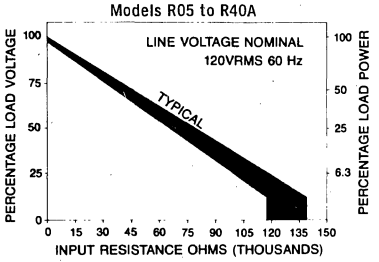


Fig. 1

Models R05 to R40B, R05 to R40D

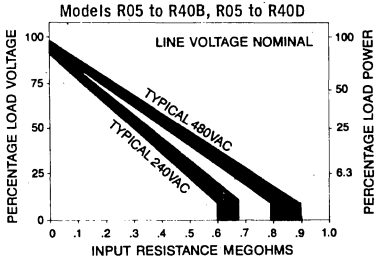


Fig. 2

PERCENT OUTPUT VOLTAGE VS INPUT VOLTAGE

Models RDA, RDB, RDD, RD04A, RD04B

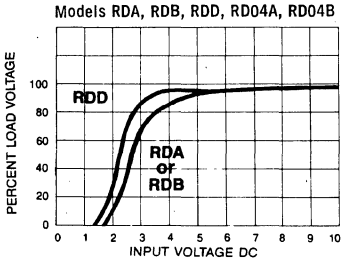


Fig. 3

DOUGLAS RANDALL SOLID STATE COMPONENTS

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Constant Current Controls combined with Series R Proportional Controls eliminate current fluctuations regardless of changes in AC voltages or changing load demands. They control loads up to 40 Amps @ 120 or 240 VAC and are available in five ranges listed in the Table.

These controls will maintain uniform current and light intensity for lamp loads as shown in Figures A and B, as well as for resistive loads as shown in Figure C. The Constant Current Controls will also maintain a constant speed in universal and other types of AC motors regardless of changing line voltage.

Constant Current Controls provide overload protection by limiting the current to a preset maximum. This makes them especially useful for keeping motor current at a safe level even under lock or stall rotor conditions (see Figure E).

The controls are encapsulated in small-sized packages for use in harsh environments.

Control Range*	Proportional Control 120 VAC	Proportional Control 240 VAC	Fixed Resistor @ Terminals1-2
2-4 Amp	R05A	R05B	None
4-8 Amp	R10A	R10B	6.65K ±1%
6-12 Amp	R15A	R15B	3.40K ±1%
10-20 Amp	R25A	R25B	1.74K ±1%
16-32 Amp	R40A	R40B	953 ±1%

* The lower end of the control range can be extended by additional loops of wire.

Fig A

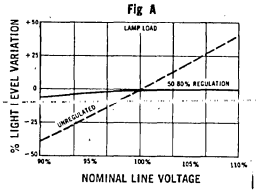


Fig B

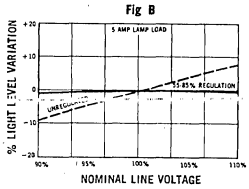


Fig C

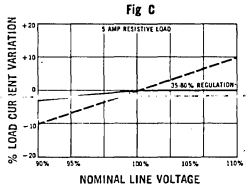


Fig D

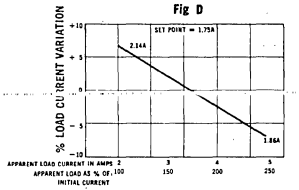
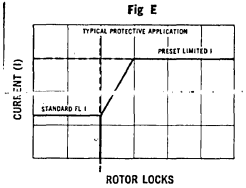


Fig E



TIME BASE PROPORTIONAL DRIVERS

Time based proportional drivers transform any conventional DC-input solid state relay into a proportional controller. The driven relay may be a DC or AC output type. External power is derived from the controlled source. If the driven relay is a zero cross-over device, zero cross-over characteristics are maintained to reduce EMI caused by switching transients. Applications for time base proportional drivers include proportional control of heaters, platers, DC motors, universal wound DC-operated motors and certain AC motors. They are compact, epoxy encapsulated in the standard hockey puck design to withstand harsh environments. Two hole mounting is provided.

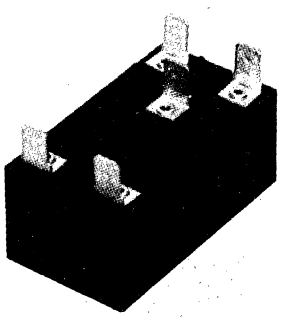
Shown at approximately 70 percent of full value is the load current and PDM control signal voltage of a typical time base proportional control of a zero cross-over relay, such as Douglas Randall D25B.

PDMA accepts external power from a 120 VAC controlled source, PDMB accepts power from a 240 VAC source and PDMD accepts power from a 10-32 VDC source.

Control Range*	Proportional Control 120 VAC	Proportional Control 240 VAC	Fixed Resistor @ Terminals1-2
2-4 Amp	R05A	R05B	None
4-8 Amp	R10A	R10B	6.65K ±1%
6-12 Amp	R15A	R15B	3.40K ±1%
10-20 Amp	R25A	R25B	1.74K ±1%
16-32 Amp	R40A	R40B	953 ±1%

* The lower end of the control range can be extended by additional loops of wire.

PROPORTIONAL CONTROL TRIAC DRIVERS



Douglas Randall Proportional Control Triac Drivers control the firing angle of separate Triacs. They vary output voltages from 0 to 95% to AC loads up to 300 Amps @ 120, 240 or 480 VAC. Five models are available, two which accept 0-10 VDC inputs and three which operate from potentiometer inputs. They are compact epoxy encapsulated in phenolic cases to withstand harsh environments and designed to accept spade or solder termination. Two hole mounting is provided.

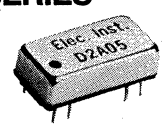
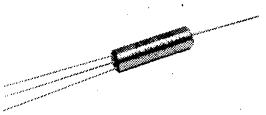
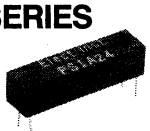
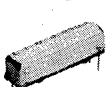
Models DPDA and DPDB accept DC inputs, and when connected to a Triac, will **increase the percentage load voltage as the DC input voltage is increased.** They provide 500 mAmps @ 6 V peak to the Triac's gate. Input to output isolation is 500 VRMS.

Models RPDA, RPDB and RPDD accept potentiometer inputs and when connected to a Triac, will **reduce the percentage load voltage as the potentiometer resistance is increased.** They provide 500 mAmps @ 6 V peak to the Triac's gate. There is no isolation between input and output.

Model	Input	Output
DPDA	0-10 VDC*	120 VAC
DPDB	0-10 VDC*	240 VAC
RPDA	Potentiometer 1W, 150 KΩ	120 VAC
RPDB	Potentiometer ½W, 1 MegΩ	240 VAC
RPDD	Potentiometer ½W, 1 MegΩ	480 VAC

* The input is not polarity sensitive but must be limited to 10 VDC.

Miniature Reed Relays

PRODUCT TYPES	STANDARD CONTACT FORMS	PACKAGE DESCRIPTION	FEATURES & OPTIONS
DL SERIES	**DRY REED** SPST (1A) SPST-NC (1B) SPDT (1C) DPST (2A) **&** **MERCURY WET DESIGNS** SPST (1A) SPDT (1C)	MOLDED DIP IC Compatible	• Electrostatic Shield • Diode • High Voltage Breakdown
D SERIES 		ENCAPSULATED DIP Magnetically Shielded	• Electrostatic Shield • Diode • Low Thermal EMF • DPDT (2C) Switching
MS SERIES		ENCAPSULATED IN-LINE Immersion Cleanable	• Multiple Switch Arrangement • Low Thermal EMF • High IR to 10^{13} • High Voltage Switching • EMI/RFI Shielding
BV SERIES		OPEN FRAME IN-LINE Low Cost	• Multiple Switch Arrangement • High Voltage Switching • Electrostatic Shielding
AL SERIES	**DRY REED** SPST (1A) SPDT (1C)	MOLDED AXIAL Low Cost	• High Voltage Switching • Lead Forming • 50 Watt Switching (Mercury Switch)
2000 SERIES 	**DRY REED** SPST-NO (1A) SPDT (1C) **MERCURY** SPST (1A)	ENCAPSULATED AXIAL Micro-Miniature Magnetically Shielded	• Electrostatic Shielding • Fast Operation
PS SERIES 	**DRY REED** SPST (1A) DPST (2A)	MOLDED PICO (0.1 × 0.7 Grid)	• Ideal For Low Power High Density Switching
PM SERIES 	**DRY REED** SPST (1A)	ENCAPSULATED PICO (0.1 × 0.7 Grid) Magnetically Shielded	• Electrostatic Shielding • Epoxy Coated Metal Cover to Minimize EMI

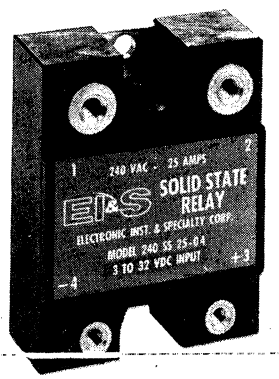
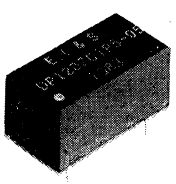
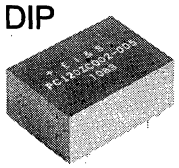
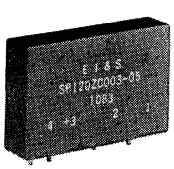
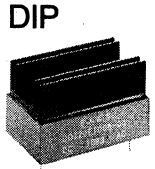
CUSTOM	SPECIALTY DESIGNS TO MEET YOUR APPLICATION.

Catalog Specifications: INPUTS: 5 V, 12 V, 24 V; OUTPUTS: 10 W, 0.5 A, 200 V dc (Form A); 3 W, 0.5 A, 28 V (Form C). Higher Ratings Available. Contact Factory For Complete Specifications.

EI&S . . . Where Innovation Sets Design Standards.

Electronic Instrument & Specialty Corp., 42 Pleasant Street, Stoneham, MA 02180 (617) 438-5300

EI&S AC Solid State Relays

PRODUCT TYPE	DESCRIPTION	FEATURES & OPTIONS
CHASSIS MOUNT		
 UL Recognized CSA Pending	**EI SERIES**—Optically Isolated Zero-Voltage Turn-On. INPUT: 3-32 V dc OUTPUT: 6,10,25 A @ 120/240 V rms	• Resistive & Moderate Inductive Load Switching. • Superior Thermal Management For Long Life.
	SS SERIES—SURGLESS™ 90° Phase Angle Turn-On INPUT: 3-32 V dc, Optically Isolated OUTPUT: 6,10,25 A @ 120/240 V rms	• Provides Soft Closure of High & Moderately Inductive Loads for Long Life.
	400 HP SERIES—35 - 550 Hz Zero-Voltage Turn-On INPUT: 3-32 V dc, Optically Isolated OUTPUT: 6,10,20 A @ 120/240 V rms	• Dual SCR, 400 Hz Designed for Military & Avionics Applications.
PRINTED CIRCUIT MOUNT	**OPTICALLY ISOLATED—ZERO-VOLTAGE TURN-ON**	
DIP 	**DP SERIES** INPUT: 5 V, 12 V, 24 V dc OUTPUT: 1.5 A @ 120/240 V rms	• Standard 16 pin PC Layout. • Optional Internal Snubber. • Discrete Design for Operation Over Full Temperature Range.
Double DIP 	**PC SERIES** Standard 0.600 Pin Spacing With Input Pins Offset. INPUT: 5 V, 12 V, 24 V dc OUTPUT: 2.0 A @ 120/240 V rms	• Optional Internal Snubber • 24 Pin DIP PC Layout
SIP 	**SP SERIES** Standard SIP and I/O Pin Spacing INPUT: 5 V, 12 V, 24 V dc OUTPUT: 3.0 A @ 120/240 V rms	• Internal Snubber Standard
Double DIP 	**DD SERIES** Standard 0.600 Pin Spacing With Output Pins Offset. INPUT: 4–15 V dc, 9–28 V dc OUTPUT: 1.5 A, 3.0 A, 5.0 A @ 120/240 V rms	• EI Zero-Voltage Turn-On. • SS (SURGLESS) 90° Phase Angle Turn-On for Inductive Loads. • FB Form B Zero-Voltage Turn-On.
CUSTOM	**SPECIALTY DESIGNS TO MEET YOUR APPLICATION.**	

EI&S . . . Where Innovation Sets Design Standards.
Electronic Instrument & Specialty Corp., 42 Pleasant Street, Stoneham, MA 02180 (617) 438-5300

ELECTRONIC SPECIALTY DIVISION
DATRON SYSTEMS INC. / 18900 N.E. Sandy Blvd. / Portland, Oregon 97230 / (Area Code 503) 665-0121 / TWX 910-469-8782

The Nation's Most Advanced Facility for the Development, Production and Testing of Relays

With over 25 years of relay experience our product line now consists of more than 20 standard relays. Within the 67,000 square feet of manufacturing space we service the switching needs for major military and industrial accounts. Quality Control is not an accident here. We believe in and practice total control of all factors which could affect the end quality of our product. Continual emphasis is placed on utilizing state-of-the-art in new designs. We encourage all of our customers to visit our facility and view the operation first hand.

STANDARD HERMETIC SEALED RELAY SPECIFICATION

	General Information	Contact Form	Contact Rating	Size	Sensitivity	Shock	Vibration	Coil Voltage	Coil Resistance ± 10%	Max. Pick Up/ Latch Voltage/ Current @ +25°C	Min. Drop Out Voltage/ Current @ +25°C	Operate Time Max.	Release Time Max.
40	Especially designed for low power input, as low as 15 mw, with dry circuit to 5 amps switching capability.	1PDT or 2PDT	Dry Circuit to 5 Amp 28 VDC Resistive	.970 x .970 x 1.781	20 mw 1PDT 40 mw 2PDT	50 G's 11±1.0 ms	10 G's 40 to 500 Hz	6.0 VDC 12.0 VDC 26.5 VDC	200 Ohms 1000 Ohms 5000 Ohms	14 MADC 6.3 MADC 2.8 MADC	5 MADC 2.3 MADC 1.0 MADC	35.0 ms	15.0 ms
50	Qualified to M5757/9 and M39016/6.	2PDT	D/C to 2A 28 VDC Resistive	.4 x .41 x .800	250 mw Pick Up	100 G's 10 ms ±2.0 ms	30 G's 56 to 3000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	40 Ohms 150 Ohms 700 Ohms	3.0 VDC 6.0 VDC 13.0 VDC	0.6 VDC 1.2 VDC 2.3 VDC	4.0 ms	4.0 ms
55N	½ size sensitive latching relay qualified to MIL-R-39016/46 and /47, all dash numbers.	2PDT	D/C to 2A 28 VDC Resistive	.4 x .41 x .800	90 mw Latch/Reset	100 G's 10 ms ±2.0 ms	30 G's 56 to 3000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	100 Ohms 500 Ohms 1800 Ohms	3.0 VDC 6.7 VDC 12.7 VDC	N/A	5 ms	N/A
68N	Crystal can "Lazy S" header.	2PDT	D/C to 2A 28 VDC Resistive	.359 x .797 x .875	300 mw Pick Up	20 G's 10 ±2 Amps	30 G's 56 to 3000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	35 Ohms 140 Ohms 552 Ohms	3.2 VDC 6.5 VDC 13.0 VDC	0.5 VDC 1.1 VDC 2.3 VDC	5 ms	5 ms
71N	Sensitive crystal can relay.	2PDT	D/C to 2A 28 VDC Resistive	.4 x .8 x 1.280	40 mw Pick Up	50 G's 10 ±2 ms	10 G's 10 to 500 Hz	6.0 VDC 12.0 VDC 26.5 VDC	200 Ohms 1000 Ohms 5000 Ohms	14.2 MADC 6.3 MADC 2.8 MADC	1.42 MADC 0.63 MADC 0.28 MADC	15 ms	10 ms
77R	Crystal can. Sensitive latching relay.	2PDT	Dry Circuit to 3 Amps 28 VDC Resistive	.4 x .8 x .875	90 mw Latch/Reset	50 G's 11 ±1 ms	50 G's 56-2000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	100 Ohms 500 Ohms 1800 Ohms	3.0 VDC 6.7 VDC 12.7 VDC	N/A	5 ms	5 ms

Note: Contact factory for specific mounting or header style.

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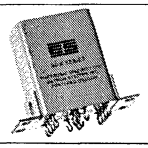
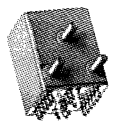
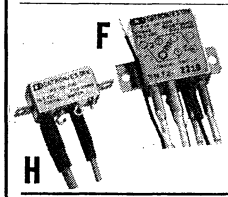
STANDARD HERMETIC SEALED RELAY SPECIFICATION

		General Information	Contact Form	Contact Rating	Size	Sensitivity	Shock	Vibration	Coil Voltage	Coil Resistance ± 10%	Max. Pick Up/ Latch Voltage/ Current @ +25°C	Min. Drop Out Voltage/ Current @ +25°C	Operate Time Max.	Release Time Max.
79N		Crystal can. Non-latching relay.	2PDT	Dry Circuit to 3 Amps 28 VDC Resistive	.4 x .8 x .875	250 mw Pick Up	100 G's 11 ±2 ms	20 G's 56-2000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	35 Ohms 140 Ohms 600 Ohms	3.0 VDC 5.9 VDC 12.5 VDC	0.3 VDC 0.6 VDC 1.5 VDC	5 ms	5 ms
80N		Sensitive — double seal construction. Coils are in hermetically sealed compartments, separate from contact chamber.	2PDT	Dry Circuit to 3 Amps 28 VDC Resistive	.41 x .915 x 1.281	40 mw Pick Up	50 G's 11 ±1 ms	20 G's 56-2000 Hz	6.0 VDC 12.0 VDC 26.5 VDC	200 Ohms 1000 Ohms 5000 Ohms	14.2 MADC 6.3 MADC 2.8 MADC	1.42 MADC 0.63 MADC 0.28 MADC	15 ms	10 ms
90N **92N**		90N Series — Non-latching. 92N Series — Latching.	4PDT	Dry Circuit to3 Amps 28 VDC Resistive	.602 x 1.032 x 1.278	80 mw Pick Up 80 mw Latch/Reset	50 G's 11 ±1 ms 50 G's 11 ±1 ms	20 G's 56-2000 Hz 20 G's 56-2000 Hz	12.0 VDC 26.5 VDC 12.0 VDC 26.5 VDC	500 Ohms 2000 Ohms 500 Ohms 2000 Ohms	12.6 MADC 6.3 MADC 6.3 VDC 12.6 VDC	1.26 MADC 0.63 MADC N/A	20 ms 9 ms	5 ms N/A
93 **94**		93 Series — Non-latching. 94 Series — Latching.	2PDT	10 Amps 28 VDC Resistive	.515 x 1.032 x 1.300	500 mw Pick Up 150 mw Latch/Reset	50 G's 11 ±1 ms 50 G's 11 ±1 ms	20 G's 56-2000 Hz 20 G's 56-2000 Hz	12.0 VDC 26.5 VDC 12.0 VDC 26.5 VDC	65 Ohms 300 Ohms 240 Ohms 1000 Ohms	5.8 VDC 12.5 VDC 6.0 VDC 12.3 VDC	1.1 VDC 2.3 VDC N/A	7 ms 10 ms	3 ms N/A
100N **102N**		100N Series — Non-latching. 102N Series — Latching.	6PDT	Dry Circuit to 3 Amps 28 VDC Resistive	.852 x 1.032 x 1.278	150 mw Pick Up 150 mw Latch/Reset	50 G's 11 ±1 ms 50 G's 11 ±1 ms	20 G's 56-2000 Hz 20 G's 56-2000 Hz	12.0 VDC 26.5 VDC 12.0 VDC 26.5 VDC	200 Ohms 1000 Ohms 250 Ohms 1000 Ohms	27.4 MADC 12.2 MADC 6.1 VDC 12.3 VDC	2.74 MADC 1.22 MADC N/A	18 ms 8 ms	5 ms N/A
103 **104***		103 Series — Non-latching. 104 Series — Latching.	4PDT	10 Amps 28 VDC Resistive	.852 x 1.032 x 1.3	1000 mw Pick Up 300 mw Latch/Reset	50 G's 11 ±1 ms 50 G's 11 ±1 ms	20 G's 56-2000 Hz 20 G's 56-2000 Hz	12.0 VDC 26.5 VDC 12.0 VDC 26.5 VDC	32 Ohms 150 Ohms 125 Ohms 500 Ohms	5.8 VDC 12.5 VDC 6.1 VDC 12.3 VDC	1.1 VDC 2.3 VDC N/A	8 ms 9 ms	5 ms N/A
F **H**		Miniature coaxial relays with 8" min. RG178 B/U cables attached. Welded sealing.	1PDT RF Plus Auxiliary 1PDT or 2PDT RF	RF to 1.5 Amps 50 Watt Max.	Frequency Range to 500 MHz VSWR — 1:1.1 Typical. Characteristic Impedance — 50 Ohm Typical. Cross Talk — 50 dB Typical.				12.0 VDC 26.5 VDC 12.0 VDC 26.5 VDC	140 Ohms 600 Ohms 150 Ohms 700 Ohms	5.9 VDC 12.5 VDC 6.0 VDC 13.0 VDC	1.0 VDC 2.3 VDC 1.2 VDC 2.3 VDC	5 ms 5 ms	5 ms 5 ms

Note: Contact factory for specific mounting or header style.

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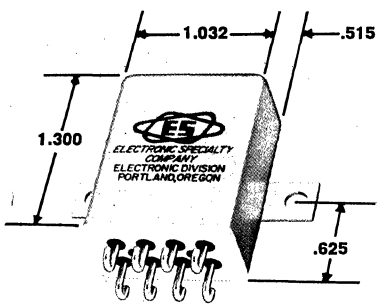
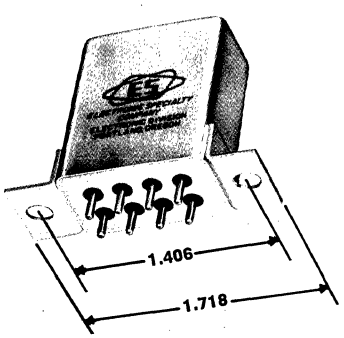
(Area Code 503) 665-0121 / TWX 910-469-8782

93 SERIES ARC-BARRIER 2PDT

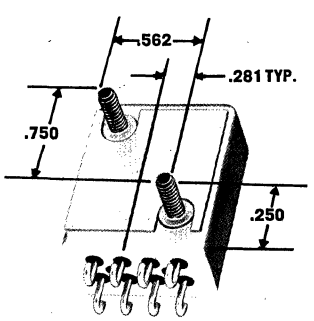
- 500 MW PICKUP
- 10 AMPERE DC LOADS
- 5 AMPERE AC LOADS
- CASE GROUNDED



93GB183



93GB1813
93GB1861



93GB184
93GB1810

MICRO-MINIATURE HIGH CURRENT TYPE WITH INTERNAL ARC BARRIER FOR GROUNDED CASE APPLICATIONS

SPECIFICATIONS (METHODS PER MIL-R-5757)

Weight: 2.0 ounces maximum.

Terminal Finish: Electro-Tin, Type 1 per MIL-T-10727, followed by a Flow Process.

Terminal Strength (Pull): 5.0 ±0.5 pound in any direction.

Case Finish: Non Corrosive.

Sealing: Seal Test per MIL-R-5757 (10^{-6} SCCPS)*

DC Coil Resistance: ±10% rated value at +25°C.

Shock: Per MIL-R-5757, Level 4.
50 G's for 11.0±1.0 Millisecond.
No contact closures of open contacts.
10 Microseconds max. chatter of closed contacts.

Minimum Contact Life (Case Grounded): Tested at +125°C, with rated contact loads.
DC Resistive: 100,000 operations at 20 CPM.
DC Inductive: 100,000 operations at 10 CPM.
DC Lamp: 100,000 operations at 3 CPM.
AC Resistive: 50,000 operations at 20 CPM.

Contact Overload: Two times rated contact loads for 100 operations.

Vibration: Per MIL-R-5757, level 4 except 0.125 inch double amplitude, 10 to 56 Hz.
20 G's max. at 56 to 2,000 Hz.
No closures of open contacts.
10 microseconds max. chatter of closed contacts.

Centrifugal Acceleration: 50 G's: No closures of open contacts.
10 microseconds max. chatter of closed contacts.

Moisture Resistance: Per MIL-R-5757, (Coil to case polarized at 100VDC).

Dielectric Strength (Sea Level): 1000 VRMS between open contacts, 500 VRMS Post Life.
500 VRMS between coil and case.
1000 VRMS between all other combinations.

Dielectric Strength (1.3" Hg): 500 VRMS (Open contacts 350 VRMS)

Insulation Resistance: 1000 Megohms minimum at 500 VDC (Coil to case 500 Megohms at +125°C), 10 Megohms Post Life

Coil Overvoltage: Reference Max. rated operate voltage.

Maximum Coil Dissipation: 3.5 Watts maximum continuous at +125°C.

Standard Pickup Power: 500 Milliwatts at +25°C.

Contact Ratings (Max. Amperes Per Pole) Case Grounded*: Contacts monitored per dynamic contact res. limits.

Res: 28 VDC, Connected Form C: 10.0 Amperes.

Res: 115 VRMS 1ϕ, Connected Form A or B: 7.5 Amperes at 400 Hz.

Res: 115 VRMS 1ϕ, Connected Form C: 5.0 Amperes at 400 Hz.

Res: 240 VRMS 1ϕ, Connected Form C: 3.5 Amperes at 400 Hz.

Inductive: 20 Millihenries, 28 VDC: 5.0 Amperes (Load spikes suppressed below 10 VDC).

Lamp: 28 VDC: 1.5 Amperes (18.0 Amperes inrush for 15 MSEC.)

Static Contact Resistance High Level: 0.01 OHM maximum; 0.02 maximum after life (Measured at or above 100 milliamperes and 6 VDC).

Dynamic Contact Resistance High Level: 1.0 OHM max. at or above 500 MA & 28 VAC or VDC.

Contact Operate Time: 7.0 Milliseconds max.

Contact Operate Bounce Time: 2.0 MSEC. Max. (Contacts above ½ Ampere)

Contact Release Time: 3.0 MSEC. max. (Contacts below ½ Ampere)
5.0 Millisecond maximum.

Contact Release Bounce Time: 3.0 MSEC. max. (Contacts above ½ Ampere).
4.0 MSEC. Max. (Contacts below ½ Ampere).

Duty Cycle: Continuous.

Rated Miss Detection: 5,000 cycles at 5 Hz maximum.
Current: 0.5 Ampere.
Voltage: 28 VDC.
Miss Level: 2.0 OHMS max.

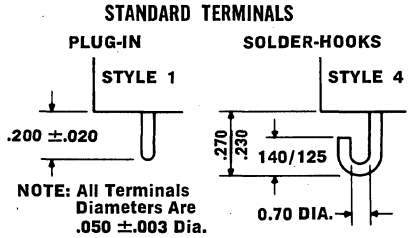
* Unless otherwise indicated, values apply throughout the ambient temperature range and with nominal voltage.

GROUNDED CASE APPLICATIONS MAY HAVE THE LOAD AND COIL SUPPLIES ELECTRICALLY CONNECTED TO CASE COMMON

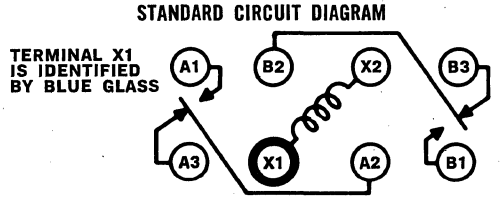
STANDARD ADJUSTMENT SCHEDULE

Coil Resistance DC Ohms +25°C	93 SERIES 2PDT ADJUSTMENT "X" 500 MW							
	RATED OPERATE VOLTAGE		MAXIMUM PICKUP VOLTAGE		MAXIMUM DROP-OUT VOLTAGE		MINIMUM DROP-OUT VOLTAGE	
	NOMINAL	MAXIMUM	+125°C	+25°C	+125°C	+25°C	+25°C	−65°C
16	6.0	7.2	4.35	3.0	2.17	1.5	0.6	0.4
65	12.0	14.4	8.35	5.8	4.17	2.9	1.1	0.7
300	26.5	32.0	18.0	12.5	9.0	6.2	2.3	1.5
950	48.0	57.6	37.0	22.0	18.5	11.0	4.0	2.6
5500	110.0	132.0	75.0	53.0	37.5	26.5	9.8	6.4

STANDARD TERMINALS



STANDARD CIRCUIT DIAGRAM



HOW TO ORDER

93G B 18 0 -1 -X -300 (*)

- 93G — SERIES TYPE (2PDT High Current)
- B — CLASS B TEMPERATURE (−65°C To +125°C)
- 18 — ARC BARRIER
- 0 — MOUNTING ARRANGEMENTS
  0 = Plain Shell
  3 = Side Bracket
  4 = 2 Side Studs ⅜" Lg.
  10 = 2 Side Studs ¼" Lg.
  13 = Flange Bottom Flush
  61 = Flange Up ¼"
- -1 — HEADER STYLE
- -X — ADJUSTMENT SCHEDULE
- -300 — COIL RESISTANCE
- (*) — SPECIAL REQUIREMENTS *Assigned Number

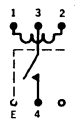
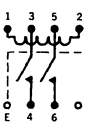
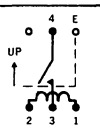
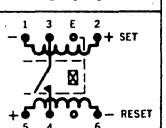
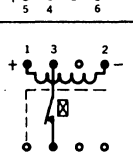
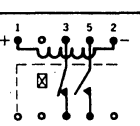
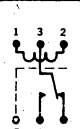
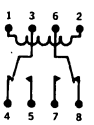
ELECTROL

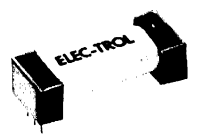
Ask for Catalog No. 200102 (was No. 121)

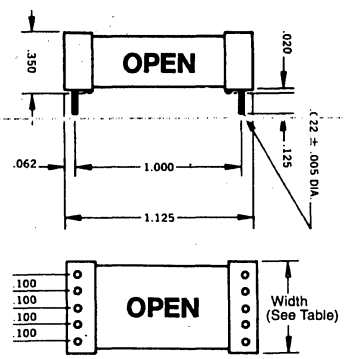
VARI-PACK REED RELAYS

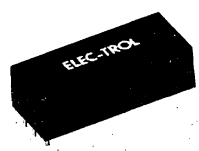
General Description:
Elec-Trol Vari-Pack Reed Relays are specially designed to meet high performance and quality standards at low cost. They are available in both open and sealed versions and with coil terminals at the same end or opposite ends of the relay. The sealed version is the open version placed within a polyester cover then encapsulated. Optional features include magnetic shielding, electrostatic shielding and contact run-in.

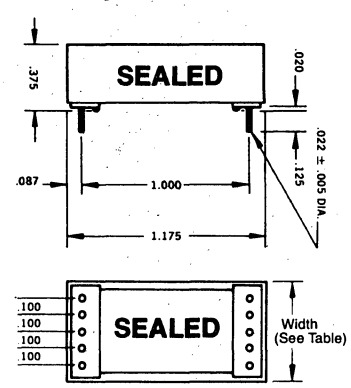
The relay body is made of durable molded polyester with the reed contacts and terminals securely held in place at each end of the relay with epoxy. These relays are available with contact forms 1A through 6A, 1A and 2A mercury wetted, 1A latching, 1B, 2B, 1A1B, 2A 2B, and 1C through 4C, also available with end to end coil termination. Consult factory for other coil or switch configurations.

CONTACT FORM	CONTACT RATING (Resistive)	PART NUMBER OPEN	PART NUMBER SEALED	COIL V.D.C.	COIL RES. (ohms) @ 20°C	WIDTH OPEN	WIDTH SEALED	CIRCUIT DIAGRAM (Top View of Relay)
1A*	10W .5A 200V	VPO1A05A10	VPS1A05A10	5	500	.36	.41	
		VPO1A06A10	VPS1A06A10	6	125			
		VPO1A12A10	VPS1A12A10	12	500			
		VPO1A24A10	VPS1A24A10	24	2000			
		VPO1A48A10	VPS1A48A10	48	8000			
2A*		VPO2A05A10	VPS2A05A10	5	200	.44	.49	
		VPO2A06A10	VPS2A06A10	6	110			
		VPO2A12A10	VPS2A12A10	12	440			
		VPO2A24A10	VPS2A24A10	24	1750			
		VPO2A48A10	VPS2A48A10	48	7000			
1A MERCURY WETTED	50W 1.0A 100V	VPO1M06A10	VPS1M06A10	6	75	.44	.49	
		VPO1M12A10	VPS1M12A10	12	300			
		VPO1M24A10	VPS1M24A10	24	1200			
		VPO1M48A10	VPS1M48A10	48	4800			
1AL* MAGNETIC LATCH	10W .5A 200V	VPO1L05A10	VPS1L05A10	5	500 ea.	.44	.49	
		VPO1L06A10	VPS1L06A10	6	300 ea.			
		VPO1L12A10	VPS1L12A10	12	1200 ea.			
		VPO1L24A10	VPS1L24A10	24	4800 ea.			
1B*		VPO1B05A10	VPS1B05A10	5	200	.44	.49	
		VPO1B06A10	VPS1B06A10	6	110			
		VPO1B12A10	VPS1B12A10	12	440			
		VPO1B24A10	VPS1B24A10	24	1750			
		VPO1B48A10	VPS1B48A10	48	7000			
1A1B*		VPO1F06A10	VPS1F06A10	6	110	.55	.60	
		VPO1F12A10	VPS1F12A10	12	440			
		VPO1F24A10	VPS1F24A10	24	1750			
		VPO1F48A10	VPS1F48A10	48	7000			
1C	3W .25A 28V	VPO1C05A10	VPS1C05A10	5	500	.44	.49	
		VPO1C06A10	VPS1C06A10	6	125			
		VPO1C12A10	VPS1C12A10	12	500			
		VPO1C24A10	VPS1C24A10	24	2000			
		VPO1C48A10	VPS1C48A10	48	8000			
2C		VPO2C05A10	VPS2C05A10	5	200	.55	.60	
		VPO2C06A10	VPS2C06A10	6	80			
		VPO2C12A10	VPS2C12A10	12	310			
		VPO2C24A10	VPS2C24A10	24	1250			
		VPO2C48A10	VPS2C48A10	48	5000			









To order available options, change last digit of part number from (0) to:
(1) Electromagnetic Shielding,
(2) Electrostatic Shielding
(3) EM & ES Shielding

* UL Recognized

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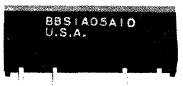
ELECTROL



BLUE BOY REED RELAYS

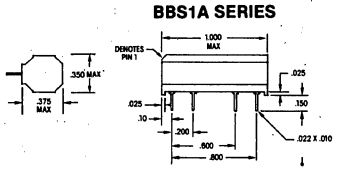
Ask for Catalog No. 200100

PART NUMBER	COIL V.D.C.	COIL RES. OHMS @20°C ±10%	MAX. OPERATE V.D.C. @20°C	MIN. RELEASE V.D.C. @20°C	NOMINAL TIMING MILLISECONDS		MAX. COIL V.D.C.	MINIMUM BREAKDOWN V.D.C.		MAXIMUM DC RESISTIVE CONTACT RATING			CIRCUIT DIAGRAM (TOP VIEW)
					OPERATE/ BOUNCE	RELEASE/ BOUNCE		OPEN CONTACTS	INSULATED TERMINALS	WATTS	AMPS	VOLTS	
BBS1A SERIES													
BBS1A05A10	5-6	500	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	1500	10	0.5	200	
BBS1A06A10	5-6	125	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	1500	10	0.5	200	
BBS1A12A10	12	500	8.0	1.0	0.4/0.3	0.1/ –	16.0	300	1500	10	0.5	200	
BBS1A24A10	24	2000	16.0	2.0	0.4/0.3	0.1/ –	32.0	300	1500	10	0.5	200	
BBS1A48A10	48	8000	32.0	4.0	0.4/0.3	0.1/ –	64.0	300	1500	10	0.5	200	
BBS1C SERIES													
BBS1C05A10	5-6	200	4.0	0.5	0.6/0.4	0.5/1.2	8.0	250	1500	3.0	0.25	28	
BBS1C06A10	5-6	125	4.0	0.5	0.6/0.4	0.5/1.2	8.0	250	1500	3.0	0.25	28	
BBS1C12A10	12	500	8.0	1.0	0.6/0.4	0.5/1.2	16.0	250	1500	3.0	0.25	28	
BBS1C24A10	24	2000	16.0	2.0	0.6/0.4	0.5/1.2	32.0	250	1500	3.0	0.25	28	
BBS1A (Electro-static Shield)													
BBS1A05B12	5-6	500	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	1500	10	0.5	200	
BBS1A06B12	5-6	125	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	1500	10	0.5	200	
BBS1A12B12	12	500	8.0	1.0	0.4/0.3	0.1/ –	16.0	300	1500	10	0.5	200	
BBS1A24B12	24	2000	16.0	2.0	0.4/0.3	0.1/ –	32.0	300	1500	10	0.5	200	
BBS1A48B12	48	8000	32.0	4.0	0.4/0.3	0.1/ –	64.0	300	1500	10	0.5	200	
BBF1A SERIES													
BBF1A05A10	5-6	500	3.8	0.5	0.4/0.3	0.1/ –	8.0	200	1500	10	0.5	100	
BBF1A06A10	5-6	125	3.8	0.5	0.4/0.3	0.1/ –	8.0	200	1500	10	0.5	100	
BBF1A12A10	12	500	8.0	1.0	0.4/0.3	0.1/ –	16.0	200	1500	10	0.5	100	
BBF1A24A10	24	2000	16.0	2.0	0.4/0.3	0.1/ –	32.0	200	1500	10	0.5	100	
BBM1A SERIES													
BBM1A06A10	5-6	125	3.8	0.5	0.4/0.3	0.1/ –	8.0	200	1500	3	0.1	28	
BBM1A12A10	12	500	8.0	1.0	0.4/0.3	0.1/ –	16.0	200	1500	3	0.1	28	
BBM1A24A10	24	2000	16.0	2.0	0.4/0.3	0.1/ –	32.0	200	1500	3	0.1	28	
BBW1A SERIES													
BBW1A05B30	5-6	400	3.8	0.5	0.7/0.3	0.3/ –	8.0	600	1500	50	1.0	200	
BBW1A06B30	5-6	100	3.8	0.5	0.7/0.3	0.3/ –	8.0	600	1500	50	1.0	200	
BBW1A12B30	12	400	8.0	1.0	0.7/0.3	0.3/ –	16.0	600	1500	50	1.0	200	
BBW1A24B30	24	1600	16.0	2.0	0.7/0.3	0.3/ –	32.0	600	1500	50	1.0	200	
BBW1A48B30	48	6400	32.0	4.0	0.7/0.3	0.3/ –	64.0	600	1500	50	1.0	200	
BBV1A SERIES*													
BBV1A05A10	5-6	500	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	5000	10	0.5	200	
BBV1A06A10	5-6	280	3.8	0.5	0.4/0.3	0.1/ –	8.0	300	5000	10	0.5	200	
BBV1A12A10	12	1120	8.0	1.0	0.4/0.3	0.1/ –	16.0	300	5000	10	0.5	200	
BBV1A24A10	24	4480	16.0	2.0	0.4/0.3	0.1/ –	32.0	300	5000	10	0.5	200	
BBV1A05A30	5-6	500	3.8	0.5	0.4/0.3	0.1/ –	8.0	500	5000	10	0.5	350	
BBV1A06A30	5-6	280	3.8	0.5	0.4/0.3	0.1/ –	8.0	500	5000	10	0.5	350	
BBV1A12A30	12	1120	8.0	1.0	0.4/0.3	0.1/ –	16.0	500	5000	10	0.5	350	
BBV1A24A30	24	4480	16.0	2.0	0.4/0.3	0.1/ –	32.0	500	5000	10	0.5	350	
*UL Recognized													

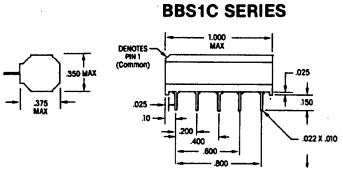
Random Vibration 10G, 20 to 2000 Hz
Maximum Shock 25G
Maximum Initial Contact Resistance 200 Milliohms except
BBW1A and BBV1AXXA30 SERIES of 500 Milliohms

Minimum Insulation Resistance $10^{10}\Omega$ except
BBS1C SERIES of $10^{9}\Omega$

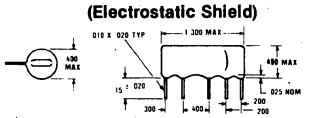
BBS1A SERIES



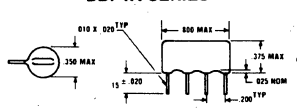
BBS1C SERIES



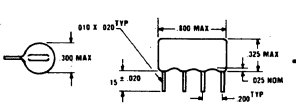
BBS1A (Electrostatic Shield)



BBF1A SERIES



BBM1A SERIES



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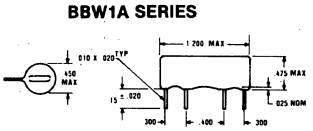
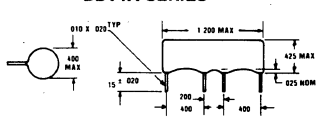


BBV1A SERIES



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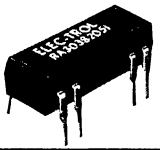
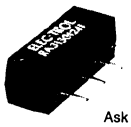
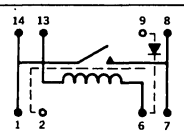
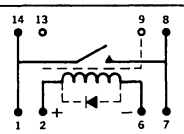
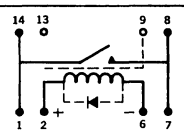
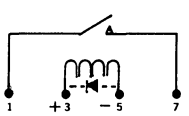
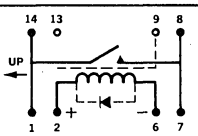
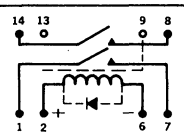
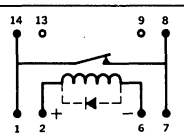
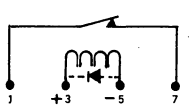
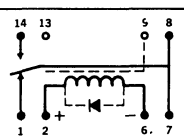


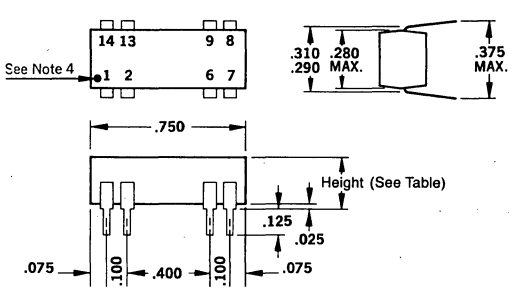
ELECTROL
DIP/SIP REED RELAYS

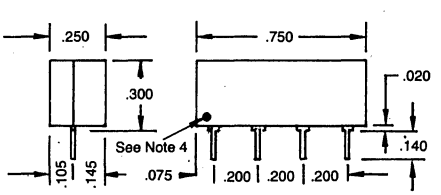


Ask for Catalog No. 200101
(was No. 103)

CONTACT FORM	CONTACT RATING MAX. LOAD (Resistive)	PART NUMBER NO DIODE	PART NUMBER WITH DIODE	COIL V.D.C.	COIL RES. (ohms) @ 20°C	MAX. PICK-UP V.D.C. @ 20°C	MIN. DROP-OUT V.D.C. @ 20°C	PHYSICAL HEIGHT	PHYSICAL NO. TERM.	E.S. OPTION *	CIRCUIT DIAGRAM (Top View of Relay)
1A SPST-NO	3W .11A 28V	RA30921051	RA31201051	5	500	3.8	1.0	.225″	8 Pin DIP	YES	
		RA30921061	RA31201061	6	500	4.0	1.0				
		RA30921121	RA31201121	12	500	8.0	2.0				
		RA30921241	RA31201241	24	1400	16.0	4.0				
		RA30381051	RA30391051	5	500	3.8	1.0	.225″	8 Pin DIP	YES	
		RA30381061	RA30391061	6	500	4.0	1.0				
		RA30381121	RA30391121	12	500	8.0	2.0				
		RA30381241	RA30391241	24	1400	16.0	4.0				
	10W .5A 100V	RA30451051	RA30461051	5	500	3.8	1.0	.275″	8 Pin DIP	YES	
		RA30451061	RA30461061	6	500	4.0	0.5				
		RA30451121	RA30461121	12	500	8.0	1.0				
		RA30451241	RA30461241	24	2150	16.0	2.0				
		RA31301051	RA31311051	5	500	3.8	1.0	.300″	4 Pin SIP	NO	
		RA31301061	RA31311061	6	500	4.0	0.5				
		RA31301121	RA31311121	12	500	8.0	1.0				
		RA31301241	RA31311241	24	2150	16.0	2.0				
1A Mercury Wetted	50W 1.0A 100V	RA31501051	RA31511051	5	55	3.8	0.5	.275″	8 Pin DIP	YES	
		RA31501061	RA31511061	6	55	4.5	0.5				
		RA31501121	RA31511121	12	300	9.0	1.0				
		RA31501241	RA31511241	24	1100	18.0	2.0				
2A DPST-NO	3W .11A 28V	RA30982051	RA31232051	5	200	3.8	1.0	.275″	8 Pin DIP	YES	
		RA30982061	RA31232061	6	200	4.0	1.0				
		RA30982121	RA31232121	12	500	8.0	2.0				
		RA30982241	RA31232241	24	2150	16.0	4.0				
1B SPST-NC	10W .5A 100V	RA30511051	RA30521051	5	500	3.8	1.0	.275″	8 Pin DIP	NO	
		RA30511061	RA30521061	6	500	4.0	0.5				
		RA30511121	RA30521121	12	500	8.0	1.0				
		RA30511241	RA30521241	24	2150	16.0	2.0				
		RA31321051	RA31331051	5	500	3.8	1.0	.300″	4 Pin SIP	NO	
		RA31321061	RA31331061	6	500	4.0	0.5				
		RA31321121	RA31331121	12	500	8.0	1.0				
		RA31321241	RA31331241	24	2150	16.0	2.0				
1C SPDT	3W .25A 28V	RA30421051	RA30441051	5	200	4.0	0.5	.275″	8 Pin DIP	YES	
		RA30421061	RA30441061	6	80	4.0	0.5				
		RA30421121	RA30441121	12	500	8.0	1.0				
		RA30421241	RA30441241	24	2000	16.0	2.0				

*For electrostatic shielding add –02 to P/N





Notes: 1. All dimensions are in inches.
2. Tolerances unless otherwise specified are ±.015″.
3. Terminals are .010″ ±.005″ X .020″ ±.005″; solderable.
4. Dot indicates terminal No. 1.

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ELECTROL
OPTO ELECTRONICS

Ask for Catalog No. 200003

SUBMINIATURE OPTICALLY COUPLED

SC6, SC8 & SB SERIES SOLID STATE RELAYS

FOR AC LOADS AND DIRECT OPERATION FROM LOW-LEVEL LOGIC CIRCUITS

The SC6, SC8, and SB Series are complete zero cross solid state relays. If your load requires greater than the 0.75 Amp offered by the SB Series, the SC6 may be used to drive a triac. This combination retains the advantage of high transient immunity and tight zero cross window of the SC6.

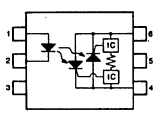
The input circuit consists of a Ga As LED; the output consists of a pair of back-to-back SCR's controlled by proprietary IC circuits. Upon activating the LED input, the LED emits infra-red light which is transmitted through an optically transparent media to the output circuit. The IC's detect the zero crossing of the AC voltage and enable the photo-sensitive SCR's for the duration of the input. This arrangement is more resistant to line borne transients than conventional circuits and eliminates the use of an AC rectifier bridge. The dual SCR output affords better commutation and improved power dissipation over single thyristor output stages. The component count is significantly reduced, improving reliability.

The SB-5421/SB-5422 perform the same circuit function as the Teledyne 642-1/642-2 units. Input voltage however is nominally 5VDC. For higher input voltages, a series resistor must be added to the input.

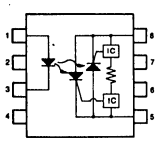
ELECTRICAL CHARACTERISTICS (25°C free air unless otherwise specified)

	CHARACTERISTICS		MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT	Forward voltage Vf			1.2	1.5	VDC	If=20 mA
	Reverse voltage Vr				3.0	VDC	
	Must operate current	SCXX0/SB542X		7	15	mADC	.5 Power Facter Inductive
		SCXX2		3	5	mADC	
	Must release current		0.1			mADC	
	Continuous forward current				40	mADC	
OUTPUT	Peak off-state leakage current	SCX10/SB5421			200	μA	200V Peak
		SCX20/SB5422			300	μA	400V Peak
		SCX12			250	μA	300V Peak
		SCX22			350	μA	500V Peak
	On voltage (V_{TM})				1.2	V	It=500mA
	Turn-on time (60 Hz)				8.4	ms	
	Turn-off time (60 Hz)				8.4	ms	
	Zero cross voltage turn-on				± 5	Vrms	.5 P.F. Inductive
	dV/dT ratings (off-state)		100	250		V/μ sec	70°C
	Rated Voltage	SCX1X/SB5421	12		140	Vrms	
		SCX2X/SB5422	24		280	Vrms	

CIRCUIT DIAGRAMS (Top View)



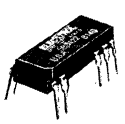
SC6 Series



SC8 Series

ACTUAL SIZE

SA-1000 and SC8 Series

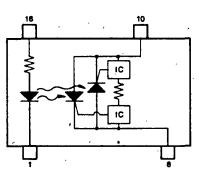


SB Series

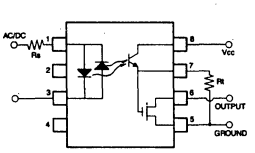
SC6 Series

RATINGS

OUTPUT		SC SERIES RATING	SB SERIES RATING
Power dissipation @ 50°C		600mW	900mW
Derate linearly from 50°C		9mW/°C	14mW/°C
Continuous AC current		0.5A	0.75A
Peak ½ cycle current		5A	7.5A
Peak repetitve off-state voltage	SCX10/SB5421	200V minimum	
	SCX20/SB5422	400V minimum	
	SCX12	300 V minimum	
	SCX22	500V minimum	
ISOLATION		**MINIMUM RATING**	
Input to output breakdown voltage		2500Vrms/t = 1 min.	
Isolation resistance, input to output		10^{11} Ohms	
Coupling capacitance (input to output)		3pf typical	
TEMPERATURE RANGE		**RATING**	
Storage		-40°C to + 125°C	
Operating		-20°C to +85°C	
Max lead soldering time @ 260°C		7 seconds	



SB 5421/SB 5422



SA-1000

Elec-Trol, Inc., 26477 N. Golden Valley Road, Saugus, CA 91350, (213) 788-7292, (805) 252-8330, Telex: 18-1151

ELECTROL
OPTO ELECTRONICS

Ask for Catalog No. 200003

SUBMINIATURE OPTICALLY COUPLED

SA-1000 SOLID STATE AC/DC SWITCH

The SA-1000 is a versatile unit that can act as an AC/DC input device or DC output device as well as a zero cross detector or voltage level sensor in other applications.

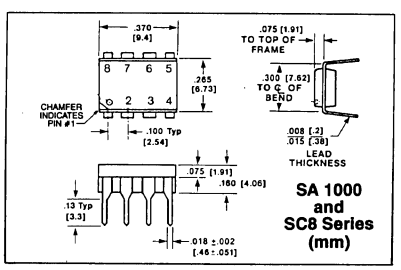
The SA-1000 is designed to perform the function of sensing the state of AC or DC voltages and reporting their status back to the low level control logic while providing a very high degree of isolation between these different systems. This is accomplished by using the drive voltage to activate an LED input through dropping resistors. The electrically isolated output circuitry detects the presence of the LED state and provides an output capable of sinking 200mA.

The SA-1000 has an output response time adjustment which allows the device to detect or ignore the zero crossover point of an A.C. input signal. The adjustment is controlled by a resistor (Rt) connected to pins #5 and #7 and typically varies over a range of 220k to 2.2m ohms.

ELECTRICAL CHARACTERISTICS (25°C free air unless otherwise specified)

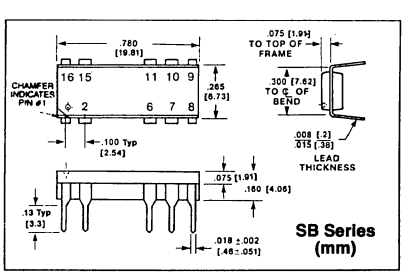
INPUT	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Forward voltage V_f			±1.5	VDC	I_f = 20 mA
Operating current		1	5	mARMSorDC	I_L = 10 mA
Continuous forward current			40	mARMSorDC	
SUPPLY (V_{cc} Pin 8)					
Supply Voltage	4.5		7	V	
Supply Current			0.2	mA	V_{cc} = 5V
OUTPUT (Pin 5)					
Off state voltage			30	V	
On state current			200	mA	
On state voltage			0.12	V	I_{sink} = 10 mA
On state voltage			1.2	V	I_{sink} = 200 mA
Power dissipation			240	mW	25°C
Derate Linearly from 40°C			4	mW/°C	
Output Voltage			30	V	
COUPLING					
Isolation voltage (input to output)	2500			V_{DC}	t = 1 min.
Isolation resistance	10^{11}			Ohm	
Coupling capacitance (input to output)		6		pf	

TEMPERATURE RANGE	
Storage	−40°C to 100°C
Operating	−20°C to 70°C
Max Lead soldering time @ 260°C	7 sec.

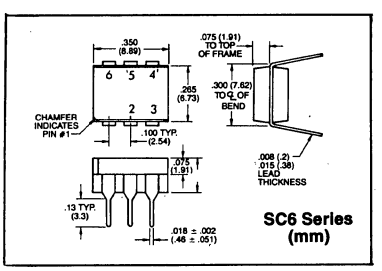


SA 1000 and SC8 Series (mm)

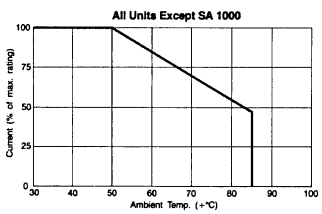
MAXIMUM DIMENSION & PIN DESIGNATION



SB Series (mm)



SC6 Series (mm)



DERATING CURVE FOR TEMPERATURE

PART NUMBER DESCRIPTION:

SC620

Complete zero cross solid state relay in mini-DIP package.

Package Size
6-6 pin
8-8 pin

Input
0- 15mA
2-5mA

Output
1-120VAC
2-240VAC

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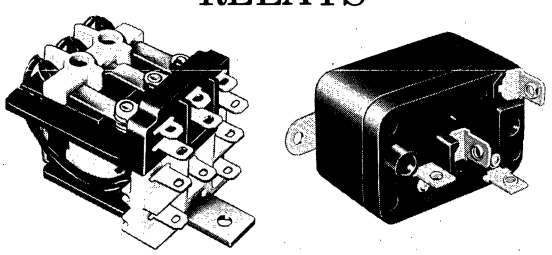
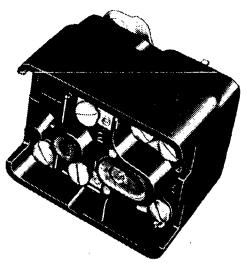
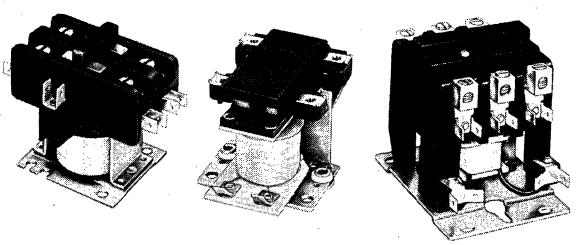
AC - DC GENERAL PURPOSE RELAYS



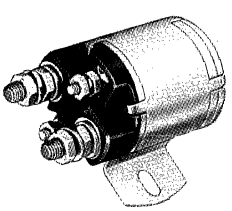
AC POWER RELAYS



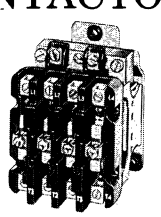
AC POWER CONTACTORS



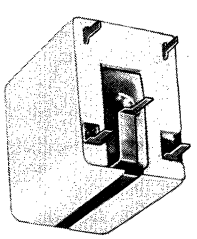
DC POWER CONTACTORS



AC INDUSTRIAL CONTACTORS



MINIATURE DC SENSITIVE RELAYS



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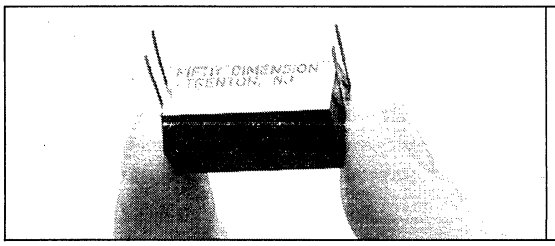
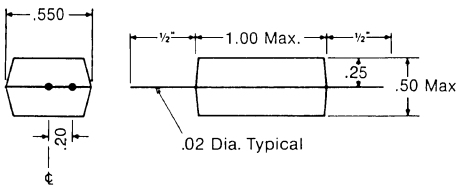
UNITED TECHNOLOGIES HAMILTON STANDARD CONTROLS

Fifth Dimension Mercury Film Relays

• Solid state circuit compatible • Two billion cycle reliability • Switch dry circuit or power loads • No contact bounce • Operate in any position



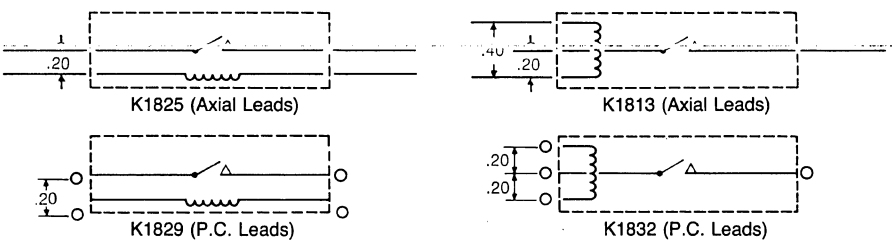
Series K Relays
Epoxy sealed, these miniature relays are available with axial leads or pins for PCB mounting. Solid State signal compatibility.



In addition to excellent signal handling capabilities, long life and low noise, Fifth Dimension Series K mercury film relays offer unusual design freedom. Small size, rugged construction—the mechanism is cased in metal, not glass—and the ability to operate in any position allow their use in applications not possible with conventional mercury relays. Series K relays are currently in use in microprocessor input interfaces, modem line pulsing, telephone line switching test systems, touch tone convertors, automatic test equipment, data acquisition systems and industrial controls.

Series K Relay Footprints

Axial distance between pins, all models, 1 inch nominal.



Specifications

Contact Form	SPST-NO	Contact Res. Stability	±0.02 Ohms
Bounce Time	None	Contact Breakdown Volts	1000 VAC RMS (Special to 2000 VAC RMS)
Life	Indefinite		
Load Current to 52 VDC	0.25 Amperes	Operational Temp. Range	−38°C to +85°C
Load Current to 200 VDC	0.1 Amperes	Storage Temp. Range	−55°C to +105°C
Contact Resistance	0.20 Ohms*	Arc Suppression Suggested	Yes

	Nominal Coil Volts	Coil Resistance (±10%)	Must Operate Volts	Must Release Volts	Operate Time (ms)	Release Time (ms)	Reliability (MCBF)	Coil to Contact Breakdown Volts	Vibration to 3000 CPS	Shock 11ms Sawtooth	Encapsulated Package	Magnetic Shield Standard/Optional (St) (Op)
K18XX-2-5-2	5	100	4	0.5	4.0	4.0	10^7	1500 Vac Rms	15g	20g	Yes	St
K18XX-2-12-2	12	575	9.6	1.2	4.0	4.0	10^7					St
K18XX-2-24-2	24	2300	19.2	2.4	4.0	4.0	10^7					St
K18XX-5-5	5	50	4	0.5	3.5	3.5	10^9		30g	40g		Op
K18XX-5-12	12	288	9.6	1.2	3.5	3.5	10^9					Op
K18XX-5-24	24	1150	19.2	2.4	3.5	3.5	10^9					Op

(XX indicates footprint)

Reliability is based upon tests conducted on over 200 relays which were exercised a total of over 34 billion operations. Specified values should not be considered as a guaranteed performance for a single relay, but rather a prediction of the performance of the cumulative results of a universe of units.

*Contact resistance is measured at end of switching capsule and does not include terminal lead resistance.
All specifications typical and subject to change without notice.

FIFTH DIMENSION, INC.
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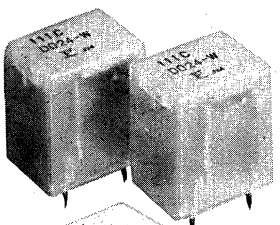
FUJITSU

RELAYS

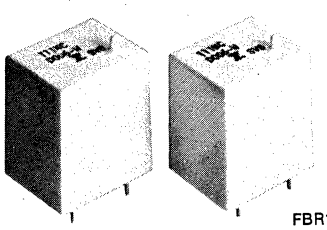
MINIATURE RELAYS FOR P.C. BOARDS

FBR111 AND FBR111N SERIES

SPDT 3A-28V DC/120V AC, 6A-28V DC/120V AC



FBR111



FBR111N

The Fujitsu FBR111 and FBR111N Series are low cost SPDT relays with a versatile switching capability. The contact is rated 3A, 28V DC; 3A 120V AC for standard contact, or up to 6A, 28V DC; 6A, 120V AC for special heavy duty contact.

These small size, sensitive relays, designed to be mounted on printed circuit boards, feature simplified construction and a low power dissipation.

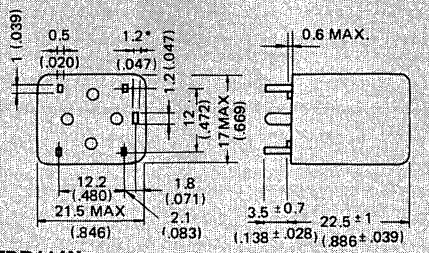
It is ideal for use in audio equipment, business machines, vending machines, security systems, game machines and automotive applications.

The FBR111N Series is the immersion cleanable version where printed circuit board cleaning is required.

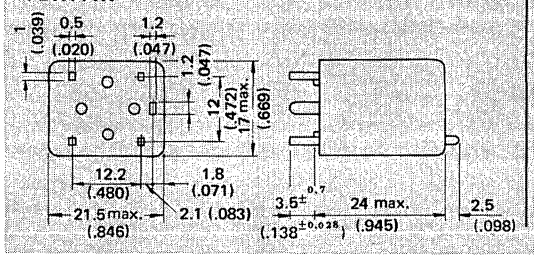
The relay specified FBR111U is UL recognized for office equipment and business machines. (File No. E63615.) CSA certified.

DIMENSIONS Unit: mm (inch)

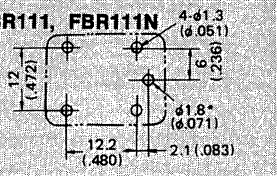
FBR111



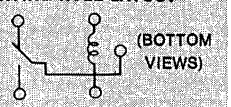
FBR111N



FBR111, FBR111N



MOUNTING HOLE LAYOUT



1 FORM C

SCHEMATICS

Notes:
1. Cut-off nib must be removed after relay soldering and board cleaning.
2. Although the plastic cover is bonded to the relay base, it is not hermetically sealed. Therefore, when the board on which the relay is soldered is cleaned by immersion, cleaning time must not exceed 2 minutes. Please use alcohol, freon or water for cleaning (water temperature is less than 50°C).

ENGINEERING DATA

Item	Specifications		
Contact Arrangement	SPDT		
Contact Ratings		Rating	UL Rating
Contact Materials	Contact Materials	28V DC or 120V AC (Resistive)	28V DC or 120V AC (Resistive)
	No suffix Silver	3A	3A
	–K Silver-Cadmium Oxide	3A	3A
	–M Gold-Plated Silver	3A	1A
	–W Special Alloy	6A	8.5A (0.8 pF @ 120V AC)
Initial Contact Resistance	100mΩ max. (at 6V DC 0.5A for No mark or -M, 6V DC 1A for -K or -W)		
Rated Coil Voltage Coil Power Dissipation Coil Temperature Rise	5, 6, 9, 12, 24V DC Standard: 0.36W approx. at rated voltage UL Type: 0.50W approx. at rated voltage Standard: 30°C max. at rated voltage UL Type: 40°C max. at rated voltage		
Insulation Resistance Dielectric Withstanding Voltage	100MΩ min. at 500V DC 500V AC tor 1 minute		
Operate Time Release Time	20 ms max. at rated voltage 10 ms max.		
Life Expectancy — Mechanical Electrical	10 x 10^6 ops. min. 100 x 10^3 ops. min. at rated load		
Vibration	10 to 50Hz (Dual amplitude: 1.5mm)		
Shock	10G (11 ms)		
Temperature Range	Standard, −30°C ~ +65°C — UL Type, −30°C ~ +55°C		
Weight	15 gr. approx.		

SELECTION TABLES

FBR111 Type	Contacts Arrangement	Contacts Materials*	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-up Voltage at 20°C	Designation	Price
Standard	SPDT	No Suffix	5	70	Less Than	FBR111CD005	$1.70
		–K	6	100	80% of	FBR111CD006	1.70
		–M	9	225	Rated	FBR111CD009	1.70
		–W	12	400	Voltage	FBR111CD012	1.70
			24	1600		FBR111CD024	1.84
UL Type	SPDT	No Suffix	5	50	Less Than	FBR111UD005	$1.84
		–K	6	72	75% of	FBR111UD006	1.84
		–M	9	160	Rated	FBR111UD009	1.84
		–W	12	290	Voltage	FBR111UD012	1.84
			24	1150		FBR111UD024	1.96

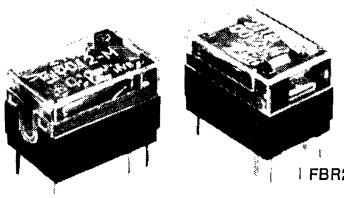
FBR111N Type	Contacts Arrangement	Contacts Materials*	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-up Voltage at 20°C	Designation	Price
Standard	SPDT	No Suffix	5	70	Less Than	FBR111NCD005	$2.04
		–K	6	100	80% of	FBR111NCD006	2.04
		–M	9	225	Rated	FBR111NCD009	2.04
		–W	12	400	Voltage	FBR111NCD012	2.04
			24	1600		FBR111NCD024	2.18
UL Type	SPDT	No Suffix	5	50	Less Than	FBR111NUD005	$2.18
		–K	6	72	80% or	FBR111NUD006	2.18
		–M	9	160	Rated	FBR111NUD009	2.18
		–W	12	290	Voltage	FBR111NUD012	2.18
			24	1150		FBR111NUD024	2.32

Note 1. 48V rated voltage relays are available on special order.
2. Each product bears its own designation on the top of the cover, but initial code 'FBR' is omitted.
* Add $0.14 to price for –K, $0.28 for –M, $0.14 for –W.
For CSA certified relays, –CSA suffix must be added to part number of UL type. Price is same as UL type.

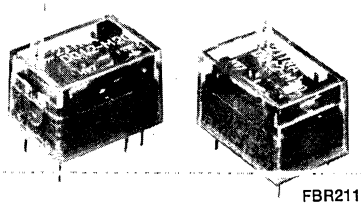
ULTRA-MINIATURE RELAYS FOR P.C. BOARDS

FBR211 AND FBR211N SERIES

SPDT 1A-28V DC, 0.5A-120V AC



FBR211



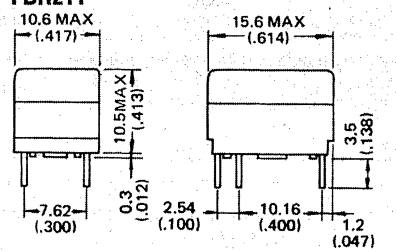
FBR211N

The FBR211 and FBR211N Series of ultra-miniature relays allow high component densities for savings in both equipment size and cost for the printed circuit board. The FBR-211N Series is suitable for immersion cleaning in freon and aqueous systems.

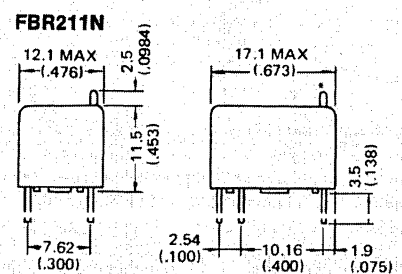
These highly sensitive relays with gold-clad SPDT contact arrangements are ingeniously designed so as to offer flux-contamination-immunity and load handling capabilities of 1A at 28V DC or 0.5A at 120V AC under a resistive load. The 0.1″ grid spacing of terminals makes these relays ideally suited for printed circuit board applications requiring high density mounting and for use in audio and wireless communications, office and vending machines, automobiles and various control applications.

DIMENSIONS Unit: mm (inch)

FBR211

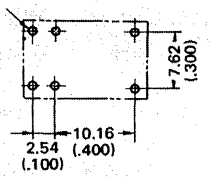


FBR211N

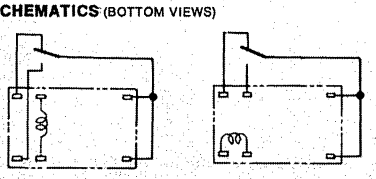


FBR211, FBR211N

MOUNTING HOLE LAYOUT



SCHEMATICS (BOTTOM VIEWS)



Notes:
1. For low level or dry circuit switching, use of gold thick-overlay silver-palladium alloy contact relays are recommended.
2. *Cut off nib must be removed after relay soldering and board cleaning.
3. Although the plastic cover is bonded to the relay board, it is not hermetically sealed. Therefore when the board on which the relay is soldered is cleaned by immersion, cleaning time must not exceed 2 minutes. Please use alcohol, freon or water for cleaning.

ENGINEERING DATA

Item	Specifications	
	Standard Model	High Sensitivity Model
Contact Arrangement	SPDT	
Contact Ratings	1A at 28V DC, 0.5A at 120V AC (resistive)	
Initial Contact Resistance	100mΩ max. at 6V DC, 0.5A	
Contact Materials	Standard: Gold overlay silver (—M) — Low Level: Gold overlay silver-palladium alloy (—P)	
Rated Coil Voltage	1.5, 3, 5, 6, 9, 12, 24V DC	
Coil Power Dissipation	0.45W at rated voltage	0.20W at rated voltage
Coil Temperature Rise	45°C approx. at rated voltage	25°C approx. at rated voltage
Insulation Resistance	100MΩ min. at 500V DC (at 20°C 65% RH)	
Dielectric Withstanding Voltage	500V AC for 1 minute	
Operate Time	5 ms approx. (at rated voltage, 20°C)	
Release Time	5 ms approx.	
Life Expectancy — Mechanical	5 x 10^6 ops. min.	
Electrical	300 x 10^3 ops. min. at 1A 28V DC, resistive 100 x 10^3 ops. min. at 0.5A 120V AC, resistive	
Vibration	10 to 40Hz (Dual amplitude: 1.5mm)	
Shock	10G (11 ms)	6G (11 ms)
Temperature Range	−25°C to +55°C	−25°C to +75°C
Weight	4 gr. approx.	

SELECTION TABLE

Type	Contact: Arrangement	Contact: Materials	Schematics	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-up Voltage at 20°C	FBR211: Designation	FBR211: Price* —M Type	FBR211N: Designation	FBR211N: Price* —M Type
Standard	SPDT	Gold Overlay Silver (M) or Gold Overlay Silver-Palladium Alloy (P)*	A	1.5	5	Less Than 70% of Rated Voltage	FBR211AD001—M or P	$1.82	FBR211NAD001—M20 or P20	$2.30
				3	20		FBR211AD003—M or P	1.82	FBR211NAD003—M20 or P20	2.30
				5	56		FBR211AD005—M or P	1.82	FBR211NAD005—M20 or P20	2.30
				6	80		FBR211AD006—M or P	1.82	FBR211NAD006—M20 or P20	2.30
				9	180		FBR211AD009—M or P	1.82	FBR211NAD009—M20 or P20	2.30
				12	320		FBR211AD012—M or P	1.82	FBR211NAD012—M20 or P20	2.30
				24	1280		FBR211AD024—M or P	1.98	FBR211NAD024—M20 or P20	2.46
Standard	SPDT	Gold Overlay Silver (M) or Gold Overlay Silver-Palladium Alloy (P)*	B	1.5	5	Less Than 70% of Rated Voltage	FBR211BD001—M or P	$1.82	FBR211NBD001—M20 or P20	$2.30
				3	20		FBR211BD003—M or P	1.82	FBR211NBD003—M20 or P20	2.30
				5	56		FBR211BD005—M or P	1.82	FBR211NBD005—M20 or P20	2.30
				6	80		FBR211BD006—M or P	1.82	FBR211NBD006—M20 or P20	2.30
				9	180		FBR211BD009—M or P	1.82	FBR211NBD009—M20 or P20	2.30
				12	320		FBR211BD012—M or P	1.82	FBR211NBD012—M20 or P20	2.30
				24	1280		FBR211BD024—M or P	1.98	FBR211NBD024—M20 or P20	2.46
High Sensitivity	SPDT	Gold Overlay Silver (M) or Gold Overlay Silver-Palladium Alloy (P)*	C	1.5	12	Less Than 70% of Rated Voltage	FBR211CD001—M or P	$1.96	FBR211NCD001—M20 or P20	$2.44
				3	45		FBR211CD003—M or P	1.96	FBR211NCD003—M20 or P20	2.44
				5	120		FBR211CD005—M or P	1.96	FBR211NCD005—M20 or P20	2.44
				6	180		FBR211CD006—M or P	1.96	FBR211NCD006—M20 or P20	2.44
				9	400		FBR211CD009—M or P	1.96	FBR211NCD009—M20 or P20	2.44
				12	700		FBR211CD012—M or P	1.96	FBR211NCD012—M20 or P20	2.44
				24	2800		FBR211CD024—M or P	2.12	FBR211NCD024—M20 or P20	2.60
High Sensitivity	SPDT	Gold Overlay Silver (M) or Gold Overlay Silver-Palladium Alloy (P)*	E	1.5	12	Less Than 70% of Rated Voltage	FBR211ED001—M or P	$1.96	FBR211NED001—M20 or P20	$2.44
				3	45		FBR211ED003—M or P	1.96	FBR211NED003—M20 or P20	2.44
				5	120		FBR211ED005—M or P	1.96	FBR211NED005—M20 or P20	2.44
				6	180		FBR211ED006—M or P	1.96	FBR211NED006—M20 or P20	2.44
				9	400		FBR211ED009—M or P	1.96	FBR211NED009—M20 or P20	2.44
				12	700		FBR211ED012—M or P	1.96	FBR211NED012—M20 or P20	2.44
				24	2800		FBR211ED024—M or P	2.12	FBR211NED024—M20 or P20	2.60

Note: Each product bears its own designation on the top of the cover, but initial code 'FBR' is omitted.
* Add $0.32 to price or —P contact material.

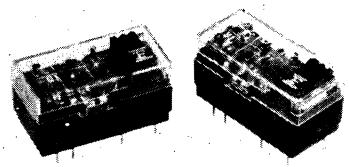
FUJITSU

RELAYS

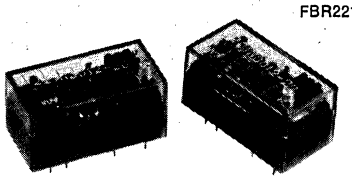
ULTRA-MINIATURE RELAYS FOR P.C. BOARDS

FBR221 AND FBR221N SERIES

DPDT 1A-28V DC, 0.5A-120V AC



FBR221



FBR221N

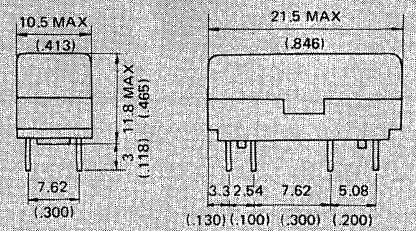
The FBR221 and FBR221N Series of ultra-miniature relays are designed to provide high component densities for savings in both equipment size and cost.

These highly sensitive relays with gold-clad DPDT contact arrangements can switch loads up to 1A at 28V DC or 0.5A at 120V AC.

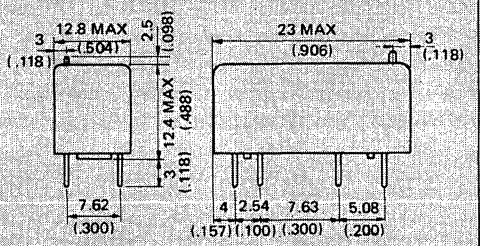
The .1″ grid spacing of terminals makes these relays ideally suited for printed circuit board applications requiring high density mounting — and for use in audio and wireless communications, office machines, various control applications and automobiles.

DIMENSIONS Unit: mm (inch)

FBR221



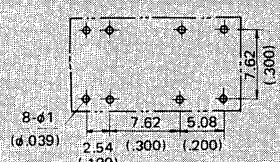
FRB221N



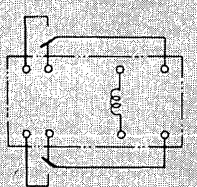
Notes:
1. For low level or dry circuit switching, use of gold thick-overlay silver-palladium alloy contact relays is recommended.
2. Cut-off nib must be removed after relay soldering and board cleaning.
3. Although the plastic cover is bonded to the relay base, it is not hermetically sealed. Therefore when the board on which the relay is soldered is cleaned by immersion, cleaning time must not exceed 2 minutes. Please use alcohol, freon or water for cleaning.

FBR221, FRB221N

MOUNTING HOLE LAYOUT



SCHEMATIC



(BOTTOM VIEW)

ENGINEERING DATA

Item	Specifications
Contact Arrangement	DPDT
Contact Rating	1A at 28V DC, 0.5A at 120V AC (resistive)
Initial Contact Resistance	100mΩ max. at 6V DC, 0.1A initial
Contact Materials	Standard: Gold overlay silver — Low Level Type: Gold overlay silver-palladium alloy
Rated Coil Voltage	3, 5, 6, 9, 12, 24V DC
Coil Power Dissipation	Typical 0.5W at rated coil voltage at 20°C
Coil Temperature Rise	50°C approx. at rated voltage at 20°C
Insulation Resistance	100MΩ min. at 500V DC (at 20°C 65% RH)
Dielectric Withstanding Voltage	500V RMS (60Hz) for 1 minuate
Operate Time	10 ms max. at rated voltage at 20°C
Release Time	5 ms max.
Life Expectancy — Mechanical	5×10^6 ops. min.
Electrical	300×10^3 ops. min. at 28V DC, 1A, resistive 100×10^3 ops. min. at 120V AC, 0.5A, resistive
Vibration	10 to 55Hz (Dual amplitude: 1.5mm)
Shock	10G (11 ms)
Temperature Range	−25°C to +50°C
Weight	5 gr. approx.

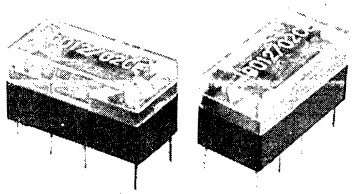
SELECTION TABLE

Type	Contact Arrangements	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-Up Voltage at 20°C	FBR221 Designation	FBR221 Price	FBR221N Designation	FBR221N Price
Standard	DPDT (Gold Overlay Silver)	3	18	Less Than 75% of Rated Voltage	FBR221D003	$3.06	FBR221ND003—20	$3.54
		5	50		FBR221D005	3.06	FBR221ND005—20	3.54
		6	72		FBR221D006	3.06	FBR221ND006—20	3.54
		9	162		FBR221D009	3.06	FBR221ND009—20	3.54
		12	290		FBR221D012	3.06	FBR221ND012—20	3.54
		24	1150		FBR221D024	3.22	FBR221ND024—20	3.70
Low Level Load	DPDT (Gold Overlay Silver-Palladium Alloy)	3	18	Less Than 75% of Rated Voltage	FBR221D003—P	$3.76	FBR221ND003—P20	$4.24
		5	50		FBR221D005—P	3.76	FBR221ND005—P20	4.24
		6	72		FBR221D006—P	3.76	FBR221ND006—P20	4.24
		9	162		FBR221D009—P	3.76	FBR221ND009—P20	4.24
		12	290		FBR221D012—P	3.76	FBR221ND012—P20	4.24
		24	1150		FBR221D024—P	3.92	FBR221ND024—P20	4.40

Note: Each product bears its own designation on the top of the cover, but initial code 'FBR' is omitted.

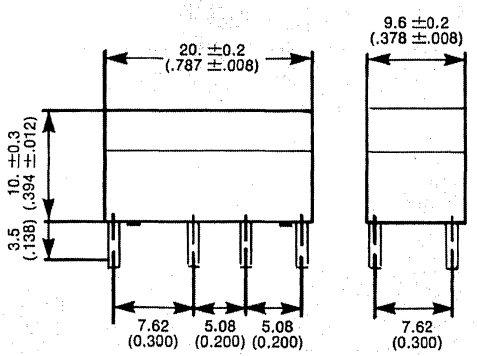
LOW PROFILE RELAYS FOR P.C. BOARDS

FBR244 AND FBR244N SERIES

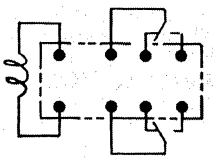


FBR244 and FBR244N Series Relays are low profile, P.C. board relays with 2 Form C (DPDT) contact arrangements in D.I.P.-compatible plastic housing and have a 2.54mm pinout grid spacing to provide 16-pin-DIP-socket compatibility. Watertight terminal sealing prevents relay from contamination by soldering flux and N type allows automatic wave soldering and board washing without relay damage. Single or bifurcated contacts switch 1A at 28V DC or 0.5A at 120V AC and have a rated-load life-time of 5×10^5 operations. These relays are suitable for telecommunication equipment, audio equipment and business machines.

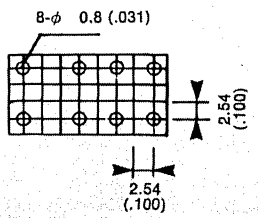
DIMENSIONS Unit: mm (inch)



SCHEMATICS



MOUNTING HOLE LAYOUT



ENGINEERING DATA

Item	Specifications
Contact Arrangement	2 Form C
Contact Material	Gold overlay silver Gold overlay silver-palladium alloy
Contact Rating	1A at 28V DC (resistive) 0.5A at 120V AC (resistive)
Initial Contact Resistance	100mΩ max. at 6V DC 0.1A
Coil Power Dissipation	Typical 0.5W at rated coil voltage
Coil Temperature Rise	50°C approx. at rated voltage 20°C
Insulation Resistance	100MΩ min. at 500V DC
Dielectric Withstanding Voltage	500V AC for 1 minute
Vibration	10 to 55 Hz (Dual amplitude: 1.5mm)
Shock	10G (11 ms)
Operate Time	10 ms max. at rated coil voltage
Release Time	5 ms max.
Life Expectancy — Mechanical	10^7 ops. min.
Electrical	5×10^5 ops. min. at 1A 28V DC (resistive) — 0.3A 120V AC (resistive) 10^5 ops. min. at 0.5A 120V AC (resistive)
Ambient Temperature Range	−30°C to +50°C
Weight	4.5 gr approx.

SELECTION TABLE

Contact Materials*	Rated Voltage in V CD	Coil Resistance in Ω ±10% at 20°C	Pick-Up Voltage at 20°C	FBR244 Designation	FBR244 Price	FBR244N Designation	FBR244N Price
S: Single Gold overlay silver P: Single Gold overlay silver-palladium alloy T: Bifurcated Gold overlay silver E: Bifurcated Gold overlay silver-palladium alloy	3	18	Less Than 75% of Rated Voltage	FBR244D003/02CS	$2.66	FBR244ND003/02CS	$3.14
	5	50		FBR244D005/02CS	2.66	FBR244ND005/02CS	3.14
	6	72		FBR244D006/02CS	2.66	FBR244ND006/02CS	3.14
	9	162		FBR244D009/02CS	2.66	FBR244ND009/02CS	3.14
	12	290		FBR244D012/02CS	2.66	FBR244ND012/02CS	3.14
	24	1150		FBR244D024/02CS	2.80	FBR244ND024/02CS	3.28

* Substitute S with P, T or E for alternate contact materials and add $0.70 to price for P, $0.32 for T or $1.00 for E.
For 48V relays add $0.60 to the prices of the 24V relays.

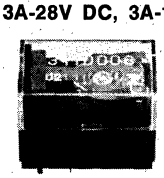
FUJITSU

RELAYS

MINIATURE RELAYS FOR P.C. BOARDS

FBR311 (SPDT) AND FBR321 (DPDT) SERIES

3A-28V DC, 3A-120V AC

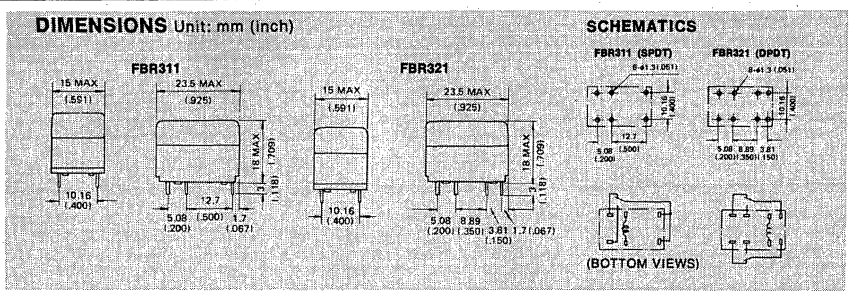


FBR311

FBR321

The FBR311 (SPDT) and FBR321 (DPDT) Series miniature relays were designed to provide 3 amps ratings contacts, accommodated in truly compact packages for P.C. boards.

These sensitive miniature relays, featuring high density mounting, flux-contamination immunity, versatile switching performance from signal level to handling 3 amps, are ideally suited for such applications as audio equipment, office machines, vending machines and automotive or other control application. These relays are UL Recognized (E63615) and CSA Certified (add —CSA suffix to P/N).



ENGINEERING DATA FBR311, 321

Item	Specifications
Contact Arrangement	SPDT (FBR311) DPDT (FBR321)
Contact Rating	3A at 28V DC, resistive — 3A at 120V AC, (resistive)
Initial Contact Resistance	100mΩ max. at 6V DC, 0.5A
Contact Material	Gold overlay silver
Rated Coil Voltage	5, 6, 9, 12, 24V DC
Coil Power Dissipation	0.45W approx. at rated voltage
Coil Temperature Rise	35°C approx. at rated voltage
Insulation Resistance	100MΩ min. at 500V DC (initial)
Dielectric Withstanding Voltage	500V AC for 1 minute
Operate Time	20 ms max. at rated voltage
Release Time	10 ms max.
Life Expectancy — Mechanical	10×10^6 ops. min.,
Electrical	100×10^3 ops. min. at rated load
Vibration	10 to 55Hz (Dual amplitude: 1.5mm)
Shock	10G (11ms)
Temperature Range	−30°C to +50°C
Weight	12 gr. approx.

SELECTION TABLE

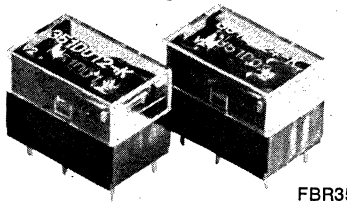
Contact Arrangement	Rated Voltage in V DC	Coil Resistance in Ω ±15% at 20°C	Pick-Up Voltage at 20°C	Designation	Price
SPDT	5	58	Less Than 80% of Rated Voltage	FBR311D005	$2.12
	6	85		FBR311D006	2.12
	9	180		FBR311D009	2.12
	12	300		FBR311D012	2.12
	24	1250		FBR311D024	2.26
DPDT	5	42	Less Than 80% of Rated Voltage	FBR321D005	$3.36
	6	60		FBR321D006	3.36
	9	135		FBR321D009	3.36
	12	230		FBR321D012	3.36
	24	960		FBR321D024	3.50

Note: Each product bears its own designation on the top of the cover, but initial code 'FBR' is omitted.
For 48V relays add $0.28 to prices of 24V relays.

MINIATURE RELAYS FOR P.C. BOARDS

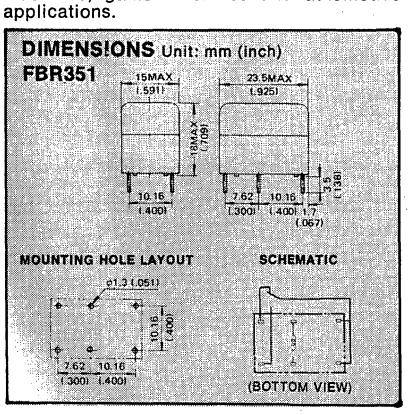
FBR351 SERIES

SPDT 3A-28V DC/120V AC, 6A-28V DC/120V AC



FBR351

FBR351 Series miniature relays are 1 Form C compact relays which can be used for a wide range of current switching from low levels to heavy loads. Two types are available: gold overlay contacts with contact ratings of 3A, 28V DC or 120V AC, and silver cadmium oxide contacts in 6A, 28V DC or 120V AC. These relays can be easily mounted on a PC board and use 3 pitch (7.62mm) pin arrangements. What's more, FBR351 Series relays endure 6KV at 40μ second in lightening. They are ideal for use in audio equipment, business machines, game machines and automotive applications.



ENGINEERING DATA FBR351

Item	Specifications	
	Standard	High-power Type
Contact Arrangement	1 Form C (SPDT)	
Contact Ratings	3A at 28V DC or 120V AC (resistive)	6A at 28V DC or 120V AC (resistive)
Contact Materials	Gold overlay	Silver-cadmium oxide
Initial Contact Resistance	100mΩ max. at 6V DC, 0.5A	100mΩ max. at 6V DC, 1A
Rated Coil Voltage	5, 6, 9, 12, 24V DC	
Coil Power Dissipation	0.45W approx. at rated voltage	
Coil Temperature Rise	35°C approx. at rated voltage	
Insulation Resistance	100MΩ min. at 500V DC	
Dielectric Withstanding Voltage	Between open contacts: 750V AC for 1 minute	
	Between coil and contact: 2000V AC for 1 minute	
Lightening	6KV at 1 x 40 μs	
Operate Time	8 ms approx. at rated voltage	
Release Time	2.5 ms approx.	
Life Expectancy — Mechanical	10×16^6 ops. min.	
Electrical	200×10^3 ops. min. at 28V DC, 3A	100×10^3 ops. min. at 28V DC, 6A
	100×10^3 ops. min. at 120V AC, 3A	50×10^3 ops. min. at 120V AC, 6A
Vibration	10~50Hz (Dual amplitude: 1.5mm)	
Shock	10G (11 ms)	
Temperature Range	−40°C~+70°C at 2A carrying current	
	−40°C~+50°C at 5A carrying current (without freezing)	
	−40 C~+40°C at 6A carrying current	
Weight	12 gr. approx.	

SELECTION TABLE

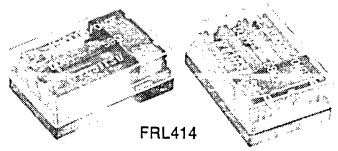
Type	Contact Rating	Contact Materials	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-Up Voltage at 20°C	Designation	Price
Standard	3A at 28V DC or 120V AC, resistive	Gold Overlay	5	58	Less Than 80% of Rated Voltage	FBR351D005	$2.32
			6	85		FBR351D006	2.32
			9	180		FBR351D009	2.32
			12	300		FBR351D012	2.32
			24	1250		FBR351D024	2.46
High-Power Type	6A at 28V DC or 120V AC, resistive	Silver-Cadmium Oxide	5	58	Less Than 80% of Rated Voltage	FBR351D005—K	$2.46
			6	85		FBR351D006—K	2.46
			9	180		FBR351D009—K	2.46
			12	300		FBR351D012—K	2.46
			24	1250		FBR351D024—K	2.60

Note: Each product bears its own designation on the top of the cover, but initial code 'FBR' is omitted.
For 48V relays add $0.28 to prices of 24V relays.

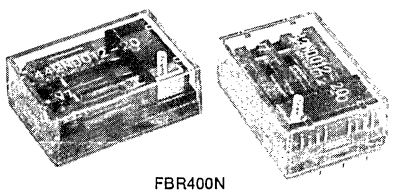
FLAT PACKAGE RELAYS

FRL-414 AND FBR400N SERIES

4PDT, DPDT 1A-30V DC, 1A-120V AC



FRL414



FBR400N

The Fujitsu FRL-414 and FBR400N (immersion cleanable) Series Flat Package Relays have been designed for P.C. board mounting and are ingeniously constructed so as to offer the advantages of flux-contamination-immunity.

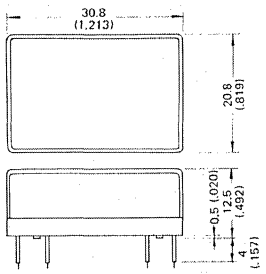
The low power consumption relays are available in both DPDT and 4PDT contact arrangements and in coil voltage ratings to 48V DC. The wide selection is useful for numerous demanding applications, including communications, data processing and controls.

Bifurcated contacts assure high reliability. These relays are capable of handling resistive loads of up to 1A at 30V DC or 120V AC.

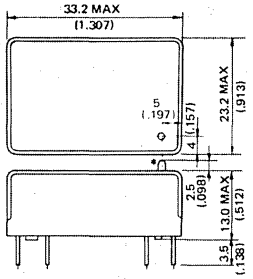
A low level load version with gold overlay silver-palladium alloy contacts is also available. Electrical life expectancy is more than three million operations at 1A-50V DC resistive load.

DIMENSIONS Unit: mm (inch)

FRL-414



FBR400N

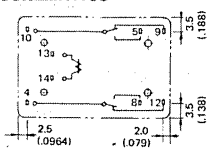


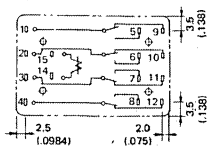
Notes:

1. For low level or dry circuit switching, use of gold overlay silver-palladium alloy contact relays is recommended.
2. *Cut-off nib must be removed after relay soldering and board cleaning.
3. Although the plastic cover is bonded to the relay base, it is not hermetically sealed. Therefore when the board on which the relay is soldered is cleaned by immersion, cleaning time must not exceed 2 minutes. Please use alcohol, freon or water for cleaning.

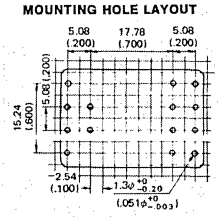
FRL-414, FBR400N

SCHEMATICS





MOUNTING HOLE LAYOUT



ENGINEERING DATA

Item	Characteristics
Contact Arrangement	DPDT and 4PDT with bifurcated contacts
Contact Rating	1A at 120V AC (resistive) — 1A at 30V DC (resistive)
Initial Contact Resistance	100mΩ max. at 3V DC, 0.5A initial
Contact Materials	Standard: Gold-overlay silver — Low-level Load: Gold-overlay silver-palladium alloy
Rated Coil Voltage	5, 6, 12, 24, 48V DC
Coil Power Dissipation	DPDT: 0.45W — 4PDT: 0.60W at rated voltage at 20°C
Coil Temperature Rise	DPDT: 30°C approx. — 4PDT: 40°C approx. at rated voltage at 20°C
Insulation Resistance	100MΩ min. at 500V DC (at 20°C 65% RH)
Dielectric Withstanding Voltage	500V rms (60 Hz) for 1 minute
Operate Time	15 ms max. at rated coil voltage at 20°C
Release Time	5 ms max.
Life Expectancy — Mechanical	30×10^6 ops. min.
Electrical	3×10^6 ops. min. at 30V DC, 1A (resistive) 100×10^3 ops. min. at 120V AC, 1A (resistive)
Shock	10G
Temperature Range	−30°C to +50°C (without freezing)
Weight	15 gr. approx.

SELECTION TABLES

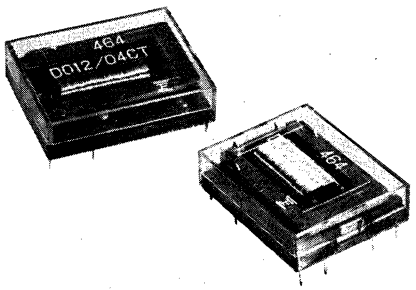
Load	Contact Materials	Contact Arrangements	Rated Voltage in V	Pick-Up Voltage at 20°C	Coil Resistance in Ω ±15%	FRL-414 Designation	FRL-414 Price	FBR400N Designation	FBR400N Price
Standard	Gold Overlay Silver	DPDT	5	Less Than 80% of Rated Voltage	56	FRL-414D005/02CT	$4.44	FBR422ND005—20	$5.04
			6		78	FRL-414D006/02CT	4.44	FBR422ND006—20	5.04
			12		320	FRL-414D012/02CT	4.44	FBR422ND012—20	5.04
			24		1250	FRL-414D024/02CT	4.44	FBR422ND024—20	5.04
			48		4000	FRL-414D048/02CT	5.04	FBR422ND048—20	5.64
Standard	Gold Overloy Silver	4PDT	5	Less Than 80% of Rated Voltage	42	FRL-414D005/04CT	$4.84	FBR442ND005—20	$5.44
			6		58	FRL-414D006/04CT	4.84	FBR442ND006—20	5.44
			12		220	FRL-414D012/04CT	4.84	FBR442ND012—20	5.44
			24		960	FRL-414D024/04CT	4.84	FBR442ND024—20	5.44
			48		2800	FRL-414D048/04CT	5.44	FBR442ND048—20	6.04
Low-Level Load	Gold Overlay Silver-Palladium Alloy	DPDT	5	Less Than 80% of Rated Voltage	56	FRL-414D005/02CE	$4.84	FBR422ND005—P20	$5.44
			6		78	FRL-414D006/02CE	4.84	FBR422ND006—P20	5.44
			12		320	FRL-414D012/02CE	4.84	FBR422ND012—P20	5.44
			24		1250	FRL-414D024/02CE	4.84	FBR422ND024—P20	5.44
			48		4000	FRL-414D048/02CE	5.44	FBR422ND048—P20	6.04
Low-Level Load	Gold Overlay Silver-Palladium Alloy	4PDT	5	Less Than 80% of Rated Voltage	42	FRL-414D005/04CE	$6.16	FBR442ND005—P20	$6.76
			6		58	FRL-414D006/04CE	6.16	FBR442ND006—P20	6.76
			12		220	FRL-414D012/04CE	6.16	FBR442ND012—P20	6.76
			24		960	FRL-414D024/04CE	6.16	FBR442ND024—P20	6.76
			48		2800	FRL-414D048/04CE	6.76	FBR442ND048—P20	7.36

FUJITSU

RELAYS

LOW PROFILE RELAYS FOR P.C. BOARDS

FBR464 AND FBR464N SERIES

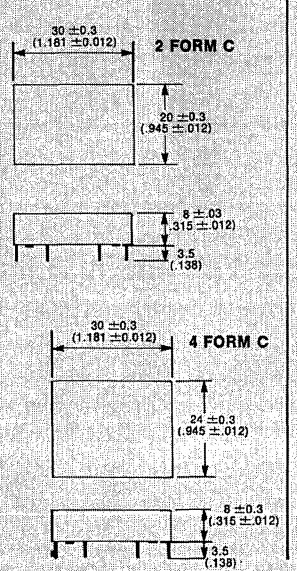


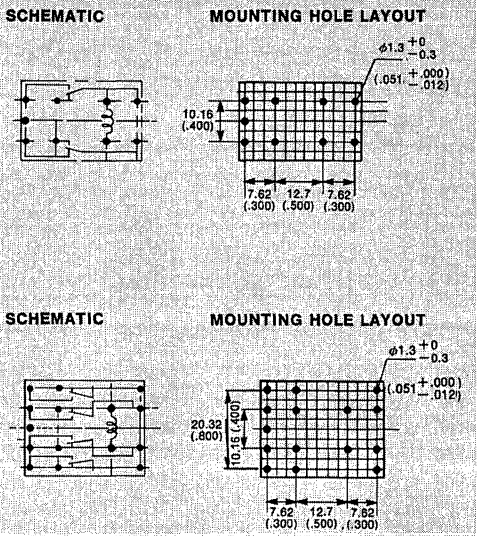
FBR464 and FBR464N Series Relays are low profile, P.C. board relays suitable for flat pack component groupings and space saving for P.C. board rack assembly. Terminal arrangement is 2.54mm grid spacing and watertight sealing for terminals prevents contact from contamination by soldering flux. 2 Form C or 4 Form C bifurcated contacts switch 1A at 30V DC or 120V AC and have life-time of 5 million operations under 1A, 30V DC resistive load. Also, N type version provides excellent protection against automatic wave soldering and board washing with aqueous cleaning solvent.

These Relays are ideal for application in communication equipment and other control machines.

DIMENSIONS Unit: mm (inch)

FBR464, FBR464N





ENGINEERING DATA

Item	Specifications
Contact Arrangements	2 Form C, 4 Form C
Contact Material	CT type Gold overlay silver CE type Gold overlay silver-palladium alloy
Contact Rating	1A, 30V DC (resistive) — 1A, 120V AC (resistive)
Initial Contact Resistance	100mΩ max.
Coil Power Dissipation	DPDT: 0.3W approx. — 4PDT: 0.48W approx.
Coil Temperature Rise	DPDT: 20°C approx. at rated voltage 20°C — 4PDT: 35°C approx.
Insulation Resistance	100MΩ min. at 500V DC
Dielectric Withstanding Voltage	500V AC for 1 minute
Vibration	10~55 Hz (Dual amplitude: 1mm)
Shock	10G (11 ms)
Operate Time	15 ms max. at rated voltage
Release Time	5 ms max.
Life Expectancy — Mechanical	30 x 10^6 ops. min.
Electrical	5 x 10^6 ops. min. (30V DC 1A, resistive) 100 x 10^3 ops. min. (120V AC 1A, resistive)
Ambient Temperature Range	−30°C~+60°C
Weight	DPDT: 11 gr. approx. — 4PDT: 12 gr. approx.

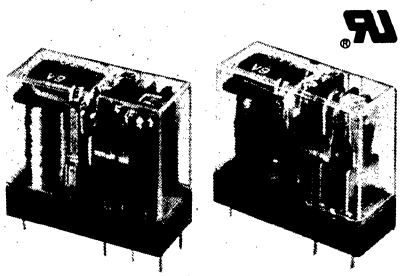
SELECTION TABLE

Contact Materials*	Rated Voltage in V DC	Coil Resistance in Ω ±10% at 20°C	Pick-Up Voltage at 20°C	Drop-Out Voltage at 20°C	FBR464 Designation	FBR464 Price	FBR464N Designation	FBR464N Price
T: Gold Overlay	5	90	Less	More	FBR464D005/02CT	$5.04	FBR464ND005/02CT	$5.64
Silver	6	137	Than	Than	FBR464D006/02CT	5.04	FBR464ND006/02CT	5.64
E: Gold Overlay	12	500	80% of	10% of	FBR464D012/02CT	5.04	FBR464ND012/02CT	5.64
Silver Palladium	24	2000	Rated	Rated	FBR464D024/02CT	5.04	FBR464ND024/02CT	5.64
Alloy	48	7000	Voltage	Voltage	FBR464D048/02CT	5.80	FBR464ND048/02CT	6.40
T: Gold Overlay	5	53	Less	More	FBR464D005/04CT	$5.70	FBR464ND005/04CT	$6.30
Silver	6	90	Than	Than	FBR464D006/04CT	5.70	FBR464ND006/04CT	6.30
E: Gold Overlay	12	330	80% of	10% of	FBR464D012/04CT	5.70	FBR464ND012/04CT	6.30
Silver Palladium	24	1200	Rated	Rated	FBR464D024/04CT	5.70	FBR464ND024/04CT	6.30
Alloy	48	4200	Voltage	Voltage	FBR464D048/04CT	6.46	FBR464ND048/04CT	7.06

* Substitute "T" with "E" or alternate contact material and add $0.66 to price for E version (2 pole) and $1.20 for E version (4 pole).

MINIATURE HIGH-POWER RELAYS

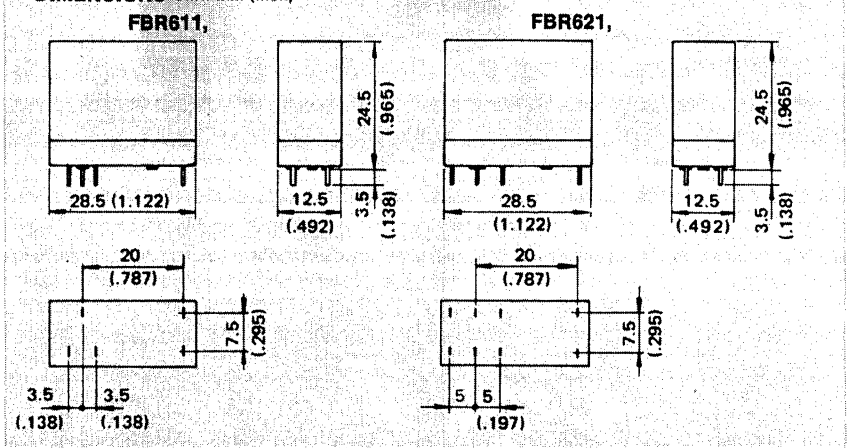
FBR600 SERIES



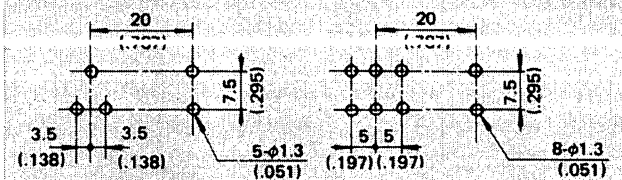
The FBR600 Series are miniature high-power relays with a switching capability of 10A, 30V DC or 240V AC for 1 Form C contact; and 5A, 30V DC or 240V AC for 2 Form C contacts. These relays, conforming to VDE, UL and CSA standards, are designed for mounting on printed circuit boards. Dielectric withstanding voltage is 500V AC for 1 minute and creeping distance is 8mm. These FBR600 Series relays are ideal for use in audio equipment, TV, vending machines, control machines, etc.

UL recognized (E63615) for industrial control equipment per UL508.

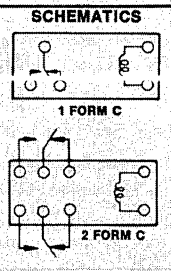
DIMENSIONS Unit: mm (inch)



MOUNTING HOLE LAYOUT



SCHEMATICS



ENGINEERING DATA

Item	Specifications
Contact Arrangement	FBR611, 1 Form C — FBR621, 2 Form C
Contact Ratings	FBR611, 10A at 30V DC or 240V AC — FBR621, 5A at 30V DC or 240V AC
Carrying Current	FBR611, 10A — FBR621, 5A
Contact Material	Silver-alloy
Initial Contact Resistance	100mΩ max. at 6V DC, 1A
Rated Coil Voltage	5, 6, 9, 12, 18, 24, 48, 60V DC
Coil Power Dissipation	FBR611/621, 0.5W at 20°C
Coil Temperature Rise	FBR611/621, 35°C at rated voltage at 20°C
Insulation Resistance	1000Ω min. at 500V DC (initial) at 20°C, 65% RH
Dielectric Withstanding Voltage	
Between Coil and Contact	5000V AC for 1 minute at 20°C, 65% RH
Between Open Contacts	1000V AC for 1 minute at 20°C, 65% RH
Between Adjacent Contacts	FBR621, 3000V AC for 1 minute at 20°C, 65% RH
Lightening (1 x 40μ sec)	
Between Coil and Contact	10,000V min
Between Adjacent Contacts	FBR621, 6000V min.
Operate Time	8 ms approx. at rated voltage at 20°C
Release Time	2.5 ms approx. at 20°C
Life Expectancy — Mechanical	20 x 10^4 ops. min.
Electrical	100 x 10^3 ops. min. at rated voltage
Vibration	10~55 Hz (Dual amplitude: 1.5mm)
Shock	10G (11 ms)
Temperature Range	FBR611/621, −40°C~+70°C
Weight	16 gr. approx.

SELECTION TABLE

Contact Material	Rated Voltage in V DC	Coil Resistance in Ω at 20°C	Pick-Up Voltage at 20°C	Open Voltage at 20°C	FBR611		FBR621	
					Designation	Price	Designation	Price
Silver-Alloy	5	50	Less Than 70% of Rated Voltage	More Than 10% of Rated Voltage (reference)	FBR611D005	$3.74	FBR621D005	$4.00
	6	72			FBR611D006	3.74	FBR621D006	4.00
	9	160			FBR611D009	3.74	FBR621D009	4.00
	12	285			FBR611D012	3.74	FBR621D012	4.00
	18	640			FBR611D018	3.74	FBR621D018	4.00
	24	1150			FBR611D024	3.86	FBR621D024	4.12
	48	4600			FBR611D048	4.56	FBR621D048	4.82
	60	7200			FBR611D060	4.96	FBR621D060	5.24

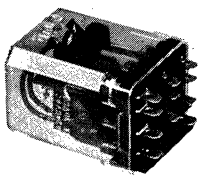
FUJITSU

RELAYS

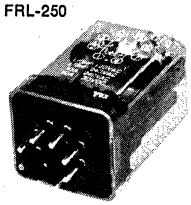
HEAVY DUTY GENERAL PURPOSE RELAYS

FRL-250 AND FRL-256 SERIES

SPDT, DPDT, 3PDT 10A-30V DC, 10A-240V AC



FRL-250

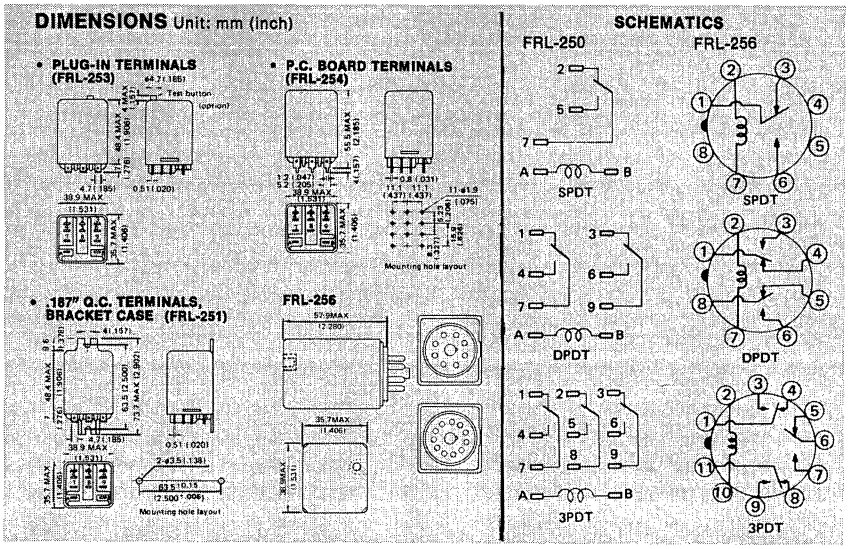


FRL-256

The FRL-250 Series Relays have been designed with particular attention to reliability, cost performance and versatility of application. These heavy duty general purpose relays provide SPDT, DPDT or 3PDT contacts with switching ability of 10A at 30V DC or 240V AC. The FRL-250 Series Relays provide various mounting styles such as plug-in, bracket case, tapped core, stud or P.C. board, and their terminals are convenient quick-connect/solder or P.C. board. The optional features are with or without test button for manual circuit checking and indicator lamp to indicate whether power is reaching relay.

These relays are particularly desirable for use in automation control, communication circuit and many other applications where high power switching and rugged construction are required.

The FRL-250 Series relays are UL recognized (File No. E63614) and C.S.A. certified (File No. LR40304).



ENGINEERING DATA

Item	Specifications
Contact Arrangement	SPDT, DPDT, 3PDT
Contact Rating	10A at 30V DC (resistive) — 10A at 240V AC (resistive) ⅓ HP at 120V AC, ½ HP at 240V AC
Initial Contact Resistance	100mΩ max. at 6V DC, 1A
Contact Material	Gold flashed silver-cadmium oxide
Rated Coil Voltage	6, 12, 24, 48, 110V DC — 12, 24, 48, 120, 240V AC
Coil Power Dissipation	DC: 1.2W, AC: 3PDT — 2.7VA, DPDT, SPDT — 2VA at rated voltage, 60 Hz
Coil Temperature Rise	DC: 40°C max., AC: 60° max.
Insulation Resistance	100MΩ min. at 500V DC
Dielectric Withstanding Voltage	2000V AC for 1 minute (1000V AC between open contacts)
Operate Time	30 ms max. at rated coil voltage
Release Time	30 ms max.
Life Expectancy — Mechanical	10×10^6 ops. min.
Electrical	100×10^3 ops. min. at rated load
Vibration	600 to 1500 rpm (Dual amplitude: 1mm)
Shock	10G (11 ms)
Temperature Range	DC: −45°C to +70°C/AC: 3PDT: −45°C to +45C°/DPDT, SPDT: −45°C to +55°C
Weight	80 gr. approx.

SELECTION TABLES

DC RELAYS

Contacts	Coil: Rated V DC	Coil: Resistance Ohms	Coil: Power Watts	Fujitsu Number QC/Solder Bracket Case*	Price	Fujitsu Number Plug-In	Price	Fujitsu Number PC Board	Price	Fujitsu Number Plug-In	Price
SPDT	6	32	1.2	FRL-251D006/01CS-OC	$6.32	FRL-253D006/01CS	$6.32	FRL-254D006/01CS	$6.32	FRL-256D006/01CS	$7.80
	12	120	1.2	FRL-251D012/01CS-OC	6.32	FRL-253D012/01CS	6.32	FRL-254D012/01CS	6.32	FRL-256D012/01CS	7.80
	24	470	1.2	FRL-251D024/01CS-OC	6.32	FRL-253D024/01CS	6.32	FRL-254D024/01CS	6.32	FRL-256D024/01CS	7.80
	48	1800	1.2	FRL-251D048/01CS-OC	6.32	FRL-253D048/01CS	6.32	FRL-254D048/01CS	6.32	FRL-256D048/01CS	7.80
	110	10000	1.2	FRL-251D110/01CS-OC	6.82	FRL-253D110/01CS	6.82	FRL-254D110/01CS	6.82	FRL-256D110/01CS	8.52
DPDT	6	32	1.2	FRL-251D006/02CS-OC	$6.86	FRL-253D006/02CS	$6.86	FRL-254D006/02CS	$6.86	FRL-256D006/02CS	$8.74
	12	120	1.2	FRL-251D012/02CS-OC	6.86	FRL-253D012/02CS	6.86	FRL-254D012/02CS	6.86	FRL-256D012/02CS	8.74
	24	470	1.2	FRL-251D024/02CS-OC	6.86	FRL-253D024/02CS	6.86	FRL-254D024/02CS	6.86	FRL-256D024/02CS	8.74
	48	1800	1.2	FRL-251D048/02CS-OC	6.86	FRL-253D048/02CS	6.86	FRL-254D048/02CS	6.86	FRL-256D048/02CS	8.74
	110	10000	1.2	FRL-251D110/02CS-OC	7.36	FRL-253D110/02CS	7.36	FRL-254D110/02CS	7.36	FRL-256D110/02CS	9.46
3PDT	6	32	1.2	FRL-251D006/03CS-OC	$8.00	FRL-253D006/03CS	$8.00	FRL-254D006/03CS	$8.00	FRL-256D006/03CS	$10.88
	12	120	1.2	FRL-251D012/03CS-OC	8.00	FRL-253D012/03CS	8.00	FRL-254D012/03CS	8.00	FRL-256D012/03CS	10.88
	24	470	1.2	FRL-251D024/03CS-OC	8.00	FRL-253D024/03CS	8.00	FRL-254D024/03CS	8.00	FRL-256D024/03CS	10.88
	48	1800	1.2	FRL-251D048/03CS-OC	8.00	FRL-253D048/03CS	8.00	FRL-254D048/03CS	8.00	FRL-256D048/03CS	10.88
	110	10000	1.2	FRL-251D110/03CS-OC	8.50	FRL-253D110/03CS	8.50	FRL-254D110/03CS	8.50	FRL-256D110/03CS	11.60

AC RELAYS

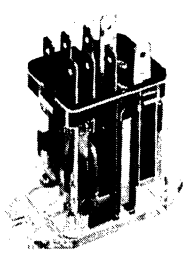
Contacts	Coil: Rated V AC	Coil: Current mA	Coil: Power VA	Fujitsu Number QC/Solder Bracket Case*	Price	Fujitsu Number Plug-In	Price	Fujitsu Number PC Board	Price	Fujitsu Number Plug-In	Price
SPDT	12	168	2.0	FRL-251A012/01CS-OC	$6.32	FRL-253A012/01CS	$6.32	FRL-254A012/01CS	$6.32	FRL-256A012/01CS	$7.80
	24	84	2.0	FRL-251A024/01CS-OC	6.32	FRL-253A024/01CS	6.32	FRL-254A024/01CS	6.32	FRL-256A024/01CS	7.80
	48	42	2.0	FRL-251A048/01CS-OC	6.32	FRL-253A048/01CS	6.32	FRL-254A048/01CS	6.32	FRL-256A048/01CS	7.80
	120	18	2.0	FRL-251A120/01CS-OC	6.86	FRL-253A120/01CS	6.82	FRL-254A120/01CS	6.82	FRL-256A120/01CS	8.52
	240	9	2.0	FRL-251A240/01CS-OC	7.12	FRL-253A240/01CS	7.12	FRL-254A240/01CS	7.12	FRL-256A240/01CS	9.32
DPDT	12	168	2.0	FRL-251A012/02CS-OC	$6.86	FRL-253A012/02CS	$6.86	FRL-254A012/02CS	$6.86	FRL-256A012/02CS	$ 8.74
	24	84	2.0	FRL-251A024/02CS-OC	6.86	FRL-253A024/02CS	6.86	FRL-254A024/02CS	6.86	FRL-256A024/02CS	8.74
	48	42	2.0	FRL-251A048/02CS-OC	6.86	FRL-253A048/02CS	6.86	FRL-254A048/02CS	6.86	FRL-256A048/02CS	8.74
	120	18	2.0	FRL-251A120/02CS-OC	7.36	FRL-253A120/02CS	7.36	FRL-254A120/02CS	7.36	FRL-256A120/02CS	9.46
	240	9	2.0	FRL-251A240/02CS-OC	7.66	FRL-253A240/02CS	7.66	FRL-254A240/02CS	7.66	FRL-256A240/02CS	10.26
3PDT	12	230	2.7	FRL-251A012/03CS-OC	$8.00	FRL-253A012/03CS	$8.00	FRL-254A012/03CS	$8.00	FRL-256A012/03CS	$10.88
	24	115	2.7	FRL-251A024/03CS-OC	8.00	FRL-253A024/03CS	8.00	FRL-254A024/03CS	8.00	FRL-256A024/03CS	10.88
	48	57	2.7	FRL-251A048/03CS-OC	8.00	FRL-253A048/03CS	8.00	FRL-254A048/03CS	8.00	FRL-256A048/03CS	10.88
	120	24	2.7	FRL-251A120/03CS-OC	8.50	FRL-253A120/03CS	8.50	FRL-254A120/03CS	8.50	FRL-256A120/03CS	11.60
	240	12	2.7	FRL-251A240/03CS-OC	8.80	FRL-253A240/03CS	8.80	FRL-254A240/03CS	8.80	FRL-256A240/03CS	12.40

* To order No. 6-32 tapped core mounting style, change suffix, **-OC** to **-OA-01** and add $0.90 to price shown; to order No. 6-32 stud mounting style, change suffix **-OC** to **-OB-01** and add $0.80 to price shown.

GENERAL PURPOSE RELAYS

FRL-260 SERIES

4PDT-3A, 3PDT-5A, DPDT-10A, SPDT-15A



The FRL-260 series relays with proven performance and top quality have been designed with emphasis on reliability, safety, cost performance and applicability to a wide range of uses.

These relays provide SPDT to 4PDT contacts, which are offered for contact ratings from 1 amp to 15 amps at 30V DC or 240V AC, resistive. Moreover, they are also available with 4 transfer bifurcated contacts that enable them to meet signal level or other light loads.

The FRL-260 series relays are available in both DC- and AC-rated coils, and with a selection of mountings, such as solder, plug-in, P.C. boards and quick connect terminals.

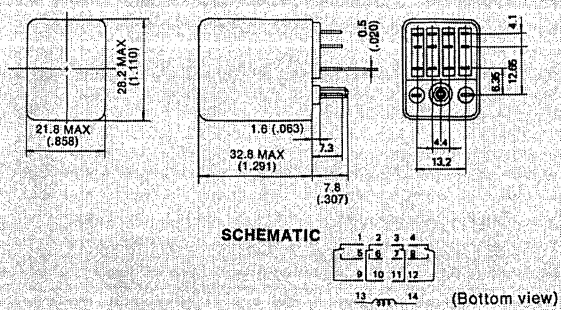
The FRL-260 series is UL recognized (File No. E63614/E63615) and C.S.A. certified.

ENGINEERING DATA

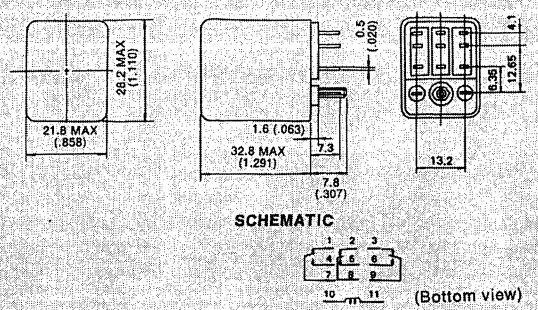
Item	Specifications
Contact Ratings (Resistive Load).	As per SELECTION TABLE
Initial Contact Resistance	General (S, K, V Contact): 100mΩ max. (at 6V DC, 1A) Low Level (T, L Contact): 50mΩ max. (at 6V DC, 0.1A)
Operate Time Release Time	25 ms max. (at rated coil voltage) 25 ms max.
Coil Power Dissipation Coil Temperature Rise	DC: 0.9W (at rated coil voltage) AC: 1.2 VA (120V max.) at rated coil voltage of 60 Hz 1.4 VA (200V min.) at rated coil voltage of 60 Hz DC: 50° max. AC: 60°C max.
Life Expectancy — Mechanical Electrical	50 x 10^6 ops. min. (at rated load) Medium Load SPDT: 500 x 10^3 ops. min. DPDT: 500 x 10^3 ops. min. 3PDT: 500 x 10^3 ops. min. 4PDT: 200 x 10^3 ops. min. 4PST: 100 x 10^3 ops. min. Heavy Load SPDT: 200 x 10^3 ops. min. SPST: 200 x 10^3 ops. min. DPDT: 500 x 10^3 ops. min.
Insulation Resistance	100MΩ min. (at 500V DC)
Dielectric Withstanding Voltage	1500V AC (1000V AC between open contacts) for 1 minute
Vibration	50 Hz (Dual Amplitude: 0.5mm)
Shock	10G (11 ms)
Temperature Range	−30°C to +55°C
Weight	35 gr. approx.

DIMENSIONS Unit: mm

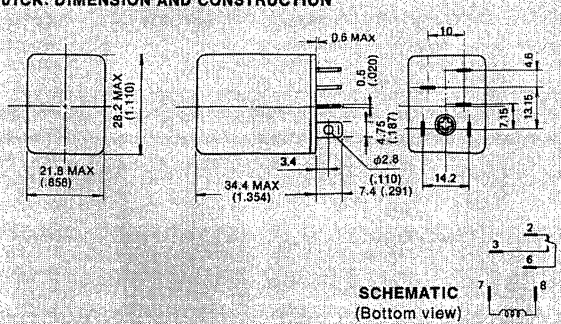
04CL: DIMENSION AND CONSTRUCTION
04CS: DIMENSION AND CONSTRUCTION
04CT: DIMENSION AND CONSTRUCTION
04CV: DIMENSION AND CONSTRUCTION



03CS: DIMENSION AND CONSTRUCTION



01CK: DIMENSION AND CONSTRUCTION



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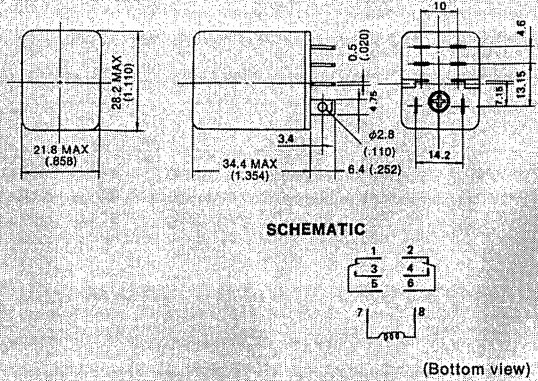


FUJITSU

RELAYS

FRL260 SERIES RELAYS SELECTION TABLE — DC COIL

Contact Arrangement and Material	Contact Ratings		Rated Voltage V DC 50/60 Hz	Coil Resistance ±15% Ohms @ 20°C	Pick-Up Voltage @ 20°C	Fujitsu Part Numbers (Plug-In)*	Price
	Resistive	Horsepower					
SPDT AgCdO	15A @ 30V DC or 150V AC 10A @ 240V AC	1/3 HP @ 120V AC 1/2 HP @ 240V AC	6	40	4.5	FRL263D006/01CK	$4.66
			12	160	9	FRL263D012/01CK	4.66
			24	650	18	FRL263D024/01CK	4.66
			48	2600	36	FRL263D048/01CK	4.66
			110	13300	82.5	FRL263D110/01CK	5.80
DPDT AgCdO	10A @ 30V DC or 240V AC	1/3 HP @ 120V AC 1/2 HP @ 240V AC	6	40	4.5	FRL263D006/02CK	$4.84
			12	160	9	FRL263D012/02CK	4.84
			24	650	18	FRL263D024/02CK	4.84
			48	2600	36	FRL263D048/02CK	4.84
			110	13300	82.5	FRL263D110/02CK	5.98
3PDT AgCdO	5A @ 30V DC or 240V AC	1/6 HP @ 120V AC	6	40	4.5	FRL263D006/03CS	$4.84
			12	160	9	FRL263D012/03CS	4.84
			24	650	18	FRL263D024/03CS	4.84
			48	2600	36	FRL263D048/03CS	4.84
			110	13300	82.5	FRL263D110/03CS	5.98
4PDT Ag + Au Clad	3A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	40	4.5	FRL263D006/04CL	$5.18
			12	160	9	FRL263D012/04CL	5.18
			24	650	18	FRL263D024/04CL	5.18
			48	2600	36	FRL263D048/04CL	5.18
			110	13300	82.5	FRL263D110/04CL	6.32
4PDT Ag	3A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	40	4.5	FRL263D006/04CS	$4.84
			12	160	9	FRL263D012/04CS	4.84
			24	650	18	FRL263D024/04CS	4.84
			48	2600	36	FRL263D048/04CS	4.84
			110	13300	82.5	FRL263D110/04CS	5.98
4PDT (Bifurcated) Ag + Au Clad	1A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	40	4.5	FRL263D006/04CT	$5.64
			12	160	9	FRL263D012/04CT	5.64
			24	650	18	FRL263D024/04CT	5.64
			48	2600	36	FRL263D048/04CT	5.64
			110	13300	82.5	FRL263D110/04CT	6.78
4PDT AgCdO	5A @ 30V AC or 240V AC	1/6 HP @ 120V AC	6	40	4.5	FRL263D006/04CV	$5.18
			12	160	9	FRL263D012/04CV	5.18
			24	650	18	FRL263D024/04CV	5.18
			48	2600	36	FRL263D048/04CV	5.18
			110	13300	82.5	FRL263D110/04CV	6.32

For CSA Certified Relays, –CSA suffix must be added to part number. Price is same.
* For PCB type terminals change prefix to FRL264

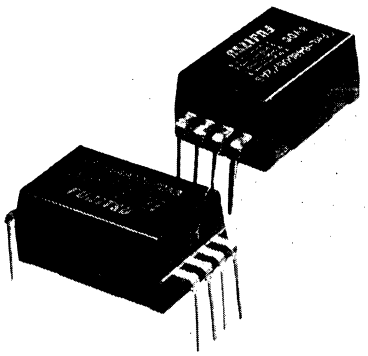
FRL260 SERIES RELAYS SELECTION TABLE — AC COIL

Contact Arrangement and Material	Contact Ratings		Rated Voltage V AC 50/60 Hz	Coil Resistance ±15% Ohms @ 20°C	Pick-Up Voltage @ 20°C	Fujitsu Part Numbers (Plug-In)*	Price
	Resistive	Horsepower					
SPDT AgCdO	15A @ 30V DC or 150V AC 10A @ 240V AC	1/3 HP @ 120V AC 1/2 HP @ 240V AC	6	9.5	4.8	FRL263A006/01CK	$4.66
			12	40	9.6	FRL263A012/01CK	4.66
			24	165	19.2	FRL263A024/01CK	4.66
			48	630	38.4	FRL263A048/01CK	4.66
			120	4400	96.0	FRL263A120/01CK	5.00
			240	13000	192.0	FRL263A240/01CK	6.66
DPDT AgCdO	10A @ 30V DC or 240V AC	1/3 HP @ 120V AC 1/2 HP @ 240V AC	6	9.5	4.8	FRL263A006/02CK	$4.84
			12	40	9.6	FRL263A012/02CK	4.84
			24	165	19.2	FRL263A024/02CK	4.84
			48	630	38.4	FRL263A048/02CK	4.84
			120	4400	96.0	FRL263A120/02CK	5.18
			240	13000	192.0	FRL263A240/02CK	6.84
3PDT AgCdO	5A @ 30V DC or 240V AC	1/6 HP @ 120V AC	6	9.5	4.8	FRL263A006/03CS	$4.84
			12	40	9.6	FRL263A012/03CS	4.84
			24	165	19.2	FRL263A024/03CS	4.84
			48	630	38.4	FRL263A048/03CS	4.84
			120	4400	96.0	FRL263A120/03CS	5.18
			240	13000	192.0	FRL263A240/03CS	6.84
4PDT Ag + Au Clad	3A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	9.5	4.8	FRL263A006/04CL	$5.18
			12	40	9.6	FRL263A012/04CL	5.18
			24	165	19.2	FRL263A024/04CL	5.18
			48	630	38.4	FRL263A048/04CL	5.18
			120	4400	96.0	FRL263A120/04CL	5.52
			240	13000	192.0	FRL263A240/04CL	7.18
4PDT Ag	3A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	9.5	4.8	FRL263A006/04CS	$4.84
			12	40	9.6	FRL263A012/04CS	4.84
			24	165	19.2	FRL263A024/04CS	4.84
			48	630	38.4	FRL263A048/04CS	4.84
			120	4400	96.0	FRL263A120/04CS	5.18
			240	13000	192.0	FRL263A240/04CS	6.84
4PDT (Bifurcated) Ag + Au Clad	1A @ 30V AC or 120V AC	1/10 HP @ 120V AC	6	9.5	4.8	FRL263A006/04CT	$5.64
			12	40	9.6	FRL263A012/04CT	5.64
			24	165	19.2	FRL263A024/04CT	5.64
			48	630	38.4	FRL263A048/04CT	5.64
			120	4400	96.0	FRL263A120/04CT	5.98
			240	13000	192.0	FRL263A240/04CT	7.64
4PDT AgCdO	5A @ 30V AC or 240V AC	1/6 HP @ 120V AC	6	9.5	4.8	FRL263A006/04CV	$5.18
			12	40	9.6	FRL263A012/04CV	5.18
			24	165	19.2	FRL263A024/04CV	5.18
			48	630	38.4	FRL263A048/04CV	5.18
			120	4400	96.0	FRL263A120/04CV	5.52
			240	13000	192.0	FRL263A240/04CV	7.18

For CSA Certified Relays, –CSA suffix must be added to part number. Price is same.
* For PCB type terminals change prefix to FRL264

MICRO REED RELAYS FOR P.C. BOARDS

FRL-648 SERIES



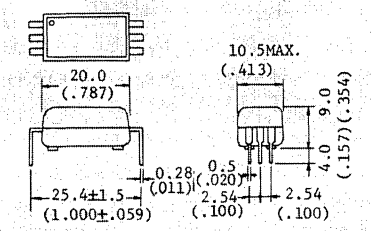
The FRL-648 Series Micro Reed Relays offer a wide selection and outstanding performance to meet those demanding on-board switching requirements and high density packaging applications.

These relays, available in 1 Form A/B and 2 Form A/B, feature a standard contact rating of 50VA/10W for S type/K type, compact size with a mounting height of only 9mm (.354"), epoxy-molded construction for immersion cleaning safety, low power consumption, and the option of magnetic shielding for isolation from the effects of adjacent relays.

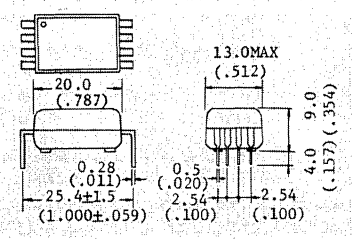
These relays are ideally used for various applications for audio equipment, data processing systems, communications, measuring and control equipment.

Fujitsu field proven dry reed switches are employed as the switching element in the relays in order to offer an excellent low resistance contact and low noise characteristics.

DIMENSIONS Unit: mm (inch)

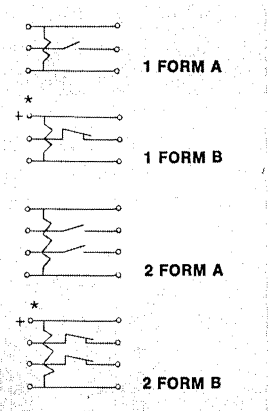


1 FORM A OR 1 FORM B



2 FORM A OR FORM B

SCHEMATICS (TOP VIEW)



* : dotted mark
Positive voltage should be applied at the terminal signed with (+) for correct operation

ENGINEERING DATA

Item	Characteristics
Contact Arrangement Contact Rating Initial Contact Resistance Contact Materials	1 Form A/B, 2 Form A/B Type K: 50VA max. (100V AC, 0.5A max.) 30W max. (100V DC, 0.7A max.) Type S: 10W max. (100V DC, 0.5A max.) 150mΩ max. at rated voltage Rhodium
Rated Coil Voltage Coil Temperature Rise	5, 6, 12, 24V DC 20°C max.
Insulation Resistance Dielectric Withstanding Voltage	100MΩ min. at 100V DC 500V DC (200V DC between open contacts)
Operate Time Release Time	1.0 ms max. including bounce time Form A: 0.1 ms max. including bounce time Form B: 1.0 ms max. including bounce time
Life Expectancy	K type 1 x 10^6 min at rated load S type: 5 x 10^6 min. at rated load
Vibration	10 to 55Hz (Dual amplitude: 1.5mm)
Shock	30G
Temperature Range	Form A: −10°C to +70°C Form B: −10°C to +50°C
Weight	6 gr. approx.

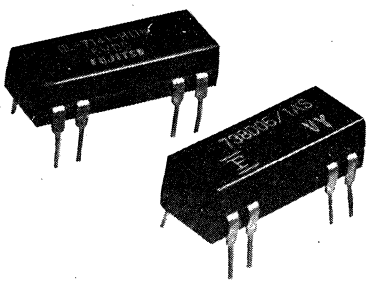
SELECTION TABLE

Type	Contact: Materials	Contact: Arrangements	Rated Voltage in V DC	Pick-Up Voltage in V DC at 20°C	Coil Resistance in Ohm ±15% at 20°C	Coil Power Dissipation in mW	Designation	Price
Standard	Rhodium	1 Form A (Make)	5	3.8	550	45	FRL-648D05/1AS	$1.82
			6	4.5	550	65	FRL-648D06/1AS	1.82
			12	9.0	1050	140	FRL-648D12/1AS	1.82
			24	18.0	2800	200	FRL-648D24/1AS	2.12
Standard	Rhodium	1 Form B (Break)	5	3.8	300	85	FRL-648D05/1BS	$3.48
			6	4.5	300	120	FRL-648D06/1BS	3.48
			12	9.0	1300	110	FRL-648D12/1BS	3.48
			24	18.0	3800	150	FRL-648D24/1BS	3.78
Standard	Rhodium	2 Form A (Make)	5	3.8	210	120	FRL-648D05/2AS	$2.42
			6	4.5	210	170	FRL-648D06/2AS	2.42
			12	9.0	800	180	FRL-648D12/2AS	2.42
			24	18.2	2600	220	FRL-648D24/2AS	2.72
Standard	Rhodium	2 Form B (Break)	5	3.8	80	300	FRL-648D05/2BS	$4.10
			6	4.5	105	340	FRL-648D06/2BS	4.10
			12	9.0	460	310	FRL-648D12/2BS	4.10
			24	18.0	1500	380	FRL-648D24/2BS	4.40
Heavy Load	Rhodium	1 Form A (Make)	5	3.8	550	45	FRL-648D05/1AK	$1.96
			6	4.5	550	65	FRL-648D06/1AK	1.96
			12	9.0	1050	140	FRL-648D12/1AK	1.96
			24	18.0	2800	200	FRL-648D24/1AK	2.28
Heavy Load	Rhodium	1 Form B (Break)	5	3.8	300	85	FRL-648D05/1BK	$3.64
			6	4.5	300	120	FRL-648D06/1BK	3.64
			12	9.0	1300	110	FRL-648D12/1BK	3.64
			24	18.0	3800	150	FRL-648D24/1BK	3.94
Heavy Load	Rhodium	2 Form A (Make)	5	3.8	210	120	FRL-648D05/2AK	$2.58
			6	4.5	210	170	FRL-648D06/2AK	2.58
			12	9.0	800	180	FRL-648D12/2AK	2.58
			24	18.0	2600	220	FRL-648D24/2AK	2.88
Heavy Load	Rhodium	2 Form B (Break)	5	3.8	80	300	FRL-648D05/2BK	$4.24
			6	4.5	105	340	FRL-648D06/2BK	4.24
			12	9.0	460	310	FRL-648D12/2BK	4.24
			24	18.0	1500	380	FRL-648D24/2BK	4.54

FUJITSU

RELAYS

D.I.P. REED RELAYS
FRL-730 SERIES

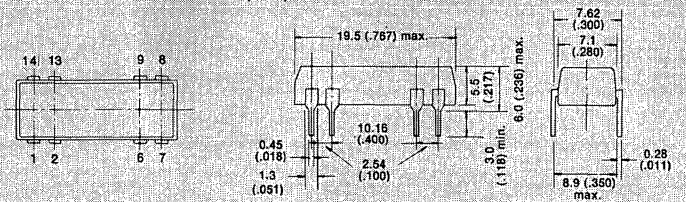


The FRL-730 Series D.I.P. Reed Relays are available in 1 Form A contact with contact rating capability of up to 10VA.

These relays can be mounted in the standard 14-pin dual-in-line package with epoxy-molded construction for safe immersion cleaning. Models with diode and/or electrostatic shield are available.

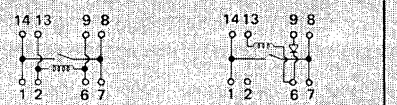
These FRL-730 D.I.P. reed relays are ideal for use in data processing systems and communications, measuring and control equipment.

DIMENSIONS Unit: mm (inch)

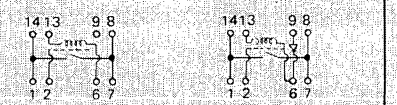


SCHEMATICS (TOP VIEW)

FRL-734 TYPE

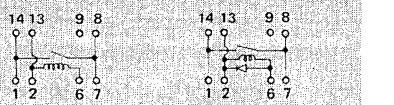


Standard (1AS) | With Diode (1AS-2)

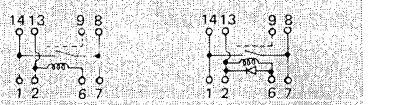


With Electrostatic Shield (1AS-3) | With Electrostatic Shield & Diode (1AS-4)

FRL-738 TYPE



Standard (1AS) | With Diode (1AS-2)



With Electrostatic Shield (1AS-3) | With Electrostatic Shield & Diode (1AS-4)

ENGINEERING DATA

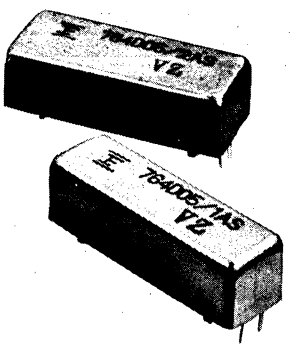
Item	Characteristics
Contact Arrangement	1 Form A
Contact Rating	10 VA max. (100V DC or peak AC max., 0.5A max.) 2.0A max. carry only
Initial Contact Resistance	150mΩ max.
Contact Material	Rhodium
Rated Coil Voltage	5, 6, 12V DC
Coil Temperature Rise	20°C max.
Insulation Resistance	10^{10}Ω min. at 100V DC, +20°C, 40% RH
Dielectric Withstanding Voltage	250V DC min. across open contacts 500V DC min. (between other mutually insulated terminals)
Operate Time	1.0 ms max. including bounce time
Release Time	0.1 ms max.
Life Expectancy	1 x 10^6 min. at rated load (resistive)
Vibration	10 to 55 Hz (Dual amplitude: 1.5mm)
Shock	50G
Temperature Range	−10°C to +70°C
Weight	4 gr. approx.

SELECTION TABLE

Contact Arrangement	Rated Coil Voltage in V DC	Coil Resistance at 20°C in Ω ±15%	Must Operate Voltage at 20°C in V DC	FRL-734 Type		FRL-738 Type	
				Designation	Price	Designation	Price
1A Standard	5	380	3.8	FRL-734D05/1AS	$3.12	FRL-738D05/1AS	$3.12
	6	380	4.5	FRL-734D06/1AS	3.12	FRL-738D06/1AS	3.12
	12	530	9.0	FRL-734D12/1AS	3.42	FRL-738D12/1AS	3.42
1A With Diode	5	380	3.8	FRL-734D05/1AS-2	$3.90	FRL-738D05/1AS-2	$3.90
	6	380	4.5	FRL-734D06/1AS-2	3.90	FRL-738D06/1AS-2	3.90
	12	530	9.0	FRL-734D12/1AS-2	4.22	FRL-738D12/1AS-2	4.22
1A With Electrostatic Shield	5	380	3.8	FRL-734D05/1AS-3	$3.42	FRL-738D05/1AS-3	$3.42
	6	380	4.5	FRL-734D06/1AS-3	3.42	FRL-738D06/1AS-3	3.42
	12	530	9.0	FRL-734D12/1AS-3	3.72	FRL-738D12/1AS-3	3.72
1A With Electrostatic Shield & Diode	5	380	3.8	FRL-734D05/1AS-4	$4.22	FRL-738D05/1AS-4	$4.22
	6	380	4.5	FRL-734D06/1AS-4	4.22	FRL-738D06/1AS-4	4.22
	12	530	9.0	FRL-734D12/1AS-4	4.52	FRL-738D12/1AS-4	4.52

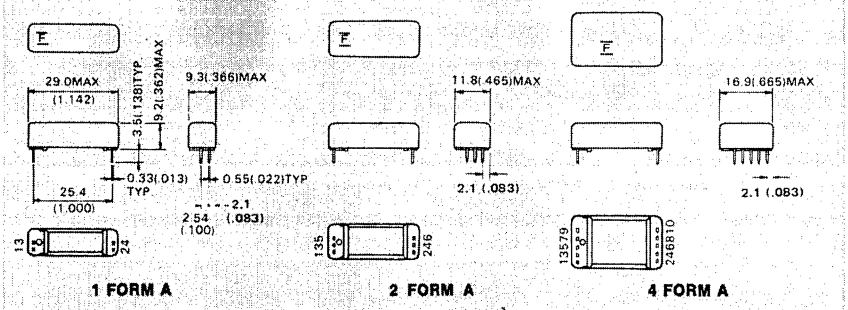
MICRO REED RELAYS FOR P.C. BOARDS

FRL-764 and 768 SERIES

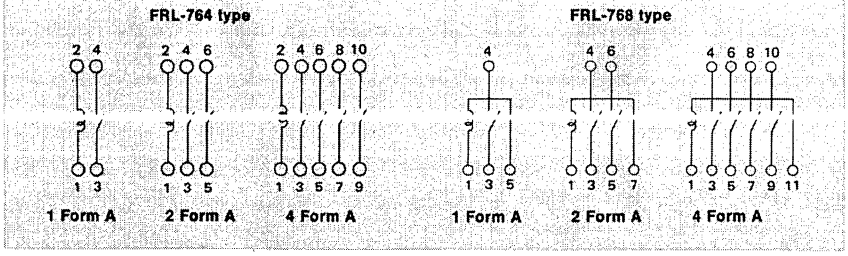


FRL-764 and 768 Series Micro Reed Relays offer excellent operating characteristics such as fast operating time, high reliability and long life. Available in a choice of contact arrangements (1 Form A, 2 Form A and 4 Form A) and contact rating capabilities (10W for standard type and 30W DC, 50VA AC for heavy load type), they are potted by polyurethane resin. These low-profile relays are compatible with 1 x .1 inch grid spacing for P.C. board mounting. These micro reed relays are ideal for use in telecommunications, audio equipment, process control systems and vending machines.

DIMENSIONS Unit: mm (inch)



SCHEMATICS



ENGINEERING DATA

Item	Characteristics
Contact Arrangement	1 Form A, 2 Form A, 4 Form A
Contact Rating Power	Standard: 10W max. (resistive) — Heavy Load Type: 30W DC, 50VA AC max. (resistive)
Voltage	Standard: 100V DC max. (resistive) — Heavy Load Type: 100V DC/100V AC max. (resistive)
Current	Standard: 0.5A DC switched max. (resistive) — Heavy Load Type: 0.5A AC switched max. 2.0A carry only max. (resistive)
Initial Contact Resistance	150mΩ max.
Contact Material	Rhodium
Rated Coil Voltage	5, 6, 12, 24V DC
Coil Temperature Rise	30°C max.
Insulation Resistance	10^{10}Ω min. at 100V DC at 20°C, 40% RH
Dielectric Withstanding Voltage	200V DC min. across open contacts 500V DC min. between other mutually insulated terminals
Operate Time	1.0 ms max. including bounce
Release Time	0.1 ms max.
Life Expectancy	K type: 1 x 10^6 min. at rated load S type: 5 x 10^6 min. at rated load
Vibration	10~55 Hz (Dual amplitude: 1.5mm)
Shock	30G, 11 ms half-sinewave
Temperature Range	−10°C~+70°C
Weight	8.5 gr. approx. (2 Form A)

SELECTION TABLES

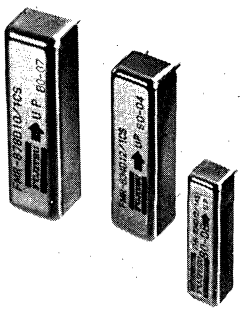
Type	Contact Arrangement	Coil Rated Voltage in V DC	Must Operate Voltage in V DC at 20°C	Coil Resistance in Ω ±15% at 20°C	Coil Power Dissipation in mW	Designation FRL-764	Price	Designation FRL-768	Price
Standard	1 Form A	5	3.8	310	80	FRL-764D05/1AS	$2.88	FRL-768D05/1AS	$2.88
		6	4.5	310	116	FRL-764D06/1AS	2.88	FRL-768D06/1AS	2.88
		12	9.0	1500	96	FRL-764D12/1AS	2.88	FRL-768D12/1AS	2.88
		24	18.0	4400	131	FRL-764D24/1AS	3.18	FRL-768D24/1AS	3.18
Standard	2 Form A	5	3.8	150	167	FRL-764D05/2AS	$3.64	FRL-768D05/2AS	$3.64
		6	4.5	150	240	FRL-764D06/2AS	3.64	FRL-768D06/2AS	3.64
		12	9.0	730	198	FRL-764D12/2AS	3.64	FRL-768D12/2AS	3.64
		24	18.0	2500	231	FRL-764D24/2AS	3.94	FRL-768D24/2AS	3.94
Standard	4 Form A	5	3.8	60	417	FRL-764D05/4AS	$6.00	FRL-768D05/4AS	$6.00
		6	4.5	90	400	FRL-764D06/4AS	6.00	FRL-768D06/4AS	6.00
		12	9.0	330	436	FRL-764D12/4AS	6.00	FRL-768D12/4AS	6.00
		24	18.0	1300	443	FRL-764D24/4AS	6.30	FRL-768D24/4AS	6.30
Heavy Load	1 Form A	5	3.8	310	80	FRL-764D05/1AK	$3.04	FRL-768D05/1AK	$3.04
		6	4.5	310	116	FRL-764D06/1AK	3.04	FRL-768D06/1AK	3.04
		12	9.0	1500	96	FRL-764D12/1AK	3.04	FRL-768D12/1AK	3.04
		24	18.0	4400	131	FRL-764D24/1AK	3.34	FRL-768D24/1AK	3.34
Heavy Load	2 Form A	5	3.8	150	167	FRL-764D05/2AK	$3.94	FRL-768D05/2AK	$3.94
		6	4.5	150	240	FRL-764D06/2AK	3.94	FRL-768D06/2AK	3.94
		12	9.0	730	198	FRL-764D12/2AK	3.94	FRL-768D12/2AK	3.94
		24	18.0	2500	231	FRL-764D24/2AK	4.24	FRL-768D24/2AK	4.24
Heavy Load	4 Form A	5	3.8	60	417	FRL-764D05/4AK	$6.60	FRL-768D05/4AK	$6.60
		6	4.5	90	400	FRL-764D06/4AK	6.60	FRL-768D06/4AK	6.60
		12	9.0	330	436	FRL-764D12/4AK	6.60	FRL-768D12/4AK	6.60
		24	18.0	1300	443	FRL-764D24/4AK	6.90	FRL-768D24/4AK	6.90

FUJITSU

RELAYS

MERCURY WETTED CONTACT RELAYS

FMR-800 SERIES

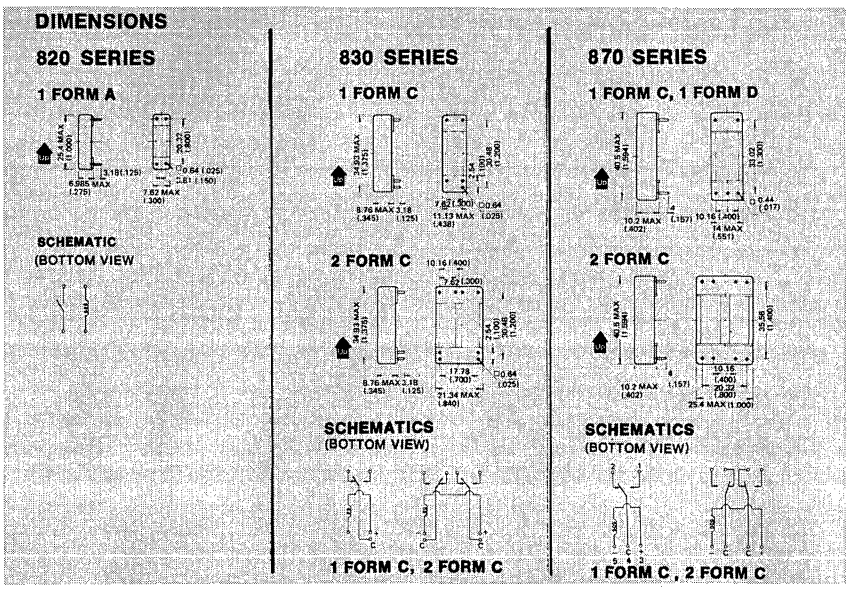


Fujitsu FMR-800 Series mercury wetted contact relays are compact for P.C. board mounting.

Highly stable, they can be used for a wide range of current switching from very low levels to heavy loads. Conventional flux cleaning can be used after P.C. board mounting as these relays are potted with polyurethane resin. The mercury switching gives these relays a bounce-free contact and an extremely long operating life. Therefore, Fujitsu mercury wetted contact relays are ideal for use in measuring equipment, communications systems, computer systems, automatic control systems etc.

FEATURES

- Extremely long life expectancy (10 x 10^9 operations)
- Short operate/release time (2 ms) and no contact bounce
- Stable, low contact resistance
- Available for wide current range switching from low level signals to 2 amps
- Contacts are independent from atmospheric conditions



SELECTION TABLE

Series	Contact Arrangement	Rated Voltage in V DC	Coil Resistance in Ω at 20°C	Coil Power Dissipation in mW	Operate in V DC at 20°C	Release in V DC at 20°C	Designation	Price
820 Series	1 Form A	5	350	72	4.0	0.5	FMR-824D05/1AS	$ 8.86
		6	350	103	4.8	0.6	FMR-824D06/1AS	8.86
		12	950	152	9.6	1.2	FMR-824D12/1AS	8.86
		24	2742	210	19.2	2.4	FMR-824D24/1AS	9.46
830 Series	1 Form C	5	117	214	2.9	0.52	FMR-834D05/1CS	$14.36
		6	196	184	3.5	0.66	FMR-834D06/1CS	14.36
		12	720	200	7.0	1.3	FMR-834D12/1CS	14.36
		24	2730	211	14.0	2.6	FMR-834D24/1CS	15.16
		48	10,000	231	28.0	5.2	FMR-834D48/1CS	15.94
830 Series	2 Form C	5	56	447	2.9	0.52	FMR-834D05/2CS	$23.90
		6	90	400	3.5	0.66	FMR-834D06/2CS	23.90
		12	392	368	7.0	1.3	FMR-834D12/2CS	23.90
		24	1440	400	14.0	2.6	FMR-834D24/2CS	24.72
		48	5460	422	28.0	5.2	FMR-834D48/2CS	25.52
830 Series	2 Form C (with C.O.T.)	5	56	447	2.9	0.52	FMR-834D05/2CT	$25.52
		6	90	400	3.5	0.66	FMR-834D06/2CT	25.52
		12	392	368	7.0	1.3	FMR-834D12/2CT	25.52
		24	1440	400	14.0	2.6	FMR-834D24/2CT	26.30
		48	5460	422	28.0	5.2	FMR-834D48/2CT	27.12
870 Series*	1 Form C	5	125	200	2.9	0.61	FMR-874D05/1CS	$13.88
		6	125	290	3.5	0.75	FMR-874D06/1CS	13.88
		12	685	210	7.1	1.5	FMR-874D12/1CS	13.88
		24	2650	220	14.0	3.0	FMR-874D24/1CS	14.68
870 Series*	1 Form D	5	125	200	2.9	0.61	FMR-874D05/1DS	$13.88
		6	125	290	3.5	0.75	FMR-874D06/1DS	13.88
		12	685	210	7.1	1.5	FMR-874D12/1DS	13.88
		24	2650	220	14.0	3.0	FMR-874D24/1DS	14.68
870 Series*	2 Form C	5	55	455	2.6	0.55	FMR-874D05/2CS	$23.12
		6	55	655	3.4	0.7	FMR-874D06/2CS	23.12
		12	370	390	6.7	1.4	FMR-874D12/2CS	23.12
		24	1370	421	13.0	2.7	FMR-874D24/2CS	24.40
870 Series*	2 Form C (with C.O.T.)	5	55	455	2.6	0.55	FMR-874D05/2CT	$24.72
		6	55	655	3.4	0.7	FMR-874D06/2CT	24.72
		12	370	390	6.7	1.4	FMR-874D12/2CT	24.72
		24	1370	421	13.0	2.7	FMR-874D24/2CT	26.00

* FMR-878 Series is available with .093 inch grid spacing instead of .100 inch grid. Price is same as FMR-874 Series.

ENGINEERING DATA

	FMR-820	FMR-830			FMR-870			
Contact Arrangements	1 Form A	1 Form C	2 Form C	2 Form C (with C.O.T.)	1 Form C	1 Form D	2 Form C	2 Form C (with C.O.T.)
Contact Ratings — Switching Carry Current	50 VA max. 1A max. 350V DC max. 2A max.	100 VA max. 2A max., 500V DC max. 5A max.						
Initial Contact Resistance	50 mΩ max.	30 mΩ max.	30 mΩ max.	30 mΩ max.	30 mΩ max.	30 mΩ max.	30 mΩ max.	30 mΩ max.
Operate Time Release Time	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.	2.0 ms max. 2.0 ms max.
Insulation Resistance Dielectric Withstanding Voltage	1000 MΩ min. (500V DC) 1000V AC min.	100 MΩ min. (500V DC) 1000V AC min.	100 MΩ min. (500V DC) 1000V AC min.	100 MΩ min. (500V DC) 1000V AC min.	100 MΩ min. (500V DC) 1000V AC min.	100 MΩ min. (500V DC) 1000V AC min.	1000 MΩ min. (500V DC) 1000V AC min.	1000 MΩ min. (500V DC) 1000V AC min.
C.O.T. (Common Open Type)	—	—	—	50 μs min. (100 Hz, 50% duty)	—	—	—	50 μs min. (100 Hz, 50% duty)
Operating Temptrature Range	−38°C to +90°C (include coil temperature rise)							
Vibration	10 Hz to 55 Hz (Dual amplitude: 1.5mm)							
Shock	30G							

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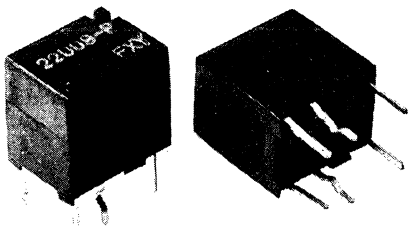
FUJITSU

RELAYS

MICROMINIATURE RELAYS FOR P.C. BOARDS

FBR20 SERIES

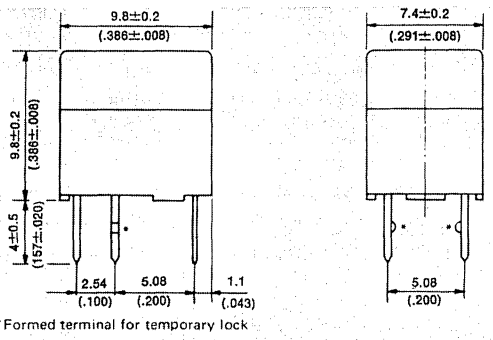


Fujitsu FBR20 series relays are designed for PC board mounting with 1A contact ratings — perfect for microminiature applications.

FEATURES

- **Microminiature size**
  Two FBR20 series relays can be mounted in the space now for a single FBR210 series relay.
- **1A contact rating**
  Despite their microminiature size, FBR20 series relays have contact rating of 1A at 24 VDC for convenient installation.
- **Gold overlay bifurcated contact**
  Contact reliability is assured in low level applications by contact shapes and materials especially designed for signal switching applications.
- **Low power consumption**
  With a rated power consumption of only 0.3W, today's expensive energy costs can be reduced significantly.
- **Wide range of drive voltages**
  Drive voltages from 1.5 VDC to 24 VDC are available for a wide range of applications.
- **Strong shock resistance**
  Even with a 50G shock, FBR20 series relays never miss a switch.
- **Easy to pattern-design**
  Separate terminal connection with drive and output sections allow easy pattern design.
- **Formed terminal available for temporary lock**
  The unique design of the forming terminal allows FBR20 series relays to be temporary mounted for greater design flexibility.
- **Automatic soldering provision**
  The terminal is sealed to prevent flux from entering during automatic soldering.

DIMENSIONS



*Formed terminal for temporary lock

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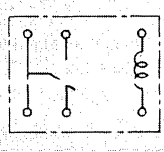
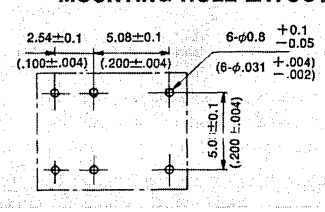


MOUNTING HOLE LAYOUT



ENGINEERING DATA

Item	Specifications
Contact Arrangement	SPDT (1 Form C)
Contact Shape	Single contact (FBR21), Bifurcated contact (FBR22)
Contact Material	Gold overlay silver, Gold overlay silver-palladium alloy (—P)
Contact Rating	24 VDC-1A, 120 VAC-0.5A (resistive load)
Maximum Carrying Current	2A
Maximum Switching Voltage	125 VDC, 125 VAC
Maximum Switching Power	24 WDC, 60 VA AC (resistive load)
Initial Contact Resistance	100mΩ max. (measured at 6V DC-0.1A)
Coil Power	0.3W (at rated voltage, 20°C)
Coil Temperature Rise	45°C (at rated voltage, 20°C)
Insulation Resistance	1,000mΩ min. (at 500 VDC)
Withstanding Voltage	Between contacts: 500 VAC for 1 minute Between contact and coil: 750 VAC for 1 minute
Vibration	20G, 10 ~ 300 Hz (dual amplitude, maximum 3.0 mm). No contact chatter longer than 1.0 ms.
Shock	Operation error: 50G (sine half-wave of 11 ms). No contact chatter longer than 1.0 ms.
Operate Time	5 ms max. (at rated voltage)
Release Time	3 ms max. (after rated operation)
Life Expectancy	Mechanical: 5 x 10^6 cps. min. Electrical: Gold-overlay silver contacts: 100 x 10^3 ops. min. Gold-overlay silver-palladium alloy contacts: 200 x 10^3 ops. min. (at rated contact load)
Maximum Switching Frequency	Mechanical: 18,000 operations/hour Electrical: 1,800 operations/hour (at contact rated load)
Ambient Temperature	−30°C ~ +65°C (at rated operation)
Ambient Humidity	45 ~ 85% RH
Weight	1.7 g (approx.)

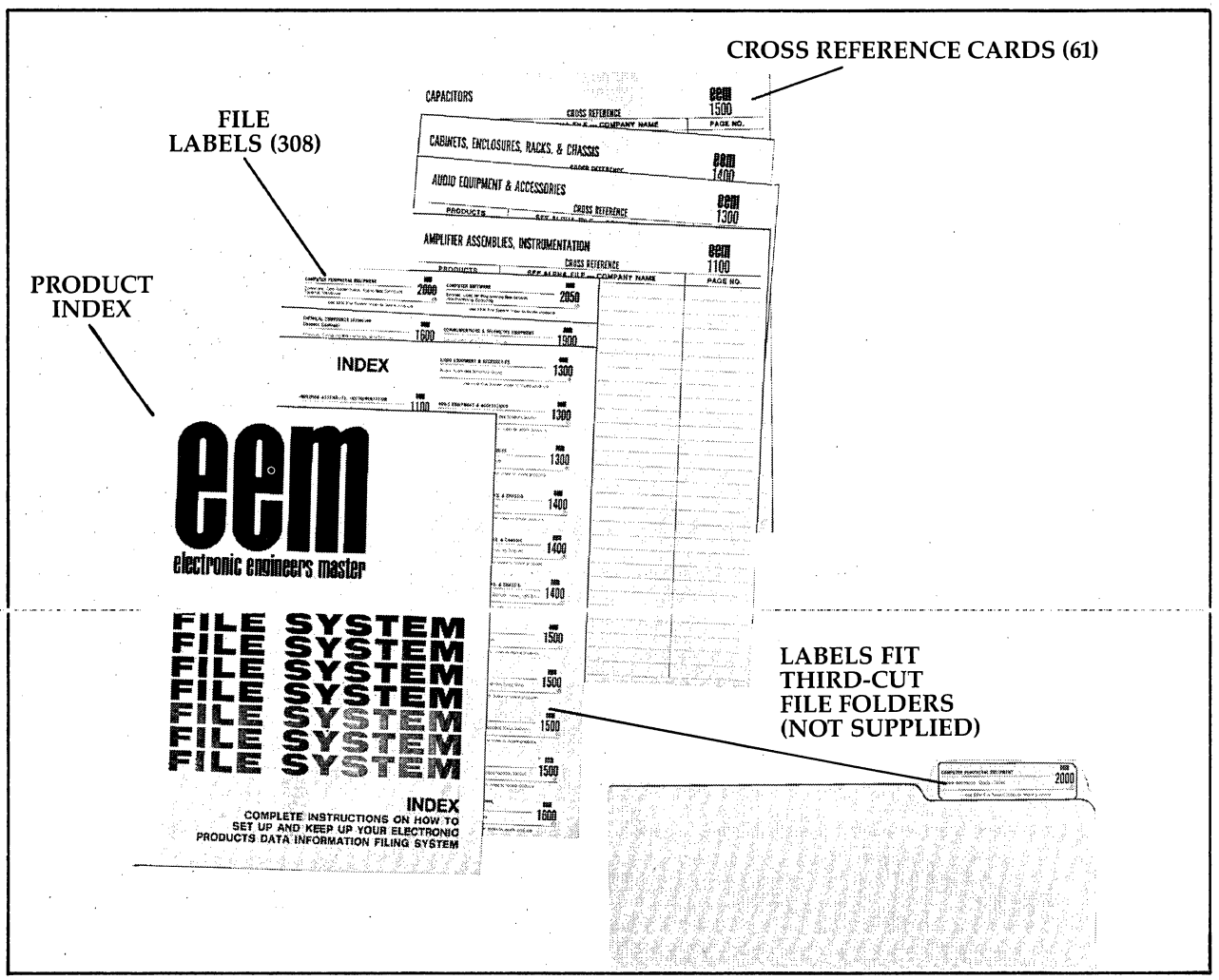
SELECTION TABLE

Type	Voltage Specifications	Coil Rated Voltage	Coil Resistance (±10%)	Coil Current (At Rated Voltage)	Pick-up Voltage	Drop-out Voltage	Maximum Voltage Allowance	Rated Power Consumption	Coil Temperature Rise
Standard Type	D01	DC 1.5V	7.5Ω	approx. 200mA	Less than 80% of rated voltage	More than 5% of rated voltage	160% of rated voltage	Approx. 300mW (at rated voltage)	Approx. 45 deg. (at rated voltage)
	D03	DC 3 V	30 Ω	approx. 100mA					
	D05	DC 5 V	83 Ω	approx. 60mA					
	D06	DC 6 V	120 Ω	approx. 50mA					
	D09	DC 9 V	270 Ω	approx. 33mA					
	D12	DC 12 V	480 Ω	approx. 25mA					
	D18	DC 18 V	1,080 Ω	approx. 17mA					

Notes: 1. 24V relay is available by request.
2. Measured at 20°C

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.



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The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

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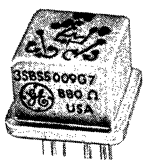
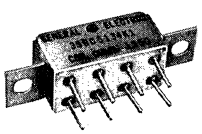
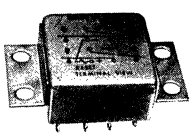
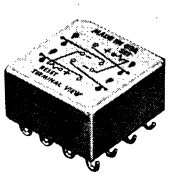
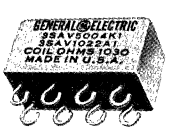
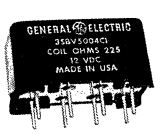
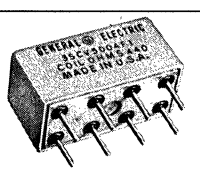
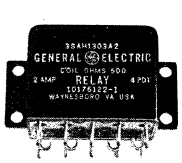
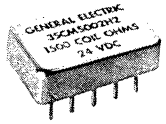
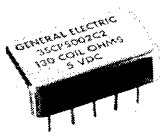
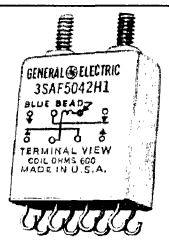
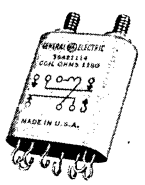
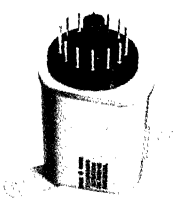
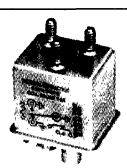
Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

SEALED RELAY Selection Guide

RELAY TYPE	PICTURE	CONTACT ARRANGEMENT	CONTACT LIFE: CURRENT LEVELS AT 28 VDC AT 115 VAC*	CONTACT LIFE: OPERATIONS	SIZE NO MOUNT L" × W" × H" & WEIGHT (OZ.)	OPERATE SENSITIVITY (MILLIWATTS)	APPLICABLE MIL SPEC MIL-R-	SHOCK	VIBRATION	TEMPERATURE RANGE	CATALOG GEA6628 PAGE NO.
3SBS Transistor Size Relay		2PDT	1A DC Res .2A DC Ind Low Level	10^5 / 10^6	Size .37 × .37 × .275 Weight 0.09	120 mW	39016/9 39016/15 39016/20	100G @ 11ms	30G 55-3000 Hz	−65C +125C	6-7
3SBC ¼ Size Two Pole 150 Grid Hybrid		2PDT 1PDT 1A, 1B	2A DC Res .5A DC Ind .5-AC Low Level	10^5 / 10^6	Size .61 × .31 × .32 Weight 0.13	135 mW	39016/13 39016/37 39016/38	100G @ 11 ms	30G 55-3000 Hz	−65C +125C	8-9 10-11
3SBH ¼ Size Four Pole 150 Grid		4PDT	2A DC Res .5A DC Ind .5A-AC Low Level	10^5 / 10^6	Size .61 × .61 × .32 Weight 0.24	250 mW	39016/14	100G @ 11 ms	30G 3000 Hz	−65C +125C	12-13
3SBM ¼ Size 150 Grid Latching Hybrid		4PDT	2A DC Res .5A DC Ind .5A-DC Low Level	10^5 / 10^6	Size .61 × .61 × .32 Weight 0.28	100mW Single Coil or 180mW Dual Coil	39016/31 39016/35 39016/36	150G @ 11 ms	30G 3000 Hz	−65C +125C	14-15 16-17
3SAV Half-Size Sensitive R.F.		2PDT	2A DC Res .5A DC Ind .75 A-AC Low Level	10^5 / 10^6	Size .80 × .40 × .40 Weight 0.30	100mW to 260mW	39016/6 39016/22 39016/33 39016/44	100G @ 11ms	30G 3000 Hz	−65C +125C	18-19 22-23 24-25
3SBV Industrial Half-Size		2PDT	2A DC Res .5A-AC Low Level	10^5 / 10^6	Size .88 × .48 × .49 Weight 0.30	285 mW				−45C +71C	20
3SCV Long Life Half-Size		2PDT	2A DC Res .5A DC Ind .5A-AC Low Level	10^5 / 100×10^6	Size .80 × .40 × .40 Weight .30	340mW				−55C +125C	21
3SAH Four Pole Grid		4PDT	2A DC Res .5A DC Ind 1A-AC Low Level	4×10^5 at 1A DC at 0.5A ac 2×10^5 at 2A dc at 1A DC / 2×10^6	Size 1.01 × .61 × .81 Weight 1.0	400 mW	39016/39	50G @ 11ms	30G 55-3000 Hz	−65C +125C	26-27

*Single-phase load, case not grounded

RELAY TYPE	PICTURE	CONTACT ARRANGEMENT	CONTACT LIFE: CURRENT LEVELS AT 28 VDC AT 115 VAC*	CONTACT LIFE: OPERATIONS	SIZE L" × W" × H" & WEIGHT (OZ.) NO MOUNT	OPERATE SENSITIVITY (MILLIWATTS)	APPLICABLE MIL SPEC MIL-R-	SHOCK	VIBRATION	TEMPERATURE RANGE	DCP OR CATALOG PAGE NO.
3SCM DeciGrid® Mag-Latch 1/10 Size		2PDT	0.5A DC Res Low Level	10^5 5×10^5	Size .350 × .575 × .165 Weight 2. Grams	105 mW	39016/47	100G @ 6ms	50G-3000 Hz	−65C +125C	DCP 1358
3SCP DeciGrid® Mono-stable 1/10 Size		2PDT	5A DC Res Low Level	10^5 5×10^5	Size .350 × .575 × .165 Weight 2. Grams	68 mW	39016/48	100G @ 6ms	50G-3000 Hz	−65C +125C	DCP 1359
3SAM Mag-Latch Grid-Space		2PDT	2A DC Res .5A DC Ind 1A-AC Low Level	10^5 at 2A DC at 1A AC 10^6	Size .80 × .40 × .90 Weight 0.60	50mW Single Coil 75mW Dual Coil	39016/32	150G @ 11ms	30G 3000 Hz	−65C +125C	28-29
3SAF Grid Spaced Micro Crystal Can		2PDT	2A DC Res 1A DC Ind 1A-AC Low Level	10^5 at 2A DC 10^6	Size .80 × .40 × .90 Weight 0.50	300 mW	5757/10	100G @ 11 ms	30G 55-2000 Hz	−65C +125C	30-31
3SAE Crystal Can "S" Header		2PDT	2A DC Res 1A DC Ind 1A-AC Low Level	10^5 at 2A DC at 2A AC 10^6	Size .797 × .359 × .875 Weight 0.45	330mW	5757/10	100G @ 11ms	20G 55-2000 Hz	−65C +125C	32-33
3SCA Miniature Industrial Relays		2PDT 4PDT 6NO	5A DC Res 2A DC Ind 5A-AC Low Level	10^5 at 5A DC 10^6	1.67 × 1.48 × 2.1 Weight 4.5	600mW				0C +71C	34-35 and DCP 1003
3SBW RF Relay		1PDT	15 Watts RF	2×10^5 at RF	1.150 × .950 × .840 Weight 1.0	250mW			10G 500 Hz	−65C +85C	36-37

*Single-phase load, case not grounded

For additional publications and product information contact:
General Electric Company, Data Communication Products Department
Relay Operation, Waynesboro, VA 22980, 1-703-949-1471

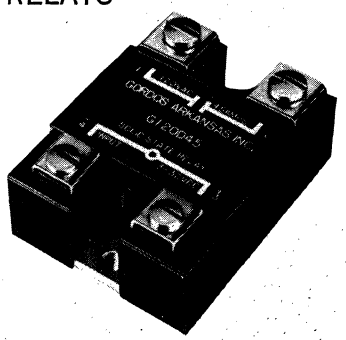
GENERAL ELECTRIC

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(photo isolation — Back-to-Back SCR)

G SERIES

BACK-TO-BACK SCR AC SOLID STATE RELAYS



- Back-to-back (dual) SCR output for switching highly inductive AC loads
- Superior turn-on immunity and positive turn-off ability at high dv/dt
- Optical coupling
- Zero-voltage turn-on
- 10 to 45 Arms current ratings
- Output RC network
- 3-32 VDC and 90-280 VAC input ratings
- 24 to 480 VAC line voltages
- UL recognized. CSA certified
- Some models optionally available in compliance with VDE specs 0730, 0730 part 2P, 0806, and IEC Specs 380 and 435. **(Consult factory for details)**

POWER CIRCUIT OUTPUT SPECIFICATIONS

Maximum Line Voltage Code Number	120	240	280	480
Maximum Line Voltage	140	250	280	480
Minimum Line Voltage	24	24	24	48
Nominal Line Voltage	120	240	240	440
Maximum AC Leakage (mArms At Rated Voltage)				
10 A relays	9	9	9	15
25 A & &45 A relays	15	15	15	—
Line Frequency	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Minimum Blocking Voltage	250 V	500 V	600 V	800 V
Zero Crossing[2]	5°	5°	5°	5°

[1] Output circuit includes RC Snubber Network
[2] Measured utilizing a resistive load

Maximum Load Current Code Number	10	25	45
Maximum Load Current (Arms)	10	25	45
Maximum 1-Cycle Surge (A Peak) Non-Repetitive 60/50 Hz	110/100	250/230	650/600
Maximum 1-Second Surge (A Peak) Non-Repetitive	40	67	134
Maximum On-State Voltage (Volts)	1.6	1.6	1.6
Off-State dv/dt (V/μS)	200	200	200
Minimum Power Factor Load	.4	.4	.4
I^2T-Amps²Sec (8.33/10 mS)	50	260	1750
$R\theta_{jc}$ (°C/Watt)	1.3	1.2	0.67
Dissipation (Watts/Amp)	1.6	1.3	0.9

Note: Consult factory for temperature derating.

CONTROL CIRCUIT INPUT SPECIFICATIONS

Control Voltage Code Number	A	D	R
Nominal Input Rating	90-280 VAC	3-32 VDC	3-32 VDC
Must Operate	90 VAC	3 VDC	3 VDC
Must Release	10 VAC	1.0 VDC	1.0 VDC
Max. Allowable Voltage	280 VAC	32 VDC	32 VDC
Nominal Input Current	10 mArms	1 mA/V	10 mA max. (Regulated)
Maximum Turn-On Time at 60/50 Hz	34/40 mS	8.33/10 mS	8.33/10 mS
Maximum Turn-Off Time at 60/50 Hz	34/40 mS	8.33/10 mS	8.33/10 mS

KEY TO PART NUMBERS

G 240 D 10

- 240 — MAXIMUM LINE VOLTAGE CODE NUMBER
- D — CONTROL VOLTAGE CODE NUMBER
- 10 — MAXIMUM LOAD CURRENT CODE NUMBER

For available standard part numbers, see the chart on the opposite page.

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(photo isolation — Back-to-Back SCR)

G SERIES

APPLICATION GRID

PART ORDERING INSTRUCTIONS:

1. Use the grid below to select your Control Voltage.
2. Then determine the Maximum Line Voltage and Maximum Load Current required.
3. When you have identified your Part Number on the grid, refer to the Part Number Key and charts at the left for complete Part Specifications.

GENERAL SPECIFICATIONS

(Apply to all part numbers)

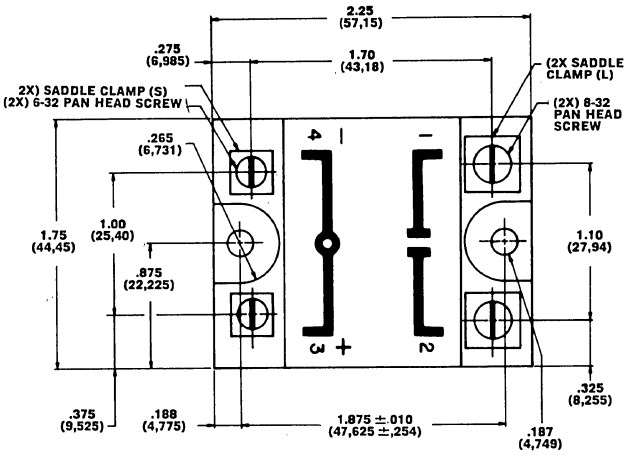
Input to Output Isolation (and Input to Base) Dielectric Strength (min.) 2500 VAC

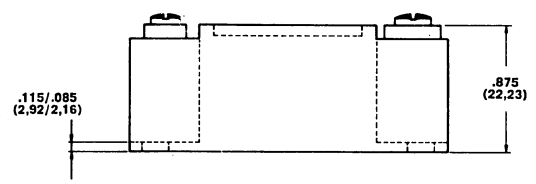
Insulation Resistance (min.): 10^{10} Ohms

Coupling Capacitance (typical): 8 pF

Operating Temperature Range: −40 to 80°C

Storage Temperature Range: −40 to 100°C





Control Voltage	Maximum Load Current (Arms)	90-280 VAC	3-32 VDC	3-32 VDC Regulated
120 VAC Line Voltage	10	G120A10	G120D10	G120R10
	25	G120A25	G120D25	G120R25
	45	G120A45	G120D45	G120R45
240 VAC Line Voltage	10	G240A10	G240D10	G240R10
	25	G240A25	G240D25	G240R25
	45	G240A45	G240D45	G240R45
280 VAC Line Voltage	10	G280A10	G280D10	G280R10
	25	G280A25	G280D25	G280R25
	45	G280A45	G280D45	G280R45
480 VAC Line Voltage	10	G480A10	G480D10	G480R10

DIMENSIONS: INCHES (MILLIMETERS)

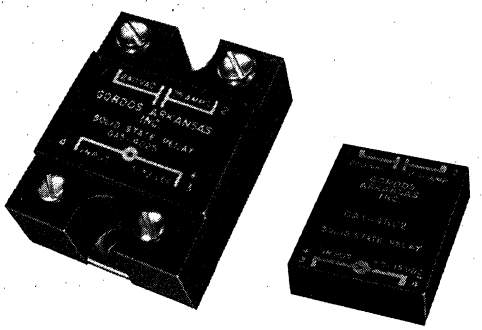
TOLERANCE: ±.02 ±,50

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(photo isolation — triac)

GA SERIES

GENERAL PURPOSE



All SSRs in the GA Series feature:

- Industry-standard packaging
- All-solid-state design
- Glass-passivated triacs for long-life component integrity
- Outputs up to 40 amps
- Output snubber networks
- Zero voltage turn-on
- 2500 VAC optical isolation
- Inductive load switching up to 0.4 power factor
- Room temperature encapsulation
- Logic compatible inputs
- UL recognition and CSA certification
- Stress-free construction

The Gordos GA Series of SSRs has been specifically designed and marketed to meet your commercial requirements.

Whether your application is gas pumps or copiers, computer peripherals or process controllers, study the GA specs carefully. Then let Gordos handle your high-volume needs from this versatile, in-stock line.

GA Series relays get a minimum of 200% testing — multiple component and functional tests that make Gordos the reliability standard in SSRs.

CONTROL CIRCUIT INPUT SPECIFICATIONS (25°C)

PACKAGE STYLE

Package Style Code Number	1	4	5	6	8

Maximum Line Voltage Code Number	2	4	6
Maximum Line Voltage	140 VAC	250 VAC	280 VAC
Minimum Line Voltage	24 VAC	24 VAC	24 VAC
Nominal Line Voltage	120 VAC	240 VAC	240 VAC
Maximum AC Leakage (At Rated Voltage) 1.5 A & 2.5 A Relays	5 mArms	6 mArms	7 mArms
Maximum AC Leakage (At Rated Voltage) 5 A, 10 A, 25 A, & 40 A Relays	9 mArms	15 mArms	15 mArms
Line Frequency	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Minimum Blocking Voltage	200 V	400 V	600 V
Zero Crossing	5°	5°	5°

Control Voltage Code Number	A	B	C	D
Nominal Input Rating	90 to 250 VAC	3.5 to 15 VDC	3.8 to 8 VDC	3 to 32 VDC
Must Operate	90 VAC	3.5 VDC	3.8 VDC	3 VDC
Must Release	10 VAC	1.0 VDC	0.8 VDC	1.0 VDC
Maximum Allowable Voltage	280 VAC	15 VDC	8 VDC	32 VDC
Nominal Input Current	10 mArms	1.0 mA per volt	4.0 mA per volt	1.0 mA per volt

POWER CIRCUIT OUTPUT SPECIFICATIONS (25°C)

Consult factory for temperature derating charts

Maximum Load Current Code Number	02	05	10	25	40
Maximum Load Current (Arms)	2.5	5.0	10	25	40
Maximum 1-Cycle Surge (A Peak) Non-Repetitive 60/50 Hz	50/45	100/90	100/90	250/230	350/320
Maximum 1-Second Surge (A Peak) Non-Repetitive	12	40	40	60	90
Maximum On-State Voltage (Volts)	1.8	1.8	1.8	1.6	1.6
Minimum Load Current (mArms)	50	50	50	100	200
Off-State dv/dt (V/μS)	100	200	200	200	200
Minimum Power Factor Load	.4	.4	.4	.4	.4
I^2T-Amps^{2}Sec (8.33/10 mS)	12	12	42	260	510

GENERAL SPECIFICATIONS (25°C)

(Apply to all part numbers)

Input to Output Isolation: 2500 VAC

Input/Output to Base Isolation: 2500 VAC (Panel Mount Models Only)

Maximum Turn-On Time at 60/50 Hz: 8.33/10 mS

Maximum Turn-Off Time at 60/50 Hz: 8.33/10 mS

Operating Temperature Range: −40° to +80°C

Storage Temperature Range: −40° to 100°C

KEY TO PART NUMBERS

GA 1 - 2 B 02

- 1: PACKAGE STYLE CODE NUMBER
- 2: MAXIMUM LINE VOLTAGE CODE NUMBER
- B: CONTROL VOLTAGE CODE NUMBER
- 02: MAXIMUM LOAD CURRENT CODE NUMBER

For available standard part numbers, see the chart on the opposite page.

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(photo isolation — triac)

GA SERIES

GENERAL PURPOSE

APPLICATION GRID

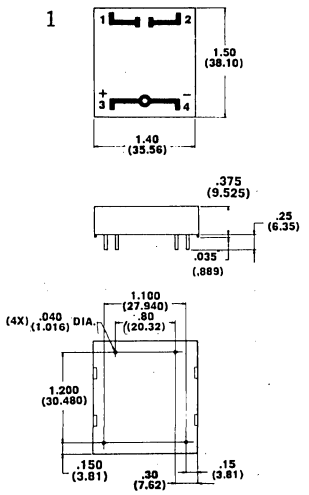
PART ORDERING INSTRUCTIONS:

1. Use the grid below to select your Control Voltage.
2. Then determine the Maximum Line Voltage and Maximum Load Current required.
3. When you have identified your Part Number on the grid, refer to the Part Number Key and charts at the left for complete Part Specifications.

DIMENSIONS: INCHES (MILLIMETERS)

TOLERANCE: ±.02 ±,50

1



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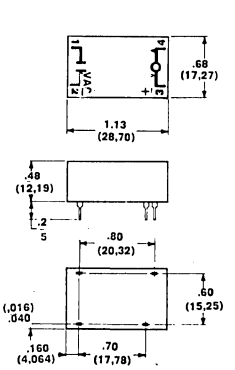

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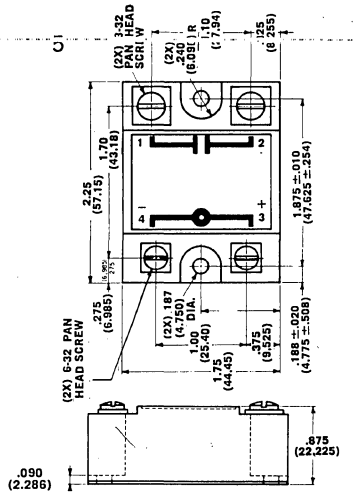

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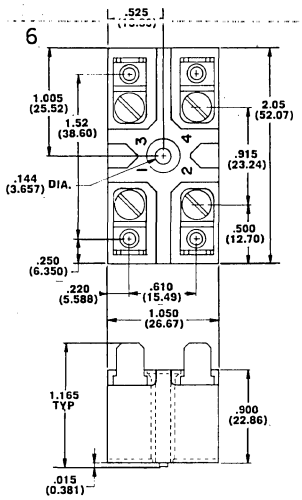

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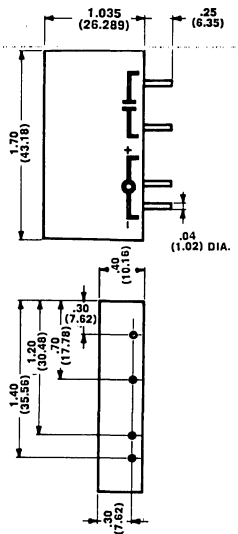
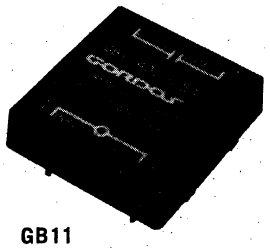


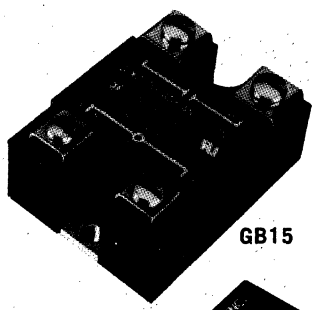
Package Style →	Maximum Load Current (Arms) Output ↓	1	4	5		6	8
Control Voltage →		3.5 to 15 VDC	3.8 to 8 VDC	3 to 32 VDC	90 to 250 VAC	3.5 to 15 VDC	3.5 to 15 VDC
140 VAC Maximum Line Voltage	2.5	GA1-2B02	GA4-2C02				GA8-2B02
	5.0					GA6-2B05	
	10.0			GA5-2D10	GA5-2A10	GA6-2B10	
	25.0			GA5-2D25	GA5-2A25		
	40.0			GA5-2D40	GA5-2A40		
250 VAC Maximum Line Voltage	2.5	GA1-4B02	GA4-4C02				GA8-4B02
	5.0					GA6-4B05	
	10.0			GA5-4D10	GA5-4A10	GA6-4B10	
	25.0			GA5-4D25	GA5-4A25		
	40.0			GA5-4D40	GA5-4A40		
280 VAC Maximum Line Voltage	2.5	GA1-6B02					GA8-6B02
	5.0					GA6-6B05	
	10.0			GA5-6D10	GA5-6A10	GA6-6B10	
	25.0			GA5-6D25	GA5-6A25		
	40.0			GA5-6D40	GA5-6A40		

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(Optical Coupling — Triac Output)

GB SERIES


GB11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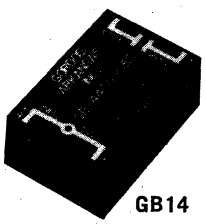
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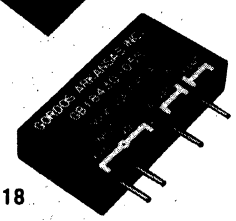

GB18

- Panel or PC mount
- Optical coupling
- Zero-voltage turn-on
- 3 to 40 Arms current ratings
- Output RC network
- 3.5-15 VDC, 3-32 VDC, or 90-280 VAC control ratings
- 24 to 280 VAC line voltages
- UL recognized — CSA certified
- Some models optionally available in compliance with VDE specs 0730, 0730 part 2P, 0806, and IEC specs 380 and 435

PACKAGE STYLE

Package Style Code Number	GB11	GB14	GB15	GB18

(1)Output circuit includes RC Snubber Network
(2)GB11000, 14000 & 18000 only
(3)GB15000 only
(4)Measured utilizing a resistive load

POWER CIRCUIT OUTPUT SPECIFICATIONS(1)

Maximum Line Voltage Code Number	2	4	6
Maximum Line Volatge (VAC)	140	250	280
Minimum Line Voltage (VAC)	24	24	24
Nominal Line Voltage (VAC)	120	240	240
Maximum AC Leakage (mArms At Rated Voltage) 2A & 3A relays	5	6	7
5A, 10A, 25A & 40A relays	9	15	15
Line Frequency	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Minimum Blocking Voltage	200 V	400 V	600 V
Zero Crossing(4)	5°	5°	5°

Maximum Load Current Code Number	30(2)	05(3)	10(3)	25(3)	40(3)
Maximum Load Current (Arms)	3	5	10	25	40
Maximum 1-Cycle Surge (A Peak) Non-Repetitive 60/50 Hz	50/45	100/90	100/90	250/230	350/320
Maximum 1-Second Surge (A Peak) Non-Repetitive	12	40	40	60	90
Maximum On-State Voltage (Volts)	1.8	1.8	1.8	1.6	1.6
Off-State dv/dt (V/μS)	100	200	200	200	200
Minimum Power Factor Load	.4	.4	.4	.4	.4
I^2T-Amps²Sec (8.33/10 mS)	12	12	42	260	510

CONTROL CIRCUIT INPUT SPECIFICATIONS

Control Voltage Code Number	-05S(2)	-2(3)	-7(3)
Nominal Input Rating	3.5-15 VDC	3-32 VDC	90-280 VAC
Must Operate	3.5 VDC	3 VDC	90 VAC
Must Release	1.0 VDC	1.0 VDC	10 VAC
Max. Allowable Voltage	15 VDC	32 VDC	280 VAC
Nominal Input Current	1.0 mA/V	1.0 mA/V	15 mArms
Maximum Turn-On Time at 60/50 Hz	8.33/10 mS	8.33/10 mS	34/40 mS
Maximum Turn-Off Time at 60/50 Hz	8.33/10 mS	8.33/10 mS	34/40 mS

KEY TO PART NUMBERS

GB 15 4 10 - 2

- GB — PACKAGE STYLE CODE NUMBER
- 15 — MAXIMUM LINE VOLTAGE CODE NUMBER
- 4 — MAXIMUM LOAD CURRENT CODE NUMBER
- 10 — CONTROL VOLTAGE CODE NUMBER
- 2 — CONTROL VOLTAGE CODE NUMBER

For available standard part numbers, see the chart on the opposite page.

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(Optical Coupling — Triac Output)

APPLICATION GRID

PART ORDERING INSTRUCTIONS:

1. Use the grid below to select your Control Voltage.
2. Then determine the Maximum Line Voltage and Maximum Load Current required.
3. When you have identified your Part Number on the grid, refer to the Part Number Key and charts at the left for complete Part Specifications.

GENERAL SPECIFICATIONS

(Apply to all part numbers)

Intput to Output Isolation (and Input to Base, GB-15000 models only) Dielectric Strength (min.) 2500 VAC.

Insulation Resistance (min.): 10^{10} Ohms

Coupling Capacitance (typical): 8 pF

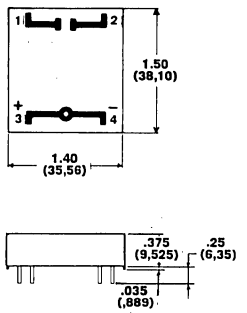
Operating Temperature Range: −40 to 80°C

Storage Temperature Range: −40 to 100°C

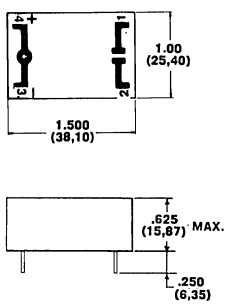
DIMENSIONS: INCHES (MILLIMETERS)

TOLERANCE: ±.02 ±,50

GB-11



GB-14



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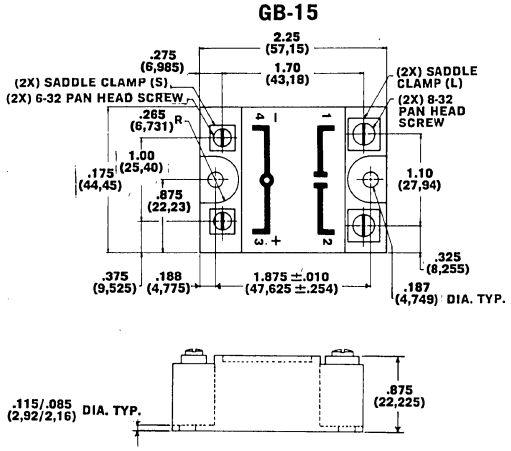
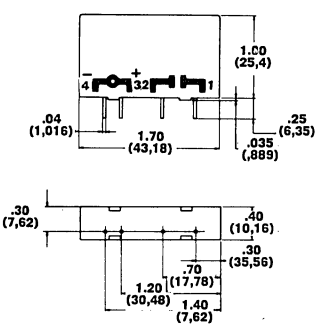


GB-18



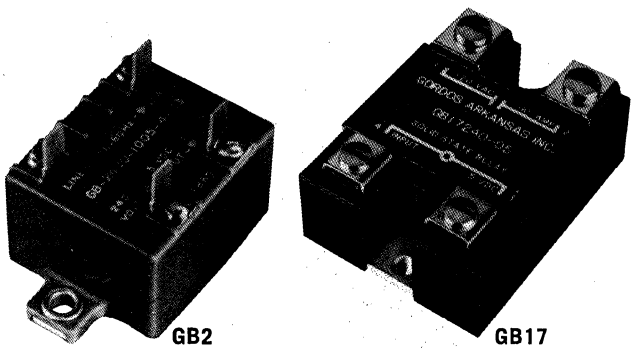
Package Style → / Control Voltage →	Maximum Load Current (Arms) ↓	GB11	GB14	GB15		GB18
		3.5 to 15 VDC	3.5 to 15 VDC	3 to 32 VDC	90 to 280 VAC	3.5 to 15 VDC
140 VAC Maximum Line Voltage	3	GB11230-05S	GB14230-05S			GB18230-05S
	5					
	10			GB15210-2	GB15210-7	
	25			GB15225-2	GB15225-7	
	40			GB15240-2	GB15240-7	
250 VAC Maximum Line Voltage	3	GB11430-05S	GB14430-05S			GB18430-05S
	5					
	10			GB15410-2	GB15410-7	
	25			GB15425-2	GB15425-7	
	40			GB15440-2	GB15440-7	
280 VAC Maximum Line Voltage	3	GB11630-05S	GB14630-05S			GB18630-05S
	5					
	10			GB15610-2	GB15610-7	
	25			GB15625-2	GB15625-7	
	40			GB15640-2	GB15640-7	

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(reed isolation — triac)

GB SERIES REEDAC®

AC SOLID STATE RELAYS



- Inductive load switching up to 0.1 power factor
- Reed coupling
- Random turn-on
- 10 to 40 Arms current ratings
- Output RC network
- 5, 12, or 24 VDC nominal input ratings
- 24 to 280 VAC line voltages
- UL recognized — CSA certified
- Some models optionally available in compliance with VDE specs 0730, 0730 part 2P, 0806, and IEC Specs 380 and 435.

POWER CIRCUIT OUTPUT SPECIFICATIONS[2]

Maximum Line Voltage Code Number	2	4	6
Maximum Line Voltage (VAC)	140	250	280
Minimum Line Voltage (VAC)	24	24	24
Nominal Line Voltage (VAC)	120	240	240
Maximum AC Leakage (mArms At Rated Voltage)	5.0	10.0	10.0
Line Frequency	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz
Minimum Blocking Voltage	200 V	400 V	600 V

Maximum Load Current Code Number	10	25	40[3]
Maximum Load Current (Arms)	10	25	40
Maximum 1-Cycle Surge (A Peak) Non-Repetitive 60/50 Hz	100/90	250/230	350/320
Maximum 1-Second Surge (A Peak) Non-Repetitive	40	60	90
Maximum On-State Voltage (Volts)	1.8	1.6	1.6
Off-State dv/dt (V/μS)	200	200	200
Minimum Power Factor Load	.1	.1	.1
I^2T-Amps²Sec (8.33/10 mS)	42	260	510

Note: Consult factory for temperature derating.

GB2 2 00-10 05-4-03

- PACKAGE STYLE/ SERIES CODE NUMBER
- MAXIMUM LINE VOLTAGE CODE NUMBER
- MAXIMUM LOAD CURRENT CODE NUMBER
- CONTROL VOLTAGE CODE NUMBER

GB17 2 10 - 05

- PACKAGE STYLE/ SERIES CODE NUMBER
- MAXIMUM LINE VOLTAGE CODE NUMBER
- MAXIMUM LOAD CURRENT CODE NUMBER
- CONTROL VOLTAGE CODE NUMBER

For available standard part numbers, see the chart on the opposite page.

CONTROL CIRCUIT INPUT SPECIFICATIONS

Control Voltage Code Number	05	12[1]	24[1]
Nominal Input Rating (VDC)	5	12	24
Must Operate (VDC)	4.0	9.0	18.0
Must Release (VDC)	0.5	1.0	2.0
Maximum Allowable Voltage	7.5	18.0	36.0
Nominal Input Current	14 mA	14 mA	13 mA

[1]GB2000 only [2]Output circuit includes RC Snubber Network [3]GB17000 only

®Reedac is a registered trademark of the Gordos Corporation for reed-coupled AC-switching SSRs.

GORDOS ARKANSAS

AC SOLID STATE RELAYS
(reed isolation — triac)

GB SERIES REEDAC®

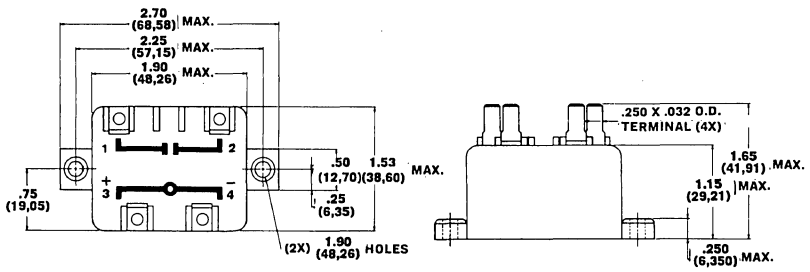
AC SOLID STATE RELAYS

APPLICATION GRID

PART ORDERING INSTRUCTIONS:

1. Use the grid below to select your Control Voltage.
2. Then determine the Maximum Line Voltage and Maximum Load Current required.
3. When you have identified your Part Number on the grid, refer to the Part Number Key and charts at the left for complete Part Specifications.

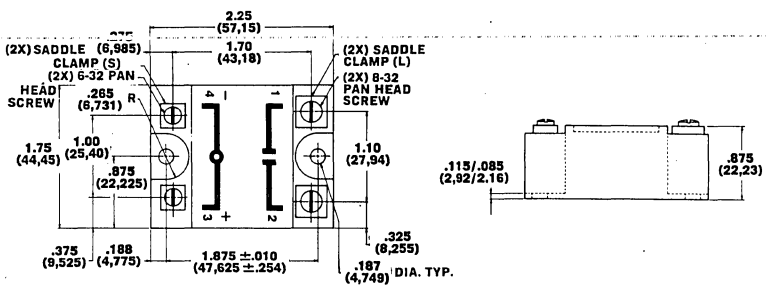
GB-2



GENERAL SPECIFICATIONS

(Apply to all part numbers)
Input to Output Isolation (and Input to Base) Dielectric Strength (min.): 2500 VAC
Insulation Resistance (min.): 10^{12} Ohms
Coupling Capacitance (typical): 8 pF
Maximum Turn-On Time at 60/50 Hz: 1.5 mS (Not frequency dependent)
Maximum Turn-Off Time at 60/50 Hz: 8.33/10 mS
Operating Temperature Range: −40 to 80°C
Storage Temperature Range: −40 to 100°C

GB-17



DIMENSIONS: INCHES (MILLIMETERS)

TOLERANCE: ±.02 ±,50

Package Style → / Control Voltage →	Maximum Load Current (Arms) ↓	GB2			GB17
		5 VDC	12 VDC	24 VDC	5 VDC
140 VAC Maximum Line Volatge	10	GB2200-1005-4-03	GB2200-1012-4-03	GB2200-1024-4-03	GB17210-05
	25	GB2200-2505-4-03	GB2200-2512-4-03	GB2200-2524-4-03	GB17225-05
	40				GB17240-05
250 VAC Maximum Line Voltage	10	GB2400-1005-4-03	GB2400-1012-4-03	GB2400-1024-4-03	GB17410-05
	25	GB2400-2505-4-03	GB2400-2512-4-03	GB2400-2524-4-03	GB17425-05
	40				GB17440-05
280 VAC Maximum Line Voltage	10	GB2600-1005-4-03	GB2600-1012-4-03	GB2600-1024-4-03	GB17610-05
	25	GB2600-2505-4-03	GB2600-2512-4-03	GB2600-2524-4-03	GB17625-05
	40				GB17640-05

® REEDAC is a registered trademark of Gordos Arkansas, Inc.

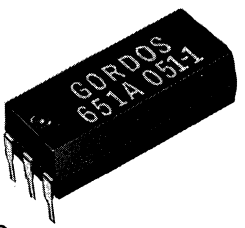
GORDOS CORPORATION

REED RELAYS
.150" x 1.000" PCB grid pattern

65 SERIES

MOLDED EPOXY REED RELAY
.150" x 1.000" PCB GRID PATTERN

- Dry reed, high-voltage, and mercury wetted versions available
- Designed to meet various packaging requirements
- Logic-compatible
- Environmental immunity assured



OPERATING CHARACTERISTICS

Series	Operate Time (Typical) Form A	Operate Time (Typical) Form B	Operate Time (Typical) Form C N/O	Operate Time (Typical) Form C N/C	Release Time (Typical) Coil Unsuppressed Form A	Release Time (Typical) Coil Unsuppressed Form B	Storage Temperature Range
Standard Dry Contacts							
65	.5	.35	1.5	1.0	.05	.5	−40°C to 85°C
Mercury-Wetted Contacts							
65	1.8		1.8	1.0			−30°C to 85°C

NOTES: 1. All times measured in milliseconds at nominal coil voltage at a test frequency of 15 Hz.
2. Consult factory for electrostatic and/or magnetic shield requirements.

CONTACT RATINGS

Type	Maximum Switching D.C. Watts	Maximum Switching D.C. Volts	Maximum Current (Amps) Switch	Maximum Current (Amps) Carry	Maximum[1] Initial Contact Resistance (Ohms)	Minimum Breakdown Voltage VAC Across Contacts	Minimum Breakdown Voltage VAC Contacts Coil	Insulation Resistance (Typical)[3] (Ohms)
1A	10	200	.5	1.5	.200	300	1000	10^{10}
1A High Voltage	10	200	.5	1.5	.200	1000	1000	10^{10}
1A Mercury	50	500	1.0[2]	2.0	.070	1000	1000	10^{10}
1C	3	28	.250	1.0	.200	250	1000	10^{10}
1C Mercury	50	500	1.0[2]	2.0	.070	1000	1000	10^{10}

NOTES: [1]Measured at nominal coil voltage applied (Except Series 65, Form B)
[2]Derate to .050A at 500 volts
[3]Measured at 25°C and 50% relative humidity using 100 VDC

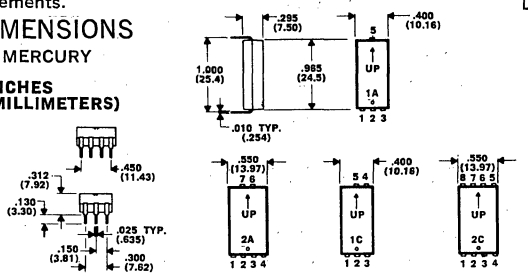
MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	3.8	0.5
12	9.0	1.2
24	18.0	2.4

OUTLINE DIMENSIONS

65 Series — DRY/MERCURY

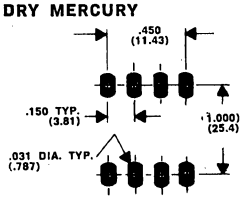
DIMENSIONS: INCHES (MILLIMETERS)



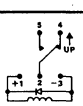
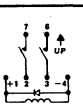
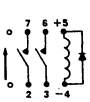
P.C. PAD LAYOUTS

65 SERIES

DRY MERCURY



REED RELAY SELECTION CHART (To specify diode add "D" after part number. All schematics show location of diode)

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Part Number End Termination	Part Number Side Termination	Schematics (Top View) End Termination	Schematics (Top View) Side Termination
1A	5 12 24	150 575 2150	651A051-1 651A121-1 651A241-1	651A052-1 651A122-1 651A242-1	Orientation arrow for mercury wetted models	Orientation arrow for mercury wetted models
1A HIGH VOLTAGE	5 12 24	150 575 2150	651A051-4 651A121-4 651A241-4	651A052-4 651A122-4 651A242-4		
1A MERCURY	5 12 24	70 320 1600	651A051-5 651A121-5 651A241-5	651A052-5 651A122-5 651A242-5		
1B (See Note 1)	5 12 24	80 320 1500	651B051-1 651B121-1 651B241-1	651B052-1 651B122-1 651B242-1		
1C	5 12 24	100 450 1750	651C051-1 651C121-1 651C241-1	651C052-1 651C122-1 651C242-1	 Orientation arrow for mercury wetted models	Orientation arrow for mercury wetted models
1C MERCURY	5 12 24	70 320 1600	651C051-5 651C121-5 651C241-5	651C052-5 651C122-5 651C242-5		
2A	5 12 24	80 320 1500	652A051-1 652A121-1 652A241-1	652A052-1 652A122-1 652A242-1	 Orientation arrow for mercury wetted models	 Orientation arrow for mercury wetted models
2A HIGH VOLTAGE	5 12 24	80 320 1500	652A051-4 652A121-4 652A241-4	652A052-4 652A122-4 652A242-4		
2A MERCURY	5 12 24	40 170 725	652A051-5 652A121-5 652A241-5	652A052-5 652A122-5 652A242-5		
2C	5 12 24	60 280 1000	652C051-1 652C121-1 652C241-1			

NOTES: 1. Excessive voltage (maximum of 7.5 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 32.0 VDC for 24 VDC model) may cause reclosure on form B models.
2. To specify diode add "D" after model number.
3. For operation above 40°C ambient temperature, consult Gordos Corporation.
4. Mercury wetted models must be mounted ±30° from vertical.

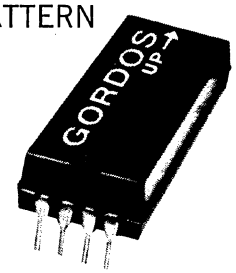
GORDOS CORPORATION

REED RELAYS
.100" x 1.000" PCB grid pattern

66 SERIES

MOLDED EPOXY REED RELAY
.100" x 1.000" PCB GRID PATTERN

- Dry reed, high-voltage, and mercury wetted versions available
- Designed to meet various packaging requirements
- Logic-compatible
- Environmental immunity assured



OPERATING CHARACTERISTICS

Series	Operate Time (Typical) Form A	Operate Time (Typical) Form B	Operate Time (Typical) Form C N/O	Operate Time (Typical) Form C N/C	Release Time (Typical) Coil Unsuppressed Form A	Release Time (Typical) Coil Unsuppressed Form B	Storage Temperature Range
Standard Dry Contacts							
66	.5	.35	1.5	1.0	.05	.5	−40°C to 85°C
Mercury-Wetted Contacts							
66	1.8		1.8	1.0			−30°C to 85°C

NOTES: 1. All times measured in milliseconds at nominal coil voltage at a test frequency of 15 Hz.
2. Consult factory for electrostatic and/or magnetic shield requirements.

CONTACT RATINGS

Type	Maximum Switching D.C. Watts	Maximum Switching D.C. Volts	Maximum Current (Amps) Switch	Maximum Current (Amps) Carry	Maximum[1] Initial Contact Resistance (Ohms)	Minimum Breakdown Voltage VAC Across Contacts	Minimum Breakdown Voltage VAC Contacts Coil	Insulation Resistance (Typical)[3] (Ohms)
1A	10	200	.5	1.5	.200	300	1000	10^{10}
1A High Voltage	10	200	.5	1.5	.200	1000	1000	10^{10}
1A Mercury	50	500	1.0[2]	2.0	.070	1000	1000	10^{10}
1C	3	28	.250	1.0	.200	250	1000	10^{10}
1C Mercury	50	500	1.0[2]	2.0	.070	1000	1000	10^{10}

NOTES: [1]Measured at nominal coil voltage applied (Except Series 66, Form B)
[2]Derate to .050A at 500 volts
[3]Measured at 25°C and 50% relative humidity using 100 VDC

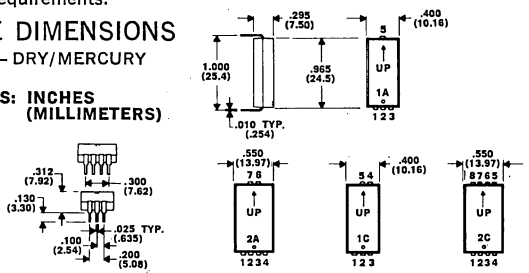
MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	3.8	0.5
12	9.0	1.2
24	18.0	2.4

OUTLINE DIMENSIONS

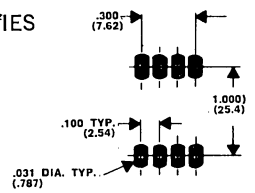
66 SERIES — DRY/MERCURY

DIMENSIONS: INCHES (MILLIMETERS)

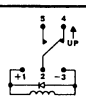
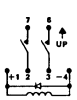
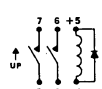


P.C. PAD LAYOUTS

66 SERIES



REED RELAY SELECTION CHART (To specify diode add "D" after part number. All schematics show location of diode)

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Part Number End Termination	Part Number Side Termination	Schematics (Top View) End Termination	Schematics (Top View) Side Termination
1A	5 12 24	150 575 2150	661A051-1 661A121-1 661A241-1	661A052-1 661A122-1 661A242-1		
1A HIGH VOLTAGE	5 12 24	150 575 2150	661A051-4 661A121-4 661A241-4	661A052-4 661A122-4 661A242-4		
1A MERCURY	5 12 24	70 320 1600	661A051-5 661A121-5 661A241-5	661A052-5 661A122-5 661A242-5	Orientation arrow for mercury wetted models	Orientation arrow for mercury wetted models
1B (See Note 1)	5 12 24	80 320 1500	661B051-1 661B121-1 661B241-1	661B052-1 661B122-1 661B242-1		
1C	5 12 24	100 450 1750	661C051-1 661C121-1 661C241-1	661C052-1 661C121-1 661C242-1	 Orientation arrow for mercury wetted models	Orientation arrow for mercury wetted models
1C MERCURY	5 12 24	70 320 1600	661C051-5 661C121-5 661C241-5	661C052-5 661C122-5 661C242-5		
2A	5 12 24	80 320 1500	662A051-1 662A121-1 662A241-1	662A052-1 662A122-1 662A242-1		
2A HIGH VOLTAGE	5 12 24	80 320 1500	662A051-4 662A121-4 662A241-4	662A052-4 662A122-4 662A242-4		
2A MERCURY	5 12 24	40 170 725	662A051-5 662A121-5 662A241-5	662A052-5 662A122-5 662A242-5	Orientation arrow for mercury wetted models	Orientation arrow for mercury wetted models
2C	5 12 24	60 280 1000	662C051-1 662C121-1 662C241-1			

NOTES: 1. Excessive voltage (maximum of 7.5 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 32.0 VDC for 24 VDC model) may cause reclosure on form B models.
2. To specify diode add "D" after model number.
3. For operation above 40°C ambient temperature, consult Gordos Corporation.
4. Mercury wetted models must be mounted ±30° from vertical..

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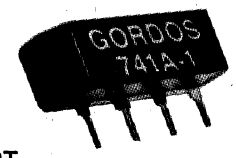
GORDOS CORPORATION

DRY REED RELAY

741 SERIES



MOLDED EPOXY

Single In-Line Package

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1A	5	380	No	741A-1
			Yes	741A-2
		500	No	741A-9
			Yes	741A-10
	12	500	No	741A-3
			Yes	741A-4
	24	1750	No	741A-7
			Yes	741A-8
1B (See Note 1)	5	150	No	741B-3
			Yes	741B-4
		450	No	741B-9
			Yes	741B-10
	12	450	No	741B-5
			Yes	741B-6
	24	1750	No	741B-7
			Yes	741B-8

NOTES:
1. Excessive voltage (maximum of 7.0 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 30.0 VDC for 24 VDC model) may cause contact reclosure on Form B models.
2. Consult factory for electrostatic and/or magnetic shield requirements

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C	Maximum Voltage (VDC)
5	4.0	0.5	7.5
12	9.6	1.2	15.0
24	19.2	2.4	32.0

CONTACT RATINGS

Model No.	Maximum Switching[2] (DC)		Maximum Current (Amps)		Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		Insulation Resistance (Typ.) (Ohms)
	Watts	Volts	Switch	Carry		Across Conts.	Conts. Coil	Across Conts.	Conts. Coil	
741A	10	100	.250	1.5	.200	250	1000	.8	1.5	10^{10}
741B	10	100	.250	1.5	.200	250	1000	.8	3.8	10^{10}

NOTES:
1. Measured with nominal coil voltage applied (Except Form B)
2. Higher voltages and/or currents may be switched with life expectancy reduced. Consult factory for these ratings.

OPERATING CHARACTERISTICS

Series	Operate Time* (Typical)		Release Time (Typical) Coil Unsuppressed		Release Time (Typical) Coil Suppressed		Storage Temperature Range
	Form A	Form B	Form A	Form B	Form A	Form B	
741	.50	.5	.05	.50	.5	.50	−40°C to +85°C

* Operate and Release Times (including bounce) in milliseconds.

SCHEMATICS

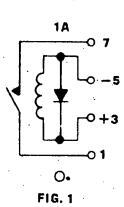


FIG. 1

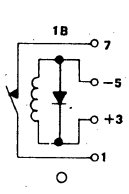
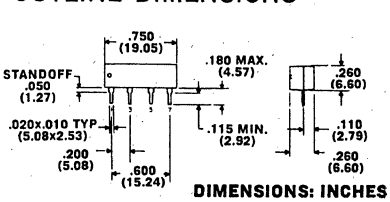


FIG. 2

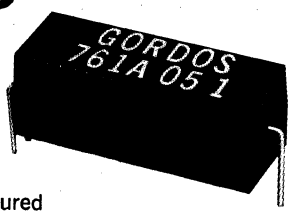
OUTLINE DIMENSIONS



DIMENSIONS: INCHES (MILLIMETERS)

76 SERIES

MOLDED EPOXY



- Low Cost
- Dry Reed, Power and Sensitive Versions
- Designed to meet various packaging requirements
- Popular PCB grid patterns
- Environmental immunity assured
- Logic compatible
- Resistant to board cleaning solvents
- Power series offers tough tungsten contacts capable of handling high inrush inductive and capacitive loads without contact protection in most applications.

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Part Number End Termination	Part Number Side Termination
1A	5	225	761A051-1	761A052-1
	12	1000	761A121-1	761A122-1
	24	2150	761A241-1	761A242-1
1A Power Series	5	225	761A051-3	761A052-3
	12	575	761A121-3	761A122-3
	24	2150	761A241-3	761A242-3
1A Sensitive Series	5	575	761A05S1-1	761A05S2-1

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C	Maximum Voltage (VDC)
5	3.8	0.5	7.5
12	9.0	1.2	15.0
24	18.0	2.4	32.0

CONTACT RATINGS

Type	Maximum Switching Watts	Maximum Switching Volts	Maximum Current Switch	Maximum Current Carry	Typical Initial Contact Resistance[1]	Minimum Breakdown Voltage Across Contacts	Minimum Breakdown Voltage Contacts Coil	Insulation Resistance (Typ.)[2]
-1	10	200	0.5	1.5	.200	300	1000	10^{10}
-3	50	200	See Note 3		1.0	300	1000	10^{10}

NOTES:
1. Measured at nominal coil voltage applied
2. Measured at 25°C and 50% relative humidity using 100 VDC
3. Inrush current capability — 5.0 amps

OPERATING CHARACTERISTICS

Form	Operating Time (Typ.)	Release Time (Typ.) (Coil Unsuppressed)
A	.5 msec	.05 msec
B	.35 msec	.5 msec

SCHEMATICS TOP VIEW

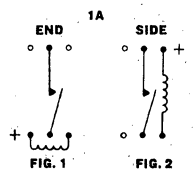
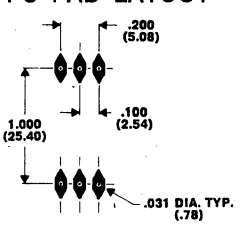
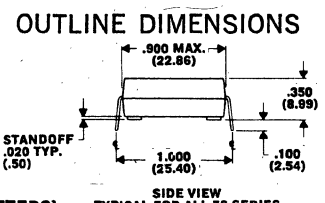


FIG. 1 FIG. 2

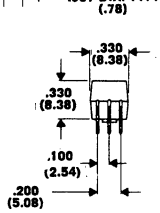
PC PAD LAYOUT



OUTLINE DIMENSIONS



SIDE VIEW TYPICAL FOR ALL 76-SERIES

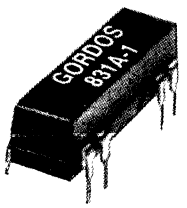


GORDOS CORPORATION

DIP DRY REED RELAYS

83 SERIES

MOLDED EPOXY DIP
(Dual In-Line Package)



- All Gordos molded reed relays are molded of glass filled, non-burning epoxy with an Underwriters Laboratory certified yellow card number UL94STD (V-O classification).
- Environmental immunity assured
- Logic compatible
- Compatible with automatic insertion equipment

CONTACT RATINGS

Model No.	Maximum Switching[2] (DC) Watts	Volts	Maximum Current (Amps) Switch	Carry	Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC) Across Contacts	Contacts Coil	Capacitance (Typical) (pF) Across Contacts	Contacts Coil	Insulation Resistance (Typ.) (Ohms)
831A	10	100	.250	1.5	.200	250	1000	.8	2	10^{10}
831B	10	100	.250	1.5	.200	250	1000	—	3.8	10^{10}
832A	3	28	.250	1.0	.200	150	1000	.8	2	10^{10}
831C	3	28	.250	1.0	.200	250	1000	1.5	3	10^{9}
835C	4	100	.110	1.0	.250	250	1000	.8	2	10^{9}
836C	4	100	.110	1.0	.250	250	1000	.8	2	10^{9}

NOTES: [1]Measured with nominal coil voltage applied (Except Form B)
[2]Higher voltages and/or current may be switched with life expectancy reduced. Consult factory for these ratings.

MUST OPERATE/RELEASE CHARACTERISTICS

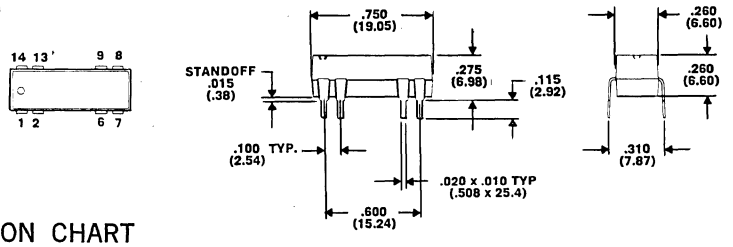
Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	4.0	0.5
12	9.6	1.2
24	19.2	2.4

OPERATING CHARACTERISTICS

Series	Operate Time* (Typical) Form A	Form B	Form C N/O	N/C	Release Time (Typical) Coil Unsuppressed Form A	Form B	Coil Suppressed Form A	Form B	Storage Temperature Range
83	.50	.5	1.0	1.5	.05	.50	.5	.50	−40°C to 85°C

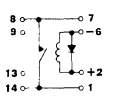
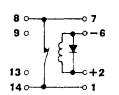
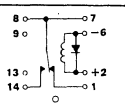
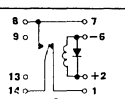
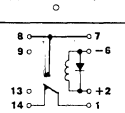
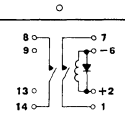
* Operate and Release Times (including bounce) in milliseconds.

OUTLINE DIMENSIONS



DIMENSIONS: INCHES (MILLIMETERS)

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance (Ohms) ±10% @ 25°C	Clamp Diode	Part Number	Schematics (Top View)
1A	5	380	No	831A-1	
			Yes	831A-2	
		500	No	831A-3	
			Yes	831A-4	
	12	500	No	831A-5	
			Yes	831A-6	
	24	1750	No	831A-7	
			Yes	831A-8	
1B (See Note 1)	5	150	No	831B-1	
			Yes	831B-2	
		450	No	831B-3	
			Yes	831B-4	
	12	450	No	831B-5	
			Yes	831B-6	
	24	1750	No	831B-7	
			Yes	831B-8	
1C	5	150	No	831C-1	
			Yes	831C-2	
	12	450	No	831C-3	
			Yes	831C-4	
	24	1750	No	831C-5	
			Yes	831C-6	
1C	5	150	No	835C-1	
			Yes	835C-2	
	12	450	No	835C-3	
			Yes	835C-4	
	24	1750	No	835C-5	
			Yes	835C-6	
1C	5	200	No	836C-1	
			Yes	836C-2	
	12	500	No	836C-3	
			Yes	836C-4	
	24	2200	No	836C-5	
			Yes	836C-6	
2A	5	150	No	832A-1	
			Yes	832A-2	
	12	450	No	832A-3	
			Yes	832A-4	
	24	1750	No	832A-5	
			Yes	832A-6	

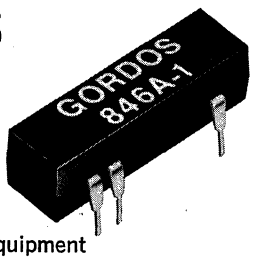
NOTES: 1. Excessive voltage (maximum of 7.0 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 30.0 VDC for 24 VDC model), may cause contact reclosure on Form B models.
2. Consult factory for electrostatic shield and/or magnetic shield requirements.

GORDOS CORPORATION

DRY AND MERCURY DIP REED RELAYS

846 SERIES

DRY REED RELAY MOLDED EPOXY DIP



- High-Voltage Form A
- Environmental Immunity Assured
- Logic-Compatible
- Compatible with Auto-Insertion Equipment
- All Gordos molded devices are molded of glass filled, non-burning epoxy with an Underwriters Laboratory certified yellow card, UL94STD, V-0 classification

High-voltage 6-pin DIP reed relays with Form A contacts for applications where high-voltage isolation is required and space is at a premium.

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1A	5	150	No	846A-1
			Yes	846A-2
	12	575	No	846A-3
			Yes	846A-4
	24	1750	No	846A-5
			Yes	846A-6

NOTES: Consult factory for electrostatic shield and/or magnetic shield requirements.

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C	Maximum Voltage (VDC)
5	4.0	0.5	7.5
12	9.6	1.2	15.0
24	19.2	2.4	32.0

CONTACT RATINGS

Model No.	Maximum Switching (DC)		Maximum Current[2] (Amps)		Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		Insulation Resistance (Typ.) (Ohms)
	Watts	Volts	Switch	Carry		Across Conts.	Conts. Coil	Across Conts.	Conts. Coil	
846A	10	800	.5	2	.200	1200	1500	.8	2	10^{10}

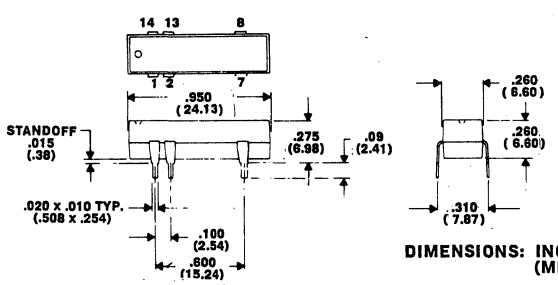
NOTES:
1. Measured with nominal coil voltage applied (Except Form B)
2. Derate to .006A at 800V

OPERATING CHARACTERISTICS

Series	Operate Time* (Typical) Form A	Release Time (Typical) Coil Unsuppressed Form A	Release Time (Typical) Coil Suppressed Form A	Storage Temperature Range
846	.50	.05	.5	−40°C to +85°C

* Operate and Release Times (including bounce) in milliseconds.

OUTLINE DIMENSIONS

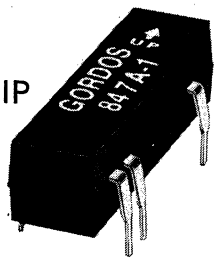


DIMENSIONS: INCHES (MILLIMETERS)

846 SERIES AND 847 SERIES

847 SERIES

MERCURY WETTED REED RELAY MOLDED EPOXY DIP



- Mercury-Wetted (Forms A, C) Versions
- Environmental Immunity Assured
- Logic-Compatible
- Compatible with Auto-Insertion Equipment
- All Gordos molded devices are molded of glass filled, non-burning epoxy with an Underwriters Laboratory certified yellow card, UL94STD, V-0 classification

Mercury-wetted 6-pin DIP reed relays with Form A or Form C contacts, offering the advantages of speed, no bounce, stability, extremely long life, and small size.

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1A	5	150	No	847A-1
			Yes	847A-2
	12	575	No	847A-3
			Yes	847A-4
	24	1750	No	847A-5
			Yes	847A-6
1C	5	70	No	847C-1
			Yes	847C-2
	12	320	No	847C-3
			Yes	847C-4
	24	1600	No	847C-5
			Yes	847C-6

NOTES: Consult factory for electrostatic shield and/or magnetic shield requirements.

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C	Maximum Voltage (VDC)
5	4.0	0.5	7.5
12	9.6	1.2	15.0
24	19.2	2.4	32.0

CONTACT RATINGS

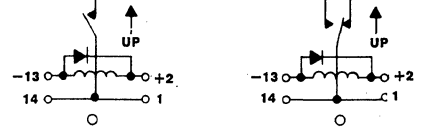
Model No.	Maximum Switching[3] (DC)		Maximum Current (Amps)		Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		Insulation Resistance (Typ.) (Ohms)
	Watts	Volts	Switch	Carry		Across Conts.	Conts. Coil	Across Conts.	Conts. Coil	
847A	50	500	1.0[2]	2	.050	1000	1500	1.1	2	10^{10}
847C	50	500	1.0[2]	2	.050	1000	1500	1.3	6	10^{9}

NOTES:
1. Measured with nominal coil voltage applied
2. Derate to .002A @ 500 volts
3. Higher voltages and/or currents may be switched with life expectancy reduced. Consult factory for these ratings.

OPERATING CHARACTERISTICS

Series	Operate Time (Typical) Form A	Operate Time (Typical) Form C N/O	Operate Time (Typical) Form C N/C	Release Time (Typical) Coil Unsuppressed Form A	Release Time (Typical) Coil Suppressed Form A	Storage Temperature Range
847	2.5	2.00	1.5	2.0	2.0	−30°C to +85°C

SCHEMATICS (TOP VIEW)

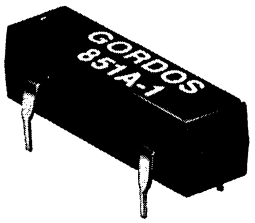


NOTE: Orientation arrow appears on all Mercury Wetted Models. These relays must be mounted ±30° from vertical.

GORDOS CORPORATION

DRY REED RELAYS

851 SERIES



DRY REED RELAYS MOLDED EPOXY DIP

- Contact Forms A and B
- Environmental Immunity Assured
- Logic-Compatible
- Compatible with Auto-Insertion Equipment
- All Gordos molded devices are molded of glass filled, non-burning epoxy with an Underwriters Laboratory certified yellow card, UL94STD, V-O classification

Special single-pole 4-pin DIP reed relays with Form A or B contacts for applications requiring high isolation between contacts and coil.

REED RELAY SELECTION CHART

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1A	5	380	No	851A-1
			Yes	851A-2
		500	No	851A-5
			Yes	851A-6
	12	500	No	851A-3
			Yes	851A-4
	24	1750	No	851A-7
			Yes	851A-8
1B (See Note 1)	5	150	No	851B-3
			Yes	851B-4
	12	450	No	851B-5
			Yes	851B-6
	24	1750	No	851B-7
			Yes	851B-8

NOTES:
1. Excessive voltage (maximum of 7.5 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 32.0 VDC for 24 VDC model) may cause reclosure on form B models.
2. Consult factory for electrostatic shield and/or magnetic shield requirements.

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C	Maximum Voltage (VDC)
5	4.0	0.5	7.5
12	9.6	1.2	15.0
24	19.2	2.4	32.0

CONTACT RATINGS

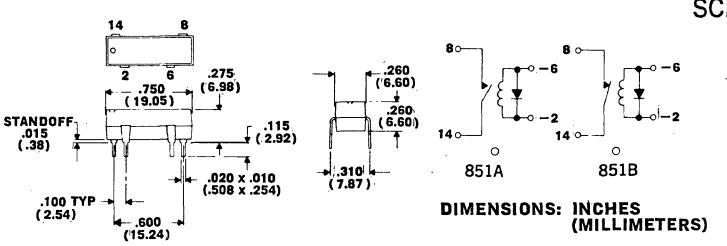
Model No.	Maximum Switching[2] (DC)		Maximum Current (Amps)		Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		Insulation Resistance (Typ.) (Ohms)
	Watts	Volts	Switch	Carry		Across Conts.	Conts. Coil	Across Conts.	Conts. Coil	
851A	10	100	.250	1.5	.200	250	2000	.8	2	10^{10}
851B	10	100	.250	1.5	.200	250	2000	.8	3.8	10^{10}

NOTES:
1. Measured with nominal coil voltage applied (Except Form B)
2. Higher voltages and/or currents may be switched with life expectancy reduced. Consult factory for these ratings.

OPERATING CHARACTERISTICS

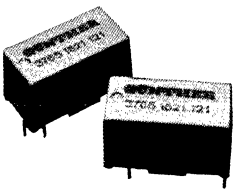
Series	Operate Time* Typical)		Release Time (Typical) Coil Unsuppressed		Release Time (Typical) Coil Suppressed		Storage Temperature Range
	Form A	Form B	Form A	Form B	Form A	Form B	
851	.50	.5	.05	.50	.5	.50	−40°C to −85°C

* Operate and Release Times (including bounce) in milliseconds.



SK SERIES

SUB-MINIATURE FORM C REED RELAY



- Small size (20 x 10 x 10mm)
- High switching capacity (20 watts at 1A)
- Contact is hermetically sealed
- Plug or solderable connection pins

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1C	5	170	No	3765-1521-05-1
			Yes	3765-1521-05-3
		425	No	3765-1522-05-1
			Yes	3765-1522-05-3
	12	890	No	3765-1521-12-1
			Yes	3765-1521-12-3
	24	2000	No	3765-1521-24-1
			Yes	3765-1521-24-3

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	3.7	1.0
12	7.0	2.0
24	15.0	3.5

OPERATING CHARACTERISTICS

Model	Operate Time* (Typical)	Release Time Without Diode* (Typical)	Operating Temperature Range
3765	.50	.20	−55°C to +105°C

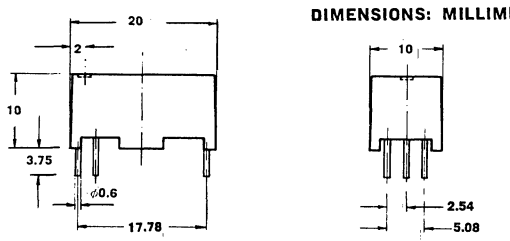
* Operate and release times (including bounce) in milliseconds.

CONTACT RATINGS

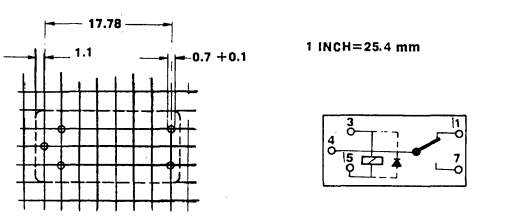
Model No.	Maximum Switching (DC)		Maximum Current (Amps)		Typical Initial Contact Resistance[1] (Ohms)	Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		Insulation Resistance (Typ.) (Ohms)
	Watts	Volts	Switch	Carry		Across Conts.	Conts. Coil	Across Conts.	Conts. Coil	
3765	20	100	1.0	1.5	.200	250	—	.6	2.0	10^{10}

OUTLINE DIMENSIONS

DIMENSIONS: MILLIMETERS



SCHEMATICS (TOP VIEW)

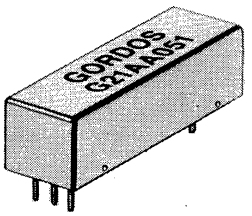


GORDOS CORPORATION

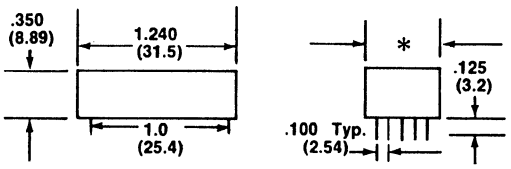
MINIATURE OPEN FRAME
DRY AND MERCURY WETTED REED RELAYS

G2 SERIES

REED RELAYS
Miniature Open Frame Reed Relay



OUTLINE DIMENSIONS

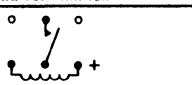
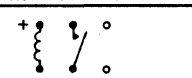
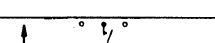
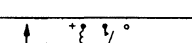
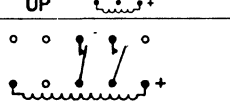
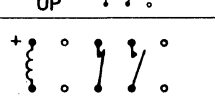
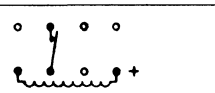
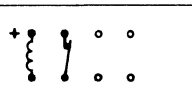
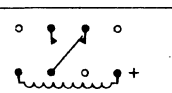
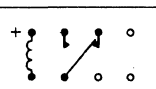
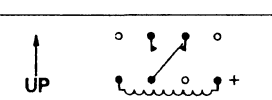
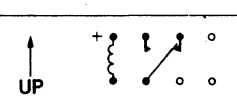
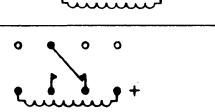
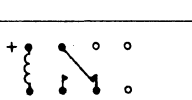
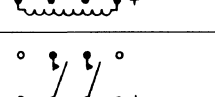
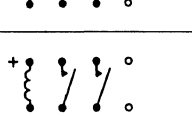
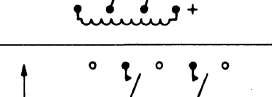
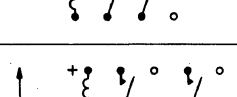
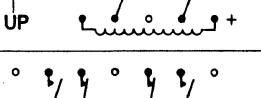
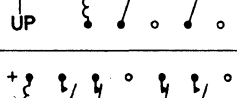
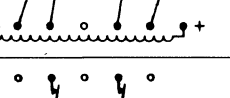
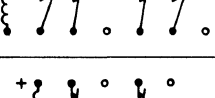


DIMENSIONS: INCHES
(MILLIMETERS)

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	4.0	0.5
12	9.6	1.2
24	19.2	2.4

REED RELAY SELECTION CHART (Add "D" for Diode)

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance (Ohms) ±10%	Part Number End Termination	Part Number Side Termination	Schematic (Pin View) End Termination	Schematic (Pin View) Side Termination	* Width
1A	5 12 24	225 1400 4340	G21AA051 G21AA121 G21AA241	G21AA052 G21AA122 G21AA242			.375 (9.5)
1A HIGH VOLTAGE	5 12 24	225 1400 4340	G21AE051 G21AE121 G21AE241	G21AE052 G21AE122 G21AE242			
1A MERCURY	5 12 24	140 800 3200	G21AH051 G21AH121 G21AH241	G21AH052 G21AH122 G21AH242			
1A and 1B	5 12 24	82 570 1540	G21A1B051 G21A1B121 G21A1B241	G21A1B052 G21A1B122 G21A1B242			.575 (14.6)
1B	5 12 24	105 730 2500	G21BB051 G21BB121 G21BB241	G21BB052 G21BB122 G21BB242			.475 (12.1)
1C	5 12 24	105 730 2500	G21CC051 G21CC121 G21CC241	G21CC052 G21CC122 G21CC242			.475 (12.1)
1C MERCURY	5 12 24	65 400 1600	G21CH051 G21CH121 G21CH241	G21CH052 G21CH122 G21CH242			.475 (12.1)
1C	5 12 24	105 730 2500	G21CX051 G21CX121 G21CX241	G21CX052 G21CX122 G21CX242			.475 (12.1)
2A	5 12 24	105 730 2500	G22AA051 G22AA121 G22AA241	G22AA052 G22AA122 G22AA242			.475 (12.1)
2A HIGH VOLTAGE	5 12 24	105 730 2500	G22AE051 G22AE121 G22AE241	G22AE052 G22AE122 G22AE242			
2A MERCURY	5 12 24	36 225 900	G22AH051 G22AH121 G22AH241	G22AH052 G22AH122 G22AH242			.575 (14.6)
2A and 2B	5 12 24	45 275 790	G22A2B051 G22A2B121 G22A2B241	G22A2B052 G22A2B122 G22A2B242			.775 (19.7)
2B	5 12 24	82 570 1540	G22BB051 G22BB121 G22BB241	G22BB052 G22BB122 G22BB242			.575 (14.6)

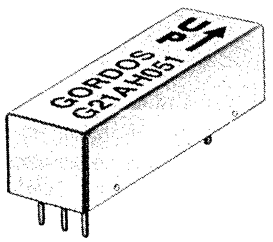
To specify diode, add "D" after part number.

GORDOS CORPORATION

MINIATURE OPEN FRAME
DRY AND MERCURY WETTED REED RELAYS

G2 SERIES

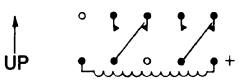
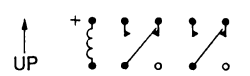
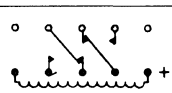
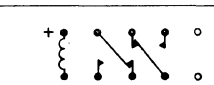
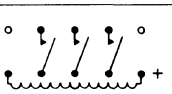
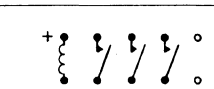
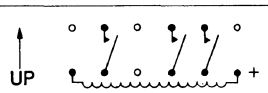
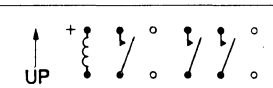
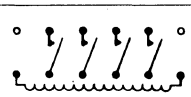
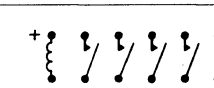
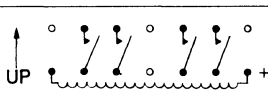
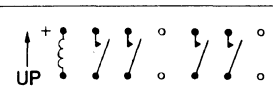
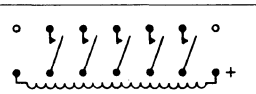
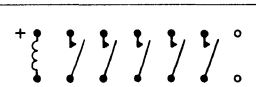
REED RELAYS
Miniature Open Frame Reed Relay



CONTACT RATINGS/CHARACTERISTICS

Switching Ratings	Standard Form A or B	High Voltage Form A	Standard Form C	Form A and C Mercury Wet
Current (Amperes, DC Max.)	.500	.500	.250	1.0
Voltage (Volts, DC Max.)	200	1000	28	500
Breakdown (AC RMS Volts)	350	1200	200	1500
Power (Watts)	10	10	3	50
Operating Time (Milliseconds Typical Including Bounce)	1.0	1.0	1.5 (N/C)	2.00
Release Time (Milliseconds Typical)	.50	.50	1.0 (N/O)	1.50
Initial Contact Resistance (Ohms Max. at Rated Coil Voltage)	.200	.200	.200	.070

REED RELAY SELECTION CHART (Add "D" for Diode)

Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance (Ohms) ±10%	Part Number		Schematic (Pin View)		Width
			End Termination	Side Termination	End Termination	Side Termination	
2C	5 12 24	82 570 1540	G22CC051 G22CC121 G22CC241	G22CC052 G22CC122 G22CC242			.575 (14.6)
2C MERCURY	5 12 24	36 225 900	G22CH051 G22CH121 G22CH241	G22CH052 G22CH122 G22CH242			.575 (14.6)
2C	5 12 24	82 570 1540	G22CX051 G22CX121 G22CX241	G22CX052 G22CX122 G22CX242			.575 (14.6)
3A	5 12 24	82 570 1540	G23AA051 G23AA121 G23AA241	G23AA052 G23AA122 G23AA242			.575 (14.6)
3A HIGH VOLTAGE	5 12 24	82 570 1540	G23AE051 G23AE121 G23AE241	G23AE052 G23AE122 G23AE242			
3A MERCURY	5 12 24	25 150 600	G23AH051 G23AH121 G23AH241	G23AH052 G23AH122 G23AH242			.675 (17.1)
4A	5 12 24	60 320 1090	G24AA051 G24AA121 G24AA241	G24AA052 G24AA122 G24AA242			.675 (17.1)
4A HIGH VOLTAGE	5 12 24	60 320 1090	G24AE051 G24AE121 G24AE241	G24AE052 G24AE122 G24AE242			
4A MERCURY	5 12 24	18 110 440	G24AH051 G24AH121 G24AH241	G24AH052 G24AH122 G24AH242			.775 (19.7)
5A	5 12 24	45 275 790	G25AA051 G25AA121 G25AA241	G25AA052 G25AA122 G25AA242			.775 (19.7)
5A HIGH VOLTAGE	5 12 24	45 275 790	G25AE051 G25AE121 G25AE241	G25AE052 G25AE122 G25AE242			

NOTES: 1. To specify diode, add "D" after part number.
2. Magnetic shielding is standard.
3. Consult factory for electrostatic shielding.
4. Orientation arrow appears on all mercury wetted models. These These relays must be mounted ±30° from vertical.
5. Excessive voltage (maximum of 7.0 VDC for 5 VDC model, 15.0 VDC for 12 VDC model, and 30.0 VDC for 24 VDC model) may cause contact reclosure on form B models.

GÜNTHER

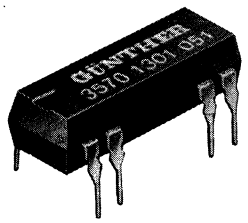
LOW PROFILE DIP
REED RELAY

A GORDOS INTERNATIONAL Company

3570 SERIES

LOW PROFILE DIP

- Low profile makes this relay ideal for microprocessor and numerical control applications
- Environmental immunity assured
- Logic compatible
- All Günther molded devices are molded of glass filled, non-burning epoxy



Contact Form	Nominal Coil Voltage (VDC)	Coil Resistance Ohms (±10%)	Clamp Diode	Part Number
1A	5	380	No	3570-1301-05-1
			Yes	3570-1301-05-3
		550	No	3570-1302-05-1
			Yes	3570-1302-05-3
		750 (Note 4)	No	3570-1303-05-1
			Yes	3570-1303-05-3
	12	530	No	3570-1301-12-1
			Yes	3570-1301-12-3
		1000	No	3570-1302-12-1
			Yes	3570-1302-12-3
	24	2000	No	3570-1301-24-1
			Yes	3570-1301-24-3
1A High Insulation Resistance (see note 1)	5	380	No	3570-1341-05-1
			Yes	3570-1341-05-3
	12	530	No	3570-1341-12-1
			Yes	3570-1341-12-3
	24	2000	No	3570-1341-24-1
			Yes	3570-1341-24-3
1A High Break-Down Voltage (see note 2)	5	380	No	3570-1342-05-1
			Yes	3570-1342-05-3
	12	530	No	3570-1342-12-1
			Yes	3570-1342-12-3
	24	2000	No	3570-1342-24-1
			Yes	3570-1342-24-3

MUST OPERATE/RELEASE CHARACTERISTICS

Nominal Coil Voltage (VDC)	Must Operate Voltage (VDC) @ 25°C	Must Release Voltage (VDC) @ 25°C
5	3.7	1
12	8.0	2
24	16.0	4

OPERATING CHARACTERISTICS

Model	Operate Time* (Typical)	Release Time Without Diode* (Typical)	Storage Temperature Range
3570	.50	.20	−55°C to +105°C

* Operate and release times (including bounce) in milliseconds, may vary depending on voltage applied.

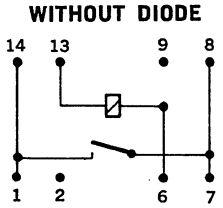
NOTES:
1. Type 3570-1341-___ ___-___ has insulation resistance between coil and contact of $10^{12}\Omega$ measured with 100 VDC at ambient temperature.
2. Type 3570-1342-___ ___-___ has 3 KV break-down voltage between coil and contact.
3. Consult factory for electrostatic shield requirements. Last digit of part number is changed to "-2" to indicate electrostatic shield or "-4" to indicate clamp diode and electrostatic shield.
4. Low-power Schottky application.

CONTACT RATINGS

Model	Maximum Switching (DC)		Maximum Current (Amps)		Typical Initial Contact Resistance (Ohms)	[2]Min. Breakdown Voltage (VAC)		Capacitance (Typical) (pF)		[1]Typical* Insulation Resistance (Ohms)
	Watts	Volts	Switch	Carry		Across Contacts	[1]Contacts Coil	Across Contacts	Contacts Coil	
3570	10	100	.5	1.0	.200	250	500	.8	1.5	10^{10}

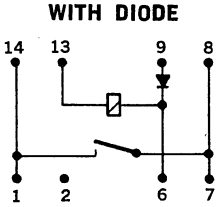
SCHEMATIC (TOP VIEW)

WITHOUT DIODE

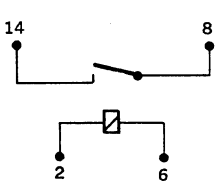


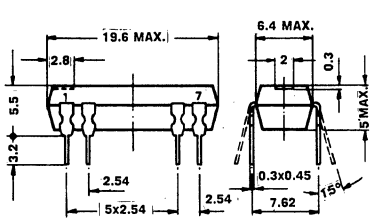
3570-1301
3570-1302

3570-1301
3570-1302
WITH DIODE



3570-1341
3570-1342



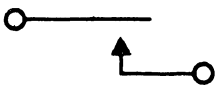


DIMENSIONS: MILLIMETERS

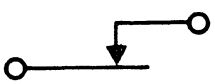
1 inch = 25.4mm

MINIGLOSSARY
RELAY CONTACT FORMS

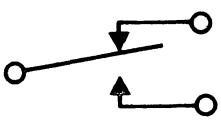
A
Make
SPST-NO



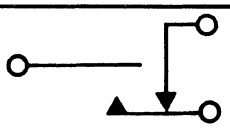
B
Break
SPST-NC



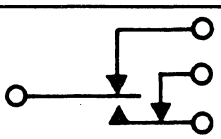
C
Break, Make
(Transfer)
SPDT



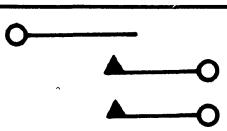
D
Make, Break
(Continuity
Transfer)



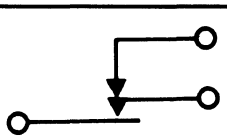
E
Break,
Make,
Break



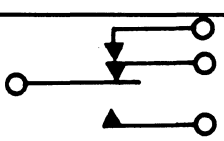
F
Make,
Make



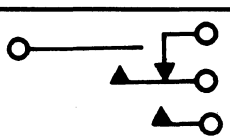
G
Break,
Make



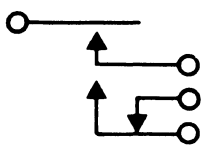
H
Break,
Break,
Make



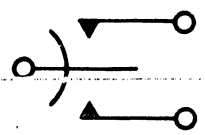
I
Make,
Break,
Make



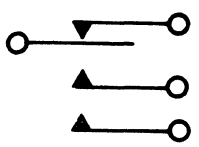
J
Make,
Make,
Break



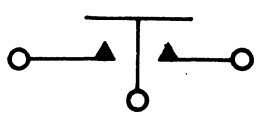
K
Center off
SPDT



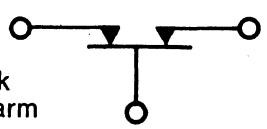
L
Break,
Make,
Make



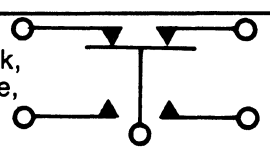
U
Double
make
Contact
on arm



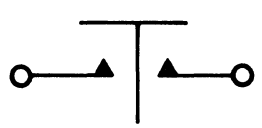
V
Double break
Contact on arm



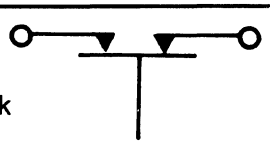
W
Double break,
Double make,
Contact
on arm



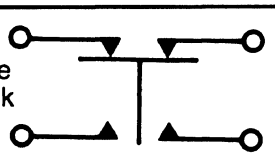
X
Double
make



Y
Double break



Z
Double make
Double break
SPDT-DB



Allied Control Relays

General Purpose Relays

CRADLE® SERIES T154/163

DC Relays — Current and Voltage Adjusted

AC Relays — Voltage Adjusted

FEATURES

- **T154 Single-Point Contacts**
- **T163 Bifurcated Contacts**
- **Proven Cradle® reliability**
- **100 million mechanical operations**
- **Contact selection to match application**
- **Contact configuration:**
  DC Voltage: up to 8 Form C
  AC Voltage: up to 4 Form C
- **Input voltages:**
  DC Voltage: from 3 VDC to 115 VDC
  AC Voltage: from 6 VAC to 220 VAC
  50/60 Hz
- **Sensitivity as low as 20 MW/pole** (DC Voltage only)
- **Low-priced relays**
- **Versatile mounting configurations**
- **High density packaging**
- **UL File E20604 / CSA File 34171**

TYPICAL OPERATING CONDITIONS @ 25°C

ELECTRICAL

Minimum drop-out (DC voltage):
10% of maximum pick-up value (5% for single and double-pole relays)

Dielectric Strength:
1000 VRMS, coil to contacts and between gaps on standard T154 series
500 VRMS, between contact gaps on sensitive, ultrasensitive relays and on all relays with bifurcated contacts

Insulation resistance:
10,000 megohms minimum

Capacitance, DC Voltage:
Closed contacts to frame 3.0 pf
Open contacts to frame 3.0 pf
Between open contacts 3.0 pf
(energized or de-energized)

Capacitance, AC Voltage:
Contact to contact 3.0 pf
Coil to contact 3.0 pf
Coil to frame 30 pf

Operate time, DC Voltage:
15 MS max. at nominal voltage

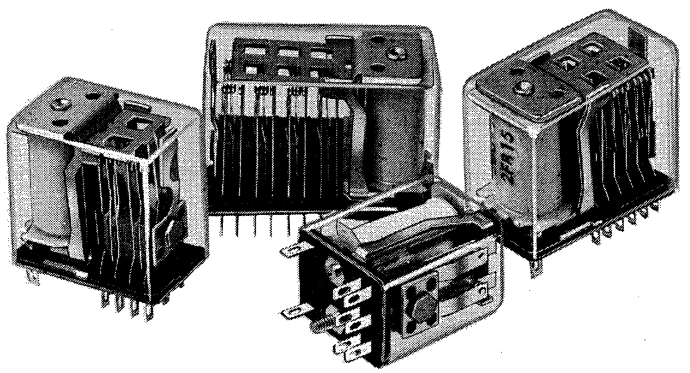
Operate time, AC Voltage: 25 MS

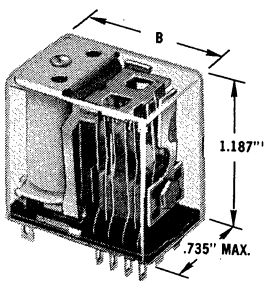
Release time, DC Voltage:
8 MS max. at nominal voltage

Release time, AC Voltage: 25 MS

ENVIRONMENTAL

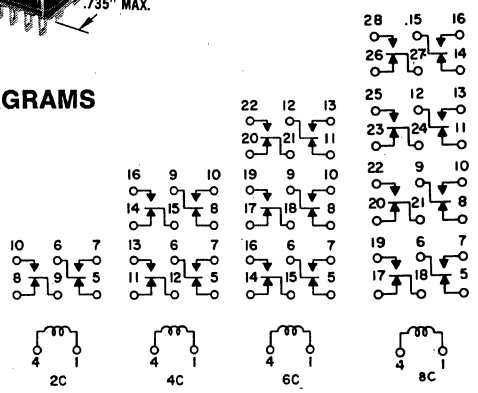
Ambient temperature: −55°C to 71°C





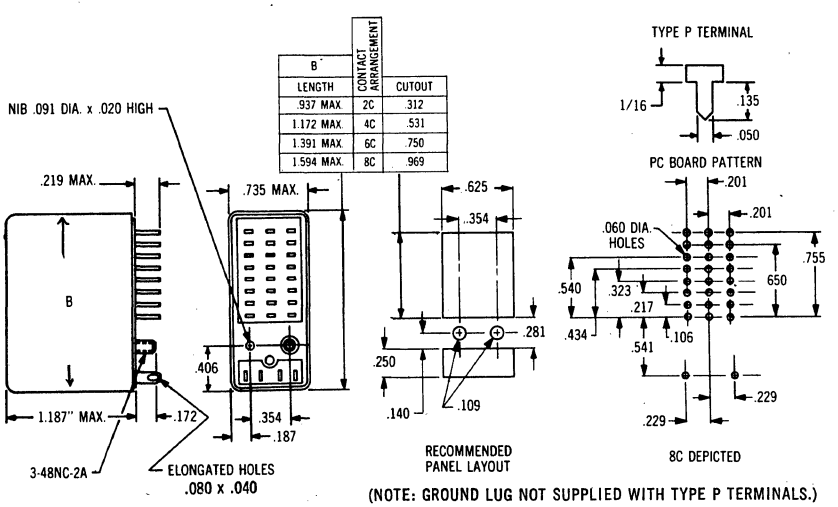
DIMENSION B	
2C	.937
4C	1.172
6C	1.391
8C	1.594

WIRING DIAGRAMS



CIRCUIT DIAGRAMS-UNENERGIZED

DETAILED DIMENSIONS



B LENGTH	CONTACT ARRANGEMENT	CUTOUT
.937 MAX.	2C	.312
1.172 MAX.	4C	.531
1.391 MAX.	6C	.750
1.594 MAX.	8C	.969

(NOTE: GROUND LUG NOT SUPPLIED WITH TYPE P TERMINALS.)

Gould Inc., Industrial Controls Division
100 Relay Road, Plantsville, CT 06479
Telephone (203) 621-6771
TWX 710-473-0079

GOULD *Electronics*

Allied Control Relays

General Purpose Relays

CRADLE® SERIES T154/163

DC RELAYS

Catalog No. 1 2	Coil Res.	Input	Pick-up	Pick-up Power	Contact 3 Arrangement	Contact 4 Rating
STANDARD DC VOLTAGE ADJUSTMENT						
T154-2C-6VDC	52Ω	6V	4.5V	500mW	2C	2 Amp
T154-2C-12VDC	185Ω	12V	9.0V	500mW	2C	2 Amp
T154-2C-24VDC	700Ω	24V	18.0V	500mW	2C	2 Amp
T154-2C-48VDC	2,500Ω	48V	36.0V	500mW	2C	2 Amp
T154-2C-115VDC	15,000Ω	115V	86.0V	500mW	2C	2 Amp
T154-4C-6VDC	52Ω	6V	4.5V	500mW	4C	2 Amp
T154-4C-12VDC	185Ω	12V	9.0V	500mW	4C	2 Amp
T154-4C-24VDC	700Ω	24V	18.0V	500mW	4C	2 Amp
T154-4C-48VDC	2,500Ω	48V	36.0V	500mW	4C	2 Amp
T154-4C-115VDC	15,000Ω	115V	86.0V	500mW	4C	2 Amp
T154-6C-6VDC	25Ω	6V	4.5V	800mW	6C	2 Amp
T154-6C-12VDC	90Ω	12V	9.0V	800mW	6C	2 Amp
T154-6C-24VDC	430Ω	24V	18.0V	800mW	6C	2 Amp
T154-6C-48VDC	1,550Ω	48V	36.0V	800mW	6C	2 Amp
T154-6C-115VDC	9,000Ω	115V	86.0V	800mW	6C	2 Amp
T154-8C-6VDC	20Ω	6V	4.5V	1.000W	8C	2 Amp
T154-8C-12VDC	75Ω	12V	9.0V	1.000W	8C	2 Amp
T154-8C-24VDC	430Ω	24V	18.0V	1.000W	8C	2 Amp
T154-8C-48VDC	1,275Ω	48V	36.0V	1.000W	8C	2 Amp
T154-8C-115VDC	9,000Ω	115V	86.0V	1.000W	8C	2 Amp
SENSITIVE DC VOLTAGE ADJUSTMENT						
TS154-2C-6VDC	185Ω	6V	4.5V	100mW	2C	2 Amp
TS154-2C-12VDC	800Ω	12V	9.0V	100mW	2C	2 Amp
TS154-2C-24VDC	3,200Ω	24V	18.0V	100mW	2C	2 Amp
TS154-2C-48VDC	13,000Ω	48V	36.0V	100mW	2C	2 Amp
TS154-4C-6VDC	110Ω	6V	4.5V	175mW	4C	2 Amp
TS154-4C-12VDC	430Ω	12V	9.0V	175mW	4C	2 Amp
TS154-4C-24VDC	1,800Ω	24V	18.0V	175mW	4C	2 Amp
TS154-4C-48VDC	7,500Ω	48V	36.0V	175mW	4C	2 Amp
TS154-6C-6VDC	75Ω	6V	4.5V	250mW	6C	2 Amp
TS154-6C-12VDC	350Ω	12V	9.0V	250mW	6C	2 Amp
TS154-6C-24VDC	1,275Ω	24V	18.0V	250mW	6C	2 Amp
TS154-6C-48VDC	5,200Ω	48V	36.0V	250mW	6C	2 Amp
TS154-8C-6VDC	52Ω	6V	4.5V	400mW	8C	2 Amp
TS154-8C-12VDC	190Ω	12V	9.0V	400mW	8C	2 Amp
TS154-8C-24VDC	800Ω	24V	18.0V	400mW	8C	2 Amp
TS154-8C-48VDC	3,200Ω	48V	36.0V	400mW	8C	2 Amp

Catalog No. 1 2	Coil Res.	Input	Pick-up	Pick-up Power	Contact 3 Arrangement	Contact 4 Rating
ULTRA-SENSITIVE VOLTAGE ADJUSTMENT						
TSS154-2C-6VDC	500Ω	6V	4.5V	40mW	2C	1 Amp
TSS154-2C-12VDC	2,000Ω	12V	9.0V	40mW	2C	1 Amp
TSS154-2C-24VDC	7,500Ω	24V	18.0V	40mW	2C	1 Amp
TSS154-4C-6VDC	250Ω	6V	4.5V	80mW	4C	1 Amp
TSS154-4C-12VDC	1,000Ω	12V	9.0V	80mW	4C	1 Amp
TSS154-4C-24VDC	3,700Ω	24V	18.0V	80mW	4C	1 Amp
SENSITIVE DC CURRENT ADJUSTMENT						
TS154-2C-8.5Madc	1,000Ω	8.5Madc	8.5Madc	85mW	2C	2 Amp
TS154-2C-5.8Madc	2,500Ω	5.8Madc	5.8Madc	85mW	2C	2 Amp
TS154-2C-4.1Madc	5,000Ω	4.1Madc	4.1Madc	85mW	2C	2 Amp
TS154-2C-3.1Madc	10,000Ω	3.1Madc	3.1Madc	85mW	2C	2 Amp
TS154-2C-2.6Madc	15,000Ω	2.6Madc	2.6Madc	85mW	2C	2 Amp
TS154-4C-13.0Madc	1,000Ω	13.0Madc	13.0Madc	175mW	4C	2 Amp
TS154-4C-8.4Madc	2,500Ω	8.4Madc	8.4Madc	175mW	4C	2 Amp
TS154-4C-6.2Madc	5,000Ω	6.2Madc	6.2Madc	175mW	4C	2 Amp
TS154-4C-4.5Madc	10,000Ω	4.5Madc	4.5Madc	175mW	4C	2 Amp
TS154-4C-3.5Madc	15,000Ω	3.5Madc	3.5Madc	175mW	4C	2 Amp
TS154-6C-16.0Madc	1,000Ω	16.0Madc	16.0Madc	250mW	6C	2 Amp
TS154-6C-10.0Madc	2,500Ω	10.0Madc	10.0Madc	250mW	6C	2 Amp
TS154-6C-7.2Madc	5,000Ω	7.2Madc	7.2Madc	250mW	6C	2 Amp
TS154-6C-5.0Madc	10,000Ω	5.0Madc	5.0Madc	250mW	6C	2 Amp
TS154-6C-4.2Madc	15,000Ω	4.2Madc	4.2Madc	250mW	6C	2 Amp
TS154-8C-20.0Madc	1,000Ω	20.0Madc	20.0Madc	400mW	8C	2 Amp
TS154-8C-13.0Madc	2,500Ω	13.0Madc	13.0Madc	400mW	8C	2 Amp
TS154-8C-9.0Madc	5,000Ω	9.0Madc	9.0Madc	400mW	8C	2 Amp
TS154-8C-6.4Madc	10,000Ω	6.4Madc	6.4Madc	400mW	8C	2 Amp
TS154-8C-5.3Madc	15,000Ω	5.3Madc	5.3Madc	400mW	8C	2 Amp
ULTRA-SENSITIVE CURRENT ADJUSTMENT						
TSS154-2C-6.5Madc	1,000Ω	6.5Madc	6.5Madc	40mW	2C	1 Amp
TSS154-2C-4.1Madc	2,500Ω	4.1Madc	4.1Madc	40mW	2C	1 Amp
TSS154-2C-2.9Madc	5,000Ω	2.9Madc	2.9Madc	40mW	2C	1 Amp
TSS154-2C-2.0Madc	10,000Ω	2.0Madc	2.0Madc	40mW	2C	1 Amp
TSS154-2C-1.7Madc	15,000Ω	1.7Madc	1.7Madc	40mW	2C	1 Amp
TSS154-4C-9.0Madc	1,000Ω	9.0Madc	9.0Madc	80mW	4C	1 Amp
TSS154-4C-5.8Madc	2,500Ω	5.8Madc	5.8Madc	80mW	4C	1 Amp
TSS154-4C-4.1Madc	5,000Ω	4.1Madc	4.1Madc	80mW	4C	1 Amp
TSS154-4C-3.0Madc	10,000Ω	3.0Madc	3.0Madc	80mW	4C	1 Amp
TSS154-4C-2.4Madc	15,000Ω	2.4Madc	2.4Madc	80mW	4C	1 Amp

AC RELAYS

Catalog No. 1 2	Coil Res.	Input	Pick-up	Contact 3 Arrangement	Contact 4 Rating
T154-2C-6VAC	14Ω	6V	5.0V	2PDT	2 Amp
T154-2C-12VAC	65Ω	12V	9.0V	2PDT	2 Amp
T154-2C-24VAC	280Ω	24V	18.0V	2PDT	2 Amp
T154-2C-48VAC	1,250Ω	48V	36.0V	2PDT	2 Amp
T154-2C-115VAC	6,000Ω	115V	86.0V	2PDT	2 Amp
T154-2C-220VAC	15,000Ω	220V	170.0V	2PDT	2 Amp

Catalog No. 1 2	Coil Res.	Input	Pick-up	Contact 3 Arrangement	Contact 4 Rating
T154-4C-6VAC	14Ω	6V	5.0V	4PDT	2 Amp
T154-4C-12VAC	65Ω	12V	9.0V	4PDT	2 Amp
T154-4C-24VAC	280Ω	24V	18.0V	4PDT	2 Amp
T154-4C-48VAC	1,250Ω	48V	36.0V	4PDT	2 Amp
T154-4C-115VAC	6,000Ω	115V	86.0V	4PDT	2 Amp
T154-4C-220VAC	15,000Ω	220V	170.0V	4PDT	2 Amp

NOTES:

1. Single-point contacts shown as standard; for bifurcated contacts, substitute "163" for "154".
2. Solder lug terminals shown as standard; for printed circuit mounts, add "P" after "T", "TS" or "TSS".
   Note: Solder Lug terminals not supplied on printed circuit mount relays.
3. Form C contact arrangement shown as standard; for Form A, B or D, substitute appropriate letter.
4. 5-amp and 10-amp contacts are also available for Standard DC and AC single-point-contact relays; if desired, add "F" after "T" for 5-amp; and add "Y" after "T" for 10-amp.

Gould Inc., Industrial Controls Division
100 Relay Road, Plantsville, CT 06479
Telephone (203) 621-6771
TWX 710-473-0079

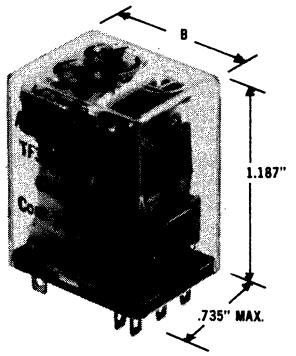
GOULD *Electronics*

Allied Control Relays

General Purpose Relays (cont'd)

CRADLE® SERIES T351/T362

MAGNETIC LATCH RELAYS

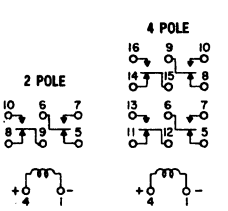


B	.937" for 2C
B	1.172" for 4C

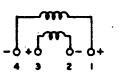
Catalog No. 1 2	Coil Res.	Input	Transfer Voltage	Contact 3 Arrangement	Contact 4 Rating
SINGLE COIL					
T351-2C-12VDC	166Ω	12V	7.0V	2C	2 Amp
T351-2C-24VDC	630Ω	24V	14.5V	2C	2 Amp
T351-4C-12VDC	166Ω	12V	7.0V	4C	2 Amp
T351-4C-24VDC	630Ω	24V	14.5V	4C	2 Amp
DUAL COIL					
T351-2C-2/12VDC	134/134Ω	2/12V	9.2V	2C	2 Amp
T351-2C-2/24VDC	485/485Ω	2/24V	18.0V	2C	2 Amp
T351-4C-2/12VDC	134/134Ω	2/12V	9.2V	4C	2 Amp
T351-4C-2/24VDC	485/485Ω	2/24V	18.0V	4C	2 Amp

NOTES:
1. Single-point contacts shown as standard; for bifurcated contacts, substitute "362" for "351."
2. Solder lug terminals shown as standard; for printed circuit mounts, add "P" after "T."
3. Form C contact arrangement shown as standard; for Form A, B or D, substitute appropriate letters.
4. 5-amp contacts are also available for single-point-contact relays; if desired, add "F" after "T" for 5-amp, and add "Y" after "T" for 10-amp.

WIRING DIAGRAM (RESET POSITION SHOWN)



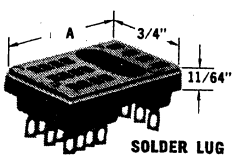
SINGLE WINDING CIRCUIT DIAGRAMS TO OPERATE REVERSE POLARITY



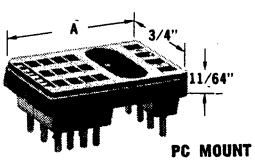
DUAL WINDING CIRCUIT DIAGRAMS
1-4 OPERATE 2-3 RESET

• Consult factory for other voltage coils.

CRADLE® SOCKETS AND HARDWARE



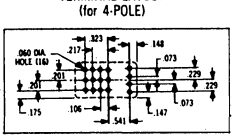
SOLDER LUG



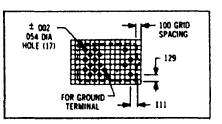
PC MOUNT

Dimensions	
Poles	A
2 Pole	31/32"
4 Pole	1-13/64"
6 Pole	1-13/32"
8 Pole	1-41/64"

TYPICAL PC MOUNT TERMINAL LAYOUT (for 4-POLE)

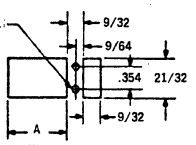


TYPICAL .1 x .1 GRID TERMINAL LAYOUT (for 4-POLE)



Selection Guide Terminal Options	Without Retainer		With Retainer	
	New Cat. No. 0211-011-	Superseded Cat. No. 30054-	New Cat. No. 0211-012-	Superseded Cat. No. 30055-
2 POLE				
Solder Lug	-001-000	-1	-001-000	-1
PC Mount	-005-000	-5	-005-000	-5
.1 x .1 Grid	-003-000	-3	-003-000	-3
4 POLE				
Solder Lug	-002-000	-2	-002-000	-2
PC Mount	-006-000	-6	-006-000	-6
.1 x .1 Grid	-004-000	-4	-004-000	-4
6 POLE				
Solder Lug	-020-000	-20	-020-000	-20
PC Mount	-024-000	-24	-024-000	-24
8 POLE				
Solder Lug	-030-000	-30	-030-000	-30
PC Mount	-032-000	-32	-032-000	-32

A DIM.	
2C	11/32
4C	9/16
6C	25/32
8C	1.0



RECOMMENDED PANEL LAYOUT

INDIVIDUAL PARTS

Part Name	Part No.	Diagram
GROUND WIRE For Solder and standard spaced printed circuit	30052-1 **(0256-002-001)**	To be inserted into socket recess under mounting screw head
GROUND WIRE For .100 grid spaced printed circuit sockets	30174-1 **(0256-003-001)**	To be inserted into socket recess

For	Retainer Part No.	Diagram
2 Pole	30040-1 **(0228-001-001)**	To be inserted into recesses on narrow sides of sockets
4 Pole	30040-2 **(0228-001-002)**	
6 Pole	30040-3 **(0228-001-003)**	
8 Pole	0330-031-001 Flat Retainer	

UL Recognized File No. E-20604

Gould Inc., Industrial Controls Division
100 Relay Road, Plantsville, CT 06479
Telephone (203) 621-6771
TWX 710-473-0079

GOULD *Electronics*

Allied Control Relays

Midget Power Relays

NEW!
GH SERIES — 10 AMPS
GY SERIES — 3 AMPS

FEATURES

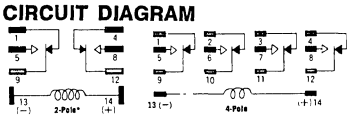
- **Low contact resistance**
- **UL listed:** E20604, E70463
  CSA listed: 35144
- **GH Series:** Smallest 10 amp relay

SPECIFICATIONS

SERIES GH
Contact resist.: 100 milliohms max.
Operate time:
SPDT, DPDT: 20 ms max.
4PDT: 25 ms max.
Release time:
SPDT, DPDT: 20 ms max.
4PDT: 25 ms max.
Power consumption:
SPDT, AC: app. 1 VA (60 Hz)
SPDT, DC: app. 0.8W
DPDT, AC: app. 1.2 VA (60 Hz)
SPDT, DC: app. 0.9W
4PDT, AC: app. 2 VA (60 Hz)
4PDT, DC: app. 1.5W

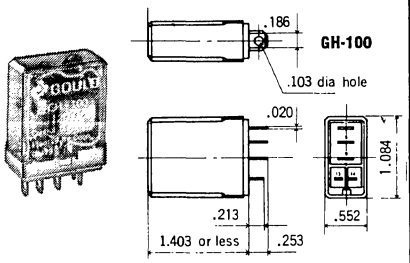
SERIES GY
Contact resist.: 100 milliohms max.
Operate time: 20 ms max.
Release time: 20 ms max.
Power consumption:
DPDT, AC: app. 1 VA (60 Hz)
DPDT, DC: app. 0.8W
4PDT, AC: app. 1.2 VA (60 Hz)
4PDT, DC: app. 0.9W

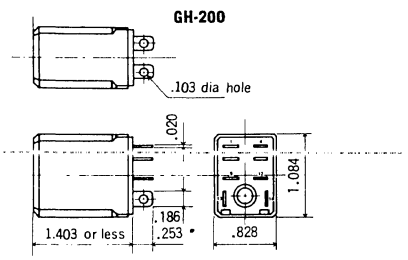
CIRCUIT DIAGRAM

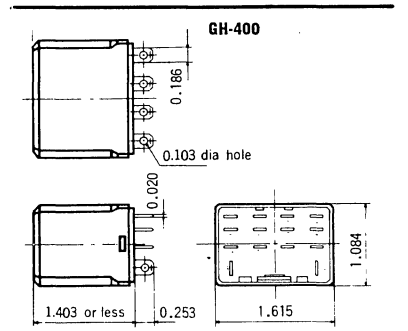


*1-Pole version has terminals 1, 5, 9, 13 and 14.

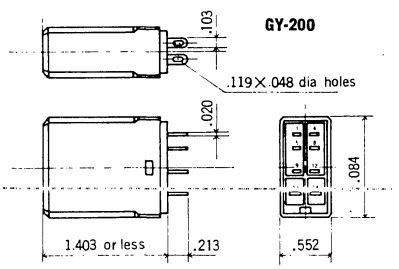
MODEL GH
Plug-in Type (Blade Terminal)

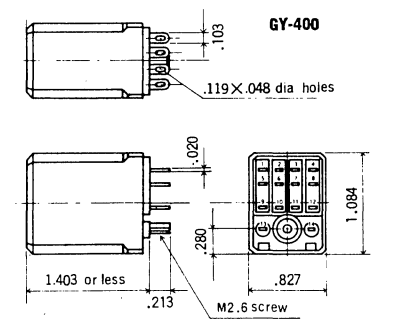






MODEL GY
Plug-in Type (Solder Terminal)





DC VOLTAGE ADJUSTMENT

P/N	Coil Res.
GH100-6VDC	47Ω
GH100-12VDC	188Ω
GH100-24VDC	750Ω
GH100-48VDC	2,660Ω
GH200-6VDC	40Ω
GH200-12VDC	160Ω
GH200-48VDC	2,660Ω
GH200-110VDC	12,100Ω
GH400-6VDC	24Ω
GH400-12VDC	96Ω
GH400-48VDC	1,550Ω
GH400-110VDC	7,340Ω
GY200-6VDC	47Ω
GY200-12VDC	188Ω
GY200-24VDC	750Ω
GY200-48VDC	2,660Ω
GY400-6VDC	40Ω
GY400-12VDC	160Ω
GY400-24VDC	650Ω
GY400-48VDC	2,660Ω
GY400-110VDC	12,100Ω

AC VOLTAGE ADJUSTMENT

P/N	Coil Res.
GH100-6VAC	18.8Ω
GH100-12VAC	76.8Ω
GH100-24VAC	300Ω
GH100-120VAC	7,680Ω
GH200-6VAC	9.6Ω
GH200-12VAC	40.5Ω
GH200-24VAC	156.7Ω
GH200-120VAC	4,280Ω
GH200-240VAC	15,720Ω
GH400-6VAC	5.4Ω
GH400-12VAC	21.2Ω
GH400-24VAC	84.5Ω
GH400-120VAC	2,220Ω
GH400-240VAC	9,120Ω
GY200-6VAC	18.8Ω
GY200-12VAC	76.8Ω
GY200-24VAC	300Ω
GY200-120VAC	6,960Ω
GY400-6VAC	9.6Ω
GY400-12VAC	40.5Ω
GY400-24VAC	156.7Ω
GY400-120VAC	4,280Ω
GY400-240VAC	15,720Ω

NOTE:
1. Solder/plug-in terminals standard; for variations, consult factory.
2. Dropout Voltage: 10% of rated voltage for D.C.
   30% of rated voltage for A.C.

Gould Inc., Industrial Controls Division
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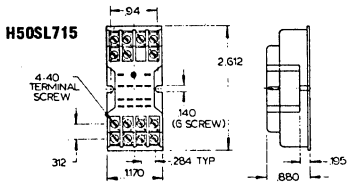
TWX 710-473-0079

GOULD *Electronics*

Allied Control Relays

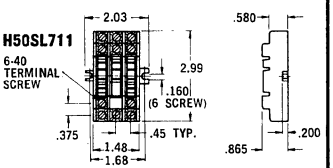
INDUSTRIAL SOCKETS — Gould — Class 50

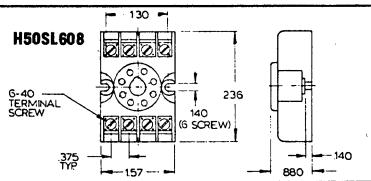
Slimline Design — self-lifting wire clips
Compact Construction — unbreakable polycarbonate body
UL Recognized #E48784
CSA Certified #28098



Blade Socket For Midget Power Relay

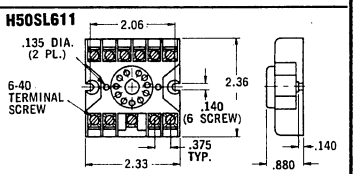
Catalog No.	Contact Arrangement
H50SL715	4 pole double throw
H50SL708	2 pole double throw
H50SL711	3 pole double throw

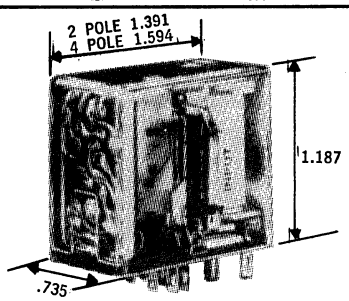




Octal Sockets For Cradle Relay

Catalog No.	Contact Arrangement
H50SL608	8 pin — 2 pole double throw
H50SL611	11 pin — 3 pole double throw

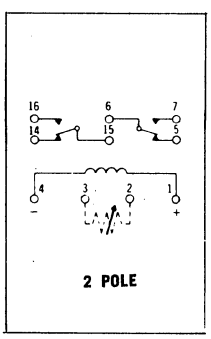


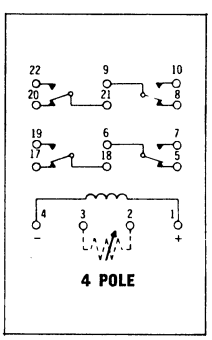


TIMERS, DPDT 5 AMP — Series TD10

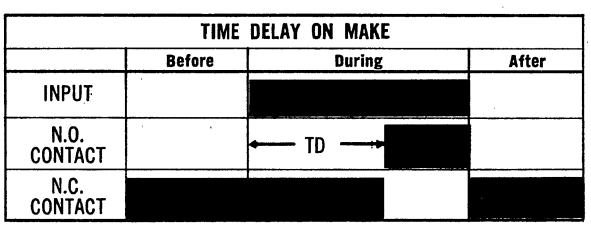
The TD10 utilizes the service proved T154 Cradle® relay with a solid state timing circuit to provide timing from 0.1 to 100 seconds with +2% repeat accuracy.

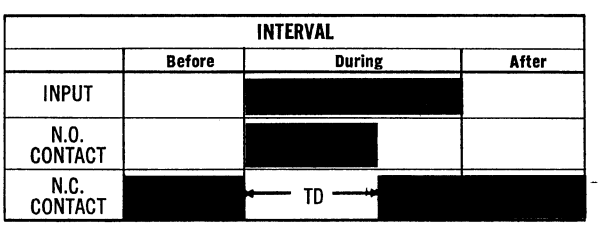
Available as "time delay to make" or "interval" timing models with optional operating and mounting features.





Catalog Number	Time Range (in seconds)	Input Volt
INTERVAL		
TD10NA-2C-12DNB	0.1 to 10	12VDC
TD10NA-2C-24DNB	0.1 to 10	24VDC
TD10NA-2C-115ANB	0.1 to 10	115VAC 50/60 Hz
TD10NA-2C-12DND	1 to 100	12VDC
TD10NA-2C-24DND	1 to 100	24VDC
TD10NA-2C-115AND	1 to 100	115VAC 50/60 Hz
DELAY TO MAKE		
TD10DA-2C-12DNB	0.1 to 10	12VDC
TD10DA-2C-24DNB	0.1 to 10	24VDC
TD10DA-2C-115ANB	0.1 to 10	115VAC 50/60 Hz
TD10DA-2C-12DND	1 to 100	12VDC
TD10DA-2C-24DND	1 to 100	24VDC
TD10DA-2C-115AND	1 to 100	115VAC 50/60 Hz





Gould Inc., Industrial Controls Division
100 Relay Road, Plantsville, CT 06479
Telephone (203) 621-6771
TWX 710-473-0079

GOULD *Electronics*

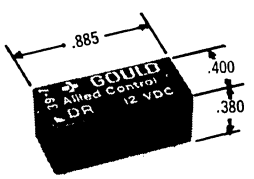
Allied Control Relays

Low Profile Relays

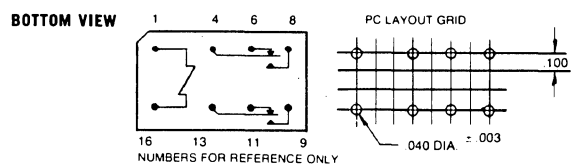
SERIES DR DIP RELAYS
FEATURES:

- Miniature Dual-in-line Relay fits standard 16 pin I.C. sockets or mounts directly on PC board within 0.5" spacing.
- Low profile, only 0.380" max. above PC board.
- Extremely sensitive coil operation 200 mw. with 1 amp. 28 vdc switching and 5 amp. carry capability, 2 amp. Resistive @ 12 VDC.
- Sealed construction for wave soldering, .010" pad on base for ease in cleaning.
- All plastic parts meet U/L 94V-O specifications.
- D.P.D.T. configuration within one small package.

NEW! SERIES DR– DUAL-IN-LINE



Catalog No.	Coil Res.	Input	Pull-in	Drop-out	Pick-up Power	Contact Rating
DPDT						
DR-2C-5VDC	45Ω	5V	3.7V	0.19V	290mW	1 Amp
DR-2C-6VDC	60Ω	6V	4.5V	0.23V	290mW	1 Amp
DR-2C-12VDC	280Ω	12V	9.0V	0.45V	290mW	1 Amp
DR-2C-24VDC	1,070Ω	24V	18.0V	0.90V	290mW	1 Amp
DR-2C-48VDC	4,000Ω	48V	36.0V	1.80V	290mW	1 Amp
DRS-2C-3VDC	25Ω	3V	2.3V	0.12V	200mW	1 Amp
DRS-2C-5VDC	63Ω	5V	3.7V	0.19V	200mW	1 Amp
DRS-2C-6VDC	100Ω	6V	4.5V	0.23V	200mW	1 Amp
DRS-2C-9VDC	250Ω	9V	6.8V	0.34V	200mW	1 Amp
DRS-2C-12VDC	400Ω	12V	9.0V	0.45V	200mW	1 Amp
DRS-2C-18VDC	1,000Ω	18V	13.5V	0.70V	200mW	1 Amp
DRS-2C-24VDC	1,600Ω	24V	18.0V	0.90V	200mW	1 Amp
DRS-2C-36VDC	4,000Ω	36V	27.0V	1.4V	200mW	1 Amp
DRS-2C-48VDC	6,400Ω	48V	36.0V	1.8V	200mW	1 Amp

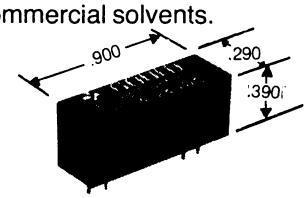


Consult factory for 1A, 2A, 1B, 2B contact configurations.

SERIES SR SIP RELAYS
FEATURES:

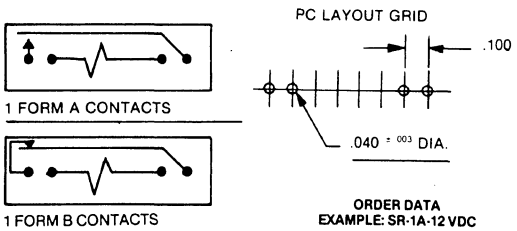
- Superior switching – 2 ampere Bifurcated contacts, handles (6) times the inductive load of a standard size Form "A" contact Reed Relay.
- Small space – ¼ in² PCB space with .390" max. height.
- Easy mounting, symmetrical, eliminates installation errors. Mounts in PCB or on strip or in DIP sockets.
- Fast response – 2 ms typical at rated pull in voltage, 1 ms release.
- 420-SEO Valox Housing meets UL 94V-0 flammability requirement.
- Housing resists fluorocarbon, aqueous detergent and chlorinated commercial solvents.

NEW! SERIES SR– SINGLE-IN-LINE



Catalog No.	Coil Res.	Input	Pull-in	Drop-out	Pick-up Power	Contact Rating
SPST-NO[1]						
SR-1A-3VDC	38Ω	3V	2.3V	0.13V	125mW	2 Amp
SR-1A-5VDC	95Ω	5V	3.7V	0.19V	125mW	2 Amp
SR-1A-6VDC	150Ω	6V	4.5V	0.23V	125mW	2 Amp
SR-1A-9VDC	380Ω	9V	6.8V	0.34V	125mW	2 Amp
SR-1A-12VDC	600Ω	12V	9.0V	0.45V	125mW	2 Amp
SR-1A-18VDC	1,500Ω	18V	13.5V	0.70V	125mW	2 Amp
SR-1A-24VDC	2,400Ω	24V	18.0V	0.90V	125mW	2 Amp
SR-1A-48VDC	6,000Ω	48V	36.0V	1.80V	125mW	2 Amp

NOTE:
1. For SPST-NC, substitute "1B" for "1A." For example SR-1B-3VDC.



Gould Inc., Industrial Controls Division
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Telephone toll free 1-800-243-3104;
in CT call 1-800-982-3045. TWX 710-473-0079.

GOULD *Electronics*

Allied Control Relays

Low Profile Relays

SERIES MPC MINIATURE RELAYS

Series MPC – Miniature PC, Standard
Series MPCS – Miniature PC, Sensitive
Series MPCL – Miniature PC, Latching

FEATURES:

LOW PROFILE – miniature dc operated relay offers space savings comparable to reed relay

LONG LIFE – patented hingeless armature construction insures long mechanical life

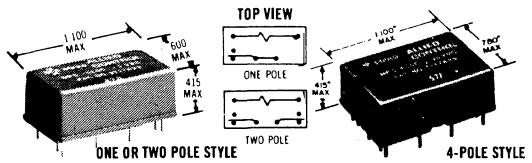
POWER SWITCHING – using standard gold plated silver contact material, MPC Relay has power handling capability of 50 watts per pole

HIGH RELIABILITY – interlocking housing to base minimizes contaminants affecting performance

MULTI-POLE CONTACTS – one form C to four form C available in two basic case sizes

SENSITIVE VERSION – operates from TTL – Driver circuits, available in one form C and two form C within same package size

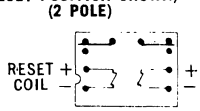
SERIES MPC – STANDARD VERSION



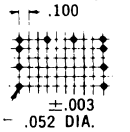
Catalog No.	Coil Res.	Input	Pull-in	Drop-out	Pick-up Power	Contact Rating
SPDT						
MPC-1C-5VDC	35Ω	5V	3.7V	0.37V	400mW	2 Amp
MPC-1C-6VDC	50Ω	6V	4.5V	0.45V	400mW	2 Amp
MPC-1C-12VDC	200Ω	12V	9.0V	0.9V	400mW	2 Amp
MPC-1C-20VDC	550Ω	20V	15.0V	1.5V	400mW	2 Amp
MPC-1C-24VDC	800Ω	24V	18.0V	1.8V	400mW	2 Amp
MPC-1C-48VDC	3,200Ω	48V	36.0V	3.6V	400mW	2 Amp
DPDT						
MPC-2C-5VDC	35Ω	5V	3.7V	0.37V	400mW	2 Amp
MPC-2C-6VDC	50Ω	6V	4.5V	0.45V	400mW	2 Amp
MPC-2C-12VDC	200Ω	12V	9.0V	0.9V	400mW	2 Amp
MPC-2C-20VDC	550Ω	20V	15.0V	1.5V	400mW	2 Amp
MPC-2C-24VDC	800Ω	24V	18.0V	1.8V	400mW	2 Amp
MPC-2C-48VDC	3,200Ω	48V	36.0V	3.6V	400mW	2 Amp
4PDT[1]						
MPC-4C-5VDC	26Ω	5V	3.7V	0.37V	550mW	2 Amp
MPC-4C-6VDC	38Ω	6V	4.5V	0.45V	550mW	2 Amp
MPC-4C-12VDC	150Ω	12V	9.0V	0.9V	550mW	2 Amp
MPC-4C-20VDC	400Ω	20V	15.0V	1.5V	550mW	2 Amp
MPC-4C-24VDC	600Ω	24V	18.0V	1.8V	550mW	2 Amp
MPC-4C-48VDC	2,400Ω	48V	36.0V	3.6V	550mW	2 Amp

NOTE:
1. For a 3PDT substitute "3C" for "4C."

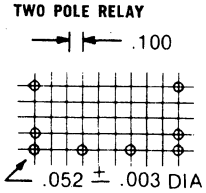
BOTTOM VIEW (RESET POSITION SHOWN) (2 POLE)



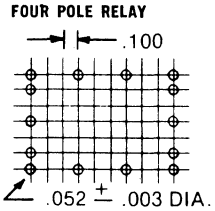
PC LAYOUT & GRID



TWO POLE RELAY



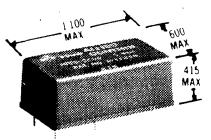
FOUR POLE RELAY



Note: Consult factory for dual source footprint layout.

SERIES MPCS – SENSITIVE VERSION

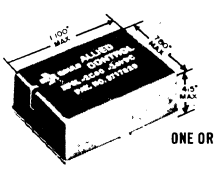
Operates from TTL – Driver Circuits



Catalog No.	Coil Res.	Input	Pull-in	Drop-out	Pick-up Power	Contact Rating
SPDT						
MPCS-1C-5VDC	80Ω	5V	46mA	5mA	160mW	2 Amp
MPCS-1C-6VDC	125Ω	6V	4.5V	0.45V	160mW	2 Amp
MPCS-1C-12VDC	500Ω	12V	9.0V	0.9V	160mW	2 Amp
MPCS-1C-24VDC	2,000Ω	24V	18.0V	1.8V	160mW	2 Amp
MPCS-1C-48VDC	8,000Ω	48V	36.0V	3.6V	160mW	2 Amp
DPDT						
MPCS-2C-5VDC	80Ω	5V	46mA	5mA	160mW	2 Amp
MPCS-2C-6VDC	125Ω	6V	4.5V	0.45V	160mW	2 Amp
MPCS-2C-12VDC	500Ω	12V	9.0V	0.9V	160mW	2 Amp
MPCS-2C-24VDC	2,000Ω	24V	18.0V	1.8V	160mW	2 Amp
MPCS-2C-48VDC	8,000Ω	48V	36.0V	3.6V	160mW	2 Amp

For sealed version precede catalog number with an "S." For example SMPC-2C-12VDC.

SERIES MPCL – LATCHING VERSION



Two completely isolated coils; no need for protection due to continuous application of coil voltage.

Catalog No.	Coil Res.	Input	Latch or Reset Voltage	Power	Contact Rating
SPST					
MPCL-1A-5VDC	28Ω	5V	3.7V	500mW	2 Amp
MPCL-1A-6VDC	40Ω	6V	4.5V	500mW	2 Amp
MPCL-1A-12VDC	160Ω	12V	9.0V	500mW	2 Amp
MPCL-1A-24VDC	640Ω	24V	18.0V	500mW	2 Amp
MPCL-1A-48VDC	2,500Ω	48V	36.0V	500mW	2 Amp
DPDT					
MPCL-2A-5VDC	28Ω	5V	3.7V	500mW	2 Amp
MPCL-2A-6VDC	40Ω	6V	4.5V	500mW	2 Amp
MPCL-2A-12VDC	160Ω	12V	9.0V	500mW	2 Amp
MPCL-2A-24VDC	640Ω	24V	18.0V	500mW	2 Amp
MPCL-2A-48VDC	2,500Ω	48V	36.0V	500mW	2 Amp

For sealed version precede catalog number with an "S." For example SMPCL-2A-12VDC.

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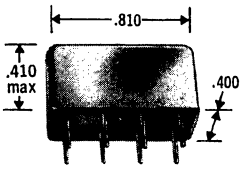
TWX 710-473-0079

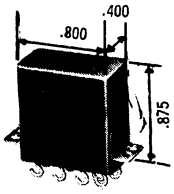
GOULD Electronics

Allied Control Relays

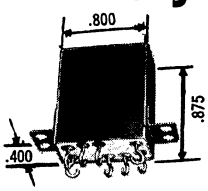
Military Relays



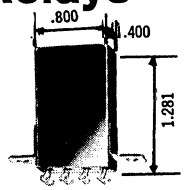
SERIES S
Now per MIL-R-39016



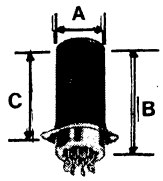
SERIES WKJ



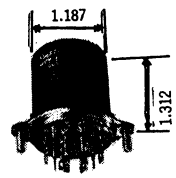
SERIES WKY



SERIES WJS



SERIES MH/MHB/MHJ



SERIES MHY

FEATURES

- **Series S:** ½ Size Crystal Can, 2 amps
- **Series WKJ/WKY:** Crystal Can, 3 amps
- **Series WJS:** Sensitive, Long Crystal Can, 3 amps
- **Series MH/MHB/MHJ:** Miniature Round Can, 5 amps
- **Series MHY:** Miniature Round Can, 10 amps

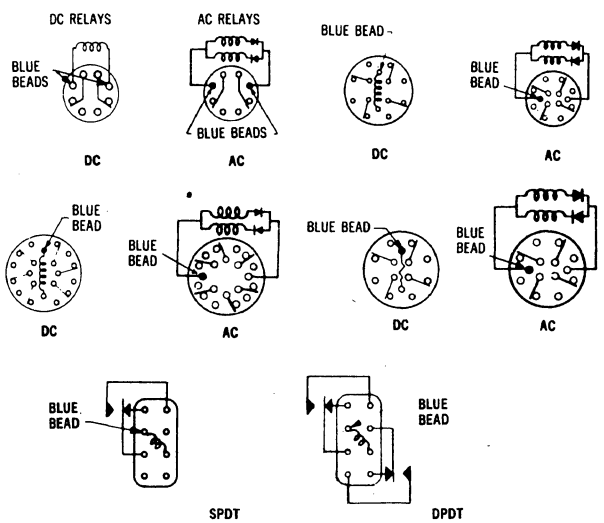
Specification per MIL-R-5757 and MIL-R-39016 as applicable.

	(Dim. in Inches) A	B	C
DPDT	.635	1.312	1.796
4PDT	1.046	1.312	1.750
6PDT	1.187	1.312	1.750

CRYSTAL CAN RELAYS

Bifurcated contacts make these relays ideal for dry circuit loads up to rated amperage.

Catalog No.	Contact Arrangement	Coil Res.	Input	Contact Rating
SERIES S — DC RELAYS				
S6-A1-12VDC	DPDT	140Ω	12.0V	2 Amp
S6-A1-26.5VDC	DPDT	700Ω	26.5V	2 Amp
SERIES WKJ/WKY — DC RELAYS				
WKJ-6D-12VDC	DPDT	150Ω	12.0V	3 Amp
WKJ-6D-26.5VDC	DPDT	600Ω	26.5V	3 Amp
WKJ-6D-115VDC	DPDT	10,000Ω	115.0V	3 Amp
WKY-6D-12VDC	DPDT	150Ω	12.0V	3 Amp
WKY-6D-26.5VDC	DPDT	600Ω	26.5V	3 Amp
WKY-6D-115VDC	DPDT	10,000Ω	115.0V	3 Amp
SERIES WJS — DC RELAYS				
WJS-3D-5.0Madc	SPDT	1,000Ω	5.0Madc	3 Amp
WJS-3D-3.2Madc	SPDT	2,500Ω	3.2Madc	3 Amp
WJS-3D-1.6Madc	SPDT	10,000Ω	1.6Madc	3 Amp
WJS-6D-6.3Madc	DPDT	1,000Ω	6.3Madc	3 Amp
WJS-6D-4.0Madc	DPDT	2,500Ω	4.0Madc	3 Amp
WJS-6D-2.0Madc	DPDT	10,000Ω	2.0Madc	3 Amp



MINIATURE ROUND CAN RELAYS

Series MH/MHB/MHJ — DC Relays — up to 5 amps

Catalog No.	Contact Arrangement	Coil Res.	Input	Temp. Range	Contact Rating
SERIES MH — DC RELAYS					
MH-6D-12VDC	DPDT	82Ω	12.0V		5 Amp
MH-6D-26.5VDC	DPDT	400Ω	26.5V		5 Amp
MH-6D-115VDC	DPDT	6,500Ω	115.0V		5 Amp
MH-12D-12VDC	4PDT	60Ω	12.0V	−55°C	5 Amp
MH-12D-26.5VDC	4PDT	300Ω	26.5V	to	5 Amp
MH-12D-115VDC	4PDT	5,000Ω	115.0V	+85°C	5 Amp
MH-18D-12VDC	6PDT	48Ω	12.0V		5 Amp
MH-18D-26.5VDC	6PDT	240Ω	26.5V		5 Amp
MH-18D-115VDC	6PDT	3,500Ω	115.0V		5 Amp
SERIES MHB — DC RELAYS					
MHB-6D-12VDC	DPDT	65Ω	12.0V		5 Amp
MHB-6D-26.5VDC	DPDT	325Ω	26.5V		5 Amp
MHB-6D-115VDC	DPDT	6,000Ω	115.0V		5 Amp
MHB-12D-12VDC	4PDT	50Ω	12.0V	−65°C	5 Amp
MHB-12D-26.5VDC	4PDT	250Ω	26.5V	to	5 Amp
MHB-12D-115VDC	4PDT	5,000Ω	115.0V	+125°C	5 Amp
MHB-18D-12VDC	6PDT	40Ω	12.0V		5 Amp
MHB-18D-26.5VDC	6PDT	200Ω	26.5V		5 Amp
MHB-18D-115VDC	6PDT	3,500Ω	115.0V		5 Amp
SERIES MHJ — DC RELAYS					
MHJ-12D-12VDC	4PDT	50Ω	12.0V		5 Amp
MHJ-12D-26.5VDC	4PDT	250Ω	26.5V	−65°C	5 Amp
MHJ-12D-115VDC	4PDT	5,000Ω	115.0V	to	5 Amp
MHJ-18D-12VDC	6PDT	40Ω	12.0V	+125°C	5 Amp
MHJ-18D-26.5VDC	6PDT	200Ω	26.5V		5 Amp
MHJ-18D-115VDC	6PDT	3,500Ω	115.0V		5 Amp

(MHJ capabilities 20G to 2000 Hz)

SERIES MHB-MHJ — AC RELAYS					
MHB-6A-115VAC	DPDT	4215/4215	115.0V		5 Amp
MHJ-12A-115VAC	4PDT	2765/2765	115.0V	−65°C to +125°C	5 Amp
MHJ-18A-115VAC	6PDT	2635/2635	115.0V		5 Amp

(MHJ capabilities 20G to 2000 Hz)

SERIES MHY — AC AND DC RELAYS					
MHY-12A-115VAC	4PDT	2635/2635	115.0V	−55°C to +85°C	10 Amp
MHY-12D-12VDC	4PDT	40Ω	12.0V	−65°C	10 Amp
MHY-12D-26.5VDC	4PDT	200Ω	26.5V	to	10 Amp
MHY-12D-115VDC	4PDT	3,500Ω	115.0V	+125°C	10 Amp

Gould Inc., Industrial Controls Division
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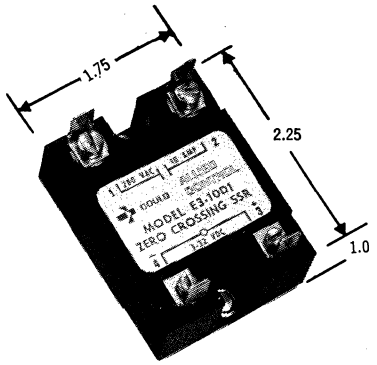
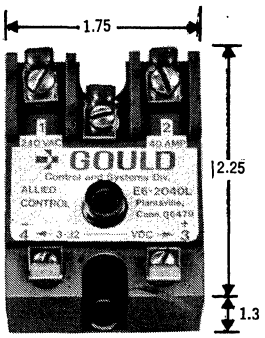
GOULD Electronics

Allied Control Relays

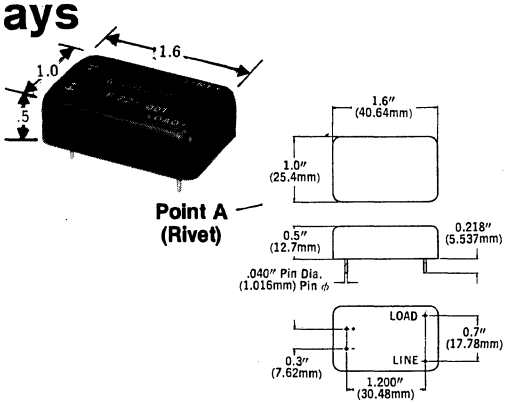
Solid State Relays



SERIES E3 — Optically isolated, zero crossing.



SERIES E6 — Optically isolated, zero crossing, "integral cycling," optional output light.



SERIES E22 — Optically isolated, miniature full-wave power switching pc mounting.

FEATURES

- Bounceless switching
- Long life
- Integrated circuit compatibility
- High noise immunity
- Photo isolated

Note: Consult factory for technical data on heat sink and special applications:

Catalog Number	Max. Load Current	Input	Output (AC)	Contact Type	Surge One Cycle	Max. Contact Voltage Drop	Off State Leakage Current	Pick-up Voltage	Drop-out Voltage	Input Impedance
SERIES E3										
E3-10D1A	10A	3-32VDC	280	A	100A	1.6V	2MA	3VDC	1VDC	2200Ω
E3-10D1B	10A	3-32VDC	280	B	100A	1.6V	2MA	3VDC	1VDC	2200Ω
E3-10A0A	10A	20-28VAC	280	A	100A	1.6V	2MA	18VAC	10VAC	10KΩ
E3-10A0B	10A	20-28VAC	280	B	100A	1.6V	2MA	18VAC	10VAC	10KΩ
E3-10A4A	10A	100-135VAC	280	A	100A	1.6V	2MA	90VAC	10VAC	40KΩ
E3-10A4B	10A	100-135VAC	280	B	100A	1.6V	2MA	90VAC	10VAC	40KΩ
E3-25D1A	25A	3-32VDC	280	A	250A	2V	4MA	3VDC	1VDC	2200Ω
E3-25D1B	25A	3-32VDC	280	B	250A	2V	4MA	3VDC	1VDC	2200Ω
E3-25A0A	25A	20-28VAC	280	A	250A	2V	4MA	18VAC	10VAC	10KΩ
E3-25A0B	25A	20-28VAC	280	B	250A	2V	4MA	18VAC	10VAC	10KΩ
E3-25A4A	25A	100-135VAC	280	A	250A	2V	4MA	90VAC	10VAC	40KΩ
E3-25A4B	25A	100-135VAC	280	B	250A	2V	4MA	90VAC	10VAC	40KΩ
E3-40D1A	40A	3-32VDC	280	A	400A	2V	4MA	3VDC	1VDC	2200Ω
E3-40D1B	40A	3-32VDC	280	B	400A	2V	4MA	3VDC	1VDC	2200Ω
E3-40A0A	40A	20-28VAC	280	A	400A	2V	4MA	18VAC	10VAC	10KΩ
E3-40A0B	40A	20-28VAC	280	B	400A	2V	4MA	18VAC	10VAC	10KΩ
E3-40A4A	40A	100-135VAC	280	A	400A	2V	4MA	90VAC	10VAC	40KΩ
E3-40A4B	40A	100-135VAC	280	B	400A	2V	4MA	90VAC	10VAC	40KΩ
SERIES E6										
E61010	10A	3-32VDC	120	A	100A	1.6V	6MA	3VDC	1VDC	1KΩ
E62010	10A	3-32VDC	240	A	100A	1.6V	7.5MA	3VDC	1VDC	1KΩ
E64010	10A	3-32VDC	480	A	100A	1.6V	8MA	3VDC	1VDC	1KΩ
E61025	25A	3-32VDC	120	A	250A	2V	6MA	3VDC	1VDC	1KΩ
E62025	25A	3-32VDC	240	A	250A	2V	7.5MA	3VDC	1VDC	1KΩ
E64025	25A	3-32VDC	480	A	250A	2V	8MA	3VDC	1VDC	1KΩ
E61040	40A	3-32VDC	120	A	400A	2V	6MA	3VDC	1VDC	1KΩ
E62040	40A	3-32VDC	240	A	400A	2V	7.5MA	3VDC	1VDC	1KΩ
E64040	40A	3-32VDC	480	A	400A	2V	8MA	3VDC	1VDC	1KΩ
SERIES E22										
E22N	4A	3-32VDC	260	A	60A	1.6V	5MA	3VDC	1VDC	2200Ω

1. Max current load when proper heat sink applied.

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100 Relay Road, Plantsville, CT 06479
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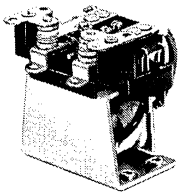
GOULD *Electronics*

Allied Control Relays

Industrial/Commercial Relays

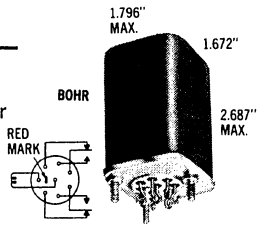
OPEN FRAME — BOT/BOY SERIES



Low Cost DPDT industrial relay. Heavy duty contact switching up to 15 amperes. AC versions use shading ring for 50/60 Hz operation. Weight: 5.0 to 9.0 ounces.

Catalog No.	Description	Contact Arrangement	Coils		Contact Rating
			Coil Res.	Input	
BOT-6A-24VAC BOT-6A-115VAC	AC	DPDT	17 445	24VAC 115VAC	15 Amp
BOT-6D-26.5VDC BOT-6D-110/120VDC	DC	DPDT	230 5,000	26.5VDC 110/120VDC	15 Amp
BOY-6D-26.5VDC BOY-6D-87VDC	Sensitive DC	DPDT	900 10,000	26.5VDC 87VDC	10 Amp

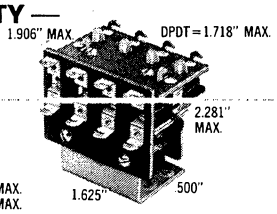
HERMETICALLY SEALED — BOHR SERIES



Hermetically sealed DPDT relay for industrial application in hostile environments. 50/60 Hz operation of AC version.

Catalog No.	Description	Contact Arrangement	Coils		Contact Rating
			Coil Res.	Input	
BOHR-6A-24VAC BOHR-6A-110/120VAC	AC	DPDT	17 445	24VAC 110/120VAC	15 Amp
BOHR-6D-26.5VDC BOHR-6D-110/120VDC	DC	DPDT	230 5,000	26.5VDC 110/120VDC	15 Amp

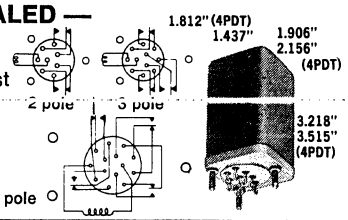
OPEN FRAME, HEAVY DUTY — PO SERIES



Low cost, up to 4PDT, industrial relay. Heavy duty contact switching up to 15 amperes. AC versions use shading ring for 50/60 Hz operation. Weight: 7.5 to 15.0 ounces.

Catalog No.	Description	Contact Arrangement	Coils		Contact Rating
			Coil Res.	Input	
PO-6A-24VAC PO-6A-110/120VAC	AC	DPDT	8 145	24VAC 110/120VAC	15 Amp
PO-9A-24VAC PO-9A-110/120VAC		3PDT	8 145	24VAC 110/120VAC	15 Amp
PO-12A-24VAC PO-12A-110/120VAC		4PDT	8 145	24VAC 110/120VAC	15 Amp
PO-6D-26.5VDC PO-6D-110/120VDC	DC	DPDT	230 5,000	26.5VDC 110/120VDC	15 Amp
PO-9D-26.5VDC PO-9D-110/120VDC		3PDT	230 5,000	26.5VDC 110/120VDC	15 Amp
PO-12D-26.5VDC PO-12D-110/120VDC		4PDT	230 5,000	26.5VDC 110/120VDC	15 Amp

HERMETICALLY SEALED — POHR SERIES

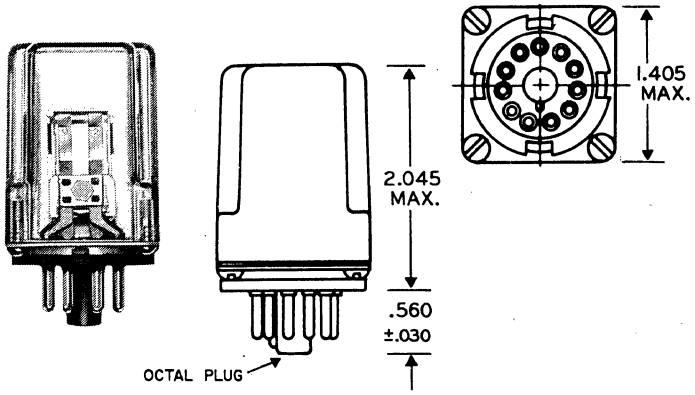


Hermetically sealed against hostile industrial environments. Up to 4PDT. Heavy duty, 15 amp rating. AC versions for 50/60 Hz operation.

Catalog No.	Description	Contact Arrangement	Coils		Contact Rating
			Coil Res.	Input	
POHR-6A-24VAC POHR-6A-110/120VAC	AC	DPDT	8 145	24VAC 110/120VAC	15 Amp
POHR-9A-24VAC POHR-9A-110/120VAC		3PDT	8 145	24VAC 110/120VAC	15 Amp
POHR-12A-24VAC POHR-12A-110/120VAC		4PDT	8 145	24VAC 110/120VAC	15 Amp
POHR-6D-26.5VDC POHR-6D-110/120VDC	DC	DPDT	230 5,000	26.5VDC 110/120VDC	15 Amp
POHR-9D-26.5VDC POHR-9D-110/120VDC		3PDT	230 5,000	26.5VDC 110/120VDC	15 Amp
POHR-12D-26.5VDC POHR-12D-110/120VDC		4PDT	230 5,000	26.5VDC 110/120VDC	15 Amp

Clear Polycarbonate Dust Cover — TYMDO Series

OCTAL BASE
UL #E20604
CSA #34171



Catalog No.	Input	Contact Arrangement	Coil Resistance	Contact Rating
TYMDO-1C-12VDC	12VDC	SPDT	185Ω	10 Amp
TYMDO-2C-12VDC	12VDC	DPDT	185Ω	10 Amp
TYMDO-3C-12VDC	12VDC	3PDT	185Ω	10 Amp
TYMDO-1C-24VDC	24VDC	SPDT	700Ω	10 Amp
TYMDO-2C-24VDC	24VDC	DPDT	700Ω	10 Amp
TYMDO-3C-24VDC	24VDC	3PDT	700Ω	10 Amp
TYMDO-1C-115VDC	115VDC	SPDT	1500Ω	10 Amp
TYMDO-2C-115VDC	115VDC	DPDT	1500Ω	10 Amp
TYMDO-3C-115VDC	115VDC	3PDT	1500Ω	10 Amp
TYMDO-1C-12VAC	12VAC	SPDT	65Ω	10 Amp
TYMDO-2C-12VAC	12VAC	DPDT	65Ω	10 Amp
TYMDO-3C-12VAC	12VAC	3PDT	65Ω	10 Amp
TYMDO-1C-24VAC	24VAC	SPDT	280Ω	10 Amp
TYMDO-2C-24VAC	24VAC	DPDT	280Ω	10 Amp
TYMDO-3C-24VAC	24VAC	3PDT	280Ω	10 Amp
TYMDO-1C-120VAC	120VAC	SPDT	6000Ω	10 Amp
TYMDO-2C-120VAC	120VAC	DPDT	6000Ω	10 Amp
TYMDO-3C-120VAC	120VAC	3PDT	6000Ω	10 Amp

Gould Inc., Industrial Controls Division
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GOULD Electronics

Grayhill INC

Solid State Relays With Transient Protection

- High dV/dT Rating
- High Blocking Voltage
- Minimal EMI and RFI
- Zero Voltage Turn-On
- UL Recognition (DC to AC)
- 100% Inspected

DC to AC Relays

Loads		Control	Description		Ordering Information	
Load Voltage AC	Max. Amps Load Current*	Voltage Range DC	Pkg. Style	Mounting and/or Termination	Part Number	Unit Price
24	2.5	3-15	H	PC	70S2-04-D-02-H	$15.25
24	2.5	14-30	H	PC	70S2-05-D-02-H	15.25
24	3	3-15	V	PC, In-line	70S2-04-D-03-V	12.14
24	3	14-30	V	PC, In-line	70S2-05-D-03-V	12.14
24	4	3-15	F	PC	70S2-04-D-04-F	15.00
24	4	14-30	F	PC	70S2-05-D-04-F	15.00
24	4	3-15	K	Plug-in	70S2-04-D-04-K	15.80
24	4	14-30	K	Plug-in	70S2-05-D-04-K	15.80
120	2.5	3-15	H	PC	70S2-04-B-02-H	15.25
120	2.5	14-30	H	PC	70S2-05-B-02-H	15.25
120	3	3-15	V	PC, In-line	70S2-04-B-03-V	12.91
120	3	14-30	V	PC, In-line	70S2-05-B-03-V	12.91
120	4	3-15	F	PC	70S2-04-B-04-F	15.00
120	4	14-30	F	PC	70S2-05-B-04-F	15.00
120	4	3-15	K	Plug-in	70S2-04-B-04-K	15.80
120	4	14-30	K	Plug-in	70S2-05-B-04-K	15.80
120	6	3-15	N	Bulkhead/Tabs	70S2-04-B-06-N	17.90
120	6	14-30	N	Bulkhead/Tabs	70S2-05-B-06-N	17.90
120	6	3-15	S	Bulkhead/Tabs	70S2-04-B-06-S	18.71
120	6	14-30	S	Bulkhead/Tabs	70S2-05-B-06-S	18.71
120	6	3-15	L	PC	70S2-04-B-06-L	15.35
120	6	14-30	L	PC	70S2-05-B-06-L	15.35
120	6	3-15	M	PC	70S2-04-B-06-M	15.25
120	6	14-30	M	PC	70S2-05-B-06-M	15.25
120	6	3-30	B	Bulkhead/Tabs	70S2-03-B-06-B	23.50
120	6	3-30	D	Bulkhead/Tabs	70S2-03-B-06-D	23.00
120	10	3-15	M	PC	70S2-04-B-10-M	16.95
120	10	14-30	M	PC	70S2-05-B-10-M	16.95
120	10	3-30	B	Bulkhead/Tabs	70S2-03-B-10-B	23.65
120	10	3-30	D	Bulkhead/Tabs	70S2-03-B-10-D	23.15
120	12	3-15	N	Bulkhead/Tabs	70S2-04-B-12-N	19.55
120	12	14-30	N	Bulkhead/Tabs	70S2-05-B-12-N	19.55
120	12	3-15	S	Bulkhead/Screws	70S2-04-B-12-S	20.60
120	12	14-30	S	Bulkhead/Screws	70S2-05-B-12-S	20.60
120	15	3-30	B	Bulkhead/Tabs	70S2-03-B-15-B	24.60
120	15	3-30	D	Bulkhead/Tabs	70S2-03-B-15-D	24.10
220	2.5	3-15	H	PC	70S2-04-C-02-H	16.65
220	2.5	14-30	H	PC	70S2-05-C-02-H	16.65
220	3	3-15	V	PC, In-line	70S2-04-C-03-V	14.32
220	3	14-30	V	PC, In-line	70S2-05-C-03-V	14.32
220	4	3-15	F	PC	70S2-04-C-04-F	16.45
220	4	14-30	F	PC	70S2-05-C-04-F	16.45
220	4	3-15	K	Plug-in	70S2-04-C-04-K	17.25
220	4	14-30	K	Plug-in	70S2-05-C-04-K	17.25
220	6	3-15	N	Bulkhead/Tabs	70S2-04-C-06-N	19.40
220	6	14-30	N	Bulkhead/Tabs	70S2-05-C-06-N	19.40
220	6	3-15	S	Bulkhead/Screws	70S2-04-C-06-S	20.16
220	6	14-30	S	Bulkhead/Screws	70S2-05-C-06-S	20.16
220	6	3-15	L	PC	70S2-04-C-06-L	16.75
220	6	14-30	L	PC	70S2-05-C-06-L	16.75
220	6	3-15	M	PC	70S2-04-C-06-M	16.75
220	6	14-30	M	PC	70S2-05-C-06-M	16.75
220	6	3-30	B	Bulkhead/Tabs	70S2-03-C-06-B	24.45
220	6	3-30	D	Bulkhead/Tabs	70S2-03-C-06-D	23.95
220	10	3-15	M	PC	70S2-04-C-10-D	18.65
220	10	14-30	M	PC	70S2-05-C-10-M	18.65
220	10	3-30	B	Bulkhead/Tabs	70S2-03-C-10-B	24.60
220	10	3-30	D	Bulkhead/Tabs	70S2-03-C-10-D	24.10
220	12	3-15	N	Bulkhead/Tabs	70S2-04-C-12-N	21.35
220	12	14-30	N	Bulkhead/Tabs	70S2-05-C-12-N	21.35
220	12	3-15	S	Bulkhead/Screws	70S2-04-C-12-S	22.34
220	12	14-30	S	Bulkhead/Screws	70S2-05-C-12-S	22.34
220	15	3-30	B	Bulkhead/Tabs	70S2-03-C-15-B	25.90
220	15	3-30	D	Bulkhead/Tabs	70S2-03-C-15-D	25.40

DC to DC Relays

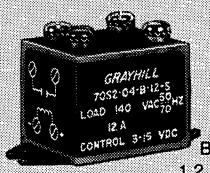
Loads		Control	Description		Ordering Information	
Load Voltage DC	Max. Amps Load Current*	Voltage Range DC	Pkg. Style	Termination and/or Mounting	Part Number	Unit Price
3-50	.4	3-10	H	PC	70S2-01-A-A5-H	$14.65
3-50	.4	10-24	H	PC	70S2-02-A-A5-H	14.65
3-50	.4	3-10	F	PC	70S2-01-A-A5-F	14.65
3-50	.4	10-24	F	PC	70S2-02-A-A5-F	14.65
3-50	.4	3-10	K	Plug-in	70S2-01-A-A5-K	15.85
3-50	.4	10-24	K	Plug-in	70S2-02-A-A5-K	15.85
3-50	2	3-10	F	PC	70S2-01-A-02-F	16.45
3-50	2	10-24	F	PC	70S2-02-A-02-F	16.45
3-50	2	3-10	K	Plug-in	70S2-01-A-02-K	17.60
3-50	2	10-24	K	Plug-in	70S2-02-A-02-K	17.60
3-50	3	3-15	V	PC, SIP	70S2-01-A-03-V	12.91

*For carry current; surge current limits are much higher.

Package Styles

V

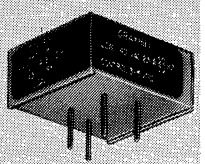
1.7 x 0.4 x 1.0



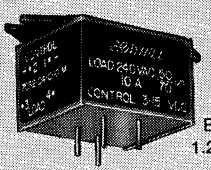
S (& N)

Body = 1.2 x 1.0 x 1.0*

H (& L)



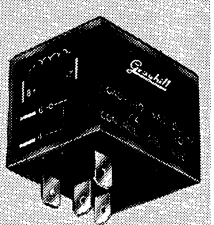
Body = 1.2 x 1.0 x 0.5*



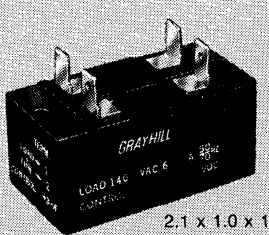
M (& F)

Body = 1.2 x 1.0 x 0.9*

K

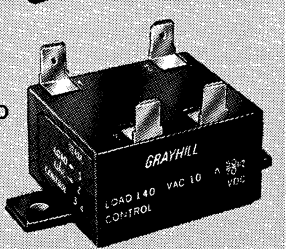


1.2 x 1.0 x 1.0



B

2.1 x 1.0 x 1.0



D

Body = 1.8 x 1.5 x 1.0*

*For styles L, M, N, and S heat sink extends length to 2.2"; for style D extended length is 2.8".

Discount Schedule

1-9	Unit Price
10-24	Less 20%
25-49	Less 28%
50-99	Less 34%
100-249	Less 40%
250 UP	Contact GRAYHILL

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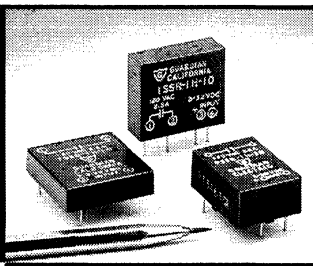
FSSR/ISSR/PSSR SERIES-2.5A

Switching full 2.5 ARMS loads, these compact, space saving SSRs are conveniently PCB mountable. Photo-isolated; "zero-voltage" switching; TTL compatibility; snubbered Triac output are highlight features.



INPUT
Signal Range: 3-32 VDC
Input Current: 5 mA
Response Time: 8.3 mS max.

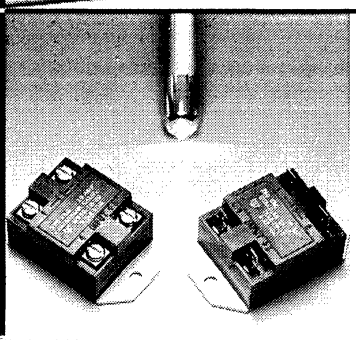
LOAD
Frequency Range: 47-65 Hz
Peak Voltage: 300 V (-1H) 500 V (-2H)
Transient dv/dt: 100V/μS

GENERAL
Operating Temp: −30 to +80°C
I/O Isolation: 1500 VAC
Weight: 0.8 oz. max.

Model No.	On/Off VDC	Load VAC	Load (40°C) ARMS
FSSR-1H-10	3/1	20-140	2.5
FSSR-2H-10	3/1	40-280	2.5
ISSR-1H-10	3/1	20-140	2.5
ISSR-2H-10	3/1	40-280	2.5
PSSR-1H-10	3/1	20-140	2.5
PSSR-2H-10	3/1	40-280	2.5

MSSR SERIES 5A/10A TSSR SERIES 2.5A/10A/20A/30A

Miniature SSRs are 50% smaller & lighter. The TSSR has quick-disconnect push-on terminals. Units feature photo-isolation, "zero-voltage" switching, and snubbered Triac output.



INPUT
Signal Range: 3-32 VDC
Input Current: 5 mA
Response Time: 8.3 mS max.

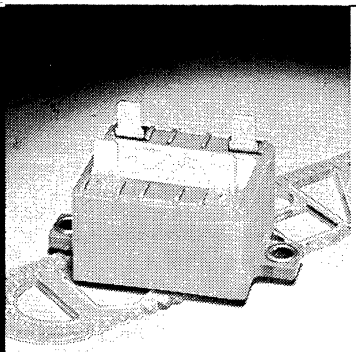
LOAD
Frequency Range: 47-65 Hz
Peak Voltage: 300V (MSSR-1B/TSSR-1H)
500V (MSSR-2B/TSSR-2H)
Transient dv/dt: 100V/μS

GENERAL
Operating Temp: −30 to +80°C
I/O Isolation: 2500 VAC
Weight: 1.5 oz. max.
Dimensions: 1.25" x 2.25" x .81"

MSSR-1I-10	3/1	20-140	5.0
MSSR-2I-10	3/1	40-280	5.0
MSSR-1B-10	3/1	20-140	10.0
MSSR-2B-10	3/1	40-280	10.0
TSSR-1H-10	3/1	20-140	2.5
TSSR-2H-10	3/1	40-280	2.5
TSSR-1B-10	3/1	20-140	10.0
TSSR-2B-10	3/1	40-280	10.0
TSSR-1G-10	3/1	20-140	20.0
TSSR-2G-10	3/1	40-280	20.0
TSSR-1F-10	3/1	20-140	30.0
TSSR-2F-10	3/1	40-280	30.0

SSR/HSSR SERIES 7A/10A/25A

Featuring ruggedized cases with .250" quick-connect push-on terminals, these compact relays come in economical reed-switching input HSSR versions or photo-isolated, "zero-voltage" turn-on SSR models, with snubbered Triac outputs. They are compact and convenient to panel mount.



INPUT
Signal Range: 3.5-12 VDC (SSR)
4.2-10 VDC (HSSR)
Input Current:
35 mA max. @ 12 VDC (SSR)
27 mA max. @ 10 VDC (HSSR)
Response Time: 8.3 mS max. (SSR)
3 mS max. (HSSR)

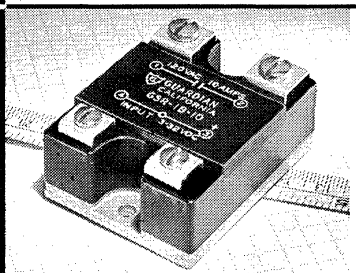
LOAD
Frequency Range: 47-65 Hz
Non-Repetitive Peak Voltage:
300V (SSR-1A/HSSR-1A)
500V (SSR-2A/HSSR-2A)
Transient dv/dt: 250V/μS

GENERAL
Operating Temp: −25 to +70°C
I/O Isolation: 1500 VAC
Weight: 2.5 oz. max.
Dimensions: 1.5" x 2.6" x 1.0"

SSR-1A-10	3.5/1	24-140	7
SSR-2A-10	3.5/1	24-280	7
SSR-1B-10	3.5/1	24-140	10
SSR-2B-10	3.5/1	24-280	10
SSR-1E-10	3.5/1	24-140	25
SSR-2E-10	3.5/1	24-280	25
HSSR-1A-10	4.2/.5	24-140	7
HSSR-2A-10	4.2/.5	24-280	7
HSSR-1B-10	4.2/.5	24-140	10
HSSR-2B-10	4.2/.5	24-280	10
HSSR-1E-10	4.2/.5	24-140	25
HSSR-2E-10	4.2/.5	24-280	25

GSR SERIES 10A/25A/40A

These industry-standard housing panel-mount SSRs are fully encapsulated for general purpose industrial use. They feature photo-isolated inputs, "zero-voltage" turn-on, and have internal Triac snubbers.



INPUT
Signal Range: 3-32 VDC
Input Current: 18 mA max.
Response Time: 8.3 mS

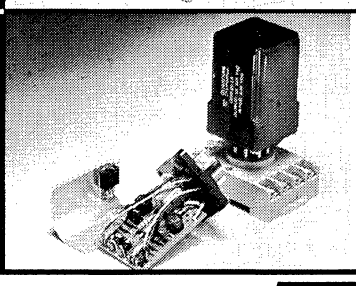
LOAD
Frequency Range: 47-70 Hz
Peak Voltage: 300V (-1B) 500V (-2B)
Transient dv/dt: 200V/μS

GENERAL
Operating Temp: −25 to +70°C
I/O Isolation: 2500 VAC
Weight: 4 oz. max.
Dimensions: 1.75" x 2.25" x .88"

GSR-1B-10	3/1	20-140	10
GSR-2B-10	3/1	40-280	10
GSR-1E-10	3/1	20-140	25
GSR-2E-10	3/1	40-280	25
GSR-1K-10	3/1	20-140	40
GSR-2K-10	3/1	40-280	40

OSR SERIES-5A

These plug-in mount units are Solid State replacements for 8-pin octal electro-mechanical relays. Features include: photo-isolation, "zero-voltage" turn-on, snubbered Triac output, and they have self-contained heat sinks. The units come in SPNO and SPDT versions.



INPUT
Signal Range: 3-32 VDC
Input Current: 5 mA
Response Time: 8.3 mS max.

LOAD
Frequency Range: 47-65 Hz
Peak Voltage: 500 VAC
Transient dv/dt: 100V/μS

GENERAL
Operating Temp: −30 to +80°C
I/O Isolation: 2500 VAC
Weight: 4 oz. max.
Dimensions: 2.18" x 1.38" square

OSR-1I-1A (SPNO)	3/1	20-140	5
OSR-2I-1A (SPNO)	3/1	40-280	5
OSR-1I-1C (SPDT)	3/1	20-140	5
OSR-2I-2C (SPDT)	3/1	40-280	5

Our cataloged Solid-State Relay products are available throughout the USA from over 100 authorized distributors. Contact your local Guardian rep or the factory for technical assistance with all your special SSR, timing, sensing and control development and procurement needs.

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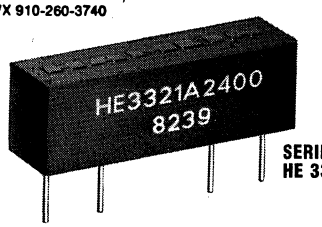
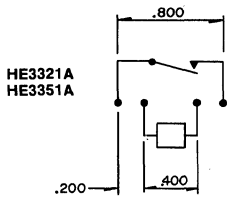
REED RELAYS



SERIES HE 3300

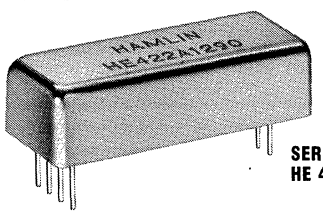


HE 3300 SERIES — Moulded SIP (Single In-Line Package).
Standard industry pin configurations, plus available in Form B, C and Mercury-wetted.

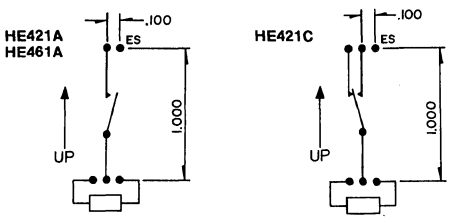
Relay Part Number	Coil Voltage (V)	Coil Resistance (Ω) (± 10%)	Must Operate Voltage V Max.	Must Release Voltage V Min.	Contact Form	Switch Voltage Max. (V)	Switch Current Max. (A)	Switch Rating Max. (W)	Min. Voltage Hold-Off VDC	Contact Resistance (Ω)	List Price
HE3321A0400	5	500	3.75	0.5	1A	200	0.500	10	250	.200	$2.13
HE3321A0500	5	125	4.0	0.5	1A	200	0.500	10	250	.200	2.13
HE3321A1200	12	500	9.0	1.0	1A	200	0.500	10	250	.200	2.13
HE3321A2400	24	2000	16.0	2.0	1A	200	0.500	10	250	.200	2.13

HIGH-VOLTAGE HOLD-OFF RELAY

Relay Part Number	Coil Voltage (V)	Coil Resistance (Ω) (± 10%)	Must Operate Voltage V Max.	Must Release Voltage V Min.	Contact Form	Switch Voltage Max. (V)	Switch Current Max. (A)	Switch Rating Max. (W)	Min. Voltage Hold-Off VDC	Contact Resistance (Ω)	List Price
HE3351A0500	5	125	4.0	0.5	1A	300	0.500	10	800	.200	$2.43
HE3351A1200	12	500	9.0	1.0	1A	300	0.500	10	800	.200	2.43
HE3351A2400	24	2000	18.0	2.0	1A	300	0.500	10	800	.200	2.43



SERIES HE 400



HE 400 SERIES — MINIATURE — HE (1" x .100" Grid).
Economy version to mercury-wetted, to high voltage, to power switch. Up to 5 Form A or 4 Form C. Options include: plastic or drawn metal cover, special schematics and a wide variety of switches.

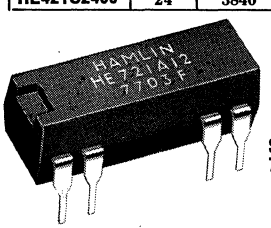
Relay Part Number	Coil Voltage (V)	Coil Resistance (Ω) (± 10%)	Must Operate Voltage V Max.	Must Release Voltage V Min.	Contact Form	Switch Voltage Max. (V)	Switch Current Max. (A)	Switch Rating Max. (W)	Min. Voltage Hold-Off VDC	Contact Resistance (Ω)	List Price
HE421A0500	5	240	3.75	0.5	1A	200	0.500	10	250	.200	$2.33
HE421A1200	12	960	8.0	0.5	1A	200	0.500	10	250	.200	2.33
HE321A2400	24	3840	16.0	1.0	1A	200	0.500	10	250	.200	2.33

HIGH POWER RELAY

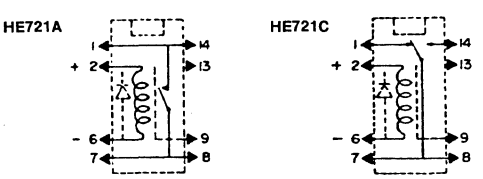
HE461A0500	5	75	3.75	0.5	1A	200	0.500	50	250	.200	$2.95
HE461A1200	12	300	8.0	0.5	1A	200	0.500	50	250	.200	2.95
HE461A2400	24	1200	16.0	1.0	1A	200	0.500	50	250	.200	2.95

3 WATT 1 FORM C

HE421C0500	5	240	3.75	0.5	1C	200	0.250	3	250	.200	$6.58
HE421C1200	12	960	8.0	0.5	1C	200	0.250	3	250	.200	6.58
HE421C2400	24	3840	16.0	1.0	1C	200	0.250	3	250	.200	6.58



SERIES 700



700 SERIES — DIP — Dual In-Line (Industry Standard Configuration).
Hamlin 8 pin .275°° package is available in 1A, 2A, 1B, 1C inputs — 5, 12, 24 volt — standard mercury-wetted — and now on all position Hg wet. Extensive testing at final inspection insures switch integrity for complete quality assurance.

Relay Part Number	Coil Voltage (V)	Coil Resistance (Ω) (± 10%)	Must Operate Voltage V Max.	Must Release Voltage V Min.	Contact Form	Switch Voltage Max. (V)	Switch Current Max. (A)	Switch Rating Max. (W)	Min. Voltage Hold-Off VDC	Contact Resistance (Ω)	List Price
HE721A0500	5	500	3.75	0.5	1A	200	0.500	10	250	.200	$3.40
HE721A1200	12	1000	8.0	1.0	1A	200	0.500	10	250	.200	3.40
HE721A2400	24	2150	16.0	2.0	1A	200	0.500	10	250	.200	3.40

FORM C, SERIES HE 721C

HE721C0500	5	200	3.75	0.5	1C	200	0.250	3	250	.200	$5.95
HE721C1200	12	500	8.0	1.0	1C	200	0.250	3	250	.200	5.95
HE721C2400	24	2000	16.0	2.0	1C	200	0.250	3	250	.200	5.95

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MINI-MOS RELAYS

- 100% elimination of RFI
- 100% elimination of Voltage Offset
- 100% elimination of False Triggering
- 100% immunity to DV/DT
- Optically isolated
- 6 Pin ½ Dip Package
- Can be parallel connected for higher load currents
- AC/DC in and AC/DC out

GENERAL ELECTRICAL CHARACTERISTICS
(common to all models).

Drop out voltage ..... 1.6 V.D.C. (Non-variable)
Off state leakage (7900-4 & 7901-4 not included)
1.0 μamp. ..... at rated voltage
0.3 μamp. ..... at 75% rated voltage
Maximum input reverse current ..... 20 ma.
Maximum input current (1 ms pulse) ..... 250 ma.
Input/Output capacitance ..... 3 pf @ 1 MHz
Input/Output Isolation ..... 2500 VAC
Insulation Resistance ..... $10^9\Omega$

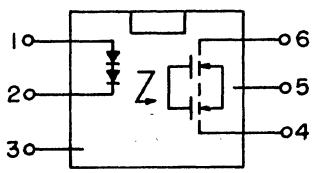
OPERATING CHARACTERISTICS

All measurements at 25°C		7900 Series AC/DC				7901 Series DC Only				
	See Note	7900-1	7900-2	7900-3	7900-4	7901-1	7901-2	7901-3	7901-4	
Contact Form		1A	1A	1A	1A	1A	1A	1A	1A	
Max. Load Voltage		300	200	60	40	300	200	60	40	VDC
Max. Contact Current	1	100	150	200	250	150	225	300	375	maDC
Max. On Resistance	2	70	30	12	4.5	35	15	6	2.25	Ω
Typical On Time	3	500	500	500	500	300	300	300	300	μSec
Typical Off Time	4	300	300	300	300	300	300	300	300	μSec
Current To Operate	5	15	15	15	15	15	15	15	15	maDC

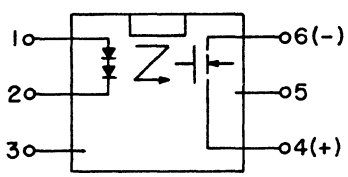
NOTES:
1) Overcurrent condition will result in failure by open circuit.
2) Measured at rated load current and 15 ma input current.
3) Time from 15 ma input current on to 90% of rated load current.
4) Time from 15 ma input current off to leakage current level.
5) a — Overcurrent to 50 ma will not damage relay.
b — Undercurrents down to 5 ma will change operating parameters.
c — External resistor may be required to limit current.

ENVIRONMENTAL

Storage Temp. ... −55°C to +125°C
Operate Temp. ... −40°C to +70°C
Shock .... 50 g (11 ms ½ Sine Wave)
Vibration ..... 20 g (10-2000 Hz)

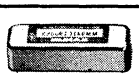


7900 Series AC/DC



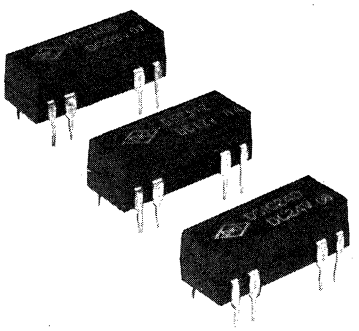
7901 Series DC Only

MERCURY-WETTED CONTACT RELAYS

Type	Relay	Terminal Type/Grid	Contact Forms	Description
	MM91	1.4/1.2 x .1	1C 2C	2 amp, 100 VA Bistable or single side stable
	MM92	1.4/1.2 x .1	1C 2C	Highest speed 1.2 ms operate time low noise, high repetition rate, 2 amp, 100 VA
	MM94	1.8/1.5 x .2 Staggered	1C, 1D 2C, 2D	2 amp, 100 VA Bistable or single side stable 120 Hz repetition rate
	ML95	3/2.4 x .2 Staggered	1D 2D	High current, 5 amp, 250 VA, 500 volt 80 Hz max. repetition rate, 1 nanosecond rise time
	MO93 MO97	8, 11, 14 pin octal plug	1C, 1D, 2C, 2D	2 amp, 100 VA sensitive mercury-wetted relay
	MO98	8 pin octal plug	1D, 2D 3D, 4D	High current, 5 amp, 250 VA, 500 volt contacts

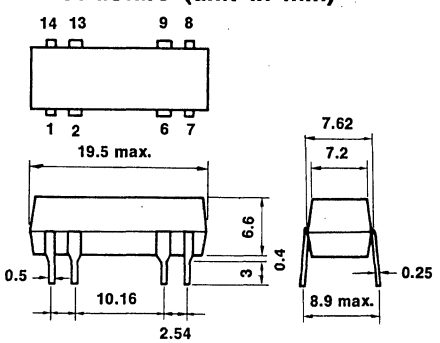
HASCO COMPONENTS INC. / REED RELAYS

OKI electric industry company, ltd.

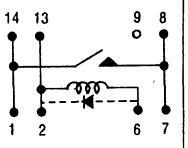
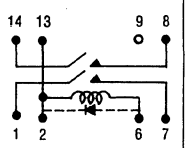
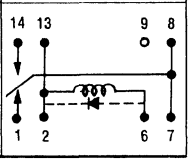


- De-activated rhodium contacts for stable contact resistance.
- Standard TO-116 Terminal Grid fits all standard DIP sockets.
- Interface directly with RTL, DTL, TTL, HTL logic.
- Molded epoxy package for environmental immunity.
- Automatic insertion compatible.
- Relay testing services test report available.

Structure (unit in mm)



Characteristics

Contact Form	Part Number	Nominal Voltage (V)	Must Operate (V)	Must Release (V)	Coil Resistance (Ω)	Circuit Schematic (Top view)
1A	RRD51A05 (D)	5	3.75	0.5	500	
	RRD51A12 (D)	12	9.0	1.2	800	
	RRD51A24 (D)	24	18.0	2.4	2000	
2A	RRD52A05 (D)	5	3.75	0.5	140	
	RRD52A12 (D)	12	9.0	1.2	400	
	RRD52A24 (D)	24	18.0	2.4	1300	
1C	RRD51C05 (D)	5	3.75	0.5	200	
	RRD51C12 (D)	12	9.0	1.2	500	
	RRD51C24 (D)	24	18.0	2.4	1500	

(D); clamp diode optional

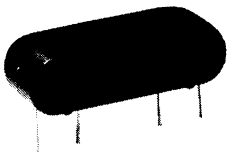
Engineering Data

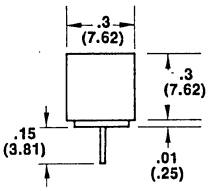
	1A, 2A	1C
Operate time	0.5msec max.	0.5msec. max.
Release time	0.2msec max.	0.2msec max.
Bounce time	0.5msec max.	2.0msec max.
Contact resistance	150mΩ max. (initial)	150mΩ max. (initial)
Contact ratings	DC10VA max.	DC3VA max.
	DC100V max.	DC30V max.
	DC1.0A max. (carry only)	DC0.5A max. (carry only)
	DC0.5A max. (switched)	DC0.25A max. (switched)
Life expectancy	50 x 10^6 operations at signal level	30 x 10^6 operations at signal level
	3 x 10^6 full rated load	1 x 10^6 at full rated load
Breakdown voltage	DC250V across open contacts	DC200V across open contacts
	DC500V between coil and contact	DC500V between coil and contact
Insulation resistance	10^9Ω min.	10^9Ω min.
Vibration	20G (10 ~ 2000Hz)	20G (10 ~ 2000Hz)
Thermal shock	−55 ~ 105°C	−55 ~ 105°C
Moisture resistance	60°C-90% 240 hours	60°C-90% 240 hours
Terminal strength	225g	225g
Operating temperature	−40 ~ 85°C	−40 ~ 85°C
Storage temperature	−55 ~ 105°C	--55 ~ 105C°

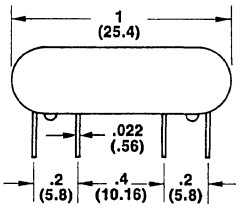
HASCO COMPONENTS INC. REED RELAYS

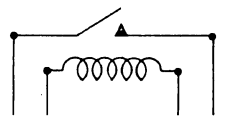
DRY CONTACT REED RELAY

SERIES 700









( ) Indicates Millimeters

ENGINEERING DATA

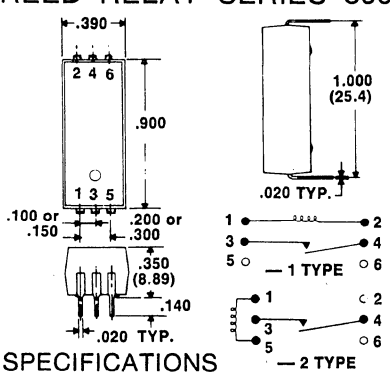
Operate Time: 0.5 mSec max.
Release Time: 0.2 mSec max.
Bounce Time: 0.5 mSec max.
Contact Resistance: 150 mΩ max. (initial)
Life Expectancy: 50 x 10^6 operations at signal level
3 x 10^6 at full rated load
Insulation Resistance: 10^9Ω min.
Vibration: 20G (10-2000 Hz)
Thermal Shock: −55~105°C
Moisture Resistance: 60°C - 90% 240 hours
Terminal Strength: 225g
Operating Temperature: −40~85°C
Storage Temperature: −55~105°C

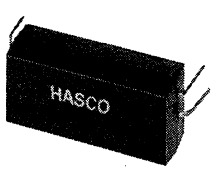
Available in non position sensitive mercury wetted contacts.
Also available in 1C Contact Rating.

SPECIFICATIONS

Part Number	Nominal Voltage (V)	Must Operate (V)	Must Release (V)	Coil Resistance (Ohms)	Contact Rating	Breakdown Voltage
711-5	5-6	3.75	0.5	500	10VA DC max 100V DC max 1.0A max carry 0.5 max switching	250V DC across contacts 1000V DC contacts to coil
711-12	12	9.0	1.2	500		
711-24	24	18.0	2.4	2000		
HEAVY DUTY						
712-5	5-6	3.75	0.5	400	70VA DC max 100V DC max 2.5 max carry 1.0A max switching	300V DC across contacts 1000V DC contacts to coil
712-12	12	9.0	1.2	400		
712-24	24	18.0	2.4	1600		
HIGH VOLTAGE						
713-5	5-6	3.75	0.5	400	50VA DC max 400 DC max 2.5A max carry 1.0A max switching	500V DC across contacts 300V DC contacts to coil
713-12	12	9.0	1.2	400		
713-24	24	18.0	2.4	1600		

REED RELAY SERIES 800





ENGINEERING DATA

Operate Time: 0.5 mSec max.
Release Time: 0.2 mSec max.
Bounce Time: 0.5 mSec max.
Contact Resistance: 150 mΩ max. (initial)
Life Expectancy: 50 x 10^6 operations at signal level
3 x 10^6 at full rated load
Insulation Resistance: 10^9Ω min.
Vibration: 20G (10-2000 Hz)
Thermal Shock: −55~105°C
Moisture Resistance: 60°C - 90% 240 hours
Terminal Strength: 225g
Operating Temperature: −40~85°C
Storage Temperature: −55~105°C

Also available in 1A, 2A, 1C and 2C Contact Rating.

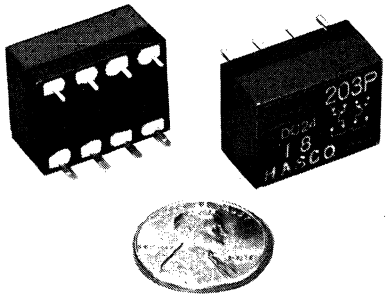
SPECIFICATIONS

Part Number	Nominal Voltage (V)	Must Operate (V)	Must Release (V)	Coil Resistance (Ohms)	Contact Rating	Breakdown Voltage
811-5	5-6	3.75	0.5	500	10 VA DC max 100 VDC max 1.0A max carry 0.5 max switching	250V DC across contacts 1000V DC contacts to coil
811-12	12	9.0	1.2	500		
811-24	24	18.0	2.4	2000		
HEAVY DUTY						
812-5	5-6	3.75	0.5	400	70VA DC max 100V DC max 2.5A max carry 1.0A max switching	300V DC across contacts 1000V DC contacts to coil
812-12	12	9.0	1.2	400		
812-24	24	18.0	2.4	1600		
HIGH VOLTAGE						
813-5	5-6	3.75	0.5	400	50VA DC max 400 DC max 2.5A max carry 1.0A max switching	750V DC across contacts 1000V DC contacts to coil
813-12	12	9.0	1.2	400		
813-24	24	18.0	2.4	1600		

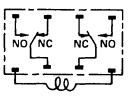
HASCO COMPONENTS INC.

RELAYS

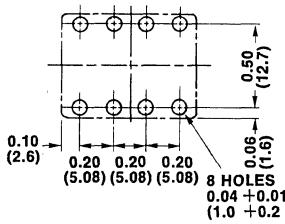
SSD203P RELAY SERIES

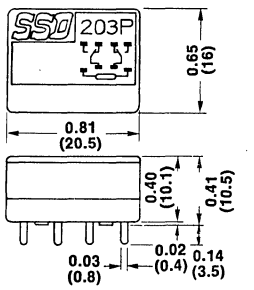


WIRING DIAGRAM

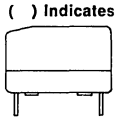


MOUNTING DIMENSIONS





( ) Indicates Millimeters



MAXIMUM LOAD RATING:
125V AC 3A, 250V AC 2.5A, 30V DC 3A and 5A

This double pole, double throw miniature relay gives 3 Amp or 5 Amp switching in a small package only .81″ x .65″ x .41″ (20.5 x 16 x 10.5mm) at low cost. It's the perfect answer for applications in Industrial Controls, Computer Peripherals and a wide range of others.

FEATURES

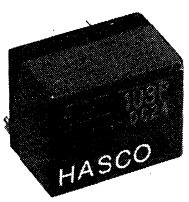
- Miniature Size: .81″ x .65″ x .41″, 20.5 x 16 x 10.5mm
- Printed circuit terminals
- Double pole, double throw
- Low cost
- Can be flow soldered

SPECIFICATIONS

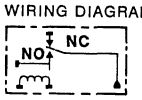
- Maximum Voltage: 120% of rated voltage at 20°C
- Must Operate Voltage: 75% of rated voltage at 20°C
- Coil Temperature Rise: 65°C max. at rated voltage
- Insulation Resistance: 100M ohm min. at 500V DC
- Dielectric Strength:
  2000V AC 1 minute between coil and terminal
  750V AC 1 minute between contacts
- Electric Life: 100,000 operations
- Mechanical Life: 10 million operations
- Contact Material: Silver alloy
- Contact Resistance: 100m ohm max. (4 to 6V DC, 1A)
- Operating Temperature Range: −10°C to +65°C

Rated Voltage (V)	5 DC	6 DC	12 DC	24 DC
Rated Current (mA)	120	100	50	25
Coil Resistance (Ω)	42	60	240	960

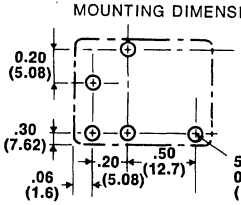
SSD103P RELAY SERIES

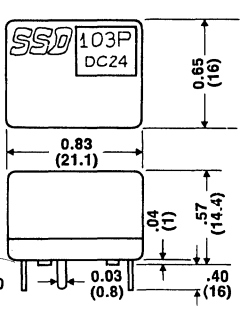


WIRING DIAGRAM



MOUNTING DIMENSIONS





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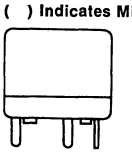


MAXIMUM LOAD RATING:
125V AC 3A, 250V AC 2.5A, 30V DC 3A
SSD105P (125V AC 5A type) also available

This single pole, double throw miniature relay gives up to 5 Amp switching in a small package only .83″ x .63″ x .57″ (21 x 16 x 14.4mm) at low cost. It is ideal for use in Computer Peripherals, Industrial Controls and a wide range of other applications.

FEATURES

- Miniature Size: .83″ x .63″ x .57″, 21 x 16 x 14.4mm
- Printed circuit terminals
- Single pole, double throw
- Can be flow soldered

SPECIFICATIONS

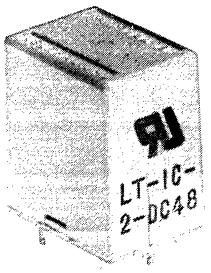
- Maximum Load Voltage: 150% of rated voltage at 20°C
- Must Operate Voltage: 65% of rated voltage at 20°C
- Coil Temperature Rise: 50°C max. at rated voltage
- Insulation Resistance: 250 ohm min. at 500V DC
- Dielectric Strength:
  2000V AC 1 minute between coil and terminal
  750V AC 1 minute between contacts
- Surge Voltage Resistance: 7000V DC min. between coil and terminals at 20°C 65% RH, 40 sec., 3 times
- Electric Life: 100,000 operations
- Mechanical Life: 20 million operations
- Contact Material: Silver alloy
- Contact Resistance: 70m ohm max. (4 to 6V DC, 1A)
- Operating Temperature Range: −30°C to +70°C

Rated Voltage (V)	6 DC	9 DC	12 DC	24 DC
Rated Current (mA)	75	50	37	18.5
Coil Resistance (Ω)	80	180	320	1280
Rated Current Tolerance: ±15%-20% at 20°C				

HASCO COMPONENTS INC.

RELAYS

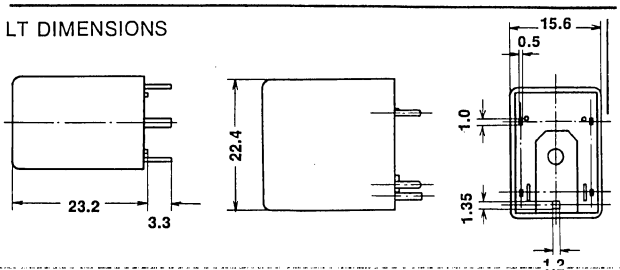
LYRE AND LT MINIATURE POWER RELAYS

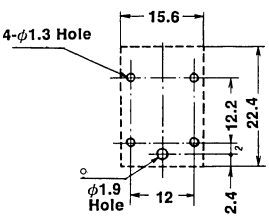


FEATURES

- Miniature, lightweight relay which requires less mounting space
- Large switching capacity like 2A, 5A, and 10A, matching for general purpose
- High reliable relay with dielectric strength, 2000V which employs the specific construction
- Economical and favorable price for simple construction

LT DIMENSIONS



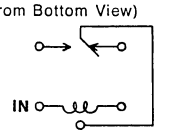


LT-1C-2-DC 24

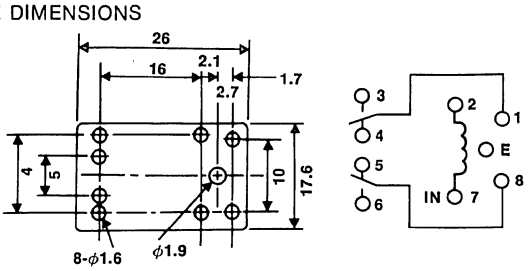
Load Current
2: 2 Amp
5: 5 Amp
10: 10 Amp

Rated Voltage
6, 9, 12, 24, 48

INTERNAL WIRING DIAGRAM
(From Bottom View)



LYRE DIMENSIONS



LYRE CONTACT SWITCHING CAPACITY

Load Current	Max. Applied Load: Voltage (V)	Max. Applied Load: Current (A): Resistance Load (PF=1)	Max. Applied Load: Current (A): Inductive Load (PF=0.4)	Electrical Life
2A	AC 120 DC 24	2	0.8	More than 100,000 times
5A		5	2.0	More than 150,000 times

GENERAL CHARACTERISTICS

Contact Material: Gold plated on silver for 2A — Silver cadmium oxide for 5A
Ambient Temperature: −20 to +60°C (not to freeze)
Ambient Humidity: 45 to 85% (not to be dewy)
Operating Time: Less than 20 mS
Release Time: Less than 20 mS
Contact Resistance (at initial): Less than 100 milliohms at 6V DC, 1A
Insulation Resistance: 500V DC, more than 100M Ohms
Dielectric Strength: Between contacts; 500V AC (50/60 Hz) 1 minute — Between coil and contact; 2,000V AC (50/60 Hz) 1 minute
Vibration: 6G (10 to 55 Hz)
Shock: 10G
(The above mentioned values are at normal temperature and humidity)

LYRE CHARACTERISTICS

Contact Arrangement: DPDT (Form C)
Power Consumption: DC 1W; AC-50 Hz 1VA AC-60 Hz 0.85VA
Temperature Rise: DC, Less than 50 deg at rated voltage; AC, Less than 60 deg at rated voltage
Mechanical Life: More than 10 million times

LT CHARACTERISTICS

Contact Arrangement: SPDT (Form C)
Power Consumption: Approx. 0.36W to approx. 0.5W
Temperature Rise: Less than 40 deg after applied max. continuous voltage

LYRE COIL RATING

Rated Voltage	Resistance Value (Ohms)	Rated Power	Pull-in Voltage	Drop-out Voltage	Maximum Continuous Applied Voltage
6V DC	35	1.03W	80% or less than rated voltage	10% or more than rated voltage	120% of rated voltage
9V DC	80	1.01W			
12V DC	145	0.99W			
24V DC	560	1.03W			
48V DC	2,100	1.10W			

Rated Voltage	Rated Current (50 Hz/60 Hz)	Rated Power	Pull-in Voltage	Drop-out Voltage	Maximum Continuous Applied Voltage
6V AC	160 mA/136 mA	50 Hz: 1VA 60 Hz: 0.85VA	80% or less than rated voltage	30% or more than rated voltage	120% of rated voltage
12V AC	83 mA/ 71 mA				
24V AC	40 mA/ 34 mA				
48V AC	21 mA/ 18 mA				
100V AC	10 mA/ 8.5 mA				
120V AC	8 mA/ 6.8 mA				

LT

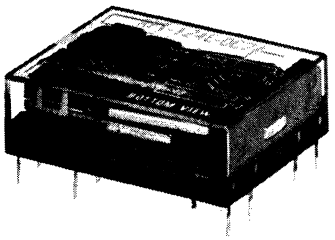
Coil: Rated Voltage (V)	Coil: Ohms (Ω)	Coil: Current Rated (mA)	Coil: Appearance	Operate Characteristics: Maximum Continuous Applied Voltage	Operate Characteristics: Minimum Operating Voltage	Operate Characteristics: Maximum Release Voltage	Max. Applied Load: Voltage (V)	Max. Applied Load: Current (A): Resistance Load	Max. Applied Load: Current (A): Inductive Load	Life: Electrical	Life: Mechanical
6	100	60	Red	120% of rated voltage	Less than 80% of rated voltage	More than 10% of rated voltage	AC 100 DC 24	2 (5) (cos=1)	0.8 (2) (cos=0.4)	More than 0.1 (0.3)x10⁶ times	More than 10x10⁶ times
9	225	40	Yellow								
12	400	30	Blue								
24	1,600	15	Green								
48	4,500	10	Transparent								

GENERAL NOTES: Allowable deviation of coil resistance is ±10% at 68°F
Operation characteristics are obtained at 68°F
LT: Parenthesized passages of "load-applied and life" are for silver cadmium oxide contact.

HASCO COMPONENTS, INC. / 214-22 WATERS EDGE DRIVE, BAYSIDE, NY 11360 / (212) 428-5155 TWX: 710-582-5750

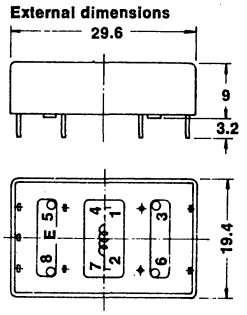
HASCO COMPONENTS INC. RELAYS

HAS/RFT SERIES LOW PROFILE RELAY

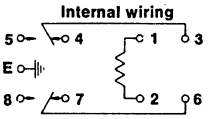


TYPE 122

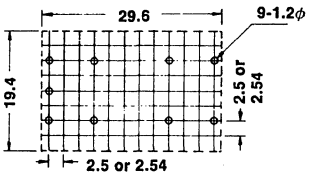
External dimensions



Internal wiring



Printed circuit board hole dimensions



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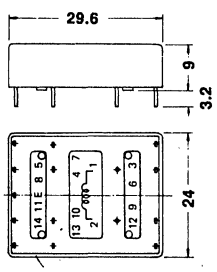
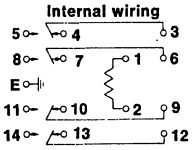
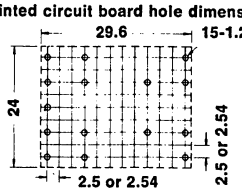


Internal wiring

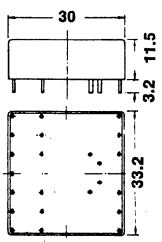


Printed circuit board hole dimensions

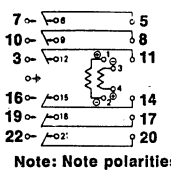


TYPE 116

External dimensions

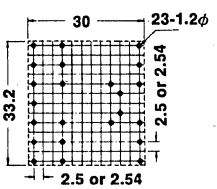


Internal wiring



Note: Note polarities for latching type.

Printed circuit board hole dimensions



Note: terminals (#3, 4) are provided to latching type only.
Note: •mark holes not required for standard type.

NOMENCLATURE BREAKDOWN

RFT — 11 6 E — DC24

- System: RFT: Standard type; RFTL: Latching type
- Type Name: 60:60 type relay; 11:11 type relay; 12:12 type relay; 05:05 type relay
- Number of Contacts Combination: 0:1 make contact; 1:1 transfer contact; 2:2 transfer contact; 4:4 transfer contact; 6:6 transfer contact
- Specification: No Symbol: Standard type; E: Sealing type
- Coil's Rated Voltage

COIL RATING

RFT-11 (STANDARD TYPE)

Type	Rated Voltage	Resistance Value	Rated Power	Pull-in Voltage
RFT-116	6V DC	35Ω	1.03W	80%V or less than rated voltage
	12V DC	130Ω	1.11W	
	24V DC	500Ω	1.15W	
	48V DC	1,900Ω	1.21	

RFTL-11 (LATCHING TYPE)

Type	Rated Voltage	Resistance Value	Rated Power	Pull-in Voltage (Set)	Drop-out Voltage (Reset)
RFTL-114 RFTL-116	6V DC	P 18Ω S 18Ω	2.0W	80% or less than rated voltage at P (set side coil)	80% or less than rated voltage at S (reset side coil)
	12V DC	P 65Ω S 65Ω	2.2W		
	24V DC	P 250Ω S 250Ω	2.3W		
	48V DC	P 850Ω S 850Ω	2.7W		

RFT-12 (STANDARD TYPE)

Type	Rated Voltage	Resistance Value	Rated Power	Pull-in Voltage	Drop-out Voltage
RFT-122	6V DC	115Ω	0.13W	80%V or less than rated voltage	10%V or more than rated voltage
	12V DC	430Ω	0.33W		
	24V DC	1,650Ω	0.35W		
	48V DC	6,000Ω	0.38W		
RFT-124	6V DC	80Ω	0.45W		
	12V DC	280Ω	0.51W		
	24V DC	1,150Ω	0.50W		
	48V DC	4,100Ω	0.56W		

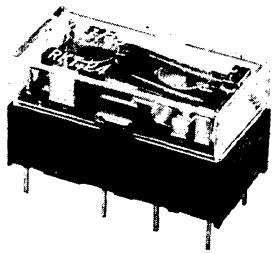
RATING PERFORMANCE

Type		RFT-116		RFT-122/124
Applicable Voltage		80~120%		2T: 80~170% 4T: 80~140%
Ambient Temperature		−10~+50°C		−10~+65°C
Contact:	Switching Capacity	30V DC 3A 100V AC 3A (COSφ=1)	30W (COSφ=1) V max 110V DC I max — 1A	
	Material	Gold plated silver (may be gold plated over silver oxide cadmium)	Movable: Gold clad on silver palladium alloy Stationary: Silver palladium alloy	
	Shape	Single contact	Twin contact (card lift off drive)	
	Contact Resistance (initial)	50 mΩ or less	100 mΩ or less	
Static Capacity	Contact-to-Contact	—	About 4 PF	
	Contact-to-Coil	—	About 6 PF	
	Contact-to-Ground	—	About 6 PF	
Operating Time		About 6 ms	About 7 ms	
Release Time		About 3 ms	About 3 ms	
Anti vibration	No Excitation	10G	Standard 10G / Latching 5G	10G / 10G
	Excitation	20G	20G	20G
Insulation Resistance		1,000 MΩ or more at 500V DC		
Dielectric Strength		Contact-to-contact 1,000V AC 1 minute Contact-to-coil 2,500V 1 minute	Contact-to-contact 750V AC 1 minute Contact-to-coil 1,000V AC 1 minute	
Life Expectancy	Mechanical (million times)	10	4T: 100 6T: 50	100 100
	Electrical	100 thousand (max. load)	5 million times (24V DC 1A resistance load)	
Weight		About 10g	4T: About 15g 6T: About 20g	2T: About 13g 4T: About 15g
PC Board Mounting Pitch		15mm		12.5mm

HASCO COMPONENTS INC.

RELAYS

TYPE HAS/RKT RELAY—Recommendable Miniature Relay for P.C. Board Mounting

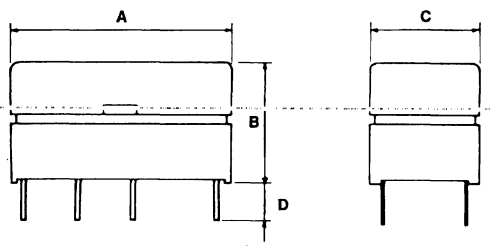


FEATURES

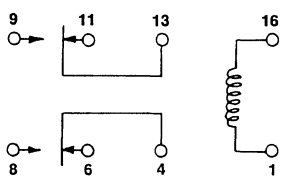
- Miniature DPDT relay just fitting for P.C. board mounting and makes it possible to minimize the equipment.
- Flow solder is available.
- Employing 16 Pin, IC pitch and very easy to design the P.C. board.
- Very reasonable price.
- Seal type is also available.

DIMENSIONS

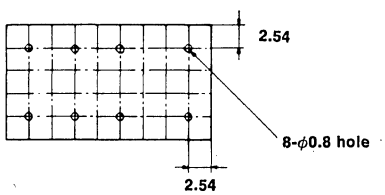
External Dimension



Internal Wiring
(Top View)



P.C. Board Drilling Design



Position	RKT/HAS (Unsealed)	RKTE/HAS (Sealed)
A	Max. 21	Max. 22.5
B	Max. 11.5	Max. 12.5
C	Max. 10.5	Max. 12.5
D	3.4	2.8

COIL RATING

Nomenclature	Rated Voltage	Coil Resistance	Pull-in Voltage	Drop-out Voltage
RKT/HAS (E)-5	5V DC	45 ohms	Less than 75% of rated voltage	Less than 10% of rated voltage
RKT/HAS (E)-6	6V DC	60 ohms		
RKT/HAS (E)-9	9V DC	140 ohms		
RKT/HAS (E)-12	12V DC	280 ohms		
RKT/HAS (E)-24	24V DC	1,070 ohms		
RKT/HAS (E)-48	48V DC	4,000 ohms		

As for the resistance value, pull-in voltage and drop-out voltage, they show the value at ambient temperature, 20°C, and the tolerance is ±10%.

RATING — PERFORMANCE

Applicable Voltage: ±15% of rated voltage

Ambient Temperature: −25°C to +50°C (But not to be frozen)

Contact Specification:
- Contact Arrangement: DPDT
- Max. Switching Wattage: 60VA/30W (Max. voltage 125V AC or DC, Max. current 1.25 Amp)
- Material: Silver alloy (Gold clad contact is also available upon request)
- Contact Resistance: Less than 100 milliohms (Initial value)

Operating Time: Approx. 6 ms

Release Time: Approx. 5 ms

Anti-shock: False operation Approx. 20G — Endurance 100 G

Anti-vibration: False operation 10 to 55 Hz 1.5 mm—Endurance 10 to 55 Hz 1.5 mm

Insulation Resistance: More than 100 Meg. ohms at 500V DC

Dielectric Strength: 1,000V AC 1 minute (Contact to coil) — 500V AC 1 minute (Contact to contact)

Life Expectancy: Mechanical 10 million times — Electrical more than 200 thousand at resistive load (110V AC 0.3 Amp, 24V DC 1.25 Amp)

Weight: Approx. 4.5 g

NOMENCLATURE BREAKDOWN

RKT/HAS E — 24

Type name

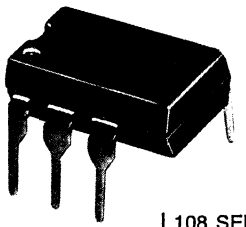
Coil voltage

E; Sealed type — Nothing; Unsealed type

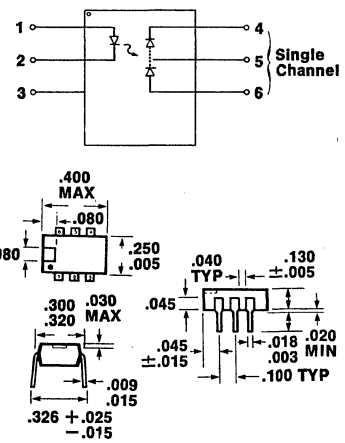
HASCO COMPONENTS INC.

RELAYS

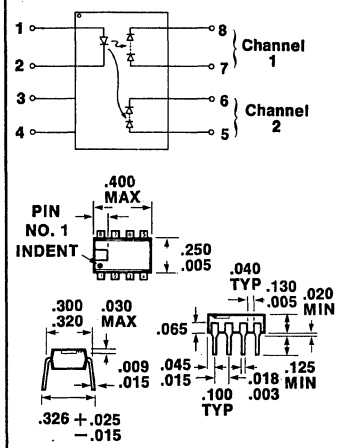
PHOTEC AC/DC SOLID STATE RELAY 107/108 SERIES NEW



107 SERIES



108 SERIES



FEATURES

- Relay is current sensitive on input stage and can be used with either 5, 12, 24 and 28 volt systems
- Low Cost.
- TTL Compatibility.
- Optical Isolation, to 2500V AC.
- No false turn-on.
- Low offset voltage, able to switch low and high level.
- Low off-state leakage current.
- Ability to switch AC or DC, up to 600V.
- High transient immunity.
- Packaging flexibility, plastic mini-dip or metal can TO-5.
- Absence of switching RFI.

DESCRIPTION

The PHOTEC 107 is a State-Of-The-Art AC/DC solid state relay incorporating an infrared LED input, and a photovoltaic diode array connected to the gates of a pair of high voltage MOSFETS as the output. The photovoltaic diode array is a series-connected group of photosensitive diodes, which are electrically isolated from, but optically coupled to, the input LED. Input/Output isolation is rated at 2500 V-RMS.

When activated, the LED emits infrared light toward the photovoltaic diode array, which then responds with a self-generated open circuit voltage, V_{OC}, proportional to the input current. This V_{OC}, which is floating and completely isolated from any power supply, is applied to the gates of the MOSFETS. At the proper value of input LED current, the generated V_{OC} is sufficient to turn on the MOSFETS and cause the relay to conduct. The relay is current sensitive on input stage and can be used with either 5, 12, 24 and 28 volt systems.

ELECTRICAL SPECIFICATIONS (25°C unless otherwise stated)

ABSOLUTE MAXIMUM RATING	PHOTEC 107	PHOTEC 108
Input (control) Current, continuous	100 mA	100 mA
Input Current, peak (100 μs)	250 mA	250 mA
Load Current, continuous	10 mA	100 mA
Load Current, peak (100 μs)	20 mA	250 mA
Load Voltage, DC or peak AC —1 —2 —3	200V 400V 600V	300V 400V
Operating Temperature	−20°C to 80°C	−20°C to 80°C
Storage Temperature	−20°C to 100°C	−20°C to 100°C

INPUT CHARACTERISTICS

Parameter	Condition	Min	Typ	Max	Unit	Condition	Min	Typ	Max	Unit
Input Voltage Drop	I_{IN} = 10 mA	—	1.25	1.70	V	I_{IN} = 10 mA	—	1.25	1.70	V
Input Reverse Leakage Current	V_R = 5V	—	—	20.0	μA	V_R = 5V	—	—	20.0	μA
Turn-on Voltage	I_L = 1 mA, V_L = rated voltage	—	—	3.0	V	I_L = 1 mA, V_L = rated voltage	—	—	3.0	V
Turn-off Voltage	I_L = 1 mA, V_L = rated voltage	1.0	—	—	V	I_L = 1 mA, V_L = rated voltage	1.0	—	—	V
Isolation (input to output)		2500	—	—	Vrms		2500	—	—	VDC
Input to Output Capacitance		—	10.0	—	pf		—	10	—	pf

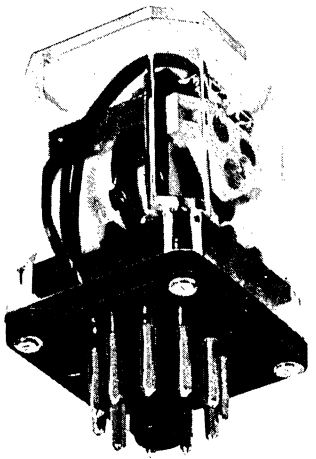
OUTPUT CHARACTERISTICS

Off-State Leakage Current —1	V_L = 200V	—	0.10	1.0	μA	V_L = 300V	—	1.0	10	μA
—2	V_L = 400V	—	0.10	1.0	μA	V_L = 400V	—	1.0	10	μA
—3	V_L = 600V	—	0.10	1.0	μA					
On Resistance —1	I_{IN} = 10 mA, I_L = 1 mA	—	—	800	Ohms	I_{IN} = 10 mA, I_L = 10 mA	—	—	70	Ohms
—2	I_{IN} = 10 mA, I_L = 1 mA	—	—	1000	Ohms	I_{IN} = 10 mA, I_L = 10 mA	—	—	100	Ohms
—3	I_{IN} = 10 mA, I_L = 1 mA	—	—	1200	Ohms					
Switching Speed										
Turn-on Time	I_{IN} = 10 mA, I_L = 1 mA	—	300	—	μs	I_{IN} = 10 mA, I_L = 10 mA	—	350	—	μs
Turn-off Time	I_{IN} = 10 mA, I_L = 1 mA	—	350	—	μs	I_{IN} = 10 mA, I_L = 10 mA	—	500	—	μs
Offset Voltage	I_{IN} = 10 mA	—	5	—	μV	I_{IN} = 10 mA	—	10	—	μV

ISKRA

• Ceramic Caps, Discs, Feed Thru • Ferrites • Meters • Motors, fractional H.P. • Semiconductors • Switches • Speakers • Trimmer Pots

GENERAL PURPOSE RELAYS
ECONOMY PLUG-IN TYPE — SERIES PR



General purpose relay enclosed in a clear polycarbonate dust cover. The PR Relay is a ruggedly constructed, UL recognized relay; available in contact arrangements up through 3 form C (3PDT) and with a mechanical life of 10 million operations, minimum. Approximate weight: 3 oz. (85 g). Other features include:

- Manual test access standard
- Anti-shock base construction
- Indicator lamp available
- Extremely low priced

Technical Specifications

GENERAL:

OPERATE TIME
15 ms. max. @ nominal voltage
RELEASE TIME
10 ms max.
LIFE EXPECTANCY

Mechanical: 10 million operations
DIELECTRIC STRENGTH
1500 VRMS 60 Hz Hipot test between all elements
INSULATION RESISTANCE
100 M Ω minimum
TEMPERATURE RANGE
PR relays will operate continuously in ambient temperatures of −45° to 75° C for D.C. coils and −45° to 55° C for A.C. coils.

CONTACTS:

CONTACT RATING/MATERIAL

Contact material	Ag-CdO (other materials on request)
Contact rating (Resistive)	10 A @ 240 VAC max.
Contact rating (Inductive)	¼ H.P. @ 240 VAC - 1 phase.

CONTACT ARRANGEMENTS
All types of the Series PR are available in standard contact arrangements up to 3PDT.

AGENCY APPROVALS:

U.L. recognized

COIL DATA:

COIL VOLTAGE/RESISTANCE

	D.C. COILS		A.C. COILS
VOLTS	D.C. RESIST-ANCE	VOLTS	D.C. RESIST-ANCE
6	29	6	4.2
12	105	12	17
24	420	24	70
110	8400	120	1300
220	8400 *	240	6700

COIL RESISTANCE
Standard coils are available with a tolerance of plus or minus 10% measured in an ambient of 20°C.

* Coils for DC versions may be supplied only for voltages not exceeding 110V. In the event of 220V. 10kOhm/2 W series resistors are supplied along with the relays, to be connected in series with the energizing winding.

PULL-IN VOLTAGE
80% of nominal
POWER CONSUMPTION

Rated voltage	DC relays	AC relays
6— 48V	1.3 W approx.	2 VA (50 Hz) approx.
60—110V	1.5 W approx.	
220 V	2.5 W approx. with series resistor	1.8 VA (60 Hz) approx.

ORDERING INFORMATION:

☐ PR − ☐ − ☐ − ☐

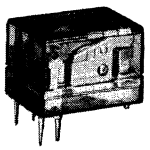
- ☐ PR — TYPE
  - 58: Octal Plug-In
  - 59: 11-Pin Plug-In
- ☐ — CONTACTS
  - A: SPDT
  - B: DPDT
  - C: 3PDT
- ☐ — 1
  - 0: D.C.
  - 6: 60Hz, A.C.
- ☐ — COIL VOLTAGE
  - 006... 6V
  - 012... 12V
  - 024... 24V
  - 048... 48V
  - 060... 60V
  - 110...110V
  - 220...220V

ISKRA ELECTRONICS INC.
8 GREENFIELD RD., SYOSSET, NY 11791 • (516) 364-2616

ITT Components
A Unit of International Telephone and Telegraph Corporation

Sub Miniature Printed Circuit Board Relays

MZ RELAY



1 Amp SPDT
L — 0.606″,
W — 0.449″,
H — 0.433″

CONTACT DATA

Arrangement — 1 Form C single cross-bar
Material — Gold overlay silver-palladium alloy
Load —50 μA to 1A @ 30V DC or 120V AC, resistive
Life — Mehanical: 20 million operations minimum
Electrical: 0.5 x 10^6 operations minimum at 1A, 24V DC, resistive
Timing — Operate: < 3ms (standard type), < 6 ms (high sensitive type)
Release: < 1ms

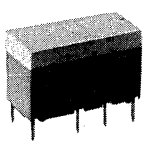
COIL DATA (@ 20°C)

Operate power — 220mW (standard type), 100mW (high sensitive type)
Nominal power — 450mW standard type), 200mW (high sensitive type)
Maximum power — 1W

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Operate Voltage	Maximum Continuous Voltage	Coil Resistance ±10%, Ohms	Ordering Code	List Price
Standard types					
1.5	1.05	2.0	5	MZ-1.5HG	$2.15
3	2.1	4.1	20	MZ-3HG	$2.15
5	3.5	6.8	56	MZ-5HG	$2.15
6	4.2	8.1	80	MZ-6HG	$2.15
9	6.3	12.2	180	MZ-9HG	$2.15
12	8.4	16.2	320	MZ-12HG	$2.15
24	16.8	32.4	1280	MZ-24HG	$2.15
High sensitive types					
1.5	1.05	3.0	12	MZ-1.5HS	$2.40
3	2.1	6.0	45	MZ-3HS	$2.40
5	3.5	10.0	120	MZ-5HS	$2.40
6	4.2	12.0	180	MZ-6HS	$2.40
9	6.3	18.0	400	MZ-9HS	$2.40
12	8.4	24.0	700	MZ-12HS	$2.40
24	16.8	48.0	2800	MZ-24HS	$2.40

RY RELAY



1 Amp DPDT
L — 0.795″,
W — 0.386″,
H — 0.472″

CONTACT DATA

Arrangement — 2 Form C, bifurcated cross-bar
Material — Gold overlay silver-palladium base
Load — Maximum switched power: 60VA, 24W
Maximum switched current: 1.25A AC or DC
Maximum switched voltage: 200V AC, 150V DC
Life — Mechanical: 20 million operations minimum
Electrical: 0.5 x 10^6 operations minimum at 1A 24V DC
0.2 x 10^6 operations minimum at 0.5A 120V AC
Timing — Operate: <6ms
Release: < 3ms

COIL DATA (@ 20°C)

Operate power — ≤ 75mW
Nominal power — 150mW
Maximum power — 1W

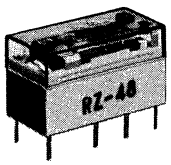
GENERAL DATA

Dielectric Strength — 500V AC between open contacts
1000V AC between all other points
Surge Strength — 1500V AC between all conductors
Temperature Range — −40°C to +85°C

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Operate Voltage	Maximum Continuous Voltage	Coil Resistance ±10%, Ohms	Ordering Code	List Price
5	3.6	12.5	167	RY-5W	$3.90
6	4.3	15.0	240	RY-6W	$3.90
9	6.4	22.5	540	RY-9W	$3.90
12	8.5	30.0	960	RY-12W	$3.90
24	16.8	51.6	2880	RY-24W	$3.90
48	32.6	84.0	7680	RY-48W	$4.70

RZ RELAY



1 Amp DPDT
L — 0.795″,
W — 0.386″,
H — 0.457″

CONTACT DATA

Arrangement — 2 Form C, single cross-bar
Material — Gold overlay silver-palladium base
Load — Maximum switched power: 30W/50VA
Maximum switched current: 1.25A AC or DC
Maximum switched voltage: 150V DC/125V AC
Life — Mechanical: 20 million operations minimum
Electrical: 0.5 x 10^6 operations minimum at rated load
Timing — Operate: < 4ms
Release: < 2ms

COIL DATA (@ 20°C)

Operate power — ≤ 230mW minimum
Nominal power — 515-560mW
Maximum power — 1050mW

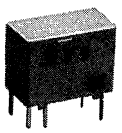
GENERAL DATA

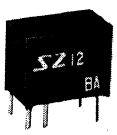
Dielectric Strength — 500V AC between open contacts
1000V AC between all other points
Surge Strength — 1500V AC between all conductors
Temperature Range — −40°C to +65°C

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Operate Voltage	Maximum Continuous Voltage	Coil Resistance ±10%, Ohms	Ordering Code	List Price
5	3.2	7.0	45	RZ-5	$3.30
6	3.8	8.4	66	RZ-6	$3.30
9	5.1	12.6	140	RZ-9	$3.30
12	7.6	16.3	280	RZ-12	$3.30
24	15.2	33.6	1070	RZ-24	$3.30
48	36.0	67.2	4000	RZ-48	$3.90

SY/SZ RELAY





1 Amp SPDT
L — 0.492″
W — 0.291″
H — 0.374″

CONTACT DATA

Arrangement — 1 Form C Single crossbar
Material — Stationary: Gold overlaid silver-palladium
Moveable: Silver-palladium
Ratings — 0.5A, 120V AC or 1A, 24V DC (resistive)
Life Expectancy — Mechanical: Min. 5 million operations
Electrical: Min. 200,000 operations at rated load

COIL DATA

Power (at 20°C) — Operate: SZ 0.15W (0.16W for 18V, 0.18W for 24V
SY .075W
Nominal: SZ 0.3W (0.32W for 18V, 0.36W for 24V
SY .150W
Maximum: 0.75W

GENERAL DATA

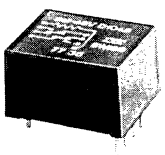
Dielectric Strength — 500V AC (50/60Hz), between all live parts
Temperature Range — SZ −40°C to +70°C (18V coil):
(at nominal voltage) −40°C to +65°C (24V coil): −30°C to +60°C
SY −40°C to +90°C

Nominal Coil Voltage	Coil Resistance	Operate Voltage	Type No.	List Price
3	30	2.1	SZ-3	$2.30
4.5	67	3.2	SZ-4.5	$2.30
5.5	100	3.9	SZ-5	$2.30
9	270	6.3	SZ-9	$2.30
12	480	8.4	SZ-12	$2.30
18	1000	12.6	SZ-18	$2.30
24	1600	16.8	SZ-24	$2.30
5	167	3.5	SY-5	$2.50
6	240	4.2	SY-6	$2.50
9	540	6.3	SY-9	$2.50
12	960	8.4	SY-12	$2.50

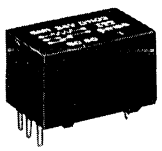
ITT Components

A Unit of International Telephone and Telegraph Corporation

Miniature Printed Circuit Board Relays



SM RELAYS



0.5 Amps DPDT, SPDT

L — 0.618″, 0.618″
W — 0.504″, 0.394″
H — 0.380″, 0.390″

CONTACT DATA

Arrangement — 2 Form C, 1 Form C, bifurcated crossbar
Material — Gold-silver nickel, bifurcated crossbar
Load — Maximum switched power: 30VA, resistive
Maximum switched current: 0.5A, resistive
Maximum switched voltage: 100V, resistive
Life — Mechanical: 200 million operations minimum
Electrical: 0.5 x 10^6 operations minimum at rated load
Timing — Operate: < 3.5ms
Release: < 2ms
Bounce: < 0.7ms on operate, < 5ms on release

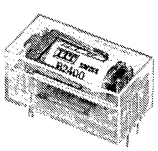
COIL DATA (@ 20°C)

Operate power — 100mW — DPDT, 85mW — SPDT
Nominal power — 200mW — DPDT, 170mW — SPDT
Maximum power — 1.0W — DPDT or SPDT

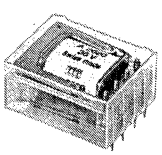
Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Pull-In Voltage	Maximum Continuous Voltage	Coil Resistance ±10%, Ohms	Ordering Code	List Price
5	3.6	12.1	148	SM1-D1101	$5.30
12	8.6	29.0	852	SM1-D1102	$5.30
24	17.1	57.6	3350	SM1-D1103	$5.30
48	34.1	117	13,830	SM1-D1104	$6.30
5	3.6	11.9	135	SM2-D1005	$7.75
12	8.5	28.6	724	SM2-D1012	$7.75
24	17.0	57.1	2760	SM2-D1024	$7.75
48	34.1	114.2	11,100	SM2-D1048	$8.80

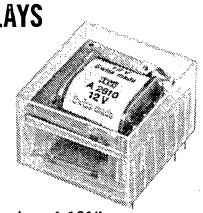
PZ & PZM RELAYS



L — 1.142″,
W — 0.677″,
H — 0.591″



L — 1.142″,
W — 0.977″,
H — 0.630″



L — 1.181″,
W — 1.386″,
H — 0.866″ PZ-6,
0.590″ PZ-6F

1 Amp DPDT, 4PDT, 6PDT, DPST

CONTACT DATA

Arrangement — 2 Form C, 4 Form C, 6 Form C, 2 Form A
Material — Silver-palladium, bifurcated crossbar
Gold-silver, bifurcated crossbar
Load — Maximum switched power: 30VA, resistive
Maximum switched current: 1A, resistive
Maximum switched voltage: 100V, resistive
Life — Mechanical: PZ types: 2 x 10^8 operations minimum
PZM types: 5 x 10^6 operations minimum
Electrical: AgPd types: 3 x 10^6 operations at rated load, minimum
AuAg types: 5 x 10^5 operations at rated load, minimum
Timing — Operate: PZ-2: < 10ms, PZ-4: < 9ms, PZ-6: < 13ms,
PZ-2A: < 12ms
Release: PZ-2, 4: < 3ms, PZ-6: < 4 ms, PZ-2A: < 2.5ms,
PZM-2: < 8ms
PZM-4: < 18ms, PZM-6 (1 winding): < 19ms, PZM-6
(2 windings): < 3.5ms
Bounce: 4ms on operate
PZ(M)-2: < 1.5ms, PZ(M)-4: < 6 ms, PZ-6 < 4ms,
PZM-6: < 6ms

COIL DATA (@ 20°C)

Operate power — PZ-2: 0.5W, PZ-4: 0.5W, PZ-6: 0.4W, PZ-2A: 0.3W
PZM-2: 1.1W, PZM-4: 1W, PZM-6 (1 winding): 1W
Nominal Power — PZ-2: 0.6-0.8W, PZ4: 0.6-0.9W, PZ-6: 0.5-0.7W, PZ-2A: 0.35-0.45W
PZM-2: 1.3W, PZM-4: 1.2W, PZM-6 (1 winding): 1.2W
Maximum power — PZ-2:1W, PZ-4: 2W, PZ-6: 2.8W, PZ-2A: 1W
PZM-2: 1.1W, PZM-4: 1W, PZM-6 (1 winding): 1W

Coil Data — Standard Relays

DC Nominal Voltage	Coil Resistance ±10%, Ohms	Ordering Code Ag/Pd Contacts*	Ordering Code Au/Ag Contacts†	List Price Ag/Pd	List Price Au/Ag
PZ-2					
6	60	A 2400	A 2405	$5.00	$6.90
12	210	A 2410	A 2415	$5.00	$6.90
18	500	A 2412	A 2417	$5.00	$6.90
24	850	A 2420	A 2425	$5.00	$6.90
36	1600	A 2430	A 2435	$5.00	$6.90
48	3000	A 2440	A 2445	$5.00	$6.90
PZ-2A					
6	90	B 70100	B 70105	$5.00	$6.90
12	360	B 70110	B 70115	$5.00	$6.90
18	780	B 70112	B 70117	$5.00	$6.90
24	1350	B 70120	B 70125	$5.00	$6.90
36	3000	B 70130	B 70135	$5.00	$6.90
48	5500	B 70140	B 70145	$5.00	$6.90
PZ-4					
6	40	A 2640	A 2645	$6.20	$9.70
12	210	A 2600	A 2605	$6.20	$9.70
18	450	A 2611	A 2616	$6.20	$9.70
24	850	A 2610	A 2615	$6.20	$9.70
36	1600	A 2620	A 2625	$6.20	$9.70
48	3000	A 2630	A 2635	$6.20	$9.70
60	4800	A 2650	A 2655	$6.20	$9.70
PZ-6					
6	66	A 2800	A 2805	$9.00	$13.80
12	230	A 2810	A 2815	$9.00	$13.80
18	520	A 2812	A 2817	$9.00	$13.80
24	900	A 2820	A 2825	$9.00	$13.80
36	1900	A 2830	A 2835	$9.00	$13.80
48	3600	A 2840	A 2845	$9.00	$13.80
60	6100	A 2850	A 2855	$9.00	$13.80
PZ-6F					
6	55	A 46400	A 46405	$8.35	$12.70
12	210	A 46410	A 46415	$8.35	$12.70
18	450	A 46412	A 46417	$8.35	$12.70
24	870	A 46420	A 46425	$8.35	$12.70
36	1800	A 46430	A 46435	$8.35	$12.70
48	3250	A 46440	A 46445	$8.35	$12.70
60	5200	A 46444	A 46449	$8.35	$12.70

* Silver Palladium alloy, 70% Silver, 30% Palladium
† Gold/Silver alloy, 80% Gold, 20% Silver

Coil Data — Latching Relays††

DC Nominal Voltage	Coil Resistance ±10%, Ohms	Ordering Code Ag/Pd Contacts*	Ordering Code Au/Ag Contacts†	List Price Ag/Pd	List Price Au/Ag
PZM-2					
6	26	B 2400	B 2405	$7.50	$9.00
12	120	B 2410	B 2415	$7.50	$9.00
18	240	B 2420	B 2425	$7.50	$9.00
24	480	B 2430	B 2435	$7.50	$9.00
36	930	B 2440	B 2445	$7.50	$9.00
48	1980	B 2450	B 2455	$7.50	$9.00
PZM-4					
6	26	B 2500	B 2505	$8.60	$11.70
12	120	B 2510	B 2515	$8.60	$11.70
18	240	B 2520	B 2525	$8.60	$11.70
24	460	B 2530	B 2535	$8.60	$11.70
36	1260	B 2540	B 2545	$8.60	$11.70
48	1840	B 2550	B 2555	$8.60	$11.70
60	2900	B 2560	B 2565	$8.60	$11.70
PZM-6, 1 WINDING					
6	27	B 2700	B 2705	$10.20	$14.50
12	120	B 2710	B 2715	$10.20	$14.50
18	260	B 2720	B 2725	$10.20	$14.50
24	560	B 2730	B 2735	$10.20	$14.50
36	1090	B 2740	B 2745	$10.20	$14.50
48	2080	B 2750	B 2755	$10.20	$14.50
60	3300	B 2760	B 2765	$10.20	$14.50
PZM-6, 2 WINDINGS					
6/6	60/19	B 2600	B 2605	$12.00	$16.30
12/12	240/110	B 2610	B 2615	$12.00	$16.30
24/24	900/360	B 2630	B 2635	$12.00	$16.30
48/48	1460/1400	B 2650	B 2655	$12.00	$16.30

†† Remanant latch — designed for pulse operation. For additional technical information contact factory.

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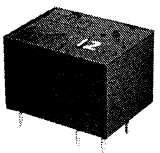
Sub Miniature Printed Circuit Board Relays

LZ RELAY



5 Amp SPDT
L — 0.843″,
W — 0.646″,
H — 0.583″

CONTACT DATA

Arrangement — 1 Form C
Material — 5A type: Gold overlay silver-nickel alloy (single)
3A type: Gold overlay silver (single)
1A type: Gold overlay silver-palladium alloy (bifurcated)
Load — 5A type: 5A @ 24V DC or 120V AC, 4A @ 240V AC resistive, 1/8 HP
3A type: 3A @ 30V DC or 120V AC, 2.5A @ 240V AC resistive, $^1/_{10}$ HP
1A type: 1A @ 30V DC or 120V AC, resistive
Life — Mechanical: 20 million operations minimum
Electrical: 0.1 x 10^6 operations minimum at rated load
Timing — Operate: < 5ms (standard type), < 6ms (high sensitive type)
Release: < 2ms

COIL DATA (@ 20°C)

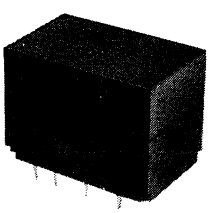
Operate power — 210mW (standard type), 150mW (high sensitive type)
Nominal power — 450mW (standard type), 330mW (high sensitive type)
Maximum power — 1.4W

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Pull-In Voltage	Maximum Continuous Voltage	Coil Resistance ±10, Ohms	Ordering Code 5A*	Ordering Code 3A	List Price
Standard types						
5	3.25	8.3	56	LZ-5H	LZ-5	$2.30
6	3.90	9.9	80	LZ-6H	LZ-6	$2.30
9	5.85	14.9	180	LZ-9H	LZ-9	$2.30
12	7.80	19.8	320	LZ-12H	LZ-12	$2.30
24	15.6	39.6	1280	LZ-24H	LZ-24	$2.30
48	28.8	79.2	3800	LZ-48H	LZ-48	$2.40
High sensitive types						
5	3.25	9.8	80	—	LZ-5S	$2.55
6	3.90	11.7	110	—	LZ-6S	$2.55
9	5.85	17.6	250	—	LZ-9S	$2.55
12	7.80	19.8	440	—	LZ-12S	$2.55
24	15.6	46.8	1780	—	LZ-24S	$2.55

* Add $0.10 to 3A List Price

GZ RELAY



5 Amp DPDT
L — 1.098″,
W — 0.728″,
H — 0.866″

CONTACT DATA

Arrangement — 2 Form C
Material — Heavy duty type: Gold overlay silver-nickel alloy (single)
Standard type: Gold overlay silver-nickel alloy (single)
Low level type: Gold overlay silver-palladium (bifurcated)
Life — Mechanical: 10 million operations minimum
Electrical: 0.1 x 10^6 operations minimum at rated load
Timing — Operate: < 10ms
Release: < 5ms

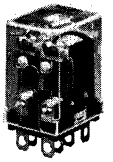
COIL DATA (@ 20°C)

Operate power — 270mW
Nominal power — 650mW
Maximum power — 1W

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Pull-In Voltage	Maximum Continuous Voltage	Coil Resistance ±10%, Ohms	Ordering Code	List Price
Heavy duty type					
6	3.8	9.0	55	GZ-6H	$4.60
12	7.6	18.0	220	GZ-12H	$4.60
24	15.2	36.0	880	GZ-24H	$4.60
48	27.8	63.4	2700	GZ-48W	$4.60
Standard types					
6	3.8	9.0	55	GZ-6	$4.40
12	7.6	18.0	220	GZ-12	$4.40
24	15.2	36.0	880	GZ-24	$4.40
48	27.8	63.4	2700	GZ-48	$4.40
Low level types					
6	3.8	9.0	55	GZ-6W	$4.95
12	7.6	18.0	220	GZ-12W	$4.95
24	15.2	36.0	880	GZ-24W	$4.95
48	27.8	63.4	2700	GZ-48W	$4.95

ITT-2R ITT-2H RELAY



10 Amps DPDT
L — 1.098″,
W — 0.843″,
H — 1.362″

CONTACT DATA

Arrangement — 2 Form C
Materials — Gold flashed silver, button
Load — 10A type: 10A @ 30V DC/120V AC, resistive, 1/4 HP
5A type: 5A @ 30V DC/120V AC, resistive, 1/8 HP
Life — Mechanical: 50 million operations minimum
Electrical: 10A type: 0.1 x 10^6 operations minimum at rated load
5A type: 0.5 x 10^6 operations minimum at rated load
Timing — Operate: < 20ms
Release: < 20ms (AC relays), < 10ms (DC relays)

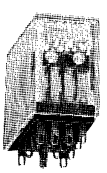
COIL DATA (@ 20°C)

Operate power — 500-575mW (DC relays), 2.0-2.3VA (AC relays)
Nominal power — 900mW (DC relays), 1.2VA (AC relays)
Maximum power — 2.2W (DC relays), 2.7VA (AC relays)

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Pull-In Voltage	Maximum Continuous Voltage	Coil Resistance ±10% DC, Ohms ±15% AC	Ordering Code Printed Ciruit	Ordering Code Standard	List Price
5A types, DC Coils						
6	4.5	8	40	ITT-2BAR	ITT-2AR	$4.85
12	9	18	160	ITT-2BBR	ITT-2BR	$4.85
24	18	36	650	ITT-2BCR	ITT-2CR	$4.85
5A types, AC Coils						
24	19.2	40	180	ITT-2ZBCR	ITT-2ZCR	$4.90
115	92	150	4270	ITT-2ZBFR	ITT-2ZFR	$5.50
10A types, DC Coils						
6	4.8	8	40	ITT-2BAH	ITT-2FAH	$6.45
12	9.6	18	160	ITT-2BBH	ITT-2FBH	$6.45
24	19.2	36	650	ITT-2BCH	ITT-2FCH	$6.45
10A types, AC Coils						
24	20.4	40	180	ITT-2ZBCH	ITT-2ZFCH	$6.80
115	97.15	150	4270	ITT-2ZBFH	ITT-2ZFFH	$7.15

ITT-4 RELAYS



5 Amp 4PDT
L — 1.098″,
W — 0.843″,
H — 1.362″

CONTACT DATA

Arrangement — 4 Form C
Material — 5A type: Gold-flashed silver-cadmium-oxide, button
3A type: Gold-flashed silver, button
1A type: Gold-silver alloy, cross-bar
Load — 5A type: 5A @ 30V DC/120V AC, resistive, 1/8 HP
3A type: 3A @ 30V DC/120V AC, resistive, $^1/_{10}$ HP
1A type: 1A @ 30V DC/120V AC, resistive
Life — Mechanical: 5A and 3A types: 50 million operations minimum
1A type: 20 million (DC relays), 10 million (AC relays) operations minimum
Electrical: 0.2 x 10^6 operations minimum at rated load
Timing — Operate: < 20ms
Release: < 20ms (AC relays), < 10ms (DC relays)

COIL DATA (@ 20°C)

Operate power — 500mW (DC relays), 2.0VA (AC relays)
Nominal power — 900mW (DC relays), 1.2VA (AC relays)
Maximum power — 2.2W (DC relays), 2.7W (AC relays)

Standard Coil and Contact Combinations (20°C)

Nominal Voltage	Pull-In Voltage	Maximum Continuous Voltage	Coil Resistance ±10% DC, ±15% AC Ohms	Ordering Code Printed Circuit	Ordering Code Standard	List Price
3A types, DC Coils						
6	4.5	8	40	ITT-4BAR	ITT-4AR	$5.30
12	9	18	160	ITT-4BBR	ITT-4BR	$5.30
24	18	36	650	ITT-4BCR	ITT-4CR	$5.30
3A types, AC Coils						
24	19.2	40	180	ITT-4ZBCR	ITT-4ZCR	$5.60
115	92	150	4270	ITT-4ZBFR	ITT-4ZFR	$5.95
5A types, DC Coils						
6	4.5	8	40	ITT-4BAH	ITT-4AH	$5.65
12	9	18	160	ITT-4BBH	ITT-4BH	$5.65
24	18	36	650	ITT-4BCH	ITT-4CH	$5.65
5A types, AC Coils						
24	19.2	40	180	ITT-4ZBCH	ITT-4ZCH	$5.95
115	92	150	4270	ITT-4ZBFH	ITT-4ZFH	$6.25

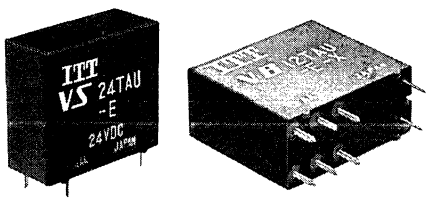
ITT Components

A Unit of International Telephone and Telegraph Corporation

Miniature Power Relays

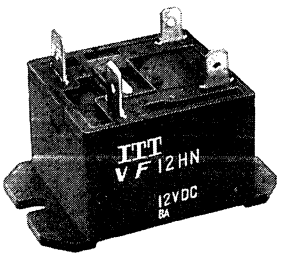
VB/VS RELAY

L — 1.150″
W — 0.508″
H — 0.996″



VF RELAY

L — 1.968″
W — 1.266″
H — 1.303″



SPECIFICATIONS VB/VS

CONTACT DATA

Arrangement — 1 Form A, B or C 10 Amp (VS)
2 Form A, B or C 5 Amp (VB)

Material — Silver Nickel (Standard)

Rating — 5 or 10 Amp at 24V DC or 240V AC
⅙ or ⅓ HP 120V AC motor load

Inrush Current — 51 or 78A at 120 V AC

Max. Carrying Current — 7A or 14A

Life Expectancy — Mechanical 5 million operations
Electrical: 100,000 operations at 5 or 10A 24V DC or 240V AC
200,000 operations at 5 or 10A 120V AC resistive
3.5 or 7A 24V DC or 240V AC
30,000 operations at ⅙ or ⅓ 120V AC motor load

COIL DATA

Nominal Voltage — 3 to 60V DC

Power (at 20°C) — Nominal: 0.72W Standard Type
0.53W High Sensitive Type
Operate: 0.35W Standard Type
0.26W High Sensitive Type
Maximum: 1.4W

GENERAL

Dielectric Strength — Min. 1000V AC between open contact
Min. 5000V AC between all other conductors

Insulation Resistance — Min. 1000MΩ at 500V DC between conductors

Surge Strength — 10,000V

Temperature Range — (TV types) −30°C to +50°C
(Standard types) −30°C to +65°C
(Sensitive types) −30°C to +75°C

Standard Coil and Contact Combinations

Type	Nominal Voltage DC (V)	Coil Resistance −10% at 20°C (V)	Must Operate Voltage at 20°C (V)	DPDT Ordering Code	SPDT Ordering Code
Standard	3	12.5	21	VB-3TAU-E	VS-3TAU-E
	5	36	35	5	5
	6	50	42	6	6
	9	115	63	9	9
	12	200	84	12	12
	18	460	126	18	18
	24	820	168	24	24
	48	3300	336	48	48
	60	5100	420	60	60
High Sensitive	3	17	21	VB-3STAU-E	VS-3STAU-E
	5	47	35	5	5
	6	68	42	6	6
	9	155	63	9	9
	12	270	84	12	12
	18	610	126	18	15
	24	1100	168	24	24
	48	4400	336	48	48
	60	6800	420	60	60

CONTACT DATA

Arrangement — 1 Form A

Material — Silver Alloy

Rating:

Classification	Rating		Maximum Inrush Current
	Resistive	Motor Load	
H	30A 250V AC	2HP 25A 250V AC	70A 200V AC
M	25A 250V AC	1.5HP 20A 250V AC	60A 200V AC
L	20A 250V AC	1HP 15A 250V AC	55A 100V AC

Maximum Carry Current — 30A

Life Expectancy — Mechanical: 5 million operations
Electrical: 200,000 operations at motor load
100,000 operations at resistive load

COIL DATA

Nominal Voltage — 3 to 60V DC

Power (at 20°C) — Nominal: 1.2W
Operate: 0.59W
Maximum: 3.0W

GENERAL DATA

Dielectric Strength — 1200V AC between open contacts
4000V AC between all other conductors

Insulation Resistance — 1000MΩ (min.) at 500V DC

Surge Voltage — 10,000V

Timing (approx.) — Operate: 15ms at nominal
Release: 3ms at nominal

Weight — 55 gr

Vibration — 10 - 55Hz

Shock — 20G

ORDERING CODE

Contact Rating			Coil Data at 20°C		
30A	25A	20A	Nominal Coil Voltage	Coil Resistance in Ohms ±10%	Must Operate Voltage
VF-6HU	VF-6MU	VF-6LU	6V DC	30	4.2
VF-9HU	VF-9MU	VF-9LU	9V DC	67	6.3
VF-12HU	VF-12MU	VF-12LU	12V DC	120	8.4
VF-24HU	VF-24MU	VF-24LU	24V DC	480	16.8
VF-48HU	VF-48MU	VF-48LU	48V DC	1920	33.6

Note: Printed Circuit Coil terminals type available (prefix VFB).

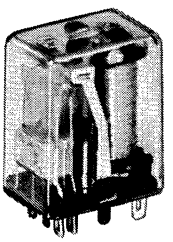
ITT Components
A Unit of International Telephone and Telegraph Corporation

Miniature Cradle Type Relays

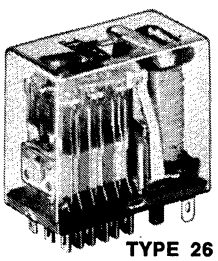
Replaces R10, W67, AZ400, 70, T154/T163, K, MHS

- **One Piece Core and Yoke** giving improved magnetic efficiency and stability
- **One Piece Bobbin and Terminal** gives rigid coil terminations
- **Polycarbonate Insulation** — negligible moisture absorption ensuring stability of spring-set adjustment
- **Underwriters Laboratories Recognized (#E57102)**
- **CSA Approval (LR 38310-1)**

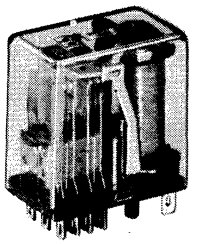
ITT Type 24/25/26 miniature relays are fully interchangeable in form fit and function with all well known cradle types. 2, 4 and 6 Form C is standard; 2, 4 or 6 Form A or B is available on request. A variety of contact materials is available in single and twin light duty. Heavy duty single contacts and sensitive versions, are also available.



TYPE 24



TYPE 26



TYPE 25

Several options are available to meet different load requirements. Single silver contacts are excellent for loads up to 2A. Twin (bifurcated) contacts should be used for carrying low loads, 100mA and lower (dry circuits). Heavy duty single cadmium oxide contacts give 5A ratings. Twin contacts are available in gold alloy or fine silver. Dimensions: L — .95″ (24), 1.18″ (25), 1.4″ (26); W — .74″; H — 1.2″

Nominal Voltage	Coil Res.	Contact Form	Contact Style	Ordering Code*	List Price
Type 24 Current Sensitive Adjustments Available					
6	52	2C	2A Single Bar	24A02C09C	$5.55
12	185			24A02C14C	$5.55
24	700			24A02C20C	$5.55
48	2500			24A02C24C	$5.75
6	200			24A02C58C	$6.05
12	800			24A02C61C	$6.05
24	3200			24A02C64C	$6.05
6	52	2C	2A Twin Bar	24A12C09C	$6.00
12	185			24A12C14C	$6.00
24	700			24A12C20C	$6.00
48	2500			24A12C24C	$6.20
6	200			24A12C58C	$6.40
12	800			24A12C61C	$6.40
24	3200			24A12C64C	$6.40
6	52	2C	5A Single Bar	24D02C09C	$5.85
12	185			24D02C14C	$5.85
24	700			24D02C20C	$5.85
48	2500			24D02C24C	$6.05
6	200			24D02C58C	$6.25
12	800			24D02C61C	$6.25
24	3200			24D02C64C	$6.25
Type 25 Current Sensitive Adjustments Available					
6	52	4C	2A Single Bar	25A04C09C	$6.40
12	185			25A04C14C	$6.40
24	700			25A04C20C	$6.40
48	2500			25A04C24C	$6.55
6	110			25A04C56C	$6.95
12	450			25A04C60C	$6.95
24	1800			25A04C63C	$6.95
6	52	4C	2A Twin Bar	25A14C09C	$7.05
12	185			25A14C14C	$7.05
24	700			25A14C20C	$7.05
48	2500			25A14C24C	$7.20
6	110			25A14C56C	$7.60
12	450			25A14C60C	$7.60
24	1800			25A14C63C	$7.60
6	52	4C	5A Single Bar	25D04C09C	$6.85
12	185			25D04C14C	$6.85
24	700			25D04C20C	$6.85
48	2500			25D04C24C	$7.05
6	110			25D04C56C	$7.35
12	450			25D04C60C	$7.35
24	1800			25D04C63C	$7.35

Nominal Voltage	Coil Res.	Contact Form	Contact Style	Ordering Code*	List Price
Type 26 Current Sensitive Adjustments Available					
6	28	6C	2A Single Bar	26A06C08C	$ 9.90
12	90			26A06C11C	$ 9.90
24	430			26A06C18C	$ 9.90
48	1700			26A06C23C	$10.10
6	80			26A06C55C	$11.50
12	320			26A06C59C	$11.50
24	1200			26A06C62C	$11.50
6	28	6C	2A Twin Bar	26A16C08C	$11.50
12	90			26A16C11C	$11.50
24	430			26A16C18C	$11.50
48	1700			26A16C23C	$11.50
6	80			26A16C55C	$12.35
12	320			26A16C59C	$12.35
24	1200			26A16C62C	$12.35
6	28	6C	5A Single Bar	26D06C08C	$10.65
12	90			26D06C11C	$10.65
24	430			26D06C18C	$10.65
48	1700			26D06C23C	$10.65
6	80			26D06C55C	$11.80
12	320			26D06C59C	$11.80
24	1200			26D06C62C	$11.80

SOCKETS

Terminal Style	No. Poles	Orientation	Ordering Code*	List Price
Solder	2	N.A.	FO10	$ .95
P.C.	2	In Line	FOR10	$ .95
P.C.	2	Staggered	FR10	$ .95
Solder	4	N.A.	FO16	$1.10
P.C.	4	In Line	FOR16	$1.10
P.C.	4	Staggered	FR16	$1.10
Solder	6	N.A.	FO22	$1.50
P.C.	6	In Line	FOR22	$1.50
P.C.	6	Staggered	FR22	$1.50

RETAINER SPRING

Relay	Poles	Clip Ordering Code	Price
24	2	HF103	$ .10
25	4	HF163	$ .10
26	6	HF223	$ .11

* Terminal designation (solder lug — "C"; P.C. — "E")

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ITT Components

A Unit of International Telephone and Telegraph Corporation

Solid-State Relays

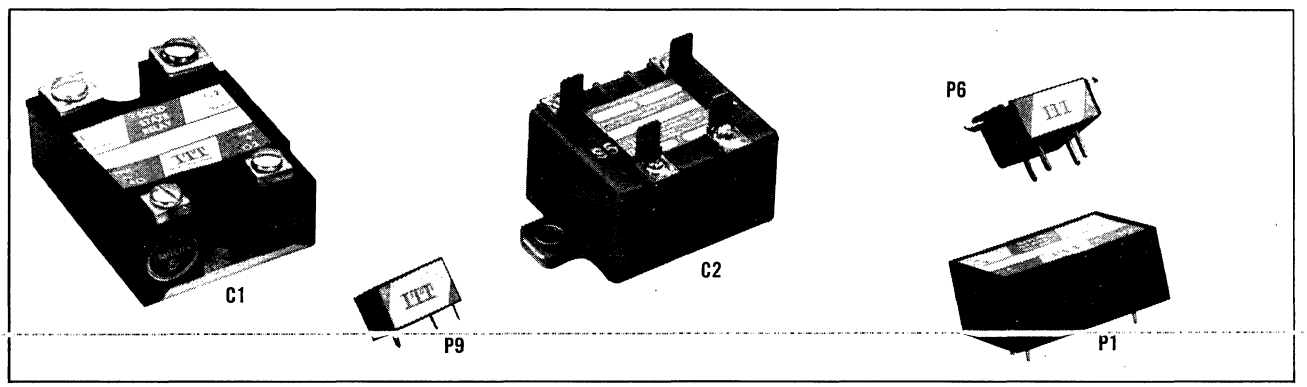
ITT Components offers a full line of Solid-State Relays to cover a wide range of switching and isolation applications where long life, environmental ruggedness, low RFI, no contact bouncing and logic circuitry compatibility are prime requisites.

These SSRs feature:

Photo-transistor or reed relay coupling.
Various chassis mounting or printed circuit board mounting housings.
AC switching.
Zero-crossing or random switching.

AC output models can switch:
Voltages of 120, 240, 330, 480V AC.
Currents of 0.5, 2, 3, 7, 10, 25 or 30A AC.

A full line of input-output modules (DC and AC input as well as DC and AC output) to fit microprocessor based controls is also available.
Do not hesitate to call us for any additional information you might need.



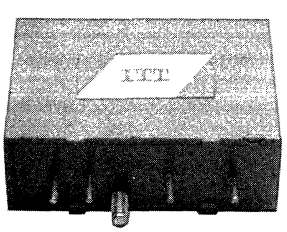
PACKAGE	INPUT VOLTAGE	INPUT TYPE	COUPLING	OUTPUT VOLTAGE	OUTPUT TYPE OF SWITCHING	OUTPUT CURRENT
C1	5	D	RC	120	R	10

PACKAGE	INPUT VOLTAGE	INPUT TYPE	COUPLING	OUTPUT VOLTAGE	OUTPUT TYPE OF SWITCHING	OUTPUT CURRENT
CHASSIS MOUNT C1 C2 PRINTED CIRCUIT MOUNT P1 P6 P9	3(3-32) 5 12 24 120 240	D → DC A → AC	PC- PHOTO TRANSISTOR COUPLED RC- REED RELAY COUPLED	12 120 240 330 480 V AC	X- ZERO CROSSING SWITCHING R- RANDOM CROSSING SWITCHING	0.5 1 2 3 7 10 25 30 A-AC

Example: C1-3D-PC-240X10

A Chassis mount, "hockey-puck" housing, the input circuit is driven with 3-32V DC, and it switches a 240V, 10A output triac. The relay features photo-transistor coupling, and zero cross-over switching.

I-O MODULES



Input	Housing	Logic Supply Voltage	Input Voltage
I	P7	5D/15D/24D	10D/120A/240A

NOT ANY COMBINATION OF THE ABOVE PARAMETERS IS POSSIBLE. PLEASE CONSULT US FOR ANY OTHER COMBINATION OF VOLTAGE, CURRENT, PACKAGE, ETC.

Output	Housing	Signal Pick-Up Voltage	Output Voltage	Output Current
O	P7	5D/15D/24D	60D/120A/240A	3

NOT ANY COMBINATION OF THE ABOVE PARAMETERS IS POSSIBLE. PLEASE CONSULT US FOR ANY OTHER COMBINATION OF VOLTAGE, CURRENT, PACKAGE, ETC.

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vacuum relays

ITT Jennings manufactures Vacuum and Gas Relays to exacting standards for use in transferring high voltage circuits. They are available in voltage ranges up to 30 KVAC, with up to 75 A. current ratings, and with operating frequencies through the VHF band. These relays are widely used in airborne, mobile and marine communications where their characteristics are particularly desirable. They have high operating speeds, withstand high voltages and carry heavy currents with high reliability ... without developing high contact resistance or generating electrical noise. The majority of applications for these relays includes the switching of antennas, frequency bands, transmit/receive modes, power circuits and elements in pulse forming networks.

ITT Jennings also produces a line of defibrillator (or capacitance discharge) vacuum relays used in medical defibrillation units, or any application that calls for a capacitor discharge circuit — research lasers and communications power supplies for example. Operating characteristics are shown under relay type RGD1 through 9.

Relay Type	Contact Configuration	KV Peak Rated Operating Voltage			Continuous Current Amps, RMS			Contact Capacitance	
		DC - 60 Hz	2.5 MHz	16 MHz	DC - 60 Hz	2.5 MHz	16 MHz	Open Contact to Ground (pF)	Between Open Contacts (pF)
SPST									
RF40, 40A	Latch	3.6	3.6	3.2	12	10	6	1.6	1.6
RF41, 42	N/C, N/O	3.6	3.6	3.2	12	10	7	1.6	1.6
RF5A	N/C	7.5	7.5	7	12	10	5	1.6	1.6
RF43	Latch	7	7	6	12	10	6	1.6	1.6
RF4A, 4B	N/C, Latch	8	7	6	30	25	15	4.0	4.0
RF4T	N/C	7	6	5	20	17	10	2.5	10
RF50, 51	N/C, N/O	10	7	6	12	10	6	1.6	1.6
RD5A, 5B RD6A, 6B	N/O, N/C	12	10	8	15	10	6	1.0	.5
RS8, 10	N/O, N/C	28	25	12	75	35	22	1.5	.7
RJ8A	N/O	28	25	12	110	60	40	1.0	1.3
SPDT									
RF1D, 1E		2	2	2	8	6	4	2.0	1.6
RF1J	Latch	3.6	3.6	3.2	12	10	7.5	2.5	2.5
RF60[1], 60A[1] RF61	Latch[1]	3.6	3.6	3.2	12	10	6	2.0	2.0
RJ1A		3.5	2.5	2.0	18	14	9	2.5	2.0
RJ1H		2.5	Hot Break		3.0	Hot Break		N/A	N/A
RF62, RF63[1], 63A[1]	Latch[1]	7	7	6	12	10	6	1.1	1.6
RF3A, 3C[1]	Latch[1]	8	7	6	30	25	15	2.5	4.0
RJ2B, 2C		12	10	8	50	30	17	1.0	.5
RB1D, 1E, RB1H, 1J		12	10	8	15	10	6	1.0	.5
RF10B		15	13	10	75	22	15	1.5	1.8
RE6B		25	20	15	25	13	8	2.5	1.0
DPDT & 4PDT									
RB7A, 7B		7	4	3	14	9	4	2.0	1.0
RB3		12/6*	10/5*	8/4*	30	10	6	2.5	1.0
RB4	4PDT	15	12	10	20	10	6	2.5	1.0
RB2A		20	15	10	20	12	6	2.5	1.0
Gas Filled/DPDT									
RGD6, RGD9†		7.5	N/A	N/A	30	N/A	N/A	0.1	N/A
RGD7		7.5	N/A	N/A	30	N/A	N/A	0.1	N/A
RGD1		18	N/A	N/A	30	N/A	N/A	0.1	N/A
RGD5		18	N/A	N/A	30	N/A	N/A	0.1	N/A

* Lower contacts.
† Gold plated contacts

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DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum relays

RF4A

RF5A

RD5B

RS8

RJ8A

RF1D

RF60

RJ1A/RJ1H

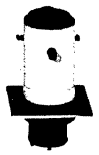
RF3A

RF40

RJ2B

RB1D

RB1E


RF10B

RE6B

RB7A

RGD1,5

Contact Resistance (Ohms)	Operate Time (ms, Max.)	Release Time (ms, Max.)	Coil Resistance (26.5 VDC Coil)	Shock (Peak g's)	Expected Mech. Life Ops.x10⁶	Weight (Oz, Max.)	Connector Type**	Relay Type
								SPST
.020	10	N/A	47	50	1	1	S	RF40, 40A
.020	10	10	290	50	1	1	S	RF41, 42
.050	12	12	920	30	1	1	S	RF5A
.020	10	N/A	47	50	1	1	S	RF43
.015	18/10[2]	18/NA[2]	156/6.7[2]	50	1	2	S	RF4A, 4B[2]
.020	10	10	156	50	1	2	S	RF4T
.020	15	15	290	50	1	1	S	RF50, 51
.010	18	8	265	30	1	3	N300/400	RD5A, 5B, RD6A, 6B
.003	30	10	120	30	1	7	S	RS8, 10
.003	18	8	120	30	2	10	S	RJ8A
								SPDT
.05	10	10	920	30	2	1	S	RF1D, 1E
.05	10	N/A	18	50	1	1	S	RF1J
.02	10	NA/10[3]	47/290[3]	50	1	1	S	RF60, 60A, 61[3]
.01	8	8	335	50	2	1	S	RJ1A
.03	6	6	335	50	1	1	S	RJ1H
.02	10	10[4]/NA	290[4]/47	50	1	1	S	RF62[4], RF63, 63A
.015	18/10[5]	18/NA[5]	156/12[5]	50	1	2	S	RF3A, 3C[5]
.012	18	9	270	50	.5	3	S	RJ2B, 2C
.012	18	8/9[6]	265	30	1	3	N300/400	RB1D, 1E, RB1H[6], 1J[6]
.012	30	10	225	30	.1	16	S	RF10B
.012	25	10	120	30	.5	7	N300/400	RE6B
								DPDT & 4PDT
.02	15	5	270	30	1	2	N300/400	RB7A, 7B
.01	20	8	120	30	.5	6	N300/400	RB3
.01	45	10	131	30	.1	16	N300/400	RB4
.01	20	10	225	30	.5	2	N300/400	RB2A
								Gas Filled
0.1	20	N/A	18***	10	.1	11	Flex.	RGD6, RGD9†
0.1	20	N/A	70	30	.1	11	Sol.	RGD7
0.1	25	N/A	52	10	.1	16	Sol.	RGD1
0.1	25	N/A	52	10	.1	10	Sol.	RGD5

** **S** — Standard Nickel: **N300** — Copper: **N400** — Heavy duty for up to 20% increase in voltage and current specifications: **Flex** — Flying Leads: **Sol.** — Solder on wire terminals.

*** 12 VDC Coil.

† Gold plated contacts

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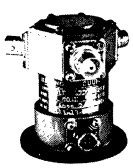
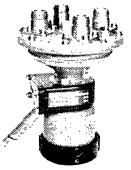
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

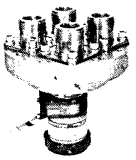
vacuum coaxial relays

ITT Jennings manufactures a broad line of coaxial relays for use where circuit currents must be contained completely within a coax system. Vacuum coaxial relays have high power handling capabilities at frequencies up to 600 MHz.

These relays and switches have characteristics that are well suited to airborne, marine and mobile communication systems, as well as fixed installations. Characteristics include: • Low insertion loss and VSWR • High RF power capability • High isolation • Fast operation • Low, stable contact resistance • No noise generation or IM distortion • Extreme high reliability combined with ruggedness for high altitude or heavy vibration environments • Small size and lightweight for their power handling capacity • Wide band-pass characteristics. Typical applications for these units might include multiple antenna-transmit switching systems such as high speed switching from omnidirectional to directional antennas, transmit-receive switching, and where elements are to be switched in transmitter and receivers. Other applications include crossbar matrices and switching trees.


RC41


RC53


RC54

RC5

RC6

RC10

RC21

	HIGH POWER						
Model Number	RC 41	RC 53	RC 54	RC 5	RC 6	RC 10	RC 21
Power Rating (KW) CW @ 30 MHz	3 30	4 30	7.5 30	25 30	25 30	90 30	90 30
Frequency Range (MHz)	500	600	600	100	400	100	500
VSWR Max. @ 50 Ohms At MHz	1.1 500	1.1 600	1.1 600	1.05 60	1.1 150	1.05 60	1.15 500
Crosstalk Isolation (dB) At MHz	30 300	75 30	53 500	70 30	65 30	65 30	60 30
Insertion Loss (dB Max.)	.1	.1	.1	.02	.01	.02	.01
Coil Resistance (Ohms ± with 26.5 VDC Coil)	265	18	19	18.8	15.4	8.3	4.8
Contact Configuration	SPDT	DPDT	DPDT	SPST	SPDT	SPST	SPDT
Line/Connector	C	N	LC	1⅝	1⅝	3⅛	3⅛
Operate Time (mS Max.)	25	30	30	30	50	30	40
Weight (lbs. max.)	1	3	7	2	8	4	14

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DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

MINIGLOSSARY ELECTROMECHANICAL RELAYS

RELAYS

Hybrid: Isolated input and output either with a solid-state input and an electromechanical output or vice versa. Typically a reed switch is used to trigger a solid-state output or a solid-state amplifier is used to trigger an electromechanical relay.

Differential: Have multiple windings to function when voltage, current and/or power difference reaches a specific level or value.

Close-differential: The dropout value is specified close to the pickup value.

Frequency sensitive: Operates at a set frequency or within specific frequency bands. A resonant reed, for example.

Hermetically sealed: Totally sealed by glass-to-metal or metal-to-metal seals to ensure very low rates of gas leakage over long time periods.

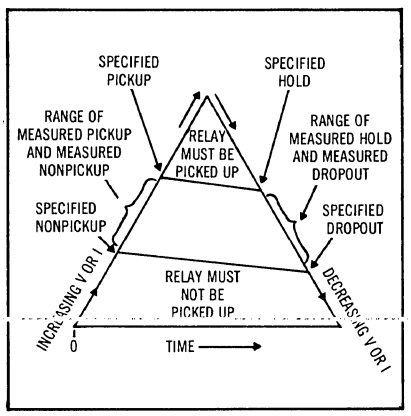
Encapsulated: Imbedded in a suitable potting compound.

Sealed: Enclosed in a relatively airtight cover. (Not the same as hermetically sealed.)

Covered: Unsealed metal or plastic enclosure or housing.

CONTACTS

Dry circuit: contacts that carry current but do not open or close during energizing of the load circuit. Often wrongly used in reference to low level contacts.



Low Level: Contacts controlling relatively low voltages and low currents. Generally below 5 Vdc and 10mA.

OPERATING CHARACTERISTICS

Measured dropout: The value at which all contacts restore to their unoperated position as current or voltage decreases.

Specified dropout: The value at or *above* which all contacts *must* restore to their unoperated position as voltage or current is decreased.

Specified hold: The value that *must* be reached before any contact change occurs as voltage or current is decreased on an operated relay.

Specified nonpickup: The value that *must* be reached before any contact change occurs as voltage or current decreases on an unoperated relay.

Measured pickup: The value at which all contacts function as voltage or current increases on an unoperated relay.

Specified pickup. The value at or *below* which all contacts *must* function as voltage or current increases on an unoperated relay.

Sensitivity: Specified pickup expressed in watts.

Normal bridging: The make-before-break action between adjacent contacts on relays designed for this purpose.

Abnormal bridging: The undesired closing of contacts caused by a metal bridge or protrusion developed by arcing.

Magnetic freezing: Sticking of the armature to the core as a result of residual magnetism.

TIME

Actuation: The interval from coil energization or de-energization to the functioning of a specified contact.

Initial actuation: The interval from coil energization or de-energization to the *first* closing or opening of a previously open or closed contact.

Final actuation: Sum of initial actuation *and* bounce intervals following an actuation.

Contact bounce: The interval from close or opening of a contact to the end of the bounce of "chatter."

Chatter: See bounce.

Operate: Normally taken as the interval between energization and the opening or closing of the last contact to function not including bounce.

Release: Normally taken as the interval between de-energization and the opening or closing of the last contact to function excluding bounce.

Transfer: The interval between opening a closed contact and closing an open contact of a break-before-make relay.

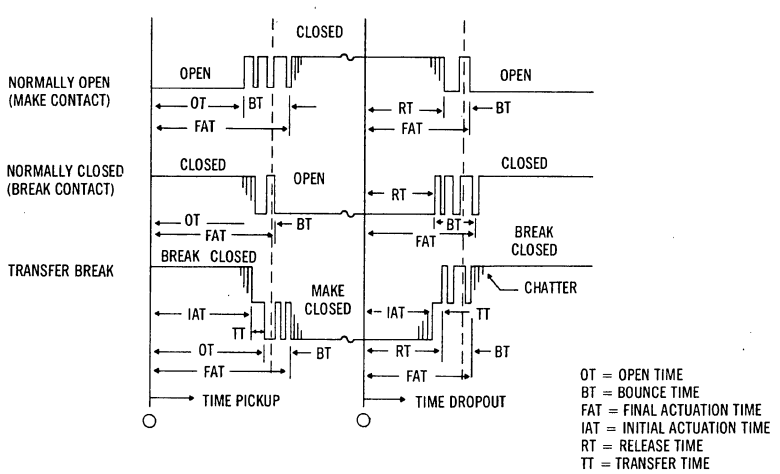


Fig. 2. Typical time vs. current (non-inductive load)

High Voltage Relays

Applications

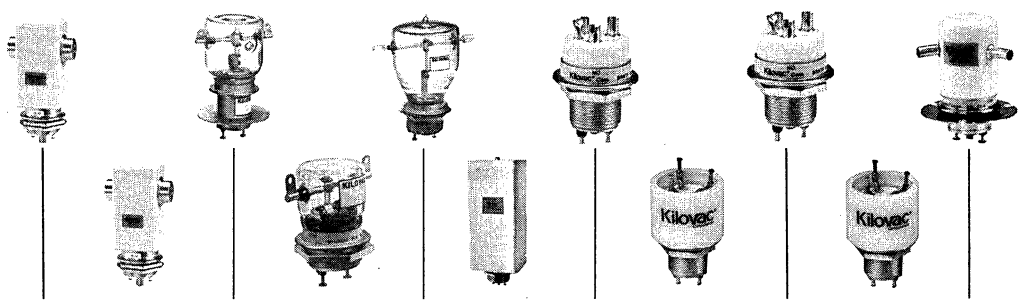
The capability to rapidly switch high voltages in a small package makes Kilovac® relays especially well suited for applications in ECM, communications, sonar and radar pulse forming networks, heart defibrillators and other capacitive discharge circuits, electrostatic coating equipment, laser and x-ray power supplies, digital antenna couplers (tuners), automatic dielectric-strength test equipment, and other high voltage equipment, or low voltage applications where extreme reliability is required.

Vacuum as a Dielectric

Since most high voltage arcs are initiated by ionization of the insulating medium, absence of any such medium (i.e., a hard vacuum) produces the greatest possible isolation between contact electrodes. In a vacuum of 10^{-8}mm of mercury, dielectric strengths can be achieved on the order of 2000 V/mil. A vacuum dielectric has the additional advantage of providing an inert (i.e., nonoxidizing) atmosphere in which high voltage contacts operate.

Low Contact Resistance

In conventional relays, contact resistance is variable from cycle to cycle. In Kilovac vacuum relays, it remains low and stable over the life of a relay (.015 ohms typical). Stability and low resistance are attributable to uniform cleanliness of parts, lack of oxidation or contamination, and use of only pure metals in the contact areas. Contact maintenance is never required.



Kilovac Part No.	KC-20	KC-22[1]	H-9	H-11/S2	H-23 H-24	KC-6	HC-1	HC-2	HC-3[1]	HC-4[1]	KC-2
Contact Arrangement	SPST-NO	SPST-NO	SPST-NC	SPST-NO	SPST[2]	SPST-NC	SPDT	SPDT	SPDT	SPDT	SPDT
Rated Operating Voltage (kVdc or 60 Hz peak)	28	25	15	9	30	100	3.5	8	3.5	8	15
Test Voltage (kVdc)	30	28	20	12	35	120	5	10	5	10	18
Continuous Current contacts closed, max (amps dc or 60 Hz peak)	110	65	15	15	30	10	25	25	18	15	50
Contact Resistance, max (ohms)	.005	.005	.015	.015	.015	.500	.010	.010	.020	.020	.012
Operate Time, max (ms)	30	30	15	18	30	30	6	6	6	6	18
Coil Resistance (ohms ±10% @ 20° C)	120	120	265	250	120	75	335	335	335	335	250
Coil Voltage (Vdc, nominal)	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Nominal Dimensions (inches)	1.31 Sq x 4.00H	1.31 Sq x 4.00H	1.3D x 2.75H	1D x 1.67H	2D x 3.62H	2.35 Sq 6.5H	.75D x 1.50H	1.13D x 1.88H	.75D x 1.50H	1.13D x 1.88H	1.00D x 2.50H
Nominal Weight (oz)	10	10	3	2	7	26	1	1.25	1	1.25	3
Mounting Style	Thr'ded Base	Thr'ded Base	Solder Flange	Thr'ded Base	Thr'ded Base	Thr'ded Base	Thr'ded Base	Thr'ded Base	Thr'ded Base	Thr'ded Base	Flange[3] Base

[1]Suitable for power switching applications. Consult factory for details.
[2]H-23: SPST-NC; H-24: SPST-NO.
[3]For threaded base, use part no. KC-2/S1.

Send for Kilovac catalog

Kilovac Corporation
P.O. Box 4422EM Santa Barbara, CA 93103 USA
(805) 684-4560 • TWX 910-336-1141

Kilovac® Corporation

High Voltage Relays

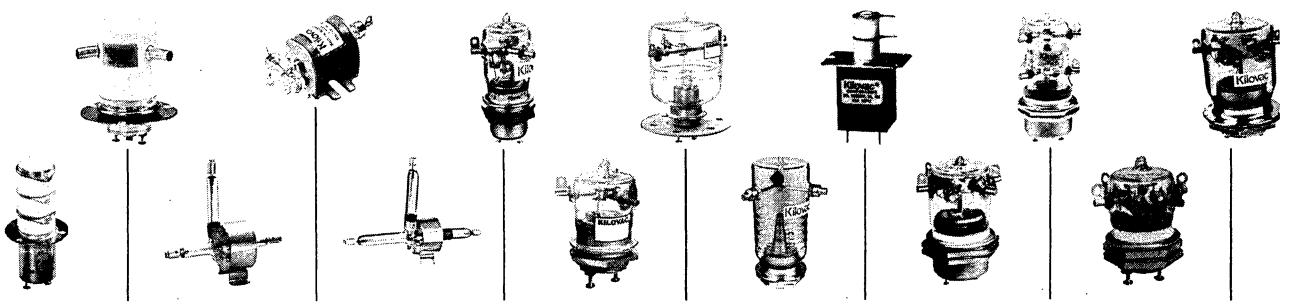
Small Size and Weight
The small contact gap and short contact travel possible with a vacuum dielectric result in minimal package size and weight.

Safety
Because contacts are sealed within the high voltage envelope, switching may be safely accomplished in explosive atmospheres.

Fast Switching Time
10 ms typical, due to small contact gap and short armature travel.

Electronegative Gas as a Dielectric
Kilovac gas-filled relays are pressurized with an electronegative gas mixture. This insulating medium offers several advantages, including high voltage isolation capability in a compact package. The primary advantage is its ability to suppress arcing in heart defibrillator and other capacitive discharge circuits.

Kilovac Medical Relays
Since 1964 Kilovac has produced and delivered thousands of high voltage relays especially designed for heart defibrillators. Kilovac produces several models of patient relays, safety discharge relays, and ECG relays, as well as a multifunction relay capable of performing all of these switching functions in a defibrillator.



KC-3	KC-8	HVS-1	H-4	H-35	H-8	H-12	H-17	H-25/S10	K-42 A332	H-14	H-16	H-18	H-19
SPDT	SPDT	SPDT	SPDT	SPDT	SPDT	SPDT	SPDT	SPDT	SPST-NO	DPDT	DPDT	DPDT	DPDT
8	12	17	5	35	15	8	25	50	5	12	12	8	20
11	15	22	7.5	40	20	12	30	60	7	15	15	10	25
25	30	7	10	10	15	15	30	30	15	30	30	10	30
.015	.025	.015	.02	.015	.015	.015	.015	.015	.020	.015	.030	.020	.015
18	18	25	10	30	15	18	25	60	10	20	20	15	30
220	180	128	250	50	265	250	120	120	680	120	120	250	225
26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26,5	26.5
.75D x 2.75H	1D x 2.50H	4.75L x 5H	1.88L x .75H	8.25L x 5.75H	1D x 3H	1D x 2.0H	2.38D x 3.57H	3D x 7.5H	.75D x 1.72 H	1.29D x 2.77H	1.03D x 3.26H	1.03D x 1.97H	1.80D x 3.25H
2.5	3	15	1	15	3	2	5	30	1	8	5	4	7
Flange Base	Flange Base	Foot Bracket	Foot Bracket	Foot Bracket	Thr'ded Base	Thr'ded Base	Flange Base	Thr'ded Base	Flange Base	Thr'ded Base	Thr'ded Base	Thr'ded Base	Thr'ded Base

Send for Kilovac catalog

Kilovac Corporation
P.O. Box 4422EM Santa Barbara, CA 93103 USA
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Kilovac® Corporation

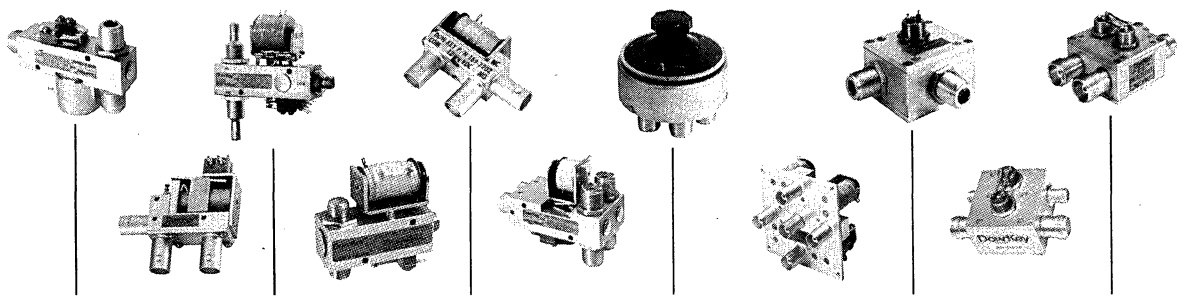
Coaxial Relays

Applications
Dow-Key® relays are widely used for applications in air traffic control radios, CATV and CCTV systems, microwave communications, remote tone signal switches, satellite terminals, switching matrices, and RF test equipment.

Options
Each relay series has a variety of options available including different connector types, coil voltages, and auxiliary (indicator circuit) contacts. Standard coil voltages are 12 VDC, 26.5 VDC, and 115 VAC on most relay series. Other coil voltages are available on special order; consult the factory customer service representative for any special requirements you may have.

Power Switching (Hot-Switching)
Power ratings are for CW power carry only. Dow-Key relays are not designed for switching under load, although it may be possible to do so at low power levels. Consult the factory for information about power switching requirements.

Relay Impedance
Relay impedance is nominally 50 ohms unless otherwise specified. The addition of a 50 ohm relay in a 75 ohm or higher impedance line will generally result in negligible discontinuity at frequencies up to 300 MHz, because the length of the RF path through the relay is a small fraction of the signal wave length. Above 300 MHz it is increasingly important that the relay impedance be the same as the line impedance.



Dow-Key Series No.	60	61	66	77	169	260	78	115 116	310	312	313
Contact Arrangement	SPDT	SPDT	SPDT	SPDT	SPDT	DPDT	Multi-Throw Manual	115: 3 position 116: 4 position	SPDT	By-Pass	Transfer
Connector Options	BNC, N, UHF, C[3]	BNC	F	BNC, F	BNC	UHF, N, BNC	UHF, BNC	BNC	SC, HN, N	SC, HN, N	SC, HN, N
Frequency, max	1000 MHz	1000 MHz	500 MHz[2]	1000 MHz	1000 MHz	1000 MHz	500 MHz	3000 MHz	400 MHz	400 MHz	400 MHz
Power Rating (CW) at 30 MHz	1000W	150W	45W	150W	150W	1000W	1000W	200W	3000W	3000W	3000W
Power Rating (CW) at max freq	350W	50W	20W	50W	50W	350W	450W	30W	850W	850W	850W
VSWR	1.3	1.2	1.3	1.3	1.3	1.3	1.2	1.4	1.1	1.1	1.1
Impedance (ohms)	50	50	75	50/75	50	50	50	50	50	50	50
Size (LxWxH, Inches)[1]	3.0 x 1.16 x 1.9	1.6 x .64 x 1.67	3.0 x 1.1 x 1.35	1.88 x .75 x 1.63	1.55 x .63 x 1.2	3.0 x 2.03 x 1.75	3.0D x 1.0H	2.5 Sq x 1.4H	2.0 x 1.68 x 1.3	2.0 x 2.13 x 1.3	2.0 x 2.13 x 1.3
Approx Weight (oz)	10	4.5	10	3	3.5	12	10	12	8	12	12

[1]Does not include connectors.
[2]Minimum -100 dB Isolation dc to 500 MHz.
[3]Special connectors producing -100 dB isolation available. Power rating is reduced to 20 CW.

Send for Dow-Key catalog

Dow-Key Division of Kilovac Corporation
P.O. Box 4422EM Santa Barbara, CA 93103 USA
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DowKey®
Division of Kilovac Corporation

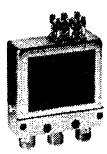
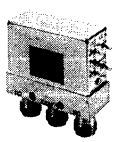
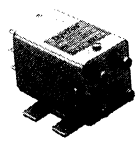
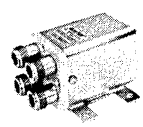
Microwave Relays

Applications
Dow-Key 400 series relays are designed for superior performance in microwave communications networks, laboratory instrumentation, high frequency test equipment, and CATV and satellite terminals.

Mechanical VS Solid State
Compared to diode or ferrite switches, coaxial relays offer the advantage of higher power handling capability, higher isolation and lower insertion loss over a broad frequency range. Operate time for Dow-Key relays is typically 10-15 ms.

Reliability
Dow-Key relays have been preferred for rugged military applications and commercial communications equipment for nearly thirty years. A balanced armature design makes Dow-Key Microwave relays well-suited for operation in severe environments. All connectors and sub-assemblies are manufactured by Dow-Key to ensure optimum conductivity and low insertion loss throughout the life of the relay.

If You Don't See What You Need
Call us. Kilovac® has many products in addition to the ones shown on this page. If we don't have a relay to fit your exact requirements, Kilovac has an experienced engineering staff available to design and produce a relay to your specifications.

Dow-Key Series No.	401	402	411	412
Contact Arrangement	SPDT	SPDT	Transfer	Transfer
Connector Options	SMA	N	SMA	N
Frequency, max	18 GHz	12.4 GHz	18 GHz	12.4 GHz
Isolation-dB, min 0-1 GHz	80	85	80	85
Isolation-dB, min at max freq	60	60	60	60
VSWR, max	1.5	1.5	1.5	1.5
Insertion Loss-dB, max	0.5	0.5	0.5	0.5
Size (inches)*	1.6H x 1.18L x .55W	2.2H x 2.64L x 1.09W	2.1L x 1.26 Sq	3.0L x 1.75 Sq
Approx Weight (oz)	2	9	6	16

*Excludes mounting bracket, terminals, and connectors.

Send for Dow-Key catalog

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P.O. Box 4422EM Santa Barbara, CA 93103 USA
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DowKey®
Division of Kilovac Corporation

SUBMINIATURE RELAYS

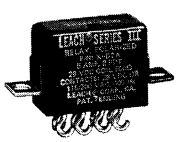
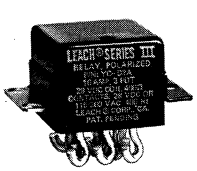
Leach subminiature relays have set the industry standards for technology and reliability for decades. With their proven high performance in the most demanding applications, they are ideal for your critical subsea, shipboard, ground-based and aerospace applications.

Our Balanced Force™ subminiature relays are rugged, high-environment relays for applications where size, weight and reliability are important. For systems where size and weight are critical, our Series III subminiature relays are the smallest, lightest aircraft relays made with their contact ratings, and are 40% the size and weight of our J and K Series relays, yet offer the same high performance. Both relay types are available in a variety of termination, mounting and operating configurations.

Subminiature Relays Dry Circuit to 10 Amps

LEACH® RELAY DIVISION

5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

		Contact Rating (Amps) 28 VDC Resistive	Inductive	Motor	Lamp	115/200 VAC 400 Hz, 3φ (Case Grounded)	Nominal Coil Voltage(s)	Coil Resistance(s)—(Ohms)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Shock, Minimum, G	Sinusoidal Vibration, Minimum, G	Weight, Maximum, Oz. (Grams)
Low Level to 5A, 2PDT Non-Latch & Latch Series X, XL Series III design, 5 mounting & 3 terminal types. 0.810″ x 0.410″ x 0.640″. Designed to MIL-R-6106. Sockets available: SO-1064-001 (Non-Latch) SO-1064-003 (Latch)		5	3	2	1	Same as DC except inductive is 5A and motor is 3A	6.0 12.0 28.0 48.0 VDC	30 125 500 1600	4	4	0.5	200	30	.56 (16)
							DC LATCH 28.0 VDC	730						
Low Level to 5A, 4PDT Non-Latch & Latch Series Y, YL Series III design, 5 mounting & 3 terminal types. 0.810″ x 0.810″ x 0.640″. Designed to MIL-R-6106. Sockets available: SO-1066-001 (Non-Latch) SO-1066-003 (Latch)		5	3	2	1	Same as DC except inductive is 5A and motor is 3A	6.0 12.0 28.0 48.0 VDC	25 100 400 1275	6	6	0.5	200	30	.92 (26)
							DC LATCH 28.0 VDC	600						
Low Level to 10A, 3 PDT Non-Latch & Latch Series YC, YCL Series III design, 5 mounting & 3 terminal types. 0.810″ x 0.810″ x 0.640″. Designed to MIL-R-6106. Sockets available: SO-1065-001 (Non-Latch) SO-1065-003 (Latch)		10	6	4	2	Same as DC except inductive is 8A	6.0 12.0 28.0 48.0 VDC	25 100 400 1275	6	6	1.0	200	30	.99 (28)
							DC LATCH 28.0 VDC	600						

Subminiature Relays Dry Circuit to 25 Amps (Cont'd)

LEACH® RELAY DIVISION
5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

	Contact Rating (Amps) 28 VDC Resistive	Inductive	Motor	Lamp	115/200 VAC 400 Hz, 3φ (Case Grounded)	Nominal Coil Voltage(s)	Coil Resistance(s)—(Ohms)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Shock, Minimum, G	Sinusoidal Vibration, Minimum, G	Weight, Maximum, Oz. (Grams)
Low Level to 12A, 2PDT Non-Latch & Latch Series J, JA & JL Balanced Force* design. 4 mounting & 3 terminal types. DC - 1.015″x 0.515″x 1.000″ AC - 1.015″x 0.515″x 1.125″ Non-Latch applicable to MS27401 Latch applicable to MS27744. Sockets available: DC, Non-Latch SO-1049-8309(#16 Crimp) SO-1049-8526(#20 Crimp); AC-115VAC SO-1049-8772(#16 Crimp); 28VAC SO-1049-8774(#16 Crimp); DC, Latch SO-1055-8690(#16 Crimp)	DC Coil 12	8	4	2	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 20 80 320	DC Non-Latch 10	DC Non-Latch 10	1	200	30	1.4 (40)
	AC Coil 10					DC Latch 6 12 28	DC Latch 38 150 600	DC Latch 10	DC Latch N/A				
						AC Coil (400 Hz) 115/28 (60 Hz) 115/28	AC Coil I, Max .040/.240 .024/.100	AC Coil 15	AC Coil 50				
Low Level to 12A, 4PDT Non-Latch & Latch Series K, KA & KL Balanced Force* design. 4 mounting & 3 terminal types. 1.015″x 1.015″x 1.000″ Non-Latch applicable to MS27400 Latch applicable to MS27745 Sockets available: DC, Non Latch SO-1048-8308(#16 Crimp) SO-1048-8518(#20 Crimp); AC-115VAC SO-1048-8776(#16 Crimp); 28VAC SO-1048-8779(#16 Crimp); DC, Latch SO-1056-8691(#16 Crimp)	DC Coil 12	8	4	2	Same as DC Rating	DC-Non-Latch 6 12 28	DC Non-Latch 18 70 200	DC Non-Latch 15	DC Non-Latch 15		200	30	DC Coil 2.5 (71)
	AC Coil 10					DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
						AC Coil (400 Hz) 115/28 (60 Hz) 115/28	AC Coil I, Max .040/.225 .018/.120 .028	AC Coil 20	AC Coil 50				AC Coil 2.7 (77)
Low Level to 25A, 1PDT Non-Latch & Latch Series JC, JCA & JCL JS & JSA***** Balanced Force* design. 50 ADC & 80A, 400 Hz overload capabilities. JS Series 20A overload capabilities. Special Models available. 3 mounting & 2 terminal types. DC-1.015″x 0.515″x 1.000″ AC-1.015″x 0.515″x 1.125″ Applicable MS, MIL-R-6106. Sockets available: DC, Non Latch SO-1063-9033; AC SO-1063-9034; DC, Latch SO-1063-9036	**JC, JCA & JCL												
	25	12	10	5	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 20 80 320	DC Non-Latch 10	DC Non-Latch 10	1	200	30	1.6 (45)
	***JS & JSA Series Only 115V, 60 Hz Case Grounded												
	10	10	8	4	N/A	DC Latch 6 12 28	DC Latch 38 150 600	DC Latch 10	DC Latch N/A				
						AC Coil (400 Hz) 115/28 (60 Hz) 115/28	AC Coil I, Max .040/.240 .024/.100	AC Coil 15	AC Coil 50				
Low Level to 25A, 3PDT Non-Latch & Latch Series KC, KCA & KCL Balanced Force* design. 50ADC & 80A, 400 Hz overload capabilities. Special Models available. 3 mounting & 2 terminal types. 1.015″x 1.015″x 1.000″ DC, Non-Latch applicable to MS27743. Latch applicable to MS27742. Sockets available: DC, Non-Latch SO-1057-8912; AC SO-1062-8917; DC, Latch SO-1058-8913	25	12	10	5	Same as DC except inductive 15A	DC Non-Latch 6 12 28	DC Non-Latch 18 70 290	DC Non-Latch 15	DC Non-Latch 15	1	200	30	3.0 (85)
						DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
						AC Coil (400 Hz) 115/28 (60 Hz) 115/28	AC Coil I, Max .040/.225 .018/.120 .028	AC Coil 20	AC Coil 50				
Low Level to 25A 3PST/NO, 2A 1PDT Aux. Non-Latch & Latch Series KD, KDA & KDL Balanced Force* design. Same design as the Series KC with added auxiliary pole. Special Models available. 3 mounting & 2 terminal types. DC, Non-Latch applicable to MIL-R-6106/13. Latch applicable to MIL-R-6106/12. Sockets available: DC, Non-Latch SO-1059-8914; AC SO-1061-8916; DC, Latch SO-1060-8915	25	12	10	5	Same as DC except inductive 15A	DC Non-Latch 6 12 28	DC Non-Latch 18 70 290	DC Non-Latch 15	DC Non-Latch 15	1 Aux 4	200	30	3.0 (85)
	Aux 2	Aux 1		Aux .05		DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
						AC Coil (400 Hz) 115/28 (60/Hz) 115/28	AC Coil 1, Max .040/.225 .018/.120 .028	AC Coil 20	AC Coil 50				

* Patented and T.M. Leach Corp.

POWER AND CONTROL RELAYS

Leach power and control relays have been used for decades in commercial and military aircraft, trucks and buses, ships and tanks—any application that calls for proven durability, high performance and long life.

To ensure that you get the right relay for your application, our power and control relays are available in a broad range of configurations. You can choose from various terminal and mounting styles, dust and moisture resistant and hermetically-sealed enclosures, and a variety of operating ratings and characteristics.

Power and Control Relays

LEACH® RELAY DIVISION

5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

	Contact Rating (Amps) 1 28 VDC 2 115 VAC, 400 Hz, 1φ 3 115 VAC, 50/60 Hz, 1φ														
	Resistive	Inductive	Motor	Lamp	Resistive 115/200VAC, 3φ, 400Hz (Case Grounded)	Contact Configuration	Resistance, Ohms ±10% @ 25°C for 28 VDC	Nominal Coil Voltage(s)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Lbs.	
5 Amp, 2PDT **Series 9229** **Series 9235; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC 400 Hz. 1.750″x 1.531″x .687″. Applicable to MS25395, MS25321, MS25465, MS25455.	1 5	3	1.5	.8	N/A	—		9229 248Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020 DC Coils .020	AC Coils .050 DC Coils .020	.002	10G 55 to 2000 Hz	25	.18
	2 5	3	1.5	.8											
	3 4	2	1	.6				9235 310Ω			9235 N.A.				.20
5 Amp, 4PDT **Series 9220** **Series 9228; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC 400 Hz. 1.750″x 1.531″x 1.032″. Applicable to MS25267, MS25325, MS25467, MS25459.	1 5	3	1.5	.8	N/A	—		9220 248Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020 DC Coils .020	AC Coils .050 DC Coils .020	.002	10G 55 to 2000 Hz	25	.30
	2 5	3	1.5	.8											
	3 4	2	1	.6				9228 200Ω			9228 N.A.				.30
5 Amp, 6PDT **Series 9226** **Series 9223; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC, 400 Hz. 1.812″x 1.531″x 1.531″. Applicable to MS25269, MS25329, MS25469, MS25463	1 5	3	1.5	.8	N/A	—		9226 180Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020 DC Coils .020	AC Coils .050 DC Coils .020	.002	10G 55 to 2000 Hz	25	.40
	2 5	3	1.5	.8											
	3 4	2	1	.6				9223 200Ω			9223 N.A.				.67
10 Amp, 2PDT **Series 9227** **Series 9237; Magnetic Latch** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. 1.781″x 1.531″x 1.032″. Applicable to MS25273, MS25323, MS25466, MS25457.	1 10	6	4	2	10	—		9227 175Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020 DC Coils .020	AC Coils .050 DC Coils .020	.002	10G 55 to 2000 Hz	25	.30
	2 10	6	4	2											
	3 6	4	3	1.5				9237 200Ω			9237 N.A.				.30

Power and Control Relays

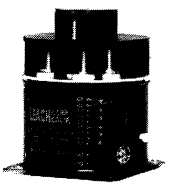
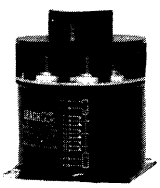
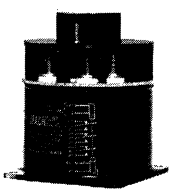
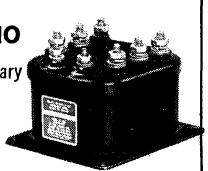
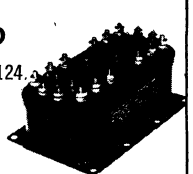
LEACH®
RELAY DIVISION

5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

	Contact Rating (Amps)					Resistive 115/200VAC, 3φ 400 Hz	Contact Configuration	Resistance, Ohms ±10% @ 25°C for 28 VDC	Nominal Coil Voltage(s)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Lbs.
	1 28 VDC														
	2 115 VAC, 400 Hz, 1φ														
	3 115 VAC, 50/60 Hz, 1φ														
	Resistive	Inductive	Motor	Lamp											
10 Amp, 4PDT **Series 9224** **Series 9225; Magnetic Latch** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. 1.812″x 1.531″x 1.531″. Applicable to MS25271, MS25327, MS25461, MS25468.	1 10	6	4	2	10	—	9224 110Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020	AC Coils .050	.002	10G 55 to 2000 Hz	25	.43
	2 10	6	4	2						DC Coils .020					
	3 6	4	3	1.5			9225 200Ω		DC Coils .020	9225 N.A.				.40
10 Amp, 2PDT **Series 9330** Contact rating @ 28 VDC or 115 VAC, 400 Hz. 1.781″x 1.531″x 1.032″. Applicable to MS24149.	1 10	10	6	2	10	—	160Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .020	AC Coils .050	.002	10G 15 to 1500 Hz	25	.30
	2 10	10	6	2						DC Coils .020					
	3 6	4	3	1.5					DC Coils .020					.30
15 Amp, 4PDT **Series 9274** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. 1.80″x 2.06″x 2.06″. Applicable to MS24568.	1 10	10	6	3	15	—	92Ω	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .025	AC Coils .050	N.O. .003 N.C. .005	10G 1000 to 2000 Hz	50	.73
	2 15	10	6	3										
	3 10	6	4	2					DC Coils .025	DC Coils .020				
20 Amp **Series 9324—3PST/NO** 20 A, 115 VAC, 60 Hz. 1.47″x 2.50″x 2.40″. Applicable to MS27418.	1 20	15	20	10	20	3PST/NO	160	28 VDC, 115 VAC, 400 Hz; 60 Hz	AC Coils .025	AC Coils .050	.002	10G 55 to 1500 Hz	25	.60
	2 20	20	20	10										
	3 20	20	12	5					DC Coils .020	DC Coils .010				
20 Amp **Series 9325—3PDT/NO** Mechanical interlock version of 9324. 3.71″x 3.00″x 3.20″. Applicable to MS27706.	1 20	15	20	10	20	3PDT/NO	160	28 VDC, 115 VAC, 400 Hz, 60 Hz	AC Coils .025	AC Coils .050	.005	10G 55 to 1500 Hz	25	1.4
	2 20	20	20	10										
	3 20	20	12	5					DC Coils .020	DC Coils .010				
25 Amp **Series 9123—3PST/NO** 50g shock, 15g vibration. Auxiliary 5 amp contacts available. 3.30″x 3.73″x 2.50″. Repairable models available. Applicable to MS27997.	1 25	25	25	N/A	25	3PST/NO	50	28 VDC 115 VAC, 400/60 Hz	.025	AC Coils .050	.002	15G 55 to 1500 Hz	50	1.25
	2 25	25	25	N/A						DC Coils .010				
	3 N/A	N/A	N/A	N/A										
25 Amp **Series 9339—3PST/NO** 25 A, 115 VAC, 60 Hz. 1.47″ x 2.50″ x 2.40″. Auxiliary Contact — 2 Amp.	1 25	15	20	10	25	3PST/NO	160	28 VDC, 115 VAC, 400 Hz; 60 Hz	AC Coils .025	AC Coils .050	.002	10G 55 to 1500 Hz	25	.60
	2 25	25	20	10		1PDT Aux.					.004 Aux.			
	3 25	25	12	5					DC Coils .020	DC Coils .010				

Power and Control Relays

LEACH® RELAY DIVISION
5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

	Contact Rating (Amps) 28 VDC: Resistive	Inductive	Motor	Lamp	Resistive 115/200VAC, 3φ 400 Hz (Case Grounded)	Contact Configuration	Resistance, Ohms ±10% @ 25°C for 28 VDC	Nominal Coil Voltage(s)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Oz./Lbs.
60 Amp Series "H" Auxiliary contacts 5 amps. Repairable models available. Basic unit: 2.50″ Dia. x 3.13″. Applicable to MS27751. 	50	20	20	10	60	3PDT 3PDT SPST/NO Aux. 3PST/NO SPST/NO SPST/NC Aux.	6 VDC, 12Ω 12 VDC, 50Ω 28 VDC, 200Ω 115 VAC, .09A	6, 12, 28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	.050	.025	.003	10G 70 to 1000 Hz	50	13.5 Oz.
60 Amp Series "HC" Center-Off Repairable models available. Basic unit: 2.50″ Dia. x 3.13″. Applicable to MS27750. 	25	15	15	10	60	3PDT	6 VDC, 12Ω 12 VDC, 50Ω 28 VDC, 200Ω	6, 12, 28 VDC	.035	.025	.003	10G 70 to 1000 Hz	50	14.0 Oz.
60 Amp Series "HL" Magnetic Latch Repairable models available. Basic unit: 2.50″ Dia. x 3.13″. Applicable to MS27749. 	50	20	20	10	60	3PDT	6 VDC, 12Ω 12 VDC, 50Ω 28 VDC, 200Ω	6, 12, 28 VDC	.035	—	.003	10G 70 to 1000 Hz	50	14.0 Oz.
50 Amp Series 9124—3PST/NO 50g shock, 15g vibration. Auxiliary 5 amp contacts available. Applicable to MS27222. 3.30″ x 3.73″ x 2.50″. Repairable models available. 	50	50	50	N/A	50	3PST/NO	50	28 VDC, 115 VAC, 400/60 Hz	.025	AC Coils .050 DC Coils .010	.002	15G 55 to 1500 Hz	50	125 lb.
50 Amp Series 9125—6PST/NO Mechanical interlock version of 9124. Design to MIL-R-6106. Aux. 5 amp contacts available. 6.21″x 3.80″x 2.70″. 	50	50	50	N/A	50	6PST/NO	50	28 VDC, 115 VAC, 400/60 Hz	.030	AC Coils .050 DC Coils .010	.002	10G 70 to 1500 Hz	50	2.90 lb.
120 Amp Series "Z" Auxiliary contacts-5 amp. available in many models of contact. Configuration-consult factory. Available in repairable models. Design to MIL-R-6106. Basic unit: 3.65″ Dia. x 4.28″.	50	30	30	N/A	120	3PDT 3PST/NO 3PST/NO SPST/NO SPST/NC Aux. 3PDT W/SPST/NO or SPST/NC Aux.	6 VDC, 1.2 A 12 VDC, .6 A 28 VDC, .31 A 115 VAC, .12 A	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	.060	.040	.004	10G 70 to 1000 Hz	15	2.0 lb.

Power and Control Relays

LEACH® RELAY DIVISION
5915 AVALON BLVD., LOS ANGELES, CA 90003
(213) 232-8221 TWX (910) 321-2303

	Contact Rating (Amps)													
	1 28 VDC													
	2 115/200 VAC 400 Hz 3φ													
	3 115/200 VAC 50/60 Hz 3φ													
	Resistive	Inductive	Motor	Lamp	Resistive 220/440 VAC 60 Hz 3φ (Case Grounded)	Contact Configuration	Resistance, Ohms @ 25°C for 28 VDC ±10%	Nominal Coil Voltage(s)	Operate Time, Maximum (MS)	Release Time, Maximum (MS)	Bounce Time, Maximum (MS)	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Oz./Lbs.
100 Amp Series "ZC" Center-Off Repairable models available. Design to MIL-R-6106. Basic unit: 3.65" Dia. x 4.28".	1 50	30	30	N/A	N/A	3PDT 3PST		6 VDC, .8 A 12 VDC, .4 A 28 VDC, .23 A 115 VAC, .09 A	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	.060	.040	.004	10G 70 to 1000 Hz	15	2.0 lb.
	2 100	100	60	N/A	N/A									
	3 N/A	N/A	N/A	N/A	N/A									
120 Amp Series "ZL" Magnetic Latch Repairable models available. Design to MIL-R-6106. Basic unit: 3.65" Dia. x 4.28".	1 50	30	30	N/A	N/A	3PDT		28 VDC, .215 A	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	.060	N/A	.004	10G 70 to 1000 Hz	15	2.0 lb.
	2 120	120	80	N/A										
	3 N/A	N/A	N/A	N/A	N/A									
100 Amp Series 9213 Sealed rotary, 1, 2, 3 and 4 pole. Auxiliary contacts from 5 amps. Design to MIL-R-6106".	1 100	100	100	N/A	50	3PST/NO 4PST/NO		44.5	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	AC Coils .040 DC Coils .030	AC Coils .060 DC Coils .020	.010	10G 55 to 1500 Hz	25	2.7 lb.
	2 100	100	100	N/A										
	3 50	50	50	N/A										
25 to 100 Amp Series 9207 Unsealed rotary, 1, 2, 3 and 4 pole. Auxiliary contacts from 5 amps. Design to MIL-R-6106.	1 100	100	100	N/A	50	3PST/NO 4PST/NO		44.5	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	.030	AC Coils .050 DC Coils .020	.010	10G 55 to 500 Hz	50	1.6 lb.
	2 100	100	100	N/A										
	3 50	50	50	N/A										
25 to 400 Amp Solenoid Type Power Contactors 1PST, 2PST Types shown: 3PST/NO, 25 amps. Design to MIL-R-6106.	1 7064: 25	25	25	N/A	N/A	3PST/NO 1PDT		Varying	28 VDC	.040	.015	N/A	2G 250 to 500 Hz	25	2.6 lb.
	50	50	50	25	N/A									
	1 7264: 200	100	200	N/A	N/A	1PST/NO								
	1 7401: 400	100	400	N/A	N/A	1PST/NO								
						1PST/NO								
300 Amp Series A Sealed Contactor SPST-NO. Auxiliary contacts — 5 amps. MIL-R-6106/33 (pending).	1 300	100	250	N/A	N/A	1PST/NO		60	28 VDC	.035	0.15	.004	10G 70 to 500 Hz 5G 500 to 1500 Hz	25	28 oz.
	2 N/A	N/A	N/A	N/A		1PST/NO 1PNO/1PNC Aux.								
	3 N/A	N/A	N/A	N/A		1PST/NO 2PDT/Aux.								
						1PST/NO 2PNO 1PNC Aux.								

ELECTRONIC TIME DELAYS AND SENSORS

To simplify systems interfacing and integration, we have a complete custom facility for the design and production of timing and sensing systems.

They are available with Leach MIL-Standard relays or special solid state outputs, manufactured with discrete circuitry or thick film hybrids manufactured to MIL-STD-883, Class B requirements.

In addition to the standard products shown below, we can provide:

—Combinations of voltage, frequency and phase sequence detection with built-in time delays for systems monitoring.

—Solid state relays with up to 3PNO contacts and ratings up to 25 amperes to MIL-STD-704 power requirements.

—Relay drivers for multiplex interface and isolation, conforming to MIL-R-28776.

—Solid state switching devices, ac and dc motor controllers, circuit breakers, current sensors and remote power controllers.

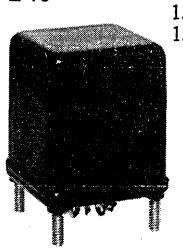
—Build to print hybrid, discrete /hybrid, and discrete designs available.

LEACH®
CONTROL PRODUCTS DIVISION
6900 ORANGETHORPE AVENUE
BUENA PARK, CALIFORNIA 90620
(714) 739-0770 TWX (910) 596-2867

Electronic Time Delays and Sensors

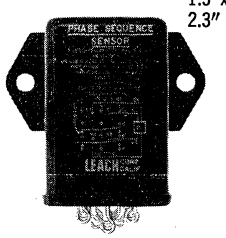
ENCLOSURE TYPES

TYPE 10 1.5″x 1.5″x 1.8″



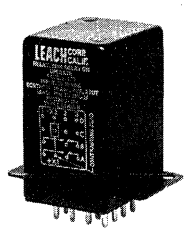
MATING SOCKET: SO-1021-7127

TYPE 10 1.5″x 1.5″x 2.3″



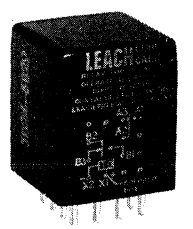
MATING SOCKET: SO-1021-7127 (SENSORS)

TYPE 20 1.2″x 1.0″x 1.8″



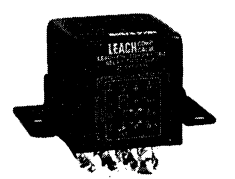
MATING SOCKET: SO-1048-8308

TYPE 30 1.0″x 1.0″x 1.3″



MATING SOCKET: SO-1048-8308

TYPE K



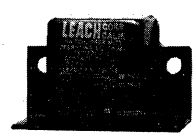
MATING SOCKET: SO-1048-8308

TYPE 40 1.0″x 0.5″x 1.1″

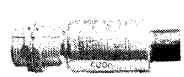
MATING SOCKET: SO-1049-8309

TYPE 01 2.1″x 0.8″x 1.3″

TYPE 02 2.1″x 1.0″x 1.0″



TYPE 04 .790″x .390″x .210″



TYPE E (HALF SIZE XTAL CAN) 0.8″x 0.4″x 0.4″

Electronic Time Delays and Sensors

LEACH®

CONTROL PRODUCTS DIVISION
6900 ORANGETHORPE AVENUE
BUENA PARK, CALIFORNIA 90620
(714) 739-0770 TWX (910) 596-2867

LEACH Series Number	Enclosure Types Available	Timing Range (1)	Accuracy (1)	Contact Configuration	Contact Ratings	Temperature Range	Input Voltage (MIL-STD-704A)	Applicable MIL-R-83726 Slash Sheet
Time Delay Relays								
Time Delay On Operate* Relay Output*	R300	10, 20, 30	0.1 SEC TO 300 SEC	±2% TO ±10%	2PDT 4PDT	2 AND 10 AMP	−55°C TO +125°C	18 VDC TO 32 VDC	3, 14
Solid State Output	S300	20, 30, 40			SPNO	0.25A			
Hybrid/Relay	TDH-8000	K	.05-500 SEC	±10%	2PDT	10 AMP			
Time Delay On Release Positive Or Negative Control									
Relay Output*	R400	10, 20, 30	100MS TO 300 SEC	±2% TO ±10%	1PDT 3PDT	2 AND 10 AMP			4, 12
Solid State Output	S400	20, 30			SPNO	0.25A			
Hybrid/Relay	TDH-8000	K	.05-500 SEC	±10%	2PDT	10 AMP			
Hybrid Construction* Time Delay On Operate*	S5100	1/2 XTAL CAN	50MS TO 500 SEC						20, 21
Repeat Cycle Timer*	S5200								22
Voltage, Frequency, and Phase Sensors									
DC, Relay Output	V110	10	N/A	±2% TO ±10%	2PDT AND 4PDT	2 AND 10 AMP	−55°C TO +125°C	18 VDC TO 32 VDC	N/A
AC Undervoltage, Relay Output	V210							90 VAC TO 124 VAC 400 Hz	
Ac Overvoltage, Relay Output	V310								
AC Frequency, Relay Output	F410								
AC Phase Sequence, Relay Output	P510			N/A					
Proximity Sensors									
Solid State Output (2)	PS100	01 02 04	N/A	±.03″	SPNO SPNC SPNO	0.20A	−55°C TO +125°C	18 VDC TO 32 VDC	N/A

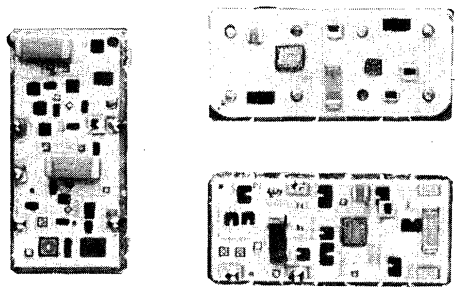
(1) EXTENDED TIMING RANGES AND GREATER ACCURACIES ARE AVAILABLE ON SPECIAL ORDER

(2) AVAILABLE FOR BOTH FERROUS AND NON FERROUS TARGET SENSING
SHORT CIRCUIT PROTECTION AVAILABLE
PACKAGES FOR MULTIPLE SENSORS AND HIGHER OUTPUT RATINGS ON SPECIAL ORDER

***TIME DELAY UNITS AVAILABLE QUALIFIED TO MIL-R-83726**
SEE THE LEACH QUALIFIED PRODUCTS LIST

LEACH® CORP.

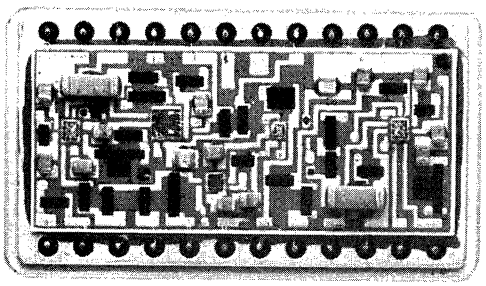
CONTROL PRODUCTS DIVISION
6900 ORANGETHORPE AVENUE
BUENA PARK, CALIFORNIA 90620
TELEPHONE: (714) 739-0770
TWX 910-596-2867



HISTORY OF HIGH QUALITY ELECTRONICS

The need for high quality thick film hybrid microcircuits for aerospace and military applications lead to Leach Corporation's entry into the field in the early 1970's. The initial 400 square foot engineering lab has evolved into a 22,000 square foot facility housing both engineering and total manufacturing capabilities.

Products include both analog and digital circuitry for interface and switching applications, and consist of both proprietary Leach products and customer designed custom hybrids.



MANAGEMENT PHILOSOPHY

Primarily designed for high reliability applications, products are manufactured to MIL-STD-883 requirements. Military environmental specifications and criteria are standard Leach practice, and products are qualified to MIL-R-83726, MIL-M-38510, and NASA standards.

ENVIRONMENTAL TESTING / QUALITY CONTROL

Within a building separate from the manufacturing area, the environmental test lab continuously maintains Leach QPL listings and conducts qualification testing to customer requirements.

Testing in accordance with MIL-STD-202 includes:

- Sine vibration with concurrent temperature testing
- Shock
- Altitude/temperature altitude
- Thermal shock and temperature cycling
- Load and life testing

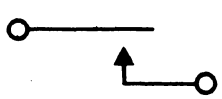
HYBRID MANUFACTURING FACILITIES

Total facilities for all aspects of thick film hybrid manufacturing as well as hybrid/electromechanical interfacing are contained within the manufacturing area.

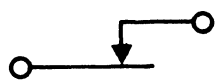
- Screen and firing
- Trimming
- Wire bonding
- Eutectic and epoxy die bonding
- Reflow soldering
- Photo processing
- Computerized testing of hardware
- Laminar flow benches
- Inert storage atmosphere

MINIGLOSSARY
RELAY CONTACT FORMS

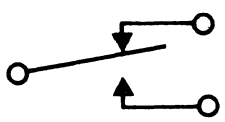
A
Make
SPST-NO



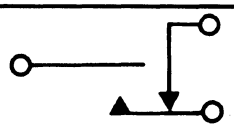
B
Break
SPST-NC



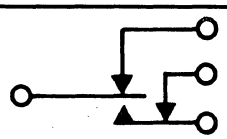
C
Break, Make
(Transfer)
SPDT



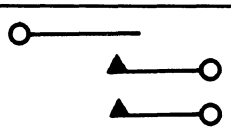
D
Make, Break
(Continuity
Transfer)



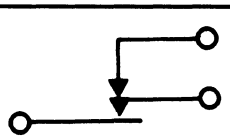
E
Break,
Make,
Break



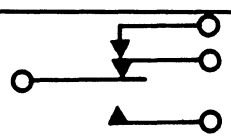
F
Make,
Make



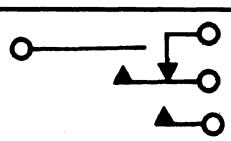
G
Break,
Make



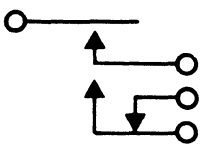
H
Break,
Break,
Make



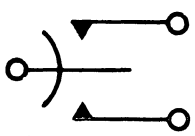
I
Make,
Break,
Make



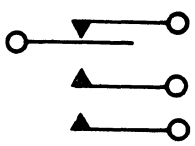
J
Make,
Make,
Break



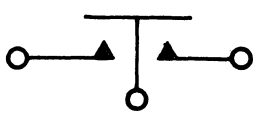
K
Center off
SPDT



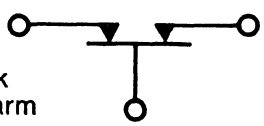
L
Break,
Make,
Make



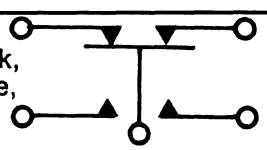
U
Double
make
Contact
on arm



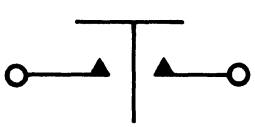
V
Double break
Contact on arm



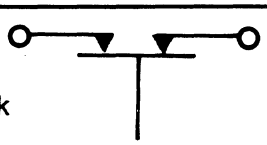
W
Double break,
Double make,
Contact
on arm



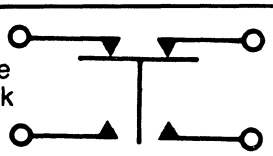
X
Double
make



Y
Double break



Z
Double make
Double break
SPDT-DB

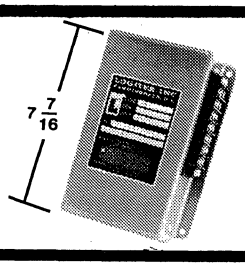


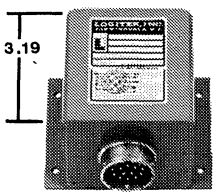
LOGITEK INC.

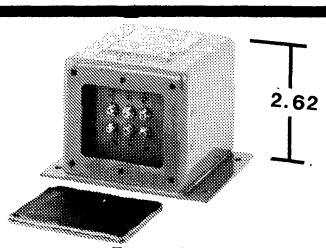
42 CENTRAL AVENUE, FARMINGDALE, NEW YORK 11735 516-694-3080

ELECTRONIC MONITORS & CONTROLS

POWER MONITORS • AC & DC VOLTAGE MONITORS • FREQUENCY MONITORS • PHASE MONITORS







APPLICATIONS

Logitek power monitoring equipment is used to continuously monitor the characteristics of AC and DC electric power systems for conformance to their design acceptable limits. This type of continuous surveillance is of particular importance in such systems where undetected power line malfunctions could cause major system failure, utilization equipment malfunction, or erroneous operation. Without continuous monitoring, utilization equipment operators are often unaware that their equipment is malfunctioning or of its slow degradation until functional failure.

EQUIPMENT TYPES

Individual units are available to monitor AC or DC voltage, line frequency, phase to phase voltage unbalance and phase angle unbalance, each for both high and low limits, or to monitor for phase loss and/or reversal. "Power Monitors" are also available incorporating any combination of these monitoring functions within a single unit. Units generally fall into two categories: those in which the limits of high and low voltage, frequency and pick-up and drop-out time delay are factory pre-set, and those in which the limits are factory set, but field adjustable. Models are also available with two limit sets, one set for abnormal condition limits and a second set of limits for emergency conditions.

OPERATING CHARACTERISTICS

The equipment is connected to the power line to be monitored where it continuously measures the desired characteristics. Should any one of these characteristics exceed the pre-set acceptable limits, the drop-out time delay will begin. If the condition persists for a time longer than the drop-out time delay, the output control circuit will de-energize. Once the control circuit de-energizes, the power line must return to normal for a time exceeding the pick-up time delay before the control circuit will re-energize. In the case of phase loss or reversal, however, the control circuit will de-energize immediately bypassing the time delay circuits. Control circuits normally consist of relay contacts, but various logic levels can also be provided. Standard units are generally supplied with a single control circuit responsive to any type anomaly, however, equipment providing many variations can be specified for particular applications. Examples of variations include control circuits which provide a logic level output, a separate output for each characteristic being monitored, both real time and delayed time signal outputs and manual reset or override capabilty.

SPECIFICATIONS

ELECTRICAL

Input Voltage	28 VDC, 120/208, 120/240, 277/480 VAC
Input Frequency	50/60/400 HZ
Sense Voltage	As Required
Sense Frequency	As Required
Accuracy	±1%, ±5%
Phase Sequence	A + B + C
Phase to Phase Voltage Unbalance/Phase Angle Shift	5-10%
Time Delay (Pick-Up and Drop Out)	250 Milliseconds to 10 Seconds, factory set or field adjustable
Relay Contacts	DPDT, 3PDT
Contact Rating	2 Amp, 10 Amp

PHYSICAL

Finish	Gloss Blue #15177, FED-STD-595, Meet or exceed MIL-E-5556 or 5557
Connector	Glass to Metal Seal Solder Hooks, MS3113H-20-16PN Connector, Barrier Strip

ENVIRONMENTAL

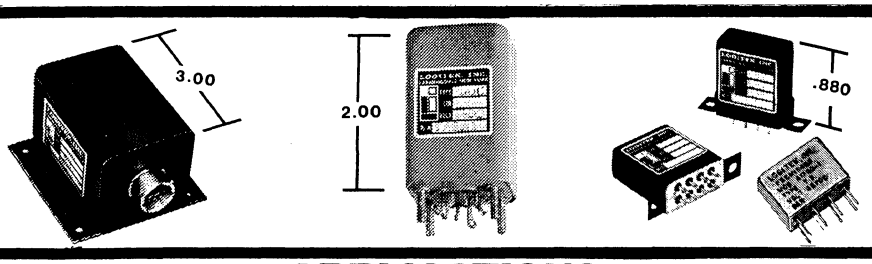
Temperature	−55°C to +125°C, −40°C to +85°C, −10°C to +70°C
Vibration	Per MIL-E-5272, Procedure II, 10 - 80 HZ @ .06" D.A. 80 - 2000 HZ 20g's
Shock	Per MIL-E-5272, Procedure V, 50g's 11 ± 1 Millisecond, any axis
Acceleration	Per MIL-E-5272, Procedure I, 20g's Steady state, any axis
Humidity	Per MIL-E-5272, Procedure I
Altitude	Per MIL-E-5272, Procedure IV, Condition F, 100,000 Feet
General	Per MIL-E-5400R, Class 4 except Paragraph 3.1.29

LOGITEK INC.

42 CENTRAL AVENUE, FARMINGDALE, NEW YORK 11735 516-694-3080

ELECTRONIC MONITORS & CONTROLS

TIME DELAY RELAYS • SOLID STATE FLASHERS • REPEAT CYCLE & INTERVAL TIMERS



APPLICATIONS

The design of complex electrical distribution systems often requires that certain operations be delayed or sustained for a precise interval of time from occurrence of a control or initializing signal. Combinations of various timing devices can be used for sequential startup or shutdown programs, load transfer or shedding, or delayed transfer to avoid race conditions. In addition, pulsers, interval timers, and flashers are used in applications such as operating instrument panel warning lights or other annunciator devices, landing gear, door open indicators and navigation lights.

EQUIPMENT TYPES

Several timing functions are available to facilitate the different timing and sequencing requirements ordinarily required. These include "delay on make," providing a time delay from application of the control signal to output circuit energization; "delay on break," providing immediate energization which sustains for a timed interval; "delayed interval," providing a delay on make followed by a timed "energized" interval and then return to the de-energized state. "Controlled" timers generally fall into two categories: timers which produce an immediate transfer of the control circuit upon application of a control signal and then a time delayed release after removal of the control signal and "true delay on break" timers which generate a timed interval and relay transfer after removal of all operating power.

OPERATING CHARACTERISTICS

Logitek timing devices are generally CMOS integrated circuits appropriately protected from line transients and other line perturbations and either a solid state or electromechanical relay output circuit. Since there are no large capacitive timing or storage elements in these devices, recycle times (the time after control removal which will cause a new timing cycle within specified accuracy) are very short. In addition, the use of CMOS IC digital counting circuits allows the use of very stable timing elements resulting in excellent stability through wide temperature ranges.

SPECIFICATIONS

ELECTRICAL

Input Voltage	28, 115, 120, 220 VAC/DC
Timing Range	50 Milliseconds to 1000 seconds
Accuracy	±10%, ±5%, ±2%
Contacts	
Relay	DPDT, 3PDT; 2 AMP, 10 AMP
Solid State	.5 AMP, 2 AMP, 2.5 AMP, 4 AMP, 5 AMP
Radio Interference	MIL-1-6181D, MIL-1-26600

PHYSICAL

Finish	Gloss Blue #15177, FED-STD-595, meet or exceed MIL-E-5556 or 5557, Flat Black per MIL-E-5556
Connector	Glass to Metal Seal Solder Hooks, MIL-STD Connector, Octal Plug

ENVIRONMENTAL

Temperature	−55°C to +125°C, −55°C to +85°C, −55°C to +71°C, −30°C to +30°C
Vibration	Per MIL-E-5272, Procedure II, 10 - 80 HZ @ .06" D.A. 80 - 2000 HZ 20g's
Shock	Per MIL-E-5272, Procedure V, 50g's 11 ±1 Millisecond, any axis
Acceleration	Per MIL-E-5272, Procedure I, 20g's Steady state, any axis
Humidity	Per MIL-E-5272, Procedure I
Altitude	Per MIL-E-5272, Procedure IV, Condition F, 100,000 Feet
General	Per MIL-E-5400R, Class 4 except Paragraph 3.1.29

• QUALITY ASSURANCE

Logitek equipment is manufactured in accordance with

- MIL-Q-9858A
- MIL-I-45208

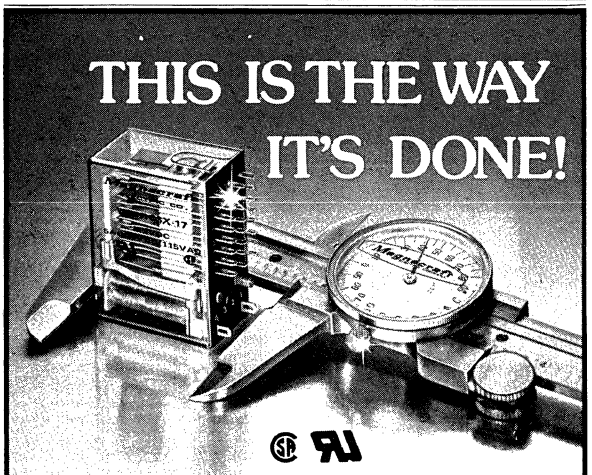
All production equipment undergoes a 100 hour burn-in schedule to insure in-service reliability.

• APPLICATIONS

- Aircraft, Electrical Systems
- Mobile Radar Systems
- Equipment Test Stations
- Tanks
- Mobile Missile Launchers
- Offshore Drilling Rigs
- Computer Systems
- Shipboard Electrical Systems
- Hospital Auxiliary Power Systems

• SPECIAL PRODUCTS

Logitek's engineering department is available to discuss your application of our product or to design special equipment to satisfy your system requirements.

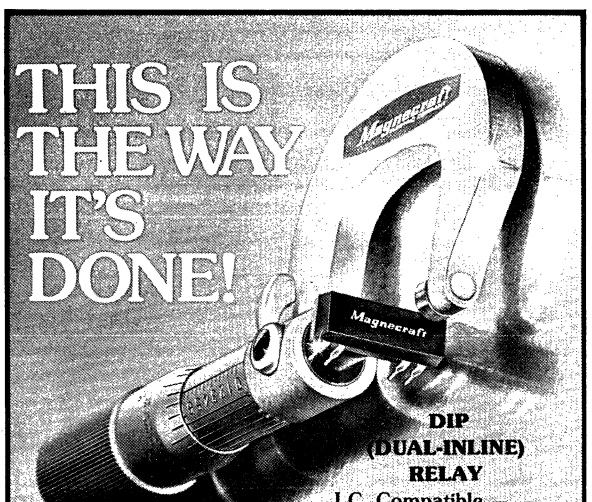


CLASS 67 MINIATURE INDUSTRIAL RELAY
Long Life and Reliable Service

- **5 AMPS:** DPDT to 8PDT
- **Control Voltages:** 5VDC to 110VDC, 6VAC to 115VAC Standard.
- **Terminals:** Plug-in/solder type and printed circuit.
- **Mating sockets available.**

71 different models are **IN STOCK** for immediate delivery.
Write for your **FREE RELAY CATALOG.**

CLASS 65 LOW PROFILE RELAY
Immersion Proof
Flat Pak or Upright Mounting
Contacts: 10 AMPS @ 250 VAC, SPDT
Standard control voltages of 5, 6, 12, 48 VDC.
16 Different Models are **IN STOCK** for Immediate Delivery.
Write for your **FREE RELAY CATALOG.**



DIP (DUAL-INLINE) RELAY
I.C. Compatible — Immersion Proof

Control Voltage: 5, 6, 12, 24VDC Standard

Standard Contact types:
SPST-NO DPST-NO SPST-NC SPDT DPDT

Options: **A.** Internal Clamping diode
B. Electrostatic shielding
C. 14 Pin arrangements
D. Mercury wetted

89 DIP Models **IN STOCK** for immediate delivery!
Write for your **FREE RELAY CATALOG!**

CLASS 199 POWER RELAY
Up to 50 AMP Switching

Standard Control Voltages:
5 to 240 VAC
6 to 220 VDC

Contact Combinations:
DPDT DPST-N.O.
SPST-D.M.
SPDT SPST-D.B.

41 Models **IN STOCK** for immediate delivery!
Write for your **FREE RELAY CATALOG.**

Magnecraft®
ELECTRIC COMPANY

5575 North Lynch Avenue, Chicago, Illinois 60630
(312) 282-5500 TWX-910-221-5221

MAGNECRAFT ELECTRIC CO. PRODUCTS INCLUDE: Low Profile Relays, Miniature Industrial Relays, Miniature Printed Circuit Relays, General Purpose and Power Relays, General Purpose Industrial Relays, Molded In-Line Packaged Reed Relays, Dual In-Line Packaged Reed Relays, Solid State Relays, Mercury Displacement Relays, Time Delay Relays, Coaxial & R.F. Switching Relays, Telephone Type Relays, Actuators and Buzzers.

Midtex is out to fold, spindle and eliminate relay *back-orders.*

When you need a relay the last thing you want to hear is: "Sorry, it's on **back-order.**"

Midtex and its franchised distributors are committed to eliminating the **back-order** and providing you with the best possible customer service and support.

To make sure we're successful, Midtex has recruited the finest distributors in the electronics industry, and backed them with a million dollar investment in inventory, equipment and service personnel. In addition, each Midtex distributor offers you these exclusives:

- **On-shelf inventory** of the most commonly needed relays and timers supported by a large distributor inventory warehoused at Midtex.
- **Superior customer service** responsive to your needs.

- **A broad-based line** of high quality products, priced competitively from a reputable, reliable source—Midtex!
- **Cross referencing** for fast, exact matching of your relay specifications to a Midtex relay.
- **Applications assistance**—44 years of Midtex experience in the design and manufacture of relays is available to you.

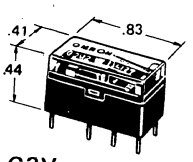
If you're tired of hearing: "Sorry, it's on back-order," contact a Midtex distributor, and give him your challenge. He'll be waiting.

Midland-Ross Corporation
Midtex Division
PO Box 3328
North Mankato, MN 56001
507/625-6521

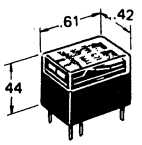
MIDLAND ROSS

OMRON®

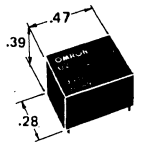
LOW SIGNAL RELAYS



G2V (inch)



G2E (inch)



G2Q (inch)

The relay products outlined on these pages are representative of hundreds of relays manufactured and distributed by Omron. Omron also manufactures a wide variety of other control components including: switches, photoelectric sensors, proximity sensors, timers, counters, temperature controllers and programmable controllers.

G2V

Ultra Small, Highly Reliable Dual In-Line Relay

- Same pitch as 16-pin DIP IC
- High contact reliability with bifurcated crossbar contacts
- Wide switching capacity from 100μA to 2A loads
- Permits .61" pitch PC board rack mounting
- Sealed type available
- High dielectric strength type is available to meet FCC 1500V surge requirement

■ **AVAILABLE TYPES**

Contact form \ Type	Unsealed		Sealed	
	Bifurcated crossbar	Single crossbar	Bifurcated crossbar	Single crossbar
DPDT	G2V-2-US	G2V-282P-US	G2V-234P-US	G2V-284P-US

• **CONTACT RATINGS**

Item \ Type	G2V-2-US, -234P-US		G2V282P-US, -284P-US	
Load	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4; L/R = 7msec)	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4; L/R = 7msec)
Rated load	110VAC 0.3A 24VDC 1A	110VAC 0.2A 24VDC 0.3A	110VAC 0.3A 24VDC 1A	110VAC 0.2A 24VDC 0.3A
Carry current	2A			
Max. operating voltage	125VAC, 125VDC			
Max. operating current	2A			
Max. switching capacity	60VA 30W	20VA 10W	60VA 30W	20VA 10W
Minimum permissible load (reference value)	0.1 VDC 100μA		1 VDC 1mA	

■ **SPECIFICATIONS**

• **COIL RATINGS**

Rated voltage \ Item	Rated current (mA)	Coil resistance Ω	Coil inductance (ref. value) (H) Armature OFF	Coil inductance (ref. value) (H) Armature ON	Must operate voltage	Must dropout voltage	Maximum voltage	Power Consumption (mW)
					% of rated voltage			
3VDC	188	16	0.031	0.041	75 max.	10 min.	125 max.	Approx. 560
5VDC	111	45	0.075	0.113				
6VDC	100	60	0.12	0.168				
12VDC	42.9	280	0.537	0.789				
24VDC	22.9	1,050	1.36	2.06				
48VDC	12.3	3,900	6.74	9.72				

NOTE: The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±10%.

G2E

Sugar Cube-Sized, Exclusive-Use PCB Relay

- High-sensitivity and sealed type is also available.
- Standard terminal arrangement on .10" grid
- Low power consumption (approx. 450mW)
- Fast response (5msec operate time)

■ **AVAILABLE TYPES**

Contact form \ Type	General purpose		High-sensitivity	
	Standard type	Sealed type	Standard type	Sealed type
SPDT Single crossbar	G2E	G2E-184P	G2E-182P-H	G2E-184P-H
Bifurcated crossbar	G2E-132P	G2E-134P	G2E-132P-H	G2E-134P-H

• **CONTACT RATINGS**

Item \ Load	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4, L/R = 7msec)
Rated load	110VAC 0.5A 24VDC 1A	110VAC 0.2A 24VDC 0.3A
Carry current	2A	
Max. operating voltage	125VAC, 60VDC	
Max. operating current	1A	
Max. switching capacity	120VA 30W	60VA 15W
Minimum permissible load (reference value)	5 VDC 1mA	

■ **SPECIFICATIONS**

• **COIL RATINGS** (Value in parentheses applies to High-sensitivity type.)

Rated voltage \ Item	Rated current (mA)	Coil resistance Ω	Coil inductance (ref. value) (H) Armature OFF	Coil inductance (ref. value) (H) Armature ON	Must operate voltage	Must dropout voltage	Maximum voltage	Power Consumption (mW)
					% of rated voltage			
1.5VDC*	300	5	0.005	0.009	70 max. (80 max.)	10 min.	110 max. (130 max.)	Approx. 450 (Approx. 200)
3VDC*	150	20	0.017	0.034				
5VDC	89.3(41.7)	56(120)	0.044(—)	0.091(—)				
6VDC	75(33.3)	80(180)	0.067(—)	0.136(—)				
9VDC	50(22.5)	180(400)	0.137(—)	0.297(—)				
12VDC	37.5(17.1)	320(700)	0.229(—)	0.496(—)				
24VDC	18.8(8.6)	1,280(2,800)	0.94 (—)	2.1 (—)				

NOTE: 1. The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±15%, −20% for rated current and ±10% for coil resistance.
2. *High-sensitivity type is not available.

G2Q

Ultra Small and Light PCB Relay

- High-sensitivity type (200mW) also available
- International .10" terminal pitch arrangement
- Fast response (5msec. operate time)
- Weight .07 oz.

■ **AVAILABLE TYPES**

Mounting style \ Type	General purpose		High-sensitivity	
	Standard	Sealed	Standard	Sealed
Horizontal mount (Flat pack)	G2Q-187P	G2Q-184P	G2Q187P-H	G2Q-184P-H
Vertical mount	G2Q-187P-V	G2Q-184P-V	G2Q-187P-V-H	G2Q-184P-V-H

• **CONTACT RATINGS**

Item \ Load	Resistive load (p.f. = 1)
Rated load	110VAC 0.5A 24VDC 1A
Carry current	2A
Max. operating voltage	125VAC 60VDC
Max. operating current	1A
Max. switching capacity	60VA 30W
Minimum permissible load (reference value)	5VDC 1mA

■ **SPECIFICATIONS**

• **COIL RATINGS**

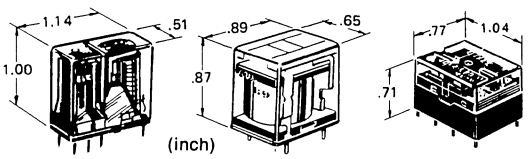
Rated voltage \ Item	Rated current (mA)	Coil resistance Ω	Coil inductance (ref value) (H) General purpose Armature OFF	Coil inductance (ref value) (H) General purpose Armature ON	Coil inductance (ref value) (H) High-sensitivity Armature OFF	Coil inductance (ref value) (H) High-sensitivity Armature ON	Must operate voltage	Must dropout voltage	Maximum voltage	Power Consumption (mW)
							% of rated voltage			
5VDC	56 (41.7)	89(120)	0.09	0.16	.12	0.22	70 max. (80 max.)	10 min.	110	Approx. 280 (Approx. 200) Approx. 360
6VDC	46.9(33.3)	128(180)	0.11	0.24	0.20	0.34				
9VDC	31 (22.5)	290(400)	0.32	0.58	0.48	0.83				
12VDC	23.5(17.1)	510(700)	0.69	1.03	0.91	1.63				
24VDC*	15	1,600	3.75	4.70	–	–				

NOTES: 1. The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±10%
2. *High-sensitivity type is not available.

OMRON®

POWER RELAYS

For more information contact **Omron Electronics, Inc.,**
Dept. EM, 650 Woodfield, Schaumburg, Illinois 60195
Phone: (312) 843-7900, TWX 910-291-2494



G2R G2U G4D

G2R

Slim Styled Power Relay Breaks Up to 10A Loads

- Miniature, slim style design
- Ideal for space saving on PCB
- Creepage distance of more than .31" (between coil and contact)
- Switching capability of up to 10A loads (SPDT type) and 5A loads (DPDT type).
- VDE, SEV, UL, CSA and TV3 approvals pending.

■ **AVAILABLE TYPES**

Contact form \ Type	Vertical mount
DPDT	G2R-212P-V
DPST-NO	G2R-2212P-V
SPDT	G2R-112P-V
SPST-NO	G2R-1112P-V

• **CONTACT RATINGS**

Item \ Type	G2R-212P-V, G2R-2212P-V		G2R-112P-V, G2R-1112P-V	
	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4, L/R = 7msec)	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4, L/R = 7msec)
Rated load	250VAC 5A 30VDC 5A	250VAC 2A 30VDC 3A	250VAC 10A 30VDC 10A	250VAC 7.5A 30VDC 5A
Carry current	5A		10A	
Max. operating voltage	380VAC, 125VDC		380VAC, 125VDC	
Max. operating current	5A	3A	10A	10A
Max. switching capacity	1,900VA, 150W	500VA, 90W	2,500VA, 300W	1,875VA, 150W
Min. permissible load (reference value)	5VDC 10mA		5VDC 100mA	

■ **SPECIFICATIONS**

• **COIL RATINGS**

Rated voltage	Rated current (mA)	Coil resistance Ω	Coil inductance (ref. value) (H) Armature OFF	Coil inductance (ref. value) (H) Armature ON	Must operate voltage (% of rated voltage)	Must dropout voltage (% of rated voltage)	Maximum voltage (% of rated voltage)	Power Consumption (mW)
6VDC	88	68	.046	0.63	70 max.	15 min.	110 max.	Approx. 530
12VDC	44	275	1.82	2.53				
24VDC	22	1,100	7.3	10.1				
48VDC	11.5	4,170	29.2	40.4				

NOTE: The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±15%.

G2U

Sugar Cube-Sized PCB Relay Capable of Switching 5A Loads

- Ideal for application in household electrical appliances
- Construction resistant to flux wicking. Dip soldering is possible.
- Sealed type is also available.

■ **AVAILABLE TYPES**

Contact form \ Type	General purpose	Sealed
SPDT	G2U-112P-US	G2U-114P-US
SPST-NO	G2U-112P-100-US	G2U-114P-100-US

• **CONTACT RATINGS**
(Value in parentheses applies to sealed type.)

Item \ Load	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4, L/R = 7msec)
Rated load	110VAC/24VDC 5A (3A)	110VAC/24VDC 2.5A (1.5A)
Carry current	5A (3A)	
Max. operating voltage	125VAC, 60VDC	
Max. operating current	5A (3A)	3A (1.5A)
Max. switching capacity	600VA/150W (350VA/90W)	300VA/70W (180VA/40W)
Min. permissible load (reference value)	5VDC 10mA	

■ **SPECIFICATIONS**

• **COIL RATINGS**

Rated voltage	Rated current (mA)	Coil resistance Ω	Coil inductance (ref. value) (H) Armature OFF	Coil inductance (ref. value) (H) Armature ON	Must operate voltage (% of rated voltage)	Must dropout voltage (% of rated voltage)	Maximum voltage (% of rated voltage)	Power Consumption (mW)
6VDC	60	100	0.34	0.51	75 max.	10 min.	130 max.	Approx.360
12VDC	30	400	1.2	2.3				
24VDC	15	1,600	4.8	8.0				

NOTE: The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±10%.

G4D

Double-pole Relay That Breaks 5A Loads

- Creepage distance of more than .12".
- International .10" terminal pitch arrangement.
- Contact section arranged at the upper part of the relay housing with unique terminal construction to seat the relay enclosure base .04" above the PC board surface, facilitates automatic flow soldering.

■ **AVAILABLE TYPES**

Contact form \ Type	Standard
DPDT	G4D-212P-US-TV2

NOTE: DPST type is also available.

• **CONTACT RATINGS**

Item \ Load		Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4, L/R = 7msec)
Rated load		110VAC 5A 24VDC 5A	110VAC 2.5A 24VDC 2.5A
Carry current		5A	
Max. operating voltage		250VAC, 125VDC	
Max. operating current		5A	
Max. switching capacity	AC	1,100VA	550VA
	DC	120W	60W
Min. permissible load (reference value)		5VDC 100mA	

■ **SPECIFICATIONS**

• **COIL RATINGS**

Rated voltage	Rated current (mA)	Coil resistance Ω	Coil inductance (ref. value) (H) Armature OFF	Coil inductance (ref. value) (H) Armature ON	Must operate voltage (% of rated voltage)	Must dropout voltage (% of rated voltage)	Maximum voltage (% of rated voltage)	Power Consumption (mW)
5VDC	160.3	31.2	0.114	0.215	80 max.	15 min.	110	800
6VDC	133.3	45	0.185	0.284				
12VDC	66.7	180	0.713	1.200				
24VDC	33.3	720	2.140	3.570				

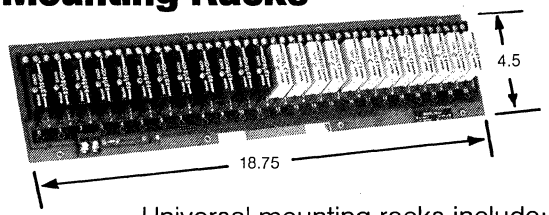
NOTE: 1. The rated current and coil resistance are measured at a coil temperature of 68°F with tolerances of ±10%.
2. The performance characteristics are measured at a coil temperature of 68°F±9.

Opto 22. Solid state of the art.

Power I/O Systems

The most versatile I/O system available – also the most complete; Choices of 4, 8, 16, 24 or 32 module mounting racks; three logic voltages; 120 VAC, 240 VAC, 60 VDC, or 200 VDC load voltages; allow maximum flexibility in system design. The first true plug-in system per NEMA ICS2-230.02 simplifies maintenance, installation and modification. Provides power interface & optical isolation between the μP (or other logic) & industrial power.

Mounting Racks



Universal mounting racks include:

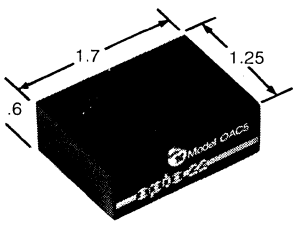
- ☐ LED status indicator
- ☐ Plug connection for logic signals (4 module board has barrier strip)
- ☐ UL Recognition, CSA Certified

Instant Delivery From Stock

MODEL	
PB4	4 Module
PB4R	4 Module with individual logic control
PB8	8 Module
PB16A	16 Module
PB16T	16 Module with barrier strip for logic connections
PB16C	16 Module with extra barrier strip for power
PB24*	24 Module
PB24Q*	24 Lines via 6 Quad Pak™ modules
PB32DEC†	32 Lines via 8 Quad Pak™ modules

*Direct connection to Intel single board computers
†Direct connection to DEC LSI 11 computer

I/O Modules



- ☐ 4000 V Optical Isolation
- ☐ Built-in Snubbers on AC output
- ☐ Zero Cross Switching on AC output
- ☐ UL Recognized, CSA Certified
- ☐ High Transient Immunity

Instant Delivery From Stock

OUTPUT MODULES

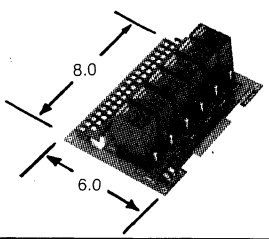
MODEL	DC Logic Voltage	Power Voltage	Power Current Rating Amps	1 Cycle Surge Rating Amps Peak
OAC5	5	12-140 VAC	3	80
OAC5A	5	24-280 VAC	3	80
ODC5	5	2-60 VDC	3	5
ODC5A	5	2-200 VDC	1	5
OAC15	15	12-140 VAC	3	80
OAC15A	15	24-280 VAC	3	80
ODC15	15	2-60 VDC	3	5
ODC15A	15	2-200VDC	1	5
OAC24	24	12-140 VAC	3	80
OAC24A	24	24-280 VAC	3	80
ODC24	24	2-60 VDC	3	5
ODC24A	24	2-200 VDC	1	5
OAC5A5*	5	24-280 VAC	3	80

*Normally closed

INPUT MODULES

MODEL	DC Logic Voltage	Power Voltage
IAC5	5	90-140 VAC
IAC5A	5	180-280 VAC
IDC5	5	10-32 VDC
IAC15	15	90-140 VAC
IAC15A	15	180-280 VAC
IDC15	15	10-32 VDC
IAC24	24	90-140 VAC
IAC24A	24	180-280VAC
IDC24	24	10-32 VDC
IDC5B	5	4-16 VDC
IAC5E	5	20-30 VAC

Quad Pak™ High Density Power I/O Modules



Instant Delivery From Stock

MODEL	Power Voltage	Power Current Rating Amps	1 Cycle Surge Rating Amps Peak
OAC5Q	12-280 VAC	3	80
ODC5Q	2-60 VDC	3	5

Note: All Quad Pak® input & output modules operate with 5 VDC logic.

MODEL	Power Voltage
IAC5Q	90-140 VAC or 95-150 VDC
IAC5AQ	180-280 VAC or 200-300 VDC
IDC5Q	10-32 VDC or 15-32 VAC
IDC5BQ	4-16 VDC

The OPTO 22 Direct Connection to Commonly Used Host Computers and Busses

OPTO 22 offers a series cable and/or adapter boards to facilitate connection to a wide variety of host computers and busses.

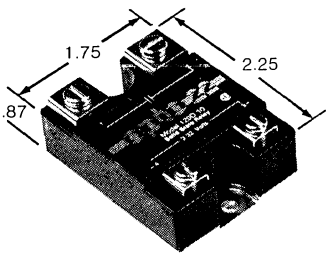
DEC LSI 11 via DRV 11J
DEC FALCON
DEC 5010/6010
NATIONAL CIMBUS CIM-311
AIM 65/40 RM65 SBC
AIM 65
STD BUS via PROLOG 7507
MULTIBUS via INTEL 8010, 8020, 8030
MULTIBUS via INTEL 519
MOTOROLA EXORBUS via M68MM17
MOTOROLA EXORBUS via M68MM22
RCA MICROBOARD via CDP18S662

Consult factory for detailed data sheets.

Optically Isolated SSRs

- ☐ TTL Compatible Control
- ☐ 4000 V Optical Isolation
- ☐ UL Recognized, CSA Certified
- ☐ Zero Cross Switching for low noise
- ☐ Intergal snubber – tested twice at Rated & Surge Current for both resistive load & 0.5 power factor inductive load.

Power Series – AC Load†



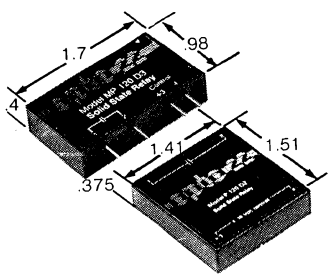
Chassis mount, heavy duty power relays untilizing two SCRs & the most advanced heat transfer design.

Instant Delivery From Stock

Output Current Rating Amps	Output Voltage Rating* 120 VAC	240 VAC	1 Cycle Surge (Amps) Peak	Control Voltage
3	120D3	240D3	25	3-32 VDC
10	120D10	240D10	110	3-32 VDC
25*	120D25	240D25	250	3-32 VDC
45	120D45	240D45	650	3-32 VDC
10	120A10	240A10	110	85-280 VAC
25*	120A25	240A25	250	85-280 VAC
45	120A45	240A45	650	85-280 VAC

*Also available with 380 VAC rating

PC Board Series – AC Load†

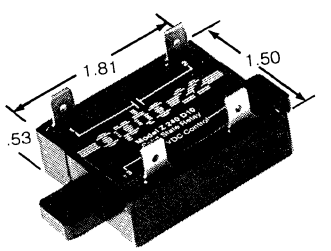


Two optimized configurations – the thin P series for edge stacked cards and the MP series where a small footprint is required.

Instant Delivery From Stock

Output Current Rating Amps	Output Voltage Rating 120 VAC	240 VAC	1 Cycle Surge (Amps) Peak	Control Voltage
2	MP120D2	MP240D2	20	3-24 VDC
4	MP120D4	MP240D4	85	3-24 VDC
2	P120D2	P240D2	20	3-32 VDC
4	P120D4	P240D4	85	3-32 VDC

Liberator Z Series



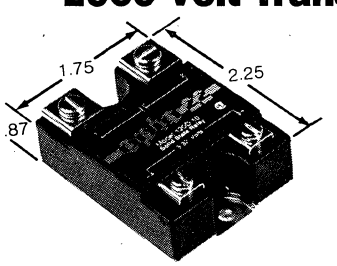
Designed for high volume the best buy in solid state relays.

Proof that quality does not have to cost more.

Instant Delivery From Stock

Output Current Rating Amps	Output Voltage Rating 120 VAC	240 VAC	1 Cycle Surge (Amps) Peak	Control Voltage
5	Z120D5	Z240D5	85	3-32 VDC
10	Z120D10	Z240D10	110	3-32 VDC

2000 Volt Transient Proof High Voltage Power Series



Advanced design provides transient immunity to 2000 volts!

Instant Delivery From Stock

Current Rating Amps	Output Voltage Rating 480 VAC	1 Cycle Surge (Amps) Peak	Control Voltage
10	480D10-12	110	3-32 VDC
15	480D15-12	150	3-32 VDC
10	480A10-12	110	85-280 VAC

†DC Load Relays – Detailed Specs On Above Models – Application Help – Contact Factory

opto 22

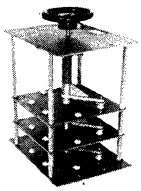
15461 Springdale Street, Huntington Beach, CA 92649 / (714) 891-5861 / Telex 692386

HIGH VOLTAGE DEVICES

RELAYS
SWITCHES
MEASUREMENT
CONTROL UNITS

AC
DC
RF
PULSE

208V to 900 KV
ENERGY STORAGE
ELECTRONIC AND POWER
SAFETY AND ACCESSORIES

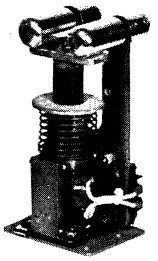


HV ROTARY SWITCHES

Ratings from 5 to 150KV, 1 to 200 amps. Either manual or electrical operators, depending upon requirements. Position detents and interlocks to prevent opening under load.

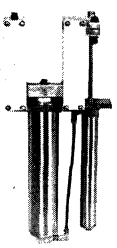
HIGH CURRENT SWITCHES

Models are available up to 20,000 amps continuous, and over 500,000 amps pulse, with voltage ratings of 6 volts to 300 KV peak test. Many are air cylinder or motor operated for high contact force.



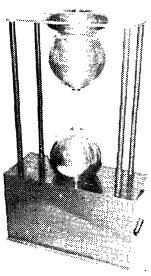
HV RELAYS

HV relays of the air insulated type both for low and high current. This series has ratings from 1 to 200 amps continuous, 100 to 100,000 amps momentary and capacitor discharge. Peak test voltages from 5 to 300KV. Single or Multipole. NO, NC, and DT. Auxiliary contacts optional on all types. Extended life and tungsten contacts also available for high current closing. Usable in oil.



HV-RF SWITCHES

For RF applications, low loss G-7 Silicone glass insulation and non-magnetic materials are used. Switches available up to 50 MHz. 1 to 50 KV, 1 to 800 amps. Air or hydraulic, and spring actuated.

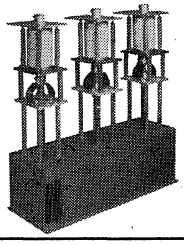


HV GROUNDING RELAYS

Extra high voltage low corona grounding relays of the air insulated type. Ratings up to 600 KV peak at 100 amps continuous. Solenoid, motor or air cylinder operated and spring or gravity return.

HIGH SPEED VACUUM CONTACTORS CIRCUIT BREAKERS

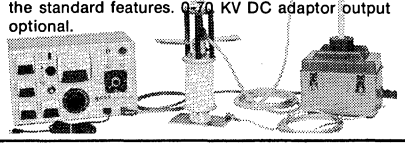
(One Cycle)



Vacuum switches, single phase, three phase, upright or low profile, for high reliability sealed arc interrupting or crobar shorting. 208V to 200 KV RMS operate. 50 to 4,000 amps continuous, 2,000 to 35,000 amps AC, 10 to 20,000 amps DC interrupt, 5,000 to 100,000 amps momentary and capacitor discharge.

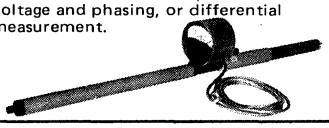
Hi-Pot TEST SETS
0-50 KV RMS, 0-50 KV DC

Specifically designed for testing HV Vacuum Devices as well as HV equipment and insulation. A built-in X-Radiation Monitor, Audible and Visible Breakdown Indicator, Breakdown Counter, and a 0-50 KV RMS Voltage Adjustment with large scale meter are among the standard features. 0-70 KV DC adaptor output optional.

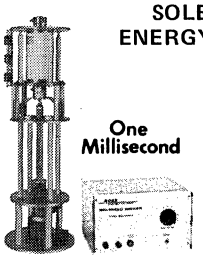


Hi-Z T.M. HV VOLTMETERS
SAFE POWER LINE USE AC - DC

Fully safe portable, all solid state, 2% to 5% accuracy. Taut band shielded high voltage measurement with minimum circuit loading. 0.0001 V to 50 KV AC and DC. Ideal for use with Elbow capacitance tap voltage test points. For cable test point or direct line voltage and phasing, or differential measurement.

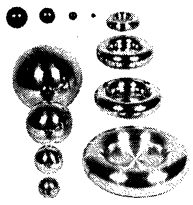


SOLENOID DRIVERS
ENERGY STORAGE UNITS



For high speed or loss of power automatic circuit breaker trip and for high speed activation of contactor or circuit breaker solenoids. Energy storage up to 400 joules or more at 150 to 700 volts or more, 100 to 4,000 microfarad or more. Instantaneous SCR control available.

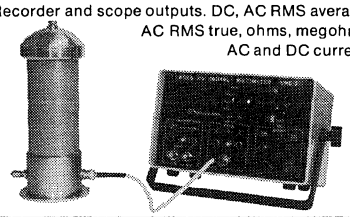
TOROIDS, SPHERES, CORONA SHIELDS



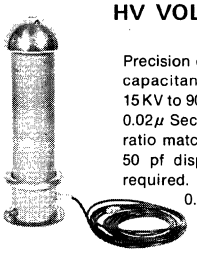
Geometrically designed to avoid excessive voltage gradients at connecting points and other areas needing shielding or balancing of electrostatic fields to increase withstand voltage and minimize corona. Diameters are to international standard metric sizes.

HV DIGITAL MULTIMETERS

Easy to read, 4½-digit display; 0.05% basic accuracy. 0.0001 volt to 900 KV. Battery/AC with charger. Recorder and scope outputs. DC, AC RMS average, AC RMS true, ohms, megohms, AC and DC current.

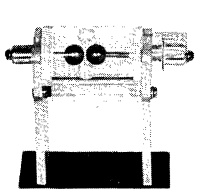


WIDE BAND HV VOLTAGE DIVIDERS



Precision compensated resistance-capacitance voltage dividers for 15KV to 900KV, DC to 10MHz or to 0.02μ Sec rise time pulse. 1,000/1 ratio matched to 1 megohm, 20 to 50 pf display or recorder, or as required. Accuracy and stability 0.1% to 3%.

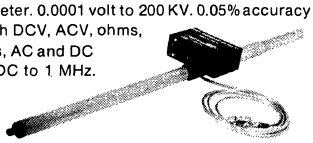
HV ADJUSTABLE SPARK GAPS



N'on-melting carbon spheres, 1 cm to 10 cm and heavy wall aluminum spheres, 10 cm and above. Dust tight transparent covers used 1 KV to 88 KV. Open style to 670 KV. Direct reading micrometer type calibrating device.

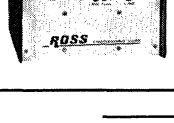
HV DIGITAL PROBES

HV DC, AC, & Wideband DC-1 MHz Safety Probes for any digital display or VTVM. Also available complete with large 4½-digit display 0.1% to 5% AC/DC accuracy, safety handle digital voltmeter. Battery/AC with charger. Removable Digital Display or Multimeter. 0.0001 volt to 200 KV. 0.05% accuracy basic, with DCV, ACV, ohms, megohms, AC and DC current. DC to 1 MHz.



WIDE BAND MATCHING AMPLIFIERS

NEW! Fiber Optics Transmission



AC or rechargable battery/AC operated. DC to 1 MHz. 1 megohm or higher input to 50 ohm load. Cable driver has a maximum output to 10V PK (20V PK to PK) and maximum input of 10V to 1,000V PK direct from signal source. With Ross wide band HV dividers useful from 0.1V to over 900KV.

ROSS ENGINEERING CORP.

559 WESTCHESTER DRIVE CAMPBELL, CALIF. 95008 PHONE (408) 377-4621 24 HR. (408) 253-1572

WRITE FOR CATALOG

New STANDEX HI-REL

Precedent Setting Proprietary Process* Achieves New Long Life Standards for Reed Switches

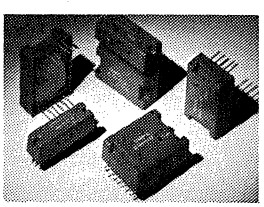
*Patent Pending

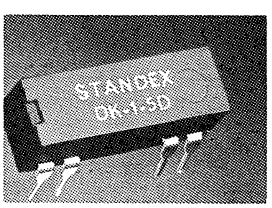
Now another major advance for Standex Electronics, the country's fastest growing manufacturer of reed switches and relays. A new reed switch has been developed for the High-Rel and ATE Reed Market. This switch features Stable Contact Resistance over life, with low dynamic noise and virtually no contact bounce. **The problem-solving switch the Automatic Test Equipment industry has been waiting for—a premium product at competitive prices.**

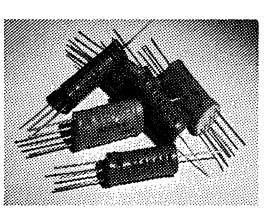
A new Standex proprietary process sets this model apart from other switches. And since we are a leading manufacturer of reed relays, we are prepared to package it for any user to specification.

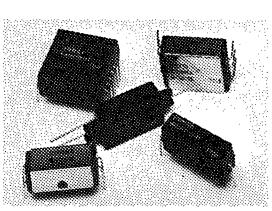
As with the complete Standex line, the new hi-rel switch features exceedingly robust glass-to-wire seals to minimize cracking or breaking at assembly, molding or testing stages of the user's product. Patented fully automatic production, testing, grading and sorting to your specifications ensure consistent performance and long life.

ATE manufacturers—call or write us for further information and test results from an independent testing laboratory. Let Standex start helping with your switching problems today.









Standex Electronics

4538 Camberwell Road, Cincinnati, OH • (513) 871-3777 Morley Road, Tonbridge, Kent, England • (732) 358398

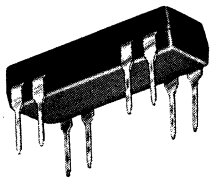
Manufacturers of Paul Smith Coils and Chokes, Underwood Mica Capacitors and Van Products Connectors. Multiple plants in U.S. and Mexico. Other plants in England and Haiti.

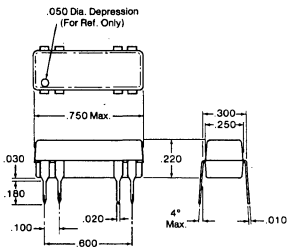
a Standex company

wabash Dept. EM, First and Webster Streets / Wabash, Indiana 46992 / (219) 563-2191 / TWX 810-290-2722

WABASH RELAY & ELECTRONICS DIVISION The Reed Relay Specialist

DIP PACKAGE DRY REED RELAYS
814 SERIES





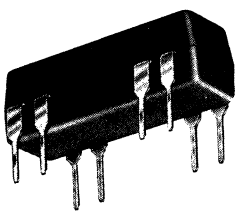
The 814 Series offers dry reed reliability and total isolation in a low profile IC type package, with DTL/TTL compatible coil drive available in most configurations.

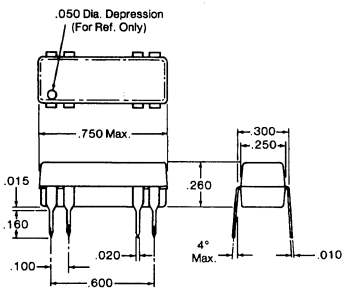
SPECIFICATIONS — Contact Rating: 28 VDC or 0.110 Amps (switching); 3 watts; 200 milliohms max. initial contact resistance; 200 Volt pk. bkdn. **Temperature:** −55°C to +105°C. **Shock:** 100G max., 8 ±1 mSec. ½ wave. **Vibration:** 20G @ 10-5000 Hz. **Insulation Resistance:** 10^{10} Ohms min. **Capacitance:** 0.2 pf. **Operate Time (Typical):** to 0.5 mSec. **Release Time (Typical):** 0.1 mSec. **Life Expectancy:** 50 x 10^6 operations at signal level; 1 x 10^6 operations at rated load.

Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	16	365	814-101-01
	5	19	500	814-102-01
	6	19	500	814-103-01
	12/15	24	800	814-104-01
	24	30	1250	814-105-01

▲ Measured at 25°C.

815 SERIES

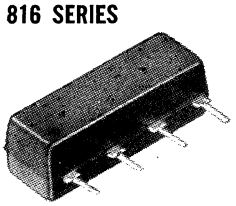


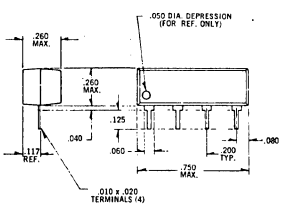


The 815 Series, with a profile slightly higher than the 814, offers increased versatility while maintaining the DIP package approach to hi-density printed circuit applications. Standard part numbers listed are subject to specifications shown for the 814 Series, however, the 815 has the capacity to offer dry reed switches to ½ Amp rating plus up to a 200 VDC max. switching voltage. Optional features include diode suppression, magnetic shielding and electrostatic shielding.

Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	14	200	815-101-01
	5/6	19	500	815-102-01
	12/15	19	500	815-103-01
	24	40	2150	815-104-01
2A	5/6	14	200	815-201-01
	12/15	19	500	815-202-01
	24	38	2000	815-203-01
1B	5/6	7	200	815-221-01
	12/15	16	500	815-222-01
	24	32	2000	815-223-01
1C	5/6	8	80	815-241-01
	12/15	19	500	815-242-01
	24	38	2000	815-243-01

816 SERIES

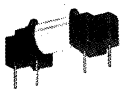


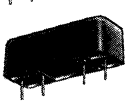


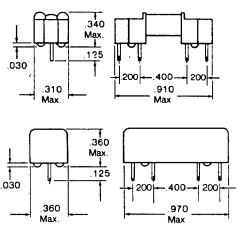
The 816 Series SIP (Single-Inline Package) provides the power handling capabilities of the 815 DIP while taking up less printed circuit board space. Standard part numbers listed are subject to specifications shown for the 814 Series; however, the 816 has the capacity to offer dry reed switches with ratings to 0.5 amps and 200 VDC. Optional features include diode suppression and magnetic shielding.

Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A SPST NO	5/6	14	200	816-101
	5/6	19	500	816-102
	12/15	19	500	816-103
	24	40	2150	816-104
1B SPST NC	5/6	7	200	816-221
	12/15	16	500	816-222
	24	32	2000	816-223

802/803 SERIES



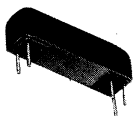


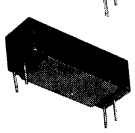


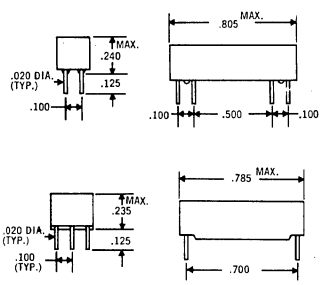
The 802 and 803 are sub-miniature reed relays in a Single-Inline package. They are both available in a 1 Form A configuration and are P.C. mountable. Contact ratings of 200 volts DC with total power handling of 10 watts is standard.

Contact Form	Nominal Voltage	Coil Resistance ±10%▲	Part Number
1A	5/6	500	802-101
	12/15	500	802-102
	24	2000	802-103
	5/6	125	802-104
Enclosed 1A	5/6	500	803-101
	12/15	500	803-102
	24	2000	803-103
	5/6	125	803-104

SUB-MINIATURE RR
804/806 SERIES





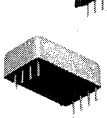


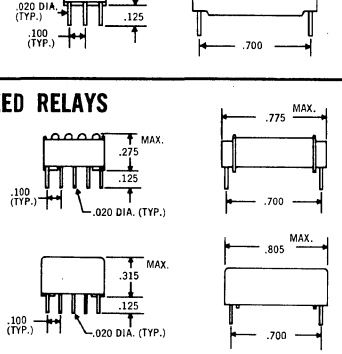
The 804 and 806 sub-miniature reed relays come in a 1 Form A configuration. Both relays are P.C. mountable and are completely enclosed for environmental protection, extended life and easy cleaning. Call Wabash Relay & Electronics for complete details.

SPECIFICATIONS — Contact Ratings: (max.) 200 VDC, 0.5 Amp (switching), 1.0 Amp (carry), 10 Watts DC, 15 V-A (AC suppressed), 250 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 30 G max., 11 ±1 mSec. **Vibration:** 10 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^{10} ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 100 x 10^6 operations at dry ckt.; 50 x 10^6 operations at signal levels; 20 x 10^6 operations at rated load.

Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	8	60	804-101
	12/15	18	370	804-102
	24	27	950	804-103
1A	5/6	12	500	806-101
	12/15	24	1200	806-102
	24	38	2000	806-103

SUB-MINIATURE DRY REED RELAYS
807/808 SERIES





Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number	Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1B†	5/6	8	200	807/808-211	1A	5/6	13	350	807/808-101
	12/15	16	800	807/808-212		12/15	24	1200	807/808-102
	24	32	2000	807/808-213		24	39	3200	807/808-103
1C† *	5/6	8	125	807/808-316	2A	5/6	10	200	807/808-201
	12/15	16	500	807/808-317		12/15	20	800	807/808-202
	24	32	2000	807/808-318		24	32	2000	807/808-203

* (1A1B guarantee break-before-make)

Contact Forms Available: 1, 2, 3 Pole. Forms A, B, & C.

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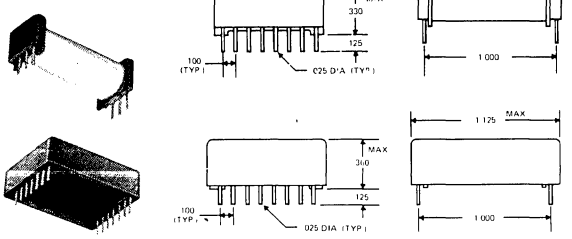
WABASH RELAY & ELECTRONICS DIVISION The Reed Relay Specialist

MINIATURE DRY REED RELAYS 827/828 SERIES



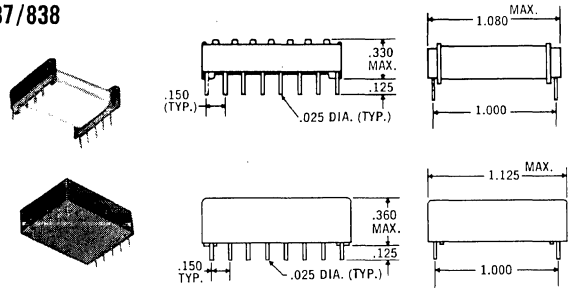
Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number	Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	22	500	827/828-101	1B†	5/6	8	200	827/828-211
	12/15	28	800	827/828-102		12/15	16	800	827/828-212
	24	44	2000	827/828-103		24	32	2000	827/828-213
2A	5/6	14	200	827/828-201	1C†	5/6	8	60	827/828-316
	12/15	29	800	827/828-202		12/15	16	240	827/828-317
	24	46	2000	827/828-203		*	24	32	960	827/828-318

* (1A1B guarantee break-before-make)

Contact Forms Available: 1, 2, 3, 4, & 6 Poles. Forms A, B, & C including magnetic latchers.

SPECIFICATIONS — Contact Ratings: (max.) 200 VDC, 150 VAC, 0.5 Amp (switching), 3 Amp (Carry), 10 Watts DC, 25 V-A (AC suppressed), 300 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 30 G max., 11 ±1 mSec. **Vibration:** 10 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 100 x 10^6 ops @ dry ckt.; 50 x 10^6 ops @ signal levels; 20 x 10^6 ops @ rated load.

MINIATURE DRY REED RELAYS 837/838



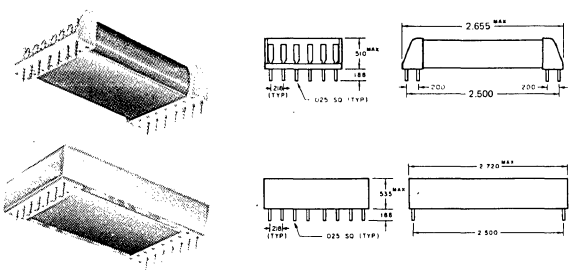
Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number	Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	22	500	837/838-101	1B†	5/6	8	200	837/838-211
	12/15	28	800	837/838-102		12/15	16	800	837/838-212
	24	44	2000	837/838-103		24	32	2000	837/838-213
2A	5/6	14	200	837/838-201	1C†	5/6	8	60	837/838-342
	12/15	29	800	837/838-202		12/15	16	240	837/838-343
	24	46	2000	837/838-203		*	24	32	960	837/838-344

* (1A1B guarantee break-before-make)

Contact Forms Available: 1, 2, 3, 4, & 6 Pole. Forms A, B, & C including magnetic latchers.

SPECIFICATIONS — Contact Ratings: (max.) 200 VDC, 150 VAC, 0.5 Amp (switching), 3 Amp (carry), 10 Watts DC, 25 V-A (AC suppressed), 300 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 30 G max., 11 ±1 mSec. **Vibration:** 10 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 100 x 10^6 ops @ dry ckt.; 50 x 10^6 ops @ signal levels; 20 x 10^6 ops @ rated load.

STANDARD REED RELAYS 842/843 SERIES



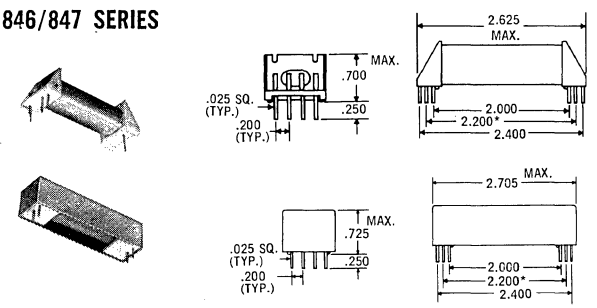
Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number	Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	22	150	842/843-101	1B†	5/6	9	100	842/843-209
	12/15	45	600	842/843-102		12/15	18	400	842/843-211
	24	90	2400	842/843-103		24	36	1600	842/843-213
	48	175	9000	842/843-104		48	72	6400	842/843-215
2A	5/6	20	100	842/843-201	1C†	6	9	100	842/843-311
	12/15	41	400	842/843-202		12	18	400	842/843-315
	24	82	1600	842/843-203		*	24	36	1600	842/843-319
	48	165	6400	842/843-204			48	72	6400	842/843-323

* (1A1B guarantee break-before-make)

Contact Forms Available: 1, 2, 3, 4, 5, 6, 8, & 12 Pole. Forms A, B, & C including magnetic latchers.

SPECIFICATIONS — Contact Ratings: 400 VDC, 250 VAC, 1.5 Amp (switching) 6 Amp (carry), 25 Watts, 40 V-A (AC suppressed) 50 milliohm max. initial contact resistance 500 volts peak breakdown. **Temperature:** −55°C to +105°C. **Shock:** 30 G max., 11 ±1 mSec. **Vibration:** 10 G max.@ 0-1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 1.5 pf. **Life Expectancy:** Dry ckt., 100 x 10^6 ops; signal level, 50 x 10^6 ops; rated power, 20 x 10^6 ops.
Available to 12 form A. True form C also available.

846/847 SERIES



Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number	Contact Form	Nom. Voltage	Max. Voltage	Coil Resist. ±10%▲	Part Number
1A	5/6	22	150	846/847-101	1B†	5/6	9	100	846/847-209
	12/15	45	600	846/847-102		12/15	18	400	846/847-211
	24	90	2400	846/847-103		24	36	1600	846/847-213
2A	5/6	20	100	846/847-201					
	12/15	41	400	846/847-202					
	24	82	1600	846/847-203					

Contact Forms Available: 1 & 2 Pole. Forms A, B, & C including magnetic latchers.

SPECIFICATIONS — Contact Ratings: 400 VDC, 250 VAC, 1.5 Amp (switching) 6 Amp (carry), 25 Watts, 40 V-A (AC suppressed) 75 milliohm max. initial contact resistance 500 volts peak breakdown. **Temperature:** −55°C to +105°C. **Shock:** 30 G max., 11 ±1 mSec. **Vibration:** 10 G max. @ 0-1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 1.5 pf. **Life Expectancy:** Dry ckt., 100 x 10^6 ops; signal level, 50 x 10^6 ops; rated power, 20 x 10^6 ops.
True form C also available.

* Spacing not available in 1 pole package.

The relays shown here are just a sampling of the many designs and configurations manufactured by Wabash Relay & Electronics as standard products. We also offer design assistance and custom designed relays through our fully staffed engineering department. Should you require a custom designed relay, here are some parameters to consider:

U.L. and C.S.A. Recognition

Several relay series are recognized under the Component Program of Underwriters' Laboratories. Most of these relays also have C.S.A. recognition. Regardless of which series you are interested in, Wabash Relay can help you obtain the U.L. or C.S.A. recognition your design requires.

Wabash Relay & Electronics Division
1st & Weber Streets, Wabash, Indiana 46992
(219) 563-2191 TWX: 810-290-2722

Prints and specifications, if available, are the best design tool. The minimum information required for Wabash Relay to design a relay is:

Mechanical Specifications

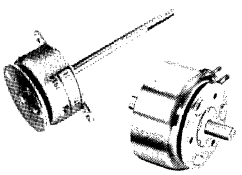
- Maximum length
- Maximum width
- Maximum height above P.C. board
- Pin configuration
- Open or covered
- Type of environment relay will be exposed to
- End Use

Electrical Specifications

- Switch configuration
- Nominal voltage
- Must operate voltage or current
- Must release voltage or current
- Coil resistance
- Switching current
- Contact resistance
- Carry current
- U.L. recognition required
- Special considerations (ESS, low thermal, high insulation resistance, etc.)

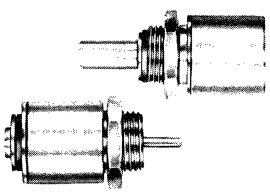
LEDEX® Solenoids

Over 300 choices of standard solenoid designs are available off-the-shelf from Ledex. But, if none of these meet your unique requirements, we'll provide you with custom engineered prototypes. Either way, Ledex offers you the widest variety of solenoids for your design.

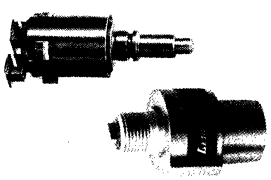


Rotary Solenoids
Step-turn-index-lock-punch-lift. For millisecond fast torque and endurance, specify a Ledex rotary solenoid.

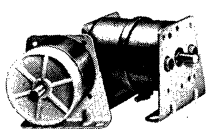
Eight basic sizes, right or lefthand strokes from 10 to 110 degrees. Torque output to 117 pound-inches. Life of over 100 million cycles with endurance engineered models.



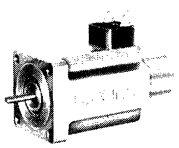
Linear Solenoids
Short-medium-long strokes are all available from one source—Ledex. Choose our low profile flat face push/pull for high force/short stroke; our low profile conical face push/pull for medium force/stroke and our tubular solenoids for long strokes. Rugged construction provides accurate repeatability after long usage. Our tubular solenoids have built-in impact cushions to absorb energy at the end of the stroke and electroless nickel plated plungers for longer life.



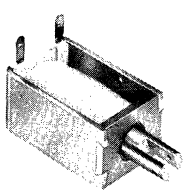
Custom Designed Solenoids
The Ledex Model 515 Dot Matrix solenoid has a special patented construction to control bounce, is easy to mount, uses standard terminals, operates at 1300 Hz., and has a life of 300 million actuations. Our printhammer solenoid was specially designed for quiet actuation to interface with plastic or metal daisy wheels while delivering variable force depending on the character.



Stepping Solenoids
Step 10-15-20 or 30 degrees with the highest torque a stepping solenoid makes – the Ledex Series 50-L. Square wave pulse drives either the unidirectional or bidirectional model for 10,000,000 steps with a non-accumulative accuracy of ±1°. Direct couple for mechanical ease and avoid linkages. Can be manually overridden in case of power failure.



Proportional Solenoids
Open loop/closed loop, variable position sensing is now possible by using the Ledex proportional solenoid with the Ledex controller for smooth, accurate response. Hydraulic systems can use our wet plunger type which requires no dynamic seals and provides up to 50 pounds force. Do away with pilot stages and expensive servo valves.



D-Frame Solenoids
Ledex D-Frame solenoids offer economical, long term service for users whose needs must be matched by a dependable product and reliable source. Eight standard models are available from stock with strokes up to 1.25". Quick connect terminals and class "B" coils are standard.

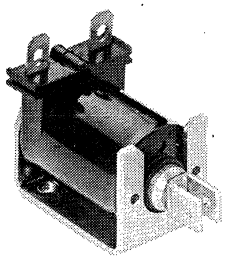
LEDEX INC., P.O. Box 427 • Vandalia, Ohio 45377 • USA

Call 513-898-3621

Manufacturer	Page No.	Model/Series	Linear				Rotary	Proportional (Servo)	Stepping		Valve
			Frame			Tubular			Unidirectional	Bidirectional	
			C	D	ME (DC Only)						
Deltrol	1•1884	C-6	●								
		C-7	●								
		D-11		●							
		D-28		●							
	1•1885	D-2		●							
		D-3HD		●							
		D-4		●							
		D-4HD		●							
Electro-Mechanisms	1•1886	SP	●								
		PO	●								
	1•1887	SP-100		●							
		PO-100		●							
		SP-375	●								
		SP-650	●								
		SP-750	●								
		PO-375	●								
		PO-650	●								
		PO-750	●								
ITT Controls	1•1888	All									●
Ledex	1•1892	50					●		●	●	
		IE-8S					●		●		
	1•1893	50-150				●					
Liberty Controls	1•1894	L-9	●								
		L-11		●							
		L-22		●							
		L-24	●								
	1•1895	L-25	●								
		L-26	●								
		L-28		●							
		L-61	●								
	1•1894	L-62	●								
		L-63	●								
		L-81		●							
		L-82		●							
	1•1895	L-88		●							
		L-89		●							
		L-90		●							
Regdon	1•1897	312		●							
		5U5	●								
		5U7	●								
		809		●							
		827		●							
		930		●							
		940		●							
		960		●							
		970		●							
		RX				●					

* Indicates MIL type

DELTROL SOLENOIDS



L = 1-1/8
W = 55/64
H = 1-17/64
.187 QUICK CONNECT/
SOLDER TERMINALS

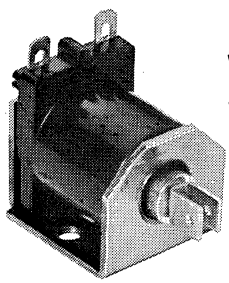
NOTE: Standard intermittent duty cycle at nominal voltage is one (1) minute on and three (3) minutes off.

C-6 PULL TYPE

Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53685-83	24VDC	Cont.	124	4.7W
53686-83	24VDC	Int.	50.8	12W
53687-94	120VAC	Cont.	776	6.8VA
53688-94	120VAC	Int.	327	19.6VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4
DC Cont.	7	3	2	1-1/2
DC Int.	15	8	5	3-1/2
AC Cont.	10	7	5	4
AC Int.	21	13	11	8



L = 1-9/64
W = 1-1/16
H = 1-13/32
.187 QUICK CONNECT/
SOLDER TERMINALS

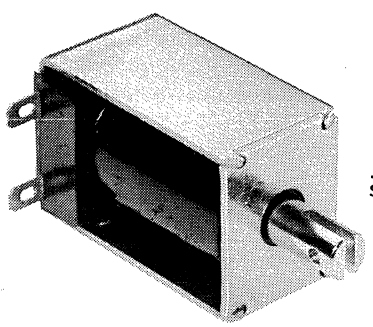
NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

C-7 PULL TYPE

Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53634-83	24VDC	Cont.	118	5W
53635-83	24VDC	Int.	.5	11.5W
53637-94	120VAC	Cont.	509	7.8VA
53638-94	120VAC	Int.	220	21VA

STROKE (INCHES) FORCE (OUNCES

	1/16	1/8	3/16	1/4
DC Cont.	19	8	5	3
DC Int.	28	12	8	5
AC Cont.	17	12	10	8
AC Int.	30	22	19	17



L = 1-27/32
W = 15/16
H = 1-3/16
.187 QUICK CONNECT/
SOLDER TERMINALS

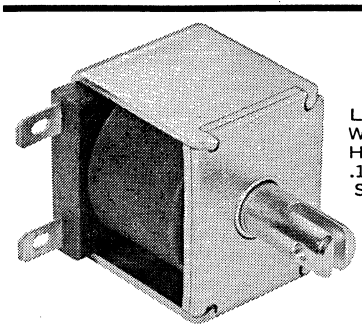
NOTE; Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

D-11 PULL TYPE

Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53736-81	12VDC	Cont.	18	8W
53736-82	24VDC	Cont.	72	8W
53736-87	12VDC	Int.	8	18W
53736-88	24VDC	Int.	32	18W
53738-84	120VAC	Cont.	200	12VA
53738-90	120VAC	Int.	85	42VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4	1/2	3/4
DC Cont.	38	28	16	11	4	3
DC Int.	55	40	24	22	10	6
AC Cont.	14	12	9	8	7	6
AC Int.	45	25	20	18	15	14



L = 1-1/4
W = 1
H = 1-7/32
.187 QUICK CONNECT/
SOLDER TERMINALS

NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

D-28 PULL TYPE

Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53708-81	12VDC	Cont.	27.1	5.5W
53708-82	24VDC	Cont.	108	5.5W
53708-87	12VDC	Int.	12.7	11.5W
53708-88	24VDC	Int.	51	11.5W
53706-84	120VAC	Cont.	420	8VA
53706-90	120VAC	Int.	220	21VA

STROKE (INCHES) FORCE (OUNCES)

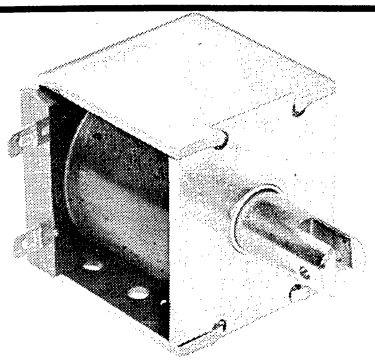
	1/16	1/8	3/16	1/4	1/2
DC Cont.	20	10	6	4	2
DC Int.	35	19	12	8	3
AC Cont.	16	12	10	8	4
AC Int.	29	20	17	14	6

ALL DIMENSIONS ARE NOMINAL.

DELTROL controls / DC DIVISION OF DELTROL CORP
2745 S. 19th Street, Milwaukee, Wisconsin 53215 Phone (414) 671-6800, Telex 2-6871

DELTROL SOLENOIDS

D-2 PULL TYPE



L = 1-9/16
W = 1-7/16
H = 1-5/8

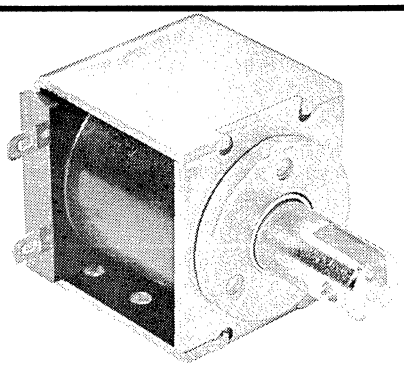
Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53728-81	12VDC	Cont.	13.6	10.5W
53728-82	24VDC	Cont.	54.7	10.5W
53728-87	12VDC	Int.	4.92	29W
53728-88	24VDC	Int.	20.0	29W
53729-84	120VAC	Cont.	139	13VA
53729-90	120VAC	Int.	47.0	44VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4	1/2	3/4
DC Cont.	84	50	34	23	8	4
DC Int.	122	97	74	56	21	9
AC Cont.	27	20	17	16	14	5
AC Int.	69	56	50	45	36	15

NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

D-3HD PULL TYPE



L = 1-3/4
W = 1-7/16
H = 1-5/8

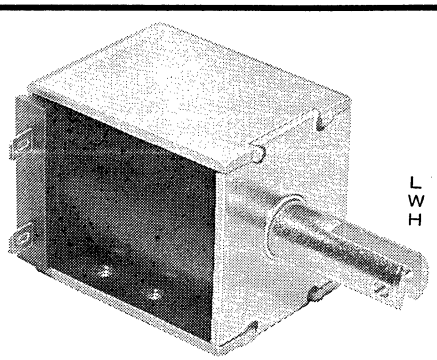
Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53732-81	12VDC	Cont.	12.8	11.2W
53732-82	24VDC	Cont.	51.5	11.2W
53732-87	12VDC	Int.	5.3	27W
53732-88	24VDC	Int.	21.4	27W
53733-84	120VAC	Cont.	109	20VA
53733-90	120VAC	Int.	27	115VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4	1/2	3/4
DC Cont.	110	72	45	31	10	4
DC Int.	150	124	96	72	25	10
AC Cont.	35	26	23	22	21	13
AC Int.	112	88	80	78	68	40

NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

D-4 PULL TYPE



L = 2
W = 1-7/16
H = 1-5/8

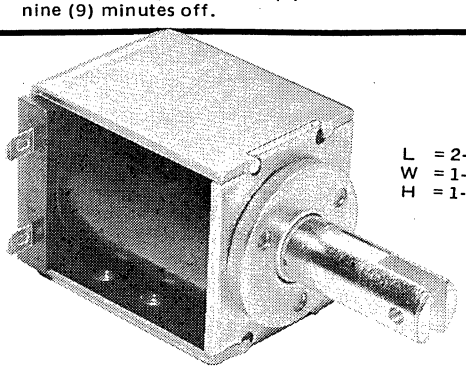
Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53717-81	12VDC	Cont.	12.3	11.5W
53717-82	24VDC	Cont.	50.4	11.5W
53717-87	12VDC	Int.	3.0	47.6W
53717-88	24VDC	Int.	12.3	47.6W
53718-84	120VAC	Cont.	133	11.5VA
53718-90	120VAC	Int.	37	60VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4	1/2	3/4
DC Cont.	94	66	46	34	14	7
DC Int.	142	122	106	92	52	30
AC Cont.	12	10	9	9	10	13
AC Int.	44	38	34	32	38	46

NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

D-4HD PULL TYPE



L = 2-3/16
W = 1-7/16
H = 1-5/8

Stock No.	Volts/ Type	Duty	Coil Resist. (Ohms)	Coil Power
53719-81	12VDC	Cont.	12.1	11.7W
53719-82	24VDC	Cont.	49.2	11.7W
53719-87	12VDC	Int.	3.8	38W
53719-88	24VDC	Int.	15.2	38W
53720-84	120VAC	Cont.	72.4	32VA
53720-90	120VAC	Int.	19.1	170VA

STROKE (INCHES) FORCE (OUNCES)

	1/16	1/8	3/16	1/4	1/2	3/4
DC Cont.	116	85	60	42	16	8
DC Int.	160	136	114	98	46	26
AC Cont.	24	20	19	18	21	24
AC Int.	84	72	64	60	66	76

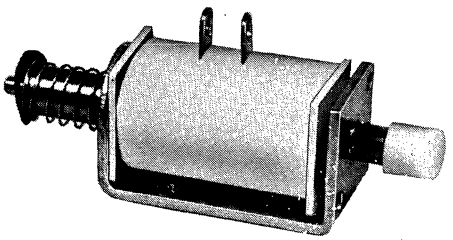
NOTE: Standard intermittent duty cycle at nominal voltage is three (3) minutes on and nine (9) minutes off.

ALL DIMENSIONS ARE NOMINAL.

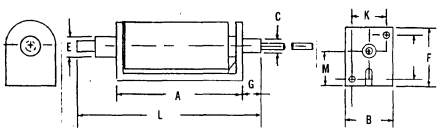
DELTROL controls DC DIVISION OF DELTROL CORP 2745 S. 19th Street, Milwaukee, Wisconsin 53215 Phone (414) 671-6800, Telex 2-6871

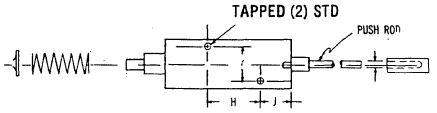
electro-mechanisms INCORPORATED
P.O. BOX A
AZUSA, CALIF. 91702
AREA CODE (213) 359-2535

MINI-SOLENOID ACTUATORS



SP SERIES PUSH TYPE





Frame: ..... C1006 Iron — Cad-II Plated
Core: ..... C1002 Electroless Nickel Plated
Plunger: ..... C1002 Electroless Nickel Plated
Wire: ..... 130°C Magnet Wire
Termination: ..... Heavy Leads — PVC, Type BU, 5″ Terminals — Solder Lugs
Tape: ..... Mylar
Bobbin: ..... 30% Glass Filled Nylon
Tip: ..... Delrin
Pushrod: ..... Phosphor Bronze
Tol: ..... .xxx ±.005

3, 6, 12, 24, 48 VDC

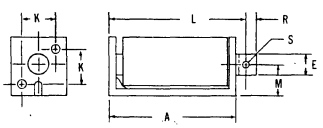
SPECIFICATIONS

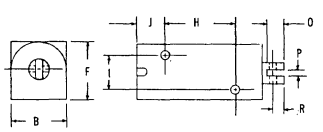
Note: Dimension L is shown with solenoid in energized position. Return Spring and Delrin Tip are Standard on all SP Series.

Part No.	A	B	C	D	E	F	G	H	I	J	K	L	M	S	Max. Stroke*	Weight Oz.	Tapped Holes	Wattage Nom.
SP-18	.403	.180	.062	.025	.068	.235	.085	3/16	3/32	1/8	*	.67	.145		3/16	.05	0-80	1.5
SP-25	.548	.236	.093	.036	.100	.298	.093	1/4	.136	1/8	*	.84	.180		1/4	.1	1-72	2
SP-37	.820	.360	.125	.051	.150	.430	.125	5/16	1/4	3/16	1/4	1.22	.250		3/8	.3	1-72	3
SP-50	.980	.488	.125	.051	.187	.530	.150	1/2	3/8	7/32	5/16	1.44	.285		1/2	.7	1-72	4.5
SP-62	1.215	.600	.187	.091	.250	.691	.178	5/8	7/16	1/4	7/16	1.732	.391		5/8	1.2	4-40	6
SP-75	1.621	.730	.240	.091	.306	.838	.172	5/8	7/16	1/4	1/2	2.15	.473		3/4	2.7	4-40	9

Standard Coils 105°C, Hi Temp Available. * Max Stroke, Standard Pushrod length.

PO SERIES PULL TYPE





Frame: ..... C1006 Iron — Cad-II Plated
Core: ..... C1002 Electroless Nickel Plated
Plunger: ..... C1002 Electroless Nickel Plated
Wire: ..... 130°C Magnet Wire
Termination: ..... Heavy Leads — PVC, Type BU, 5″ Terminals — Solder Lugs
Tape: ..... Mylar
Bobbin: ..... 30% Glass Filled Nylon
Tip: ..... Delrin
Pushrod: ..... Phosphor Bronze
Tol: ..... .xxx ±.005

SPECIFICATIONS

Note: Dimension L is shown with solenoid in energized position.

Part No.	A	B	E	F	H	I	J	K	L	M	O	P	R	S	Max. Stroke	Weight Oz.	Tapped Holes	Wattage Nom.
PO-25	.548	.236	.100	.298	1/4	.136	1/8	*	.734	.180	.100	.025	.062	.031	1/4	.1	1-72	2
PO-37	.820	.360	.150	.430	5/16	1/4	3/16	1/4	.892	.250	.150	.051	.075	.031	3/8	.3	1-72	3
PO-50	.980	.488	.187	.530	1/2	3/8	7/32	5/16	1.180	.285	.200	.063	.106	.063	1/2	.7	1-72	4.5
PO-62	1.215	.600	.250	.691	5/8	7/16	1/4	7/16	1.434	.391	.200	.063	.094	.063	5/8	1.2	4-40	6
PO-75	1.621	.730	.306	.838	5/8	7/16	1/4	1/2	1.891	.473	.200	.063	.094	.063	3/4	2.7	4-40	9

Standard Coils 105°C, Hi Temp Available.

SPECIALS

ELECTRO-MECHANISMS, INC., is completely equipped, both engineering and production wise, to supply you with variations of our solenoids that you might need for your application. We are also capable of designing special types that you might need within the size range of our products. We would appreciate the opportunity to help you solve design and application problems you may have in the area of miniature solenoid actuators.

The force charts below represent three different duty cycles.

Nominal voltage represents continuous duty.

2X Nominal voltage represents a 25%, intermittent duty cycle 4X Nominal voltage represents a 6% intermittent duty cycle.

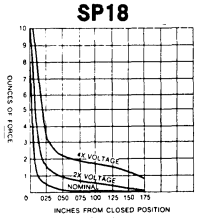
The duty cycle consists of two factors:

1. Percentage of time solenoid is energized in one complete operating cycle.

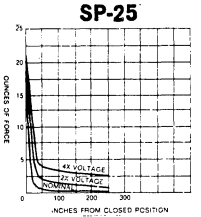
$$\text{(Ref: DUTY CYCLE} = \frac{\text{Time On}}{\text{Time On} + \text{Time Off}} \times 100\text{)}$$

2. Length of time of the longest single energization in one complete operating cycle.

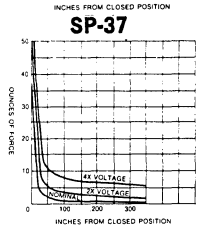
SP18



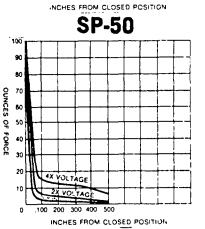
SP-25



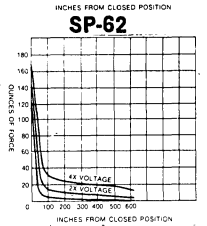
SP-37



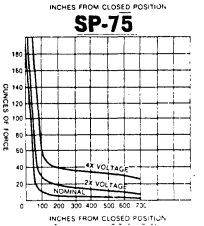
SP-50



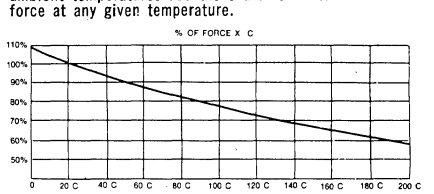
SP-62



SP-75



All forces shown are at 25° ambient. For use at higher ambient temperatures use the chart below to determine force at any given temperature.



FEATURES

ELECTRO-MECHANISMS micro-miniature solenoids offer you static and impact forces equal to standard solenoids 2 to 3 times the size of these units.

Because of their small size, they have extremely fast reaction time. As fast as 2 msec at 4x nominal voltage.

The unique design of PUSH or PULL action, offers many applications beyond the conventional pull type solenoid.

A complete line of 15 solenoids from 3/16″ O.D. to 1.250″ O.D. allows you to choose the correct solenoid with the force you require, from stock items.

The units are highly reliable with life of many millions of operations.

The solenoids are also available with coils in Class F and Class H for high temperature requirements.

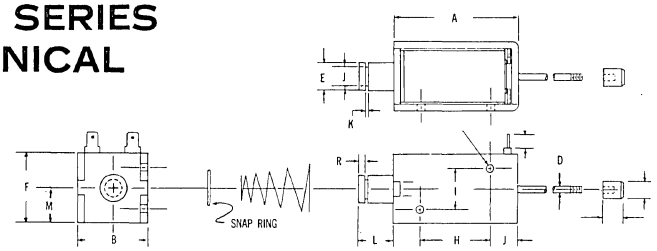
Simplicity of design helps keep the costs down and allows us to pass these savings on to you, our customer.

TYPICAL APPLICATIONS

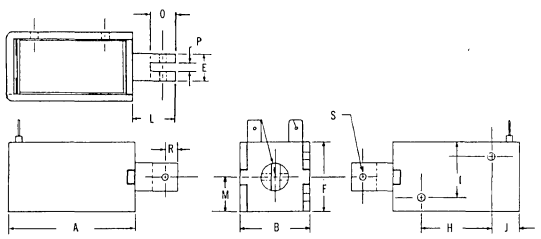
- Hammers for high speed printers
- Camera shutter actuators
- Locking mechanisms for switches, adding machines and typewriters
- Interposers for card punching and tape perforation
- Cam actuation
- Pen lifters for plotters
- Event markers for chart recorders
- Key actuators for numerical readouts on typewriters and adding machines
- For life testing different devices
- For indicator flags
- Sensing devices
- Remote switching and actuation

electro-mechanisms INCORPORATED
P.O. BOX A
AZUSA, CALIF. 91702
AREA CODE (213) 359-2535

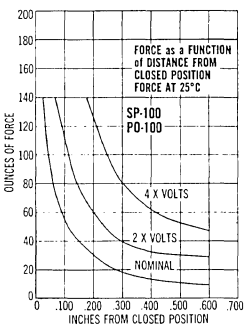
SP-100 SERIES
60° CONICAL



PO-100 SERIES
60° CONICAL



11.5 WATTS VDC
3, 6, 12, 24, 48, 110
60° CONICAL



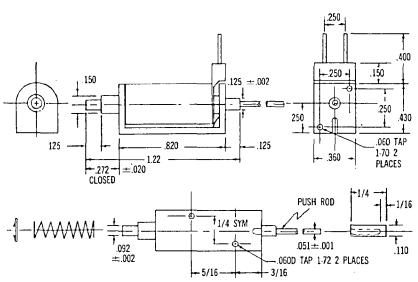
SPECIFICATIONS

Part No.	A	B	D	E	F	H	I	J	K	L	M	O	P	R	S	T	Height of Terms	Max. Stroke	Tapped Holes	Weight Oz.
SP-100	2.270	1.254	.092	.500	1.254	1.115	.750	.430	.040	.752	.627	*	*	.100	*	.343	.365	1	6-32	10
PO-100	2.270	1.254	*	.500	1.254	1.115	.750	.430	*	.700	.627	.375	.143	.168	.100	*	.365	1	6-32	10

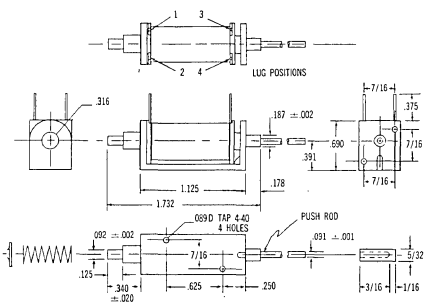
Standard Coils 130°C, Hi Temp Coils Available. * Not Applicable.

SOLENOIDS WITH MOLDED TERMINAL PINS

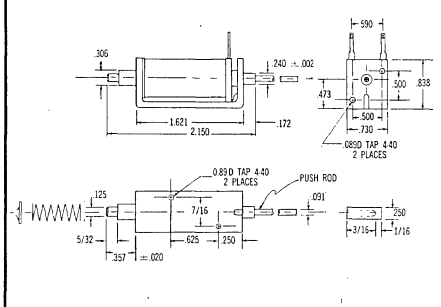
SERIES SP-375



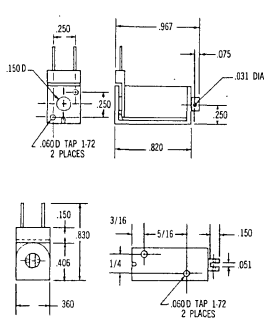
SERIES SP-650



SERIES SP-750



SERIES PO-375



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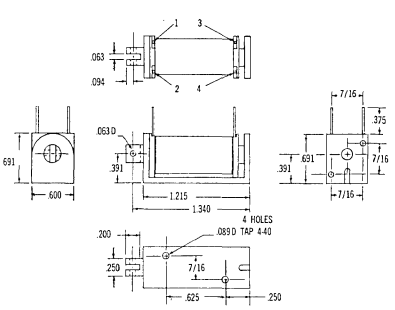
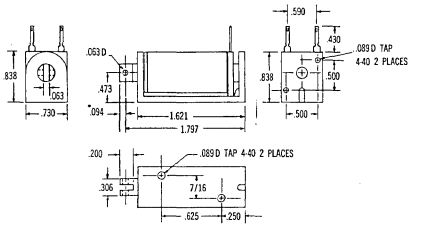
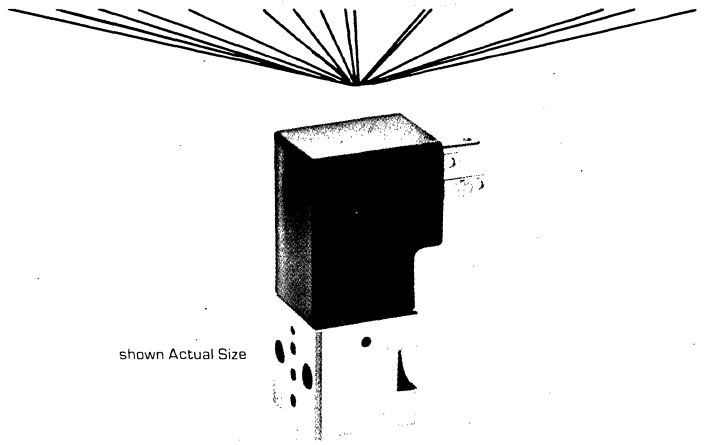


SERIES PO-750



MINIATURE SOLENOID VALVE



The **MICROSOL** miniaturized Solenoid Valve is particularly suitable for engineering applications requiring a low electrical power consumption, minimum space and weight and high pressure/flow rate characteristics.

The **MICROSOL** Valve consists of a solenoid and a rigidly fastened valve body. The solenoid includes a Class 155 (F) coil and its magnetic core is encapsulated with synthetic material. The magnetic circuit includes a magnetic housing and a fixed or a mobile magnetic core. The mobile magnetic core (plunger) has a return spring which operates the main sealing disc located in the valve body of the **MICROSOL** Solenoid Valve. The low inertia of the moving parts of the **MICROSOL** Solenoid Valve assures long life at a high cycling rate.

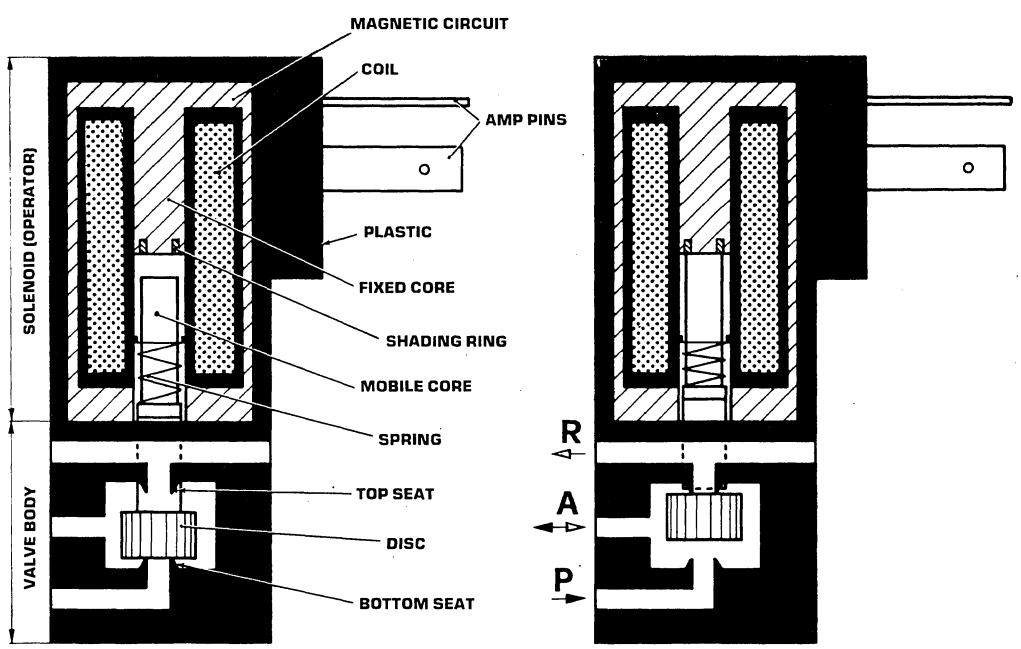
Available in 2-way or 3-way Normally Closed or Normally Open modes with various functional combinations. Used with air, inert gas, and liquids media. Pressures from vacuum to 150 PSI. Available in AC and DC voltages. Consult Factory for more specific information and other available options.

- Low Heat Generation
- Compact
- All Ports in Body Design—lends itself to manifolding
- Low Power Consumption
- Fast Response
- Easy Mounting
- Multipoised—May be mounted to operate in all positions
- Lightweight
- Large Exhaust
- Long Cycle Life
- Printed Circuit Board Mountable

GENERAL CONTROLS DIVISION ITT
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
801 Allen Ave., Glendale, California 91201

MICROSOL™ Solenoid Valve

Pilot Valve for 3-Way or 4-Way Valves
Dental Consoles—drill cooling, air blowers
Pick and Place Robots—direct actuation of small cylinders, suction pads
Control Cabinets of Complex Machines—condenser manufacturing, blister packaging, low melt packaging such as wax milk cartons
Keyboard Test Equipment—cylinder actuates keys
Adhesive Applicators
Textile Machines—especially knitting
Electronic Production Machinery—printed circuit board manufacturing
Low Pressure Hydraulic Controls—grinding machines, milling machine tables
Instrumentation—pneumatic panels
Household Automation—lighting, heating/cooling, irrigation
CO_2 Aquarium Supply
Animation—theme parks, window displays, trade-show exhibits
Ship Controls
Gas Mixing Equipment—Medical Instrumentation
Blood Pressure Machines
Actuation of Hydraulic Valves—machinery interlocks
EDM—electrode feed system
Powder Metallurgy—handling equipment
Microprocessor Controlled Systems
Mark Space Positioning (frequency shift modulation)



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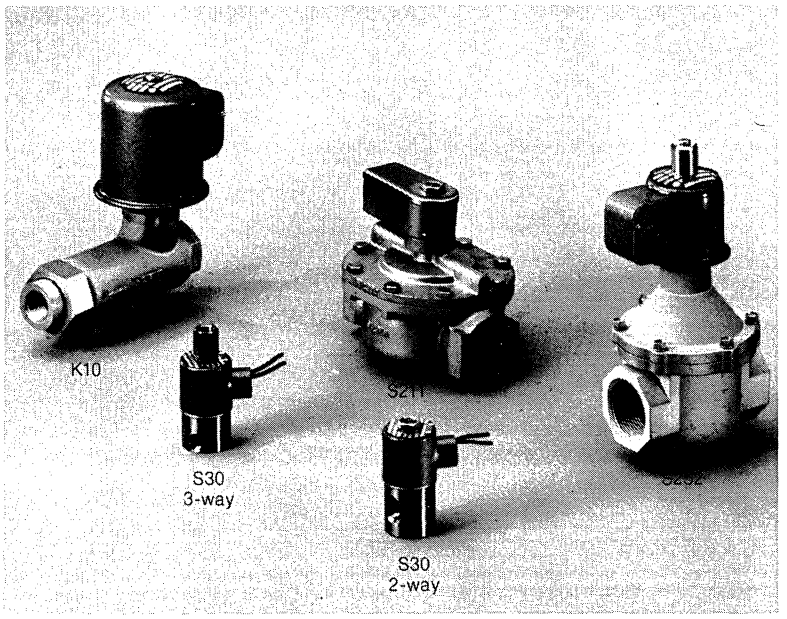
ITT GENERAL CONTROLS DIVISION

Solenoid Valves

A Better Valve at a Competitive Price



If you think all solenoid valves are the same, take a close look at ITT General Controls. Our solenoid valves offer you a combination of exclusive features you won't find anywhere else. Built better to last longer no matter what your application my require, our Solenoid Valves perform around the clock to give you the kind of operational security you have come to expect from ITT General Controls.

Engineered with Vision

ITT General Controls Solenoid Valves have been designed to bring you tomorrow's technology today, with 5 important features that set us apart from every other solenoid valve on the market:

- Superior coils — ITT General Controls has standardized on the highest quality UL listed, Class F, epoxy-molded coils for factory stocked catalog items. Class H coils also are available.
- Floating Main Seal — Our unique seal design assures tight shut-off every time by allowing the seal to position itself on the orifice and self-adjust for wear.
- Compensating Top Seal — All of our 3-way, direct acting solenoid valves feature a compensating top seal which can withstand wider temperature variations and is self-adjusting for extended cycle life.
- Simple Service — All ITT General Controls Solenoid Valves are engineered for easy installation and servicing. For example, our 2-way normally open S302 Valve features both pipe connections in the body. This important design benefit allows coil replacement without disconnecting any fluid lines, unlike other 2-way normally open solenoid valves which require shut down for coil change.

Built with Care

ITT General Controls Solenoid Valves are manufactured to the industry's most exacting quality standards — ours! For instance, our break-through holes are drilled by EDM — electrodata machining. This is a non-contact machining process that virtually eliminates metallic burrs which can contaminate flow passages, damage the valve, or even jam the piston. Longer life and protection against corrosion are assured by a chemical passification process which removes the smallest trace of residue. The result is a tougher and longer working trouble-free solenoid valve.

More Features at a Competitive Price

Our solenoid valves give you all of these exclusive standard features not always available in other solenoid valves. Plus, you can choose between low cost 2-way or 3-way valves in normally open, normally closed, universal, or directional flow configurations. There are also extensive choices for flow rates, media, pipe sizes, and valve body materials, as well as custom designs for your specific needs.

So before you specify solenoid valves, look closely — they're not all the same. For the best solenoid valve, the best price, the best service, and the best delivery, call ITT General Controls. Get the only solenoid valves that are... **Engineered with Vision — Built with Care.**

GENERAL CONTROLS DIVISION ITT **801 Allen Avenue, Glendale, CA 91201 (213) 842-6131**

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

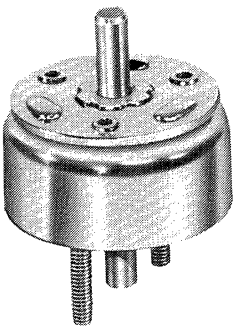
Y

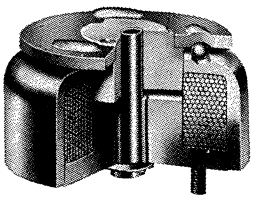
YIG yttrium iron garnet

LEDEX ROTARY SOLENOIDS

Ledex Rotary Solenoids step, turn, pull, push, index, hammer, punch or trigger—whenever there is a need for fast and dependable direct rotary action. No complicated linkages or circuitry required. They're simple, have superior shock and vibration resistance, high torque over the full stroke. 250 standard models in stock for prototype work, ship in 48 hours. 117 to .09 lb.-in. torque range. Right or left hand strokes available in a variety of degrees.

Write for our complete catalog.





Gross Torque in Pound-Inches by duty cycle for standard rotary strokes

Model	O.D.	Ht. in.	25° cont.	25° 1/20	35° cont.	35° 1/20	45° cont.	45° 1/20	67½° cont.	67½° 1/20	95° cont.	95° 1/20
1E	1	5/8	—	1.1			—	.62				
2E	1 1/8	21/32	.2	1.7	.15	1.3	.10	.89				
3B	1 5/16	7/8	.35	3.2	.25	2.3	.15	1.7	.09	.80		
3E	1 5/16	51/64	.35	3.2	.25	2.3	.15	1.8	.09	.89		
4E	1 5/16	61/64	.9	5.2	.6	3.5	.4	3.1	.2	1.9	.15	1.2
5B	1 7/8	1 13/64	1.8	10.0	.9	8.3	.7	6.0	.5	4.0	.19	1.9
5S	1 7/8	1 3/64	1.9	13.2	.9	9.2	.7	6.9	.5	4.9	.2	2.6
6S	2 1/4	1 27/64	4.6	30.6	3.4	20.5	1.7	12.1	1.6	9.7	.9	5.7
7B	2 3/4	2	9.0	35.5	5.0	32.0						
7S	2 3/4	1 55/64	11.0	46.6	6.0	42.0	5.0	32.8	2.5	19.3	1.5	11.6
8S	3 3/8	2 5/16	16.0	117.0	12.0	77.0	10.0	65.0	4.2	35.0	3.5	20.0

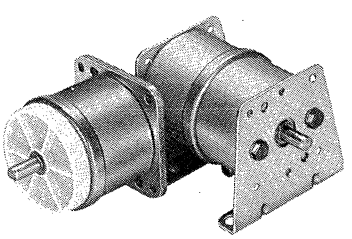
CUSTOM DESIGNS

Design application assistance, and custom design rotary solenoids are always available from Ledex.

A few examples include:

Special shaft extensions
Special shaft configurations
Subminiature rotary solenoids
Special armature plate contours
Special finishes
Special mountings
Special rotary strokes
Zero axial stroke models
Two coil solenoids

STEPPING SOLENOIDS—SERIES 50



Extended life stepping solenoids have a 10 million cycle minimum life on unidirectional models, and in each direction on bidirectional models. 12, 18, 24, and 36 position designs, accurate to ±1° nonaccumulative. High torque-to-size ratios, with breakaway torques to 246 ounce-inches. The exclusive tooth clutch drive yields greater usable torque output, and acts as a built-in electromechanical clutch brake for inertia loads. 64 stock models for quick prototype development.

Write for our complete catalog.

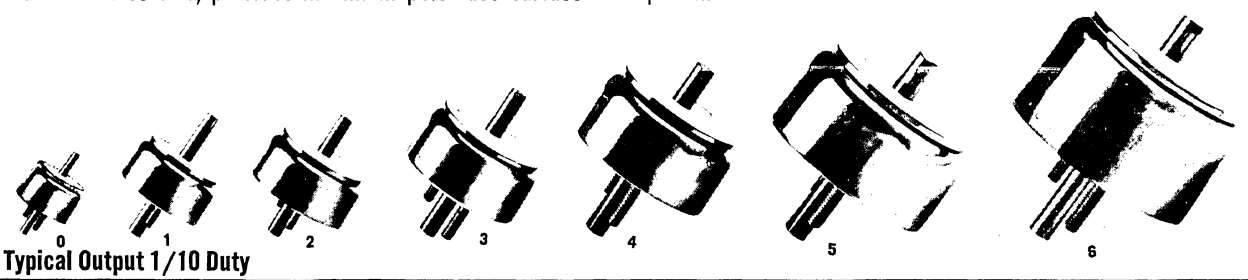
Summary Specifications	Unidirectional	Bidirectional
Voltage	6 to 220 VDC	6 to 220 VDC
High temperature	+85°C	+85°C
Low temperature	−40°C	−40°C
Length	1.9"	2.8"
Height	2¼" (sq. plate)	2¼"
Weight	14 oz.	24 oz.

LEDEX
P.O. Box 427
Vandalia, Ohio 45377 U.S.A.
Phone: 513-898-3621

PUSH & PULL SOLENOIDS

You name the job.
Short, medium or long stroke. High speed.
Tight space. Unusual load. Ledex has the solenoid for you, usually on the shelf. Expert design assistance for your toughest custom requirements.

Low-profile Ledex push/pull solenoids are built for high force to size and fast response. Better than 10ms response. Form factor minimizes size, provides maximum pole face surface for best efficiency. Two types available. Flat face is for short stroke, rapid response. Conical face gives more mid-range punch.

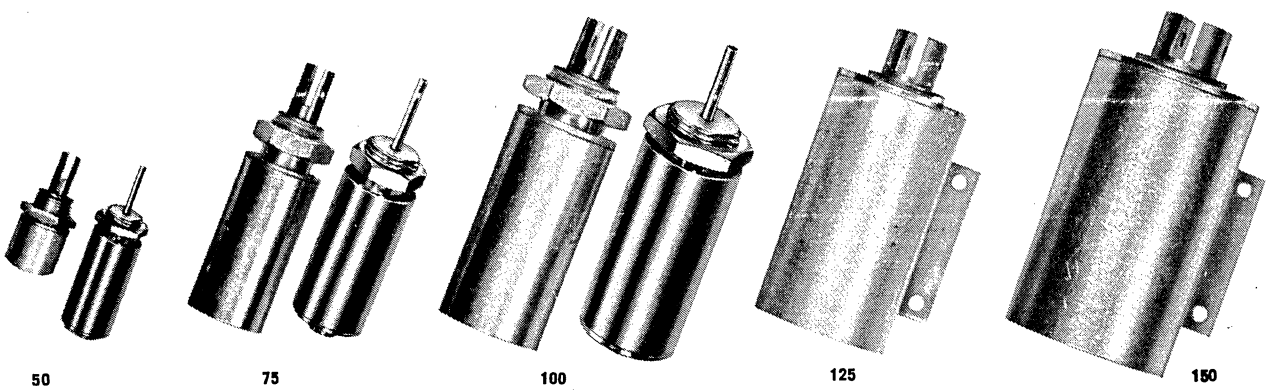


Typical Output 1/10 Duty

Model	0	1		2		3		4		5		6		7	8
Size	.75″D x ½″ Conical Face	1.0″D x 17/32″ Conical Face	Flat Face	1.125″D x 37/64″ Conical Face	Flat Face	1.312″D x 1 1/16″ Conical Face	Flat Face	1.562″D x 55/64″ Conical Face	Flat Face	1.875″ D x 1 1/16″ Conical Face	Flat Face	2.250″D x 1 21/64″ Conical Face	Flat Face	2.750″D x 1 33/64″ Flat Face	3.375″D x 1 27/32″ Flat Face
Stroke (in.)	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.040	.040
Force (lbs.)	4.4	7.8	12.8	11.0	16.5	16.0	27.0	17.8	46.0	35.5	95.0	65.0	160	240	328
Stroke (in.)	.120	.120	.060	.120	.060	.120	.060	.200	.100	.250	.100	.250	.190	.380	.380
Force (lbs.)	1.0	2.4	3.3	3.6	5.3	7.8	10.0	6.1	11.8	16.2	20.0	33.0	30.0	18	27
Weight	⅞ oz.	1½ oz.		2¼ oz.		3¾ oz.		6 oz.		9 oz.		1 lb. 5½ oz.		2 lb. 4 oz.	4 lbs. 3 oz.

(For detail performance curves, write for our Catalog)

Quality engineered for efficiency and long term dependability, the Ledex long stroke solenoid has a built-in impact cushion pad to absorb energy at the end of the power stroke. For smooth travel and long wear, the solenoid plunger is electroless nickel plated. It rides in a smooth bushing track designed for positive alignment and low friction. Off-the-shelf models available for 12, 28 and 100 VDC operations.



Typical Output 1/10 Duty

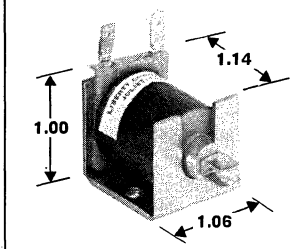
Model	Size 50		Size 75	Size 100	Size 125	Size 150
Size	½″D x ½″	½″D x 1″	¾″D x 1½″	1″D x 2″	1¼″D x 2¼″	1½″ x 2½″
Force, .050 Stroke	4.5 oz.	15 oz.	3 lbs.	7 lbs.	11.5 lbs.	16.5 lbs.
Force, .750 Stroke	—	—	.6 lbs.	2 lbs.	4 lbs.	7 lbs.
Shaft Diameter, pull	.187″	.187″	.312″	.437″	.500″	.625″
Shaft Diameter, push	.062″	.062″	.094″	.125″	—	—
Mounting	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Saddle	Saddle
Weight	14 grams	24 grams	3 oz.	6¾ oz.	9 oz.	1 lb. ½ oz.

When it comes to actuating, Ledex has both the people and products to give you the quickest and best solution. There's a wide choice of stock models for a fast start on your prototype. And our expert application staff is always glad to custom engineer to your exact stroke, force, speed and size requirements. Other models (not shown) are available on made-to-order basis with force outputs in excess of 350 pounds. Write for our catalog.

P.O. Box 427
Vandalia, Ohio 45377 U.S.A.
Phone: 513-898-3621

LIBERTY CONTROLS, INC. SOLENOIDS

L-9



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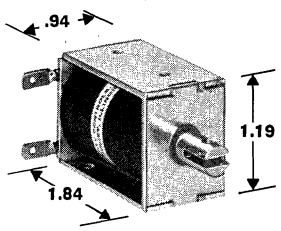

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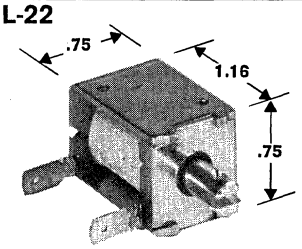

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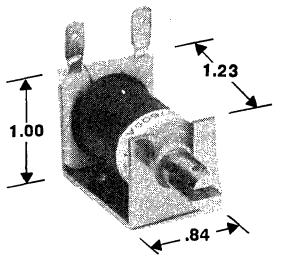

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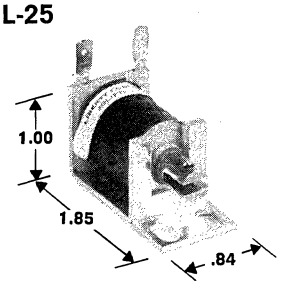

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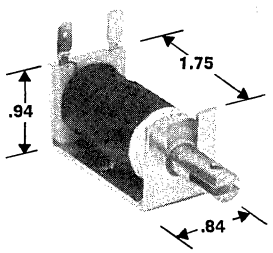

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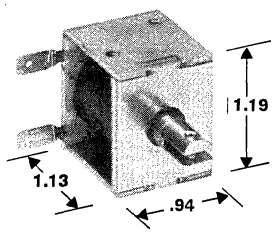

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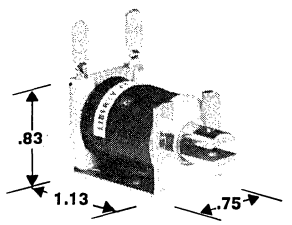


FORCE CURVE DATA

CONTINUOUS DUTY DC

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	13	5	2	1	0.5	—	—	—	—	—
L-61	18	9	3	1	1	—	—	—	—	—
L-20	21	11	4	2	1	—	—	—	—	—
L-9	27	13	6.5	2.5	1.5	—	—	—	—	—
L-24	28	14	6	3	2	2	—	—	—	—
L-25	28	14	6	3	2	2	—	—	—	—
L-28	31	15	5	3	1	—	—	—	—	—
L-26	33	18	7	4	3	2	1	—	—	—
L-81	38	19	9.5	4	—	—	—	—	—	—
L-62	46	26	11	5	3	—	—	—	—	—
L-11	48	32	14	8	5	4	3	—	—	—
L-63	56	31	14	8	5	3	2	—	—	—
L-82	55	40	19	10	5	3	2	—	—	—
L-88	120	74	30	15	8	4	—	—	—	—
L-89	144	102	49	27	16	11	7	—	—	—
L-90	148	114	62	35	23	17	13	11	8	5

CONTINUOUS DUTY AC

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	5.5	4	2.5	1.5	0.5	—	—	—	—	—
L-20	10	7	5	3.5	2	—	—	—	—	—
L-61	10	7	5	4	2	—	—	—	—	—
L-90	12	9	7	7	7	8	8	9	9	7
L-24	14	10	7	6	4	2	—	—	—	—
L-25	14	10	7	6	4	2	—	—	—	—
L-9	15	10.5	6.5	4.5	2.5	—	—	—	—	—
L-28	15	11	7	4.5	2	—	—	—	—	—
L-26	16	12	9	8	6	5	3	—	—	—
L-82	17	12	10	10	11	11	11	—	—	—
L-89	17	13	10.5	10	9.5	9	7	—	—	—
L-11	18	13	10	10	10	8	6	—	—	—
L-81	19	13	9	5	—	—	—	—	—	—
L-63	20	15	13	13	11	9	6	—	—	—
L-88	24	18	14	11	8	—	—	—	—	—
L-62	24	19	15	13	10	—	—	—	—	—

INTERMITTENT DUTY DC

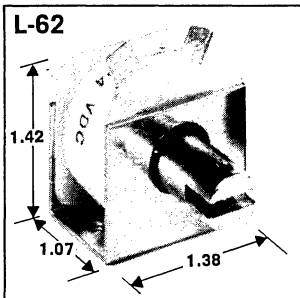
TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	22	10	3	2	1	—	—	—	—	—
L-20	34	21	8	4	2	—	—	—	—	—
L-61	38	21	8	4	2	—	—	—	—	—
L-9	38	21	9	5	3	—	—	—	—	—
L-24	46	27	12	7	4	3	—	—	—	—
L-25	46	27	12	7	4	3	—	—	—	—
L-28	47	32	12	6	3	—	—	—	—	—
L-81	53	34	16	7	—	—	—	—	—	—
L-62	80	47	20	10	5	—	—	—	—	—
L-26	52	36	21	11	7	5	3	—	—	—
L-11	67	53	31	19	13	11	7	—	—	—
L-63	84	54	27	15	10	6	4	—	—	—
L-82	92	70	43	24	14	9	7	—	—	—
L-88	184	136	68	36	20	11	—	—	—	—
L-89	200	156	99	60	36	25	16	—	—	—
L-90	208	176	131	95	72	56	44	36	28	16

INTERMITTENT DUTY AC

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	10	6	4	2	1.5	—	—	—	—	—
L-20	20	14	9	7	4	—	—	—	—	—
L-61	22	15	12	9	5	—	—	—	—	—
L-24	26	19	14	11	8	5	—	—	—	—
L-25	26	19	14	11	8	5	—	—	—	—
L-26	25	19	15	13	11	9	6	—	—	—
L-28	29	20	14	9	4	—	—	—	—	—
L-90	27	22	18	17	18	19	20	21	21	17
L-81	34	23	15	8	—	—	—	—	—	—
L-9	35	25	17	12	7	—	—	—	—	—
L-11	33	25	20	18	18	16	13	—	—	—
L-82	46	31	26	26	28	29	28	—	—	—
L-89	42	33	27	25	24	22	18	—	—	—
L-88	49	36	28	23	17	10	4	—	—	—
L-63	56	44	38	36	34	27	18	—	—	—
L-62	64	55	42	36	26	—	—	—	—	—

LIBERTY CONTROLS, INC. SOLENOIDS

L-62



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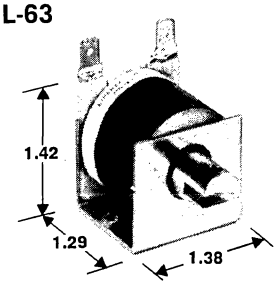

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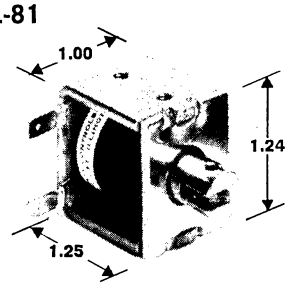

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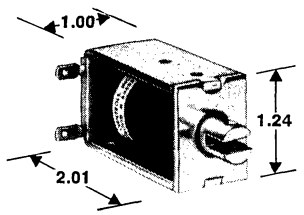

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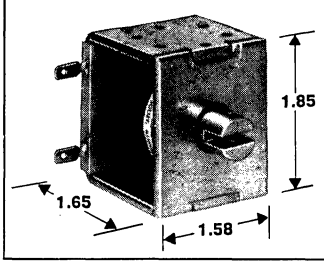

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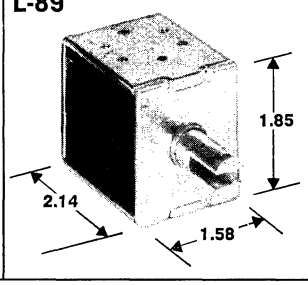

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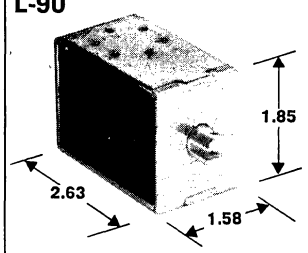

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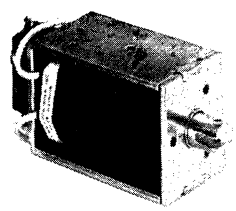


FORCE CURVE DATA

STANDARD VOLTAGES: 6, 12, 24, 48, 120, 240 AC
6, 12, 24, 48, 110, 220 DC

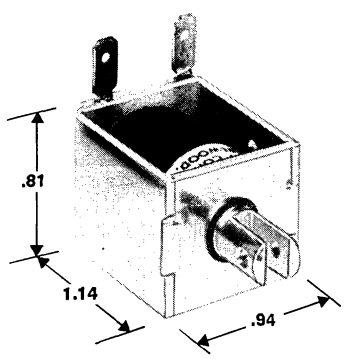
PULSE DUTY DC

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	38	25	11	6	3	—	—	—	—	—
L-20	62	50	27	14	8	—	—	—	—	—
L-61	67	51	27	14	8	—	—	—	—	—
L-24	68	52	32	20	13	8	—	—	—	—
L-25	68	52	32	20	13	8	—	—	—	—
L-26	74	62	43	30	22	17	11	—	—	—
L-9	84	63	35	18	11	—	—	—	—	—
L-28	83	70	43	23	13	—	—	—	—	—
L-11	90	80	53	42	37	34	26	—	—	—
L-81	107	89	64	34	—	—	—	—	—	—
L-82	136	117	90	62	40	26	16	—	—	—
L-62	172	142	89	43	27	—	—	—	—	—
L-63	168	147	105	67	45	28	16	—	—	—
L-88	276	241	180	94	71	40	—	—	—	—
L-89	265	234	190	149	110	82	58	—	—	—
L-90	266	230	188	154	126	106	94	89	68	40

PULSE DUTY AC

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
L-22	19	14	9	6	3	—	—	—	—	—
L-61	44	32	24	20	11	—	—	—	—	—
L-20	48	36	26	19	11	—	—	—	—	—
L-24	52	38	30	25	18	—	—	—	—	—
L-25	52	38	30	25	18	—	—	—	—	—
L-11	54	42	34	32	30	27	23	—	—	—
L-28	62	46	34	21	11	—	—	—	—	—
L-9	72	53	34	24	15	—	—	—	—	—
L-26	72	53	43	39	36	30	20	—	—	—
L-90	80	58	47	45	46	47	50	51	51	43
L-81	90	61	41	25	—	—	—	—	—	—
L-82	96	66	53	52	54	55	51	—	—	—
L-89	98	75	61	57	54	50	43	—	—	—
L-63	103	80	70	67	60	50	34	—	—	—
L-62	117	91	76	66	48	—	—	—	—	—
L-88	138	101	76	63	47	31	13	—	—	—

NEW
L-20



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Now Liberty Controls offers a line of clickers and clappers. Especially designed for use on today's solid state keyboards, and disc drives.

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Shorewood, IL 60435
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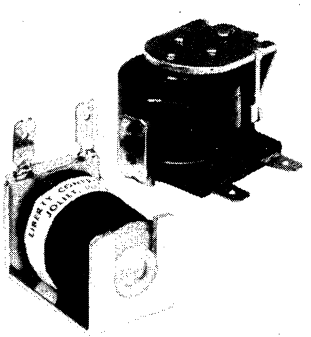


In addition to our standard product line Liberty Controls can modify an existing unit or design one to meet your specific requirements. For further information on possible modifications contact the factory.

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.

BOX-FRAME SOLENOIDS

TYPE	VOLTS	DUTY	OHMS	FORCES AND STROKES ounces @ inches (min.)	(max.)	BODY inches H x L x W	PRICE 1-24
312-6005	24VDC	Cont.	144	22 @ 1/32"	2 @ 1/4"	3/4 x 1 5/32 x 3/4	$5.05
312-6006	24VDC	Int.	60	28 @ 1/32"	4 @ 1/4"	3/4 x 1 5/32 x 3/4	5.05
312-6011	120VAC	Cont.	390	12 @ 1/32"	2.5 @ 1/4"	3/4 x 1 5/32 x 3/4	5.70
312-6012	120VAC	Int.	100	20 @ 1/32"	4 @ 1/4"	3/4 x 1 5/32 x 3/4	5.70
5U5-6053	24VDC	Cont.	114	14 @ 1/16"	2.5 @ 3/8"	15/16 x 1 1/4 x 2 7/32	5.30
5U5-6054	24VDC	Int.	52	27 @ 1/16"	5 @ 3/8"	15/16 x 1 1/4 x 2 7/32	5.30
5U5-6059	120VAC	Cont.	500	10 @ 1/16"	4.5 @ 3/8"	15/16 x 1 1/4 x 2 7/32	5.60
5U5-6060	120VAC	Int.	310	17 @ 1/16"	8.5 @ 3/8"	15/16 x 1 1/4 x 2 7/32	5.60
5U7-6065	24VDC	Cont.	85	15 @ 1/8"	3 @ 1/2"	15/16 x 1 3/4 x 2 7/32	6.10
5U7-6066	24VDC	Int.	33	32 @ 1/8"	7 @ 1/2"	15/16 x 1 3/4 x 2 7/32	6.10
5U7-6071	120VAC	Cont.	250	11 @ 1/8"	7.5 @ 1/2"	15/16 x 1 3/4 x 2 7/32	6.30
5U7-6072	120VAC	Int.	140	18 @ 1/8"	12 @ 1/2"	15/16 x 1 3/4 x 2 7/32	6.30
809-6101	24VDC	Cont.	104	12 @ 1/8"	2 @ 1/2"	1 3/16 x 1 1/8 x 15/16	5.70
809-6102	24VDC	Int.	50	22 @ 1/8"	3 @ 1/2"	1 3/16 x 1 1/8 x 15/16	5.70
809-6107	120VAC	Cont.	400	12 @ 1/8"	5 @ 1/2"	1 3/16 x 1 1/8 x 15/16	6.00
809-6108	120VAC	Int.	220	24 @ 1/8"	7 @ 1/2"	1 3/16 x 1 1/8 x 15/16	6.00
827-6113	24VDC	Cont.	72	24 @ 1/8"	4 @ 5/8"	1 3/16 x 1 7/8 x 15/16	6.50
827-6114	24VDC	Int.	32	40 @ 1/8"	8 @ 5/8"	1 3/16 x 1 7/8 x 15/16	6.50
827-6119	120VAC	Cont.	200	12 @ 1/8"	6 @ 5/8"	1 3/16 x 1 7/8 x 15/16	6.70
827-6120	120VAC	Int.	85	20 @ 1/8"	13 @ 5/8"	1 3/16 x 1 7/8 x 15/16	6.70
930-6125	24VDC	Cont.	54	63 @ 1/8"	7 @ 3/4"	1 5/8 x 2 x 1 7/16	9.90
930-6126	24VDC	Int.	15	113 @ 1/8"	25 @ 3/4"	1 5/8 x 2 x 1 7/16	9.90
930-6131	120VAC	Cont.	133	8 @ 1/8"	7 @ 3/4"	1 5/8 x 2 x 1 7/16	10.00
930-6132	120VAC	Int.	37	36 @ 1/8"	26 @ 3/4"	1 5/8 x 2 x 1 7/16	10.00
940-6137	24VDC	Cont.	50	78 @ 1/8"	8 @ 3/4"	1 5/8 x 2 3/16 x 1 7/16	12.85
940-6138	24VDC	Int.	15	140 @ 1/8"	18 @ 3/4"	1 5/8 x 2 3/16 x 1 7/16	12.85
940-6143	120VAC	Cont.	53	24 @ 1/8"	15 @ 3/4"	1 5/8 x 2 3/16 x 1 7/16	13.80
940-6144	120VAC	Int.	15	100 @ 1/8"	65 @ 3/4"	1 5/8 x 2 3/16 x 1 7/16	13.80
960-6149	24VDC	Cont.	58	50 @ 1/8"	8 @ 1/2"	1 5/8 x 1 9/16 x 1 7/16	9.75
960-6150	24VDC	Int.	21	100 @ 1/8"	18 @ 1/2"	1 5/8 x 1 9/16 x 1 7/16	9.75
960-6155	120VAC	Cont.	166	14 @ 1/8"	10 @ 1/2"	1 5/8 x 1 9/16 x 1 7/16	9.75
960-6156	120VAC	Int.	60	45 @ 1/8"	30 @ 1/2"	1 5/8 x 1 9/16 x 1 7/16	9.75
970-6161	24VDC	Cont.	58	65 @ 1/8"	9 @ 1/2"	1 5/8 x 1 25/32 x 1 7/16	12.15
970-6162	24VDC	Int.	20	120 @ 1/8"	24 @ 1/2"	1 5/8 x 1 25/32 x 1 7/16	12.15
970-6167	120VAC	Cont.	100	22 @ 1/8"	16 @ 1/2"	1 5/8 x 1 25/32 x 1 7/16	12.15
970-6168	120VAC	Int.	125	85 @ 1/8"	58 @ 1/2"	1 5/8 x 1 25/32 x 1 7/16	12.15

Specifications on request. Sales Representatives in major cities.

regdon solenoids

CORPORATION

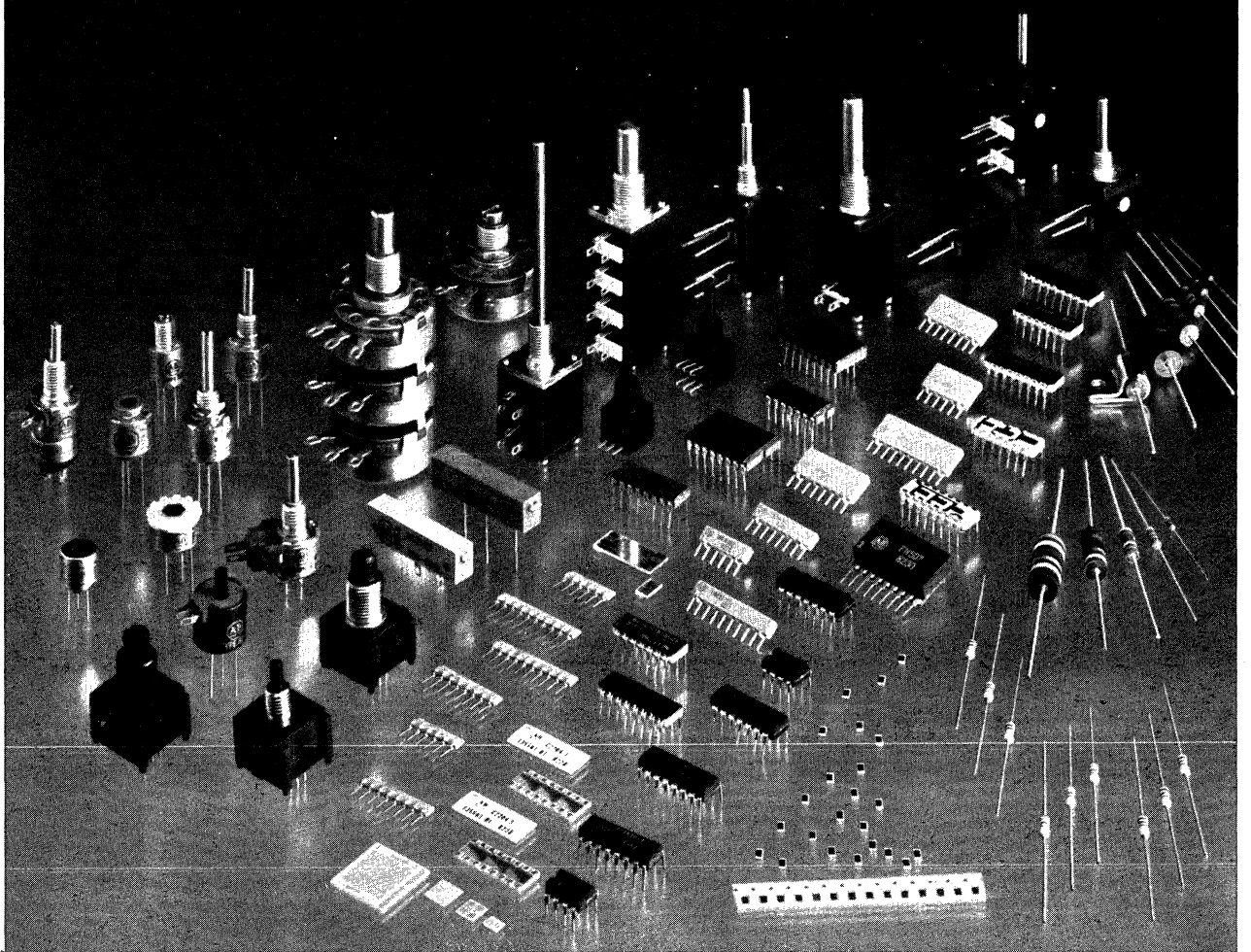
3715 GRAND BLVD / BROOKFIELD IL 60513 / 312/485-5152

TUBULAR SOLENOIDS

TYPE	VOLTS	DUTY	OHMS	FORCES AND STROKES ounces @ inches (min.)	(max.)	BODY inches Length x Dia.	PRICE 1-24
R7X9-6171	12VDC	Cont.	80	5 @ 1/32"	1.2 @ 5/32"	1 1/8 x 1/16	$9.15
R7X9-6172	12VDC	Int.	14	9 @ 1/32"	2.5 @ 5/32"	1 1/8 x 1/16	$9.15
R7X9-6173	24VDC	Cont.	260	5 @ 1/32"	1.2 @ 5/32"	1 1/8 x 1/16	$9.15
R7X9-6174	24VDC	Int.	57	9 @ 1/32"	2.5 @ 5/32"	1 1/8 x 1/16	$9.15
R8X7-6362	12VDC	Cont.	55	2.5 @ 1/16"	1 @ 3/16"	7/8 x 1/2	8.95
R8X7-6363	12VDC	Int.	20	6 @ 1/16"	1.5 @ 3/16"	7/8 x 1/2	8.95
R8X7-6364	24VDC	Cont.	240	2.5 @ 1/16"	1 @ 3/16"	7/8 x 1/2	8.95
R8X7-6365	24VDC	Int.	80	6 @ 1/16"	1.5 @ 3/16"	7/8 x 1/2	8.95
R8X12-6372	12VDC	Cont.	40	7 @ 1/32"	1.5 @ 1/4"	1 1/2 x 1/2	7.75
R8X12-6373	12VDC	Int.	10	14 @ 1/32"	4 @ 1/4"	1 1/2 x 1/2	7.75
R8X12-6374	24VDC	Cont.	160	7 @ 1/32"	1.5 @ 1/4"	1 1/2 x 1/2	7.75
R8X12-6375	24VDC	Int.	38	14 @ 1/32"	4 @ 1/4"	1 1/2 x 1/2	7.75
R8X16-6384	24VDC	Cont.	145	2.8 @ 1/8"	1.5 @ 3/4"	2 x 1/2	8.10
R8X16-6385	24VDC	Int.	24	7 @ 1/8"	4 @ 3/4"	2 x 1/2	8.10
R12X12-6211	12VDC	Cont.	41	6.5 @ 1/8"	1.2 @ 5/8"	1 1/2 x 3/4	7.90
R12X12-6212	12VDC	Int.	6	20 @ 1/8"	6 @ 5/8"	1 1/2 x 3/4	7.90
R12X12-6213	24VDC	Cont.	165	6.5 @ 1/8"	1.2 @ 5/8"	1 1/2 x 3/4	7.90
R12X12-6214	24VDC	Int.	25	20 @ 1/8"	6 @ 5/8"	1 1/2 x 3/4	7.90
R16X9-6221	12VDC	Cont.	36	22 @ 1/16"	2.5 @ 1/2"	1 1/8 x 1	11.80
R16X9-6222	12VDC	Int.	8	33 @ 1/16"	4 @ 1/2"	1 1/8 x 1	11.80
R16X9-6223	24VDC	Cont.	145	22 @ 1/16"	2.5 @ 1/2"	1 1/8 x 1	11.80
R16X9-6224	24VDC	Int.	30	33 @ 1/16"	4 @ 1/2"	1 1/8 x 1	11.80
R16X16-6231	12VDC	Cont.	26	21 @ 1/8"	6.5 @ 5/8"	2 x 1	13.75
R16X16-6232	12VDC	Int.	3.8	56 @ 1/8"	20 @ 5/8"	2 x 1	13.75
R16X16-6233	24VDC	Cont.	105	21 @ 1/8"	6.5 @ 5/8"	2 x 1	13.75
R16X16-6234	24VDC	Int.	15	56 @ 1/8"	20 @ 5/8"	2 x 1	13.75
R24X13-6243	24VDC	Cont.	85	50 @ 1/8"	5 @ 5/8"	1 5/8 x 1 1/2	15.70
R24X13-6244	24VDC	Int.	14	150 @ 1/8"	20 @ 5/8"	1 5/8 x 1 1/2	15.70
R24X19-6253	24VDC	Cont.	59	80 @ 1/8"	8 @ 1"	2 3/8 x 1 1/2	20.40
R24X19-6254	24VDC	Int.	10	140 @ 1/8"	32 @ 1"	2 3/8 x 1 1/2	20.40

Push Versions Also Available.

A-B electronic components



COMPONENT DESCRIPTION			TYPE/SERIES	PAGE
FIXED RESISTORS	Hot-Molded Composition Metal Film		BB, CB, EB, GB, HB, GM, HM Types RN, RNK	1•1902 1•1903
RESISTOR NETWORKS	Thick Film (Cermet) Networks	Ceramic I-SIP Conformal Coated C-SIP Ceramic I-DIP Military DIP	Series 100, 400 Series 700 Series 314, 316 Series 514, 516	1•1904 1•1905 1•1906 1•1907
	Thin Film (Precision) Networks	Standard DIP Voltage Divider Custom	Series F08, F14, F16 Series FN507 Series FC, FG	1•1908 1•1909 1•1910
LEADLESS RESISTORS	Standard Chip Resistors		Type BC	1•1912
TRIMMING POTENTIOMETERS	Cermet	Single-turn Multi-turn	Types S, 81, 90 Types 85, 94	1•2113 1•2113
	Hot-Molded Composition	Single-turn Multi-turn	Types F, Y, BT Types N, R	1•2113 1•2113
PANEL POTENTIOMETERS	Cermet Conductive Plastic Hot-Molded Composition		MOD POT, Type SP MOD POT, Types M, 2000 MOD POT, Types J, EJ, G, W, WR	1•2114 1•2114 1•2114

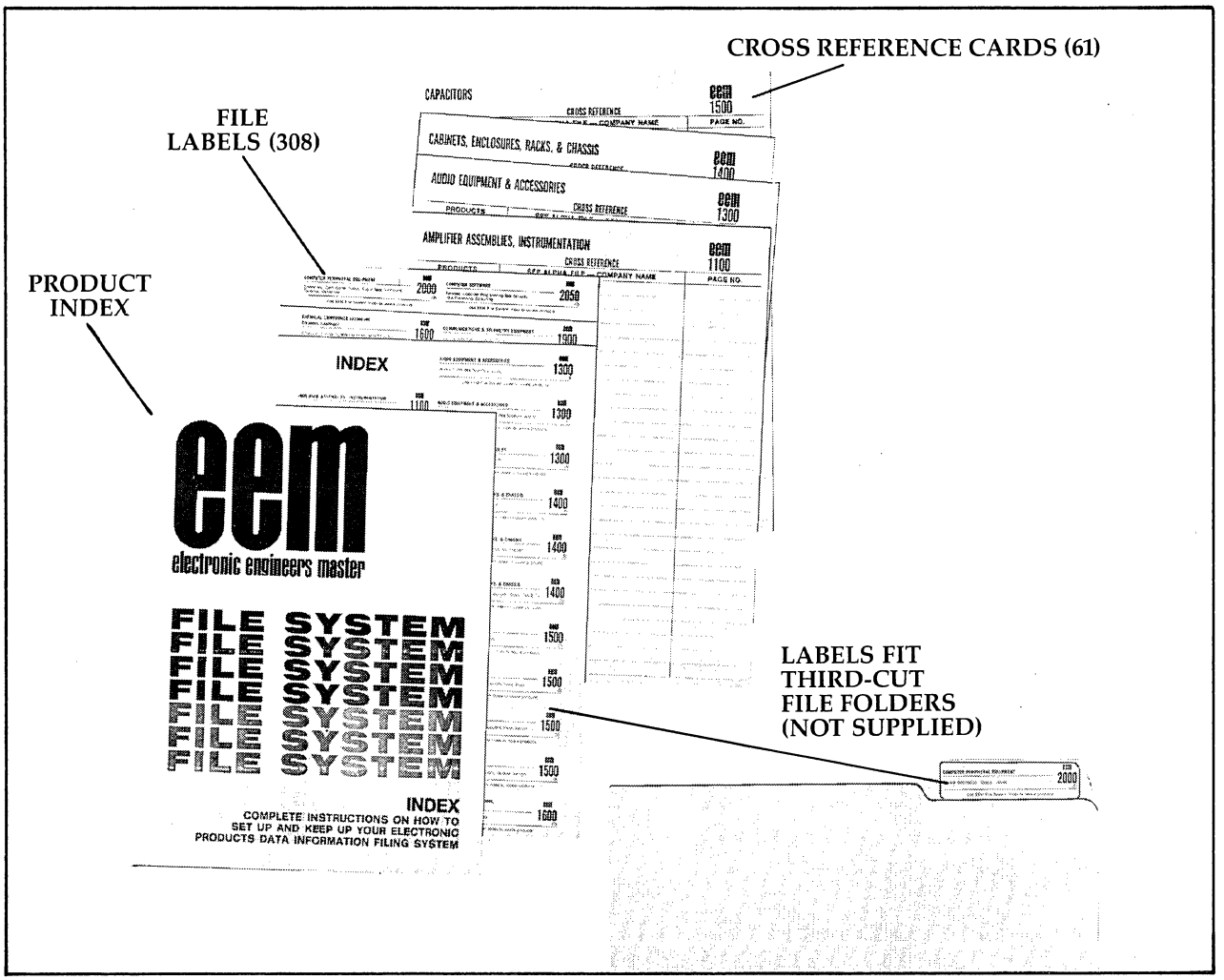
ALLEN-BRADLEY 1201 S. Second St. Milwaukee, Wisconsin

RESISTORS

Manufacturer	Bulk Ceramic	Ceramic Core	Cermet	Carbon Comp.	FILM		Wirewound	POWER			Foil	Fused	Chip	Network	MIL	Precision	High Voltage (1000V) △	Non-Inductive	Flame Retardant
					Metallized & Nonmetallized	Carbon		Greater than 2W	5 to 15W	Greater than 15W									
Allen-Bradley			1•1898	1•1898, 1•1902	1•1898, 1•1903			1•1902					1•1898, 1•1912	1•1898, 1•1904-1•1911	1•1902, 1•1903, 1•1907	1•1903			
Bourns														1•1914-1•1917					
Caddock					1•1918-1•1927, 1•1932, 1•1934, 1•1935, 1•1937			1•1919, 1•1922, 1•1923, 1•1924	1•1919, 1•1922, 1•1923, 1•1925	1•1919, 1•1923, 1•1925				1•1918, 1•1919, 1•1928-1•1931, 1•1933, 1•1936	1•1937	1•1918-1•1927, 1•1932, 1•1934, 1•1935	1•1918-1•1924, 1•1932, 1•1935	1•1918, 1•1921-1•1924, 1•1926, 1•1927, 1•1934	
CAL-R			1•1939				1•1940, 1•1941	1•1940	1•1940	1•1940			1•1939	1•1939, 1•1941	1•1931, 1•1932	1•1933			
Carborundum	1•1942-1•1944								1•1942-1•1944	1•1942-1•1944							1•1942-1•1944		
Colber							1•1946	1•1946	1•1946	1•1946		1•1946							
Corning					1•1947									1•1947	1•1947	1•1947			1•1947
CTS														1•1949-1•1953					
Dale					1•1962-1•1967	1•1968	1•1969-1•1976	1•1967-1•1970, 1•1974-1•1976	1•1967-1•1969, 1•1971-1•1973, 1•1974-1•1976	1•1968, 1•1969, 1•1971, 1•1972			1•1960, 1•1961	1•1954-1•1959	1•1957-1•1959, 1•1962-1•1967, 1•1969-1•1971	1•1960, 1•1965, 1•1969, 1•1972	1•1966, 1•1967-1•1969		
E-Systems							1•1977	1•1977	1•1977	1•1977									
Electro-Films					1•1980, 1•1981								1•1980, 1•1981	1•1980, 1•1981		1•1981			
Electronic Precision Components							1•1982	1•1982						1•1982	1•1982	1•1982			
General Resistance							1•1983					1•1983		1•1983	1•1983	1•1983			1•1983
HyComp														1•1984					
Hytek														1•1985					
International Components				1•1986	1•1986	1•1986								1•1986					1•1986
Iskra						1•1987						1•1987							1•1987
ISL Products					1•1988	1•1988						1•1988			1•1988				1•1988
Julie Research					1•1989		1•1989	1•1989	1•1989						1•1989				
K&M Electronics								1•1991	1•1991					1•1991		1•1991	1•1991		
KDI Pyrofilm					1•1990								1•1990	1•1990	1•1990		1•1990		
Kelvin							1•1992-1•1994	1•1993	1•1993					1•1992-1•1994	1•1992, 1•1994	1•1992-1•1994		1•1992, 1•1993	

RESISTORS

Manufacturer	Bulk Ceramic	Ceramic Core	Cermet	Carbon Comp.	FILM		Wirewound	POWER			Foil	Fused	Chip	Network	MIL	Precision	High Voltage (1000V) △	Non-Inductive	Flame Retardant
					Metallized & Nonmetallized	Carbon		Greater than 2W	5 to 15W	Greater than 15W									
KOA Speer Electronics					1•1995	1•1995								1•1995	1•1995	1•1995			
Meissner Industries							1•1997	1•1997	1•1997							1•1997		1•1997	
Mepco/Electra					1•1998	1•1998							1•1998	1•1999	1•1998	1•1998			
Micro Ohm					1•2001	1•2000	1•2000	1•2001	1•2000, 1•2001	1•2000, 1•2001						1•2000	1•2000, 1•2001	1•2000	
Microplex													1•2002		1•2002				
Mills Resistor							1•2003		1•2003					1•2003		1•2003			
Milwaukee Resistor							1•2004-1•2007	1•2006	1•2004-1•2007	1•2004-1•2007					1•2004				
Murata					1•2011			1•2011						1•2009			1•2011		1•2010
Mini-Systems													1•2008		1•2008				
Nytronics		1•2012-1•2014		1•2012-1•2014				1•2012-1•2014	1•2012-1•2014	1•2014								1•2012-1•2014	
Ohmite							1•2016-1•2023	1•2020-1•2022	1•2016-1•2023	1•2016-1•2019									
Ohmtek													1•2015	1•2015	1•2015				
Pacific Resistors							1•2024-1•2027	1•2024-1•2027	1•2025, 1•2026	1•2025					1•2024-1•2026	1•2024-1•2027	1•2024-1•2027	1•2024, 1•2025	
Precision Resistor (PRC)							1•2026, 1•2027	1•2027	1•2026							1•2026, 1•2027	1•2026, 1•2027		
Precision Resistive Products					1•2029									1•2029	1•2029	1•2029			
RCD			1•2031		1•2031	1•2031	1•2031	1•2031	1•2031	1•2031		1•2031	1•2031	1•2031	1•2031	1•2031	1•2031	1•2031	1•2031
RCL/Shallcross					1•2035		1•2032-1•2038	1•2032, 1•2034, 1•3036, 1•3037	1•2032-1•2034	1•2033, 1•2034		1•2035			1•2032-1•2034, 1•2036, 1•2037	1•2036-1•2038		1•2035	
Res-Net					1•2039			1•2039						1•2039		1•2039			
Resistor Inc.							1•2040	1•2040	1•2040	1•2040								1•2095	
Tel Labs							1•2041	1•2041	1•2041						1•2041		1•2041		
TRW Resistive Prods.		1•2085		1•2043, 1•2044	1•2045-1•2048, 1•2050-1•2057 1•2070, 1•2084 1•2086		1•2073-1•2083	1•2047, 1•2076-1•2082, 1•2085-1•2086	1•2051, 1•2070, 1•2076-1•2082, 1•2086	1•2082, 1•2086			1•2049	1•2054, 1•2058-1•2069, 1•2072	1•2046-1•2048, 1•2050, 1•2054, 1•2057, 1•2059, 1•2062, 1•2073-1•2075, 1•2082	1•2051-1•2057	1•2051, 1•2070 1•2085-1•2086		1•2047-1•2048, 1•2080, 1•2085
Ultronix							1•2092-1•2095		1•2094		1•2090, 1•2091			1•2091	1•2090-1•2095	1•2090-1•2095	1•2092, 1•2094		
Vamistor					1•2097										1•2097	1•2097			
Victoreen					1•2098	1•2098			1•2099, 1•2100	1•2101				1•2099	1•2101	1•2099	1•2099-1•2101		
Vishay									1•2105				1•2103	1•2103, 1•2105	1•2102-1•2105	1•2103-1•2105			
Ward Leonard							1•2106-1•2108	1•2106	1•2106-1•2108	1•2107, 1•2108							1•2106	1•2106	



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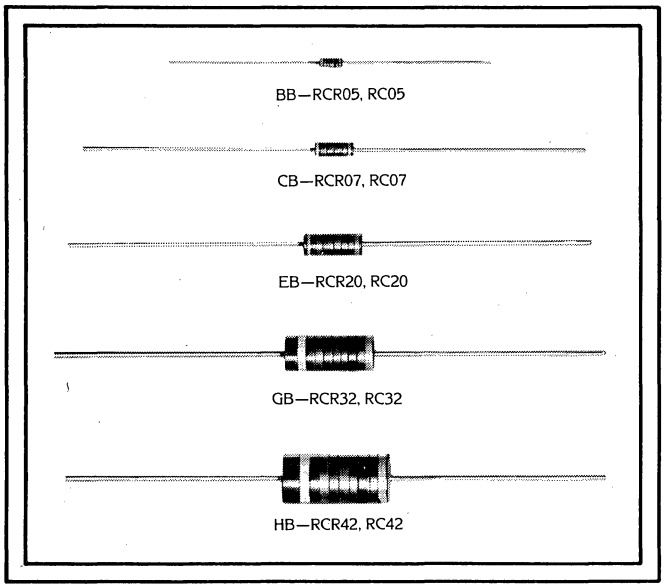
Types BB, CB, EB, GB, HB, GM, HM Hot-Molded Fixed Resistors



Allen-Bradley hot-molded composition resistors are high quality units intended for general purpose use in the electronics industry.

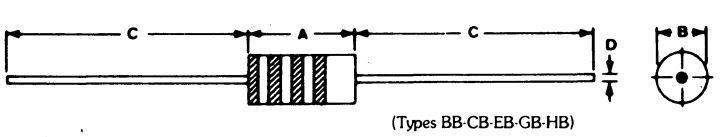
Allen-Bradley Style RCR resistors not only meet all requirements of MIL-R-39008 but also exceed the S level (best level) of Established Reliability of 0.001% failure rate per 1000 hours. And only Allen-Bradley resistors are available in S level reliability in all five wattage sizes over the entire resistance range. The S reliability level is indicated by a yellow 5th color band on the resistor body.

Metal-clad hot-molded resistors (Types GM and HM) are fitted with metal clamps which surround the major portion of the resistor. The metal clamps provide rigid mounting and efficient heat transfer from the resistors to the metal chassis or panels on which they are mounted.

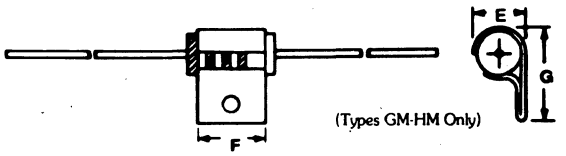
For more information request Publication EC5021-2.1.

SPECIFICATIONS

Type	Power at 70° C	Resistance Range	Tolerance	Voltage Rating (RMS)	Maximum Ambient Temperature	Dimensions in Inches (millimeters)						
						A	B	C	D	E	F	G
BB	1/8 watt	2.7 Ohms to 100 Megohms	±5, 10, 20%	150V	+130° C	0.145	0.062	1.000	0.015			
RCR05		2.7 Ohms to 22 Megohms	±5, 10%			(3,68)	(1,59)	(25,40)	(0,38)			
CB	1/4 watt	2.7 Ohms to 100 Megohms	±5, 10, 20%	250V		0.250	0.090	1.500	0.025			
RCR07		2.7 Ohms to 22 Megohms	±5, 10%			(6,35)	(2,29)	(38,10)	(0,64)			
EB	1/2 watt	1.0 Ohm to 100 Megohms	±5, 10, 20%	350V		0.375	0.140	1.500	0.033			
RCR20		1.0 Ohm to 22 Megohms	±5, 10%			(9,52)	(3,56)	(38,10)	(0,84)			
GB	1 watt	1.0 Ohm to 100 Megohms	±5, 10, 20%	500V		0.562	0.225	1.500	0.041			
RCR32		1.0 Ohm to 22 Megohms	±5, 10%			(14,29)	(5,72)	(38,10)	(1,04)			
HB	2 watts	10 Ohms to 100 Megohms	±5, 10, 20%	750V		0.688	0.312	1.500	0.045			
RCR42		10 Ohms to 22 Megohms	±5, 10%	500V		(17,46)	(7,94)	(38,10)	(1,14)			
GM	3 watts	2.7 Ohms to 22 Megohms	±5% ±10%	500V		0.562 (14,29)	0.225 (5,72)	1.500 (38,10)	0.041 (1,04)	0.305 (7,75)	0.438 (11,11)	0.656 (16,67)
HM	4 watts	10 Ohms to 22 Megohms		750V		0.688 (17,46)	0.312 (7,94)	1.500 (38,10)	0.045 (1,14)	0.391 (9,92)	0.562 (14,29)	0.766 (19,45)



(Types BB-CB-EB-GB-HB)



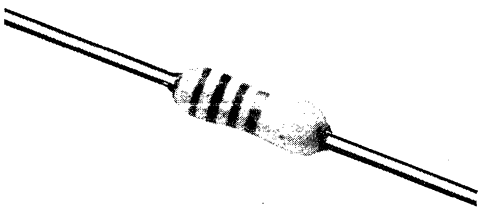
(Types GM-HM Only)

ALLEN-BRADLEY

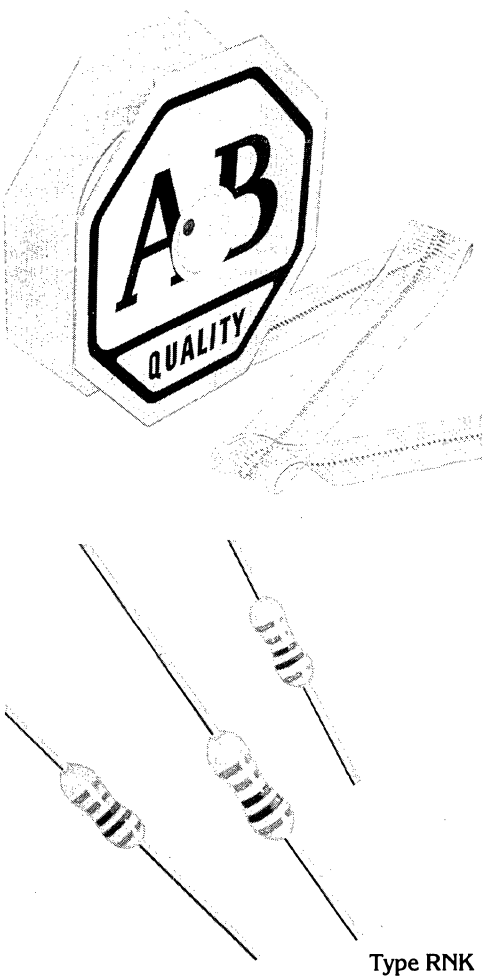
Milwaukee, Wisconsin 53204

Types RN, RNK

Metal Film Fixed Resistors



Type RN



Type RNK

1/4 Watt at 70° C
10 Ohms to 1 Megohm
±1% Tolerance, ±5% Tolerance
±100 PPM/° C, ±200 PPM/° C

FEATURES

- Highly Stable Metal Film
- Tight TCR
- Laser Trimmed Element
- High Quality Performance
- Standard Tape Reel Packaging
- Automatically Insertable

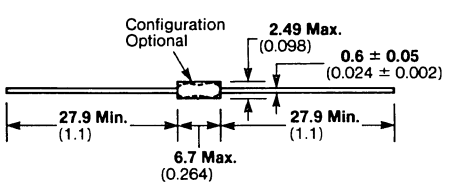
Allen-Bradley metal film resistors are high quality units intended for general purpose use in the electronics industry.

Nichrome resistance element provides stable performance under load, in various environments, and on the shelf. Type RN performance characteristics are better than MIL-R-22684 (RL07) requirements. Type RNK performance characteristics are better than MIL-R-10509 (RN55D) requirements.

For more information request Publication EC5030-2.1 (Type RN) or Publication EC5032-2.1 (Type RNK).

SPECIFICATIONS

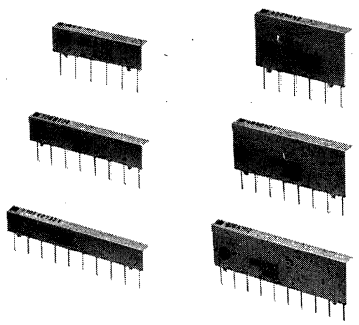
Type	Power at 70°C	Resistance Range	Tolerance	RCWV	Maximum Ambient Temperature
RN	¼ Watt	10 Ohms to 1.0 Megohm	± 5, 2%	250V or Less	+ 155°C
RNK	¼ Watt	10 Ohms to 1.0 Megohm	± 1%	250V or Less	+ 155°C



Note: Dimensions in Millimeters (inches).

ALLEN-BRADLEY

Milwaukee, Wisconsin 53204



I-SIP
Single In-Line Package

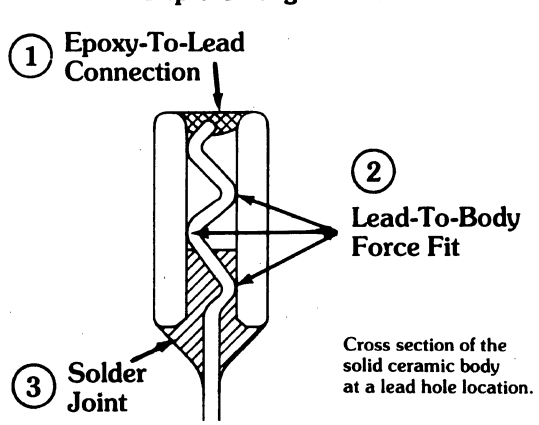
Series 100 400 Cermet Resistor Networks

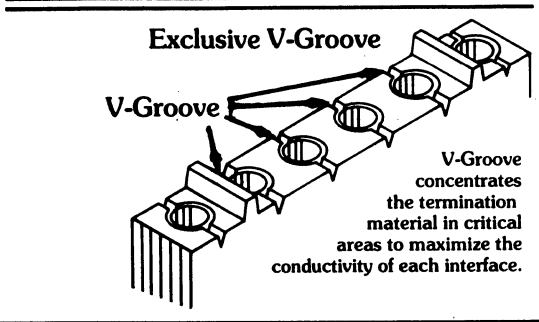
FEATURES

- Solid Ceramic Body, with V-Groove
- Triple-Strength Leads
- 0.100 Inch (2,54mm) Lead Spacing
- Two Package Heights: 0.190 Inch (4,83mm), 0.350 Inch (8,89mm)
- 6, 8 and 10 Pins
- Automatically Insertable
- Permanent Laser Marking
- Part Markings — Side and Top

For more information request Publication EC5420-2.1

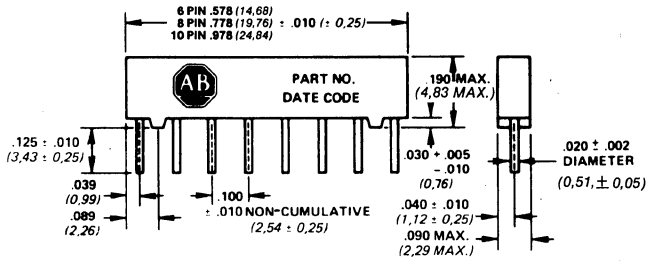
Tough new package



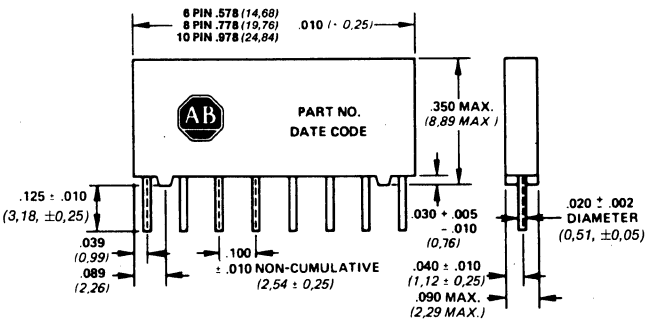


DIMENSIONS

Low profile 100 series



High profile 400 series



Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.

TOLERANCES
Dimensional Tolerance ±.005 (0,13)
Angular Tolerance ±5° Except as Specified.

NOT TO SCALE

Applications

- Pull-up and pull-down arrays
- Transmission line terminators
- Current limiting resistors
- ECL terminating networks
- A wide array of custom designs

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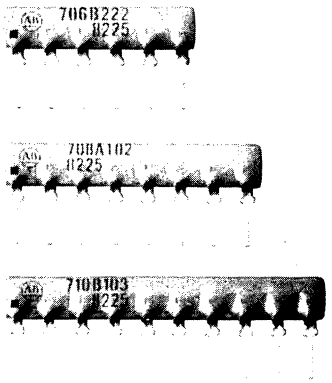


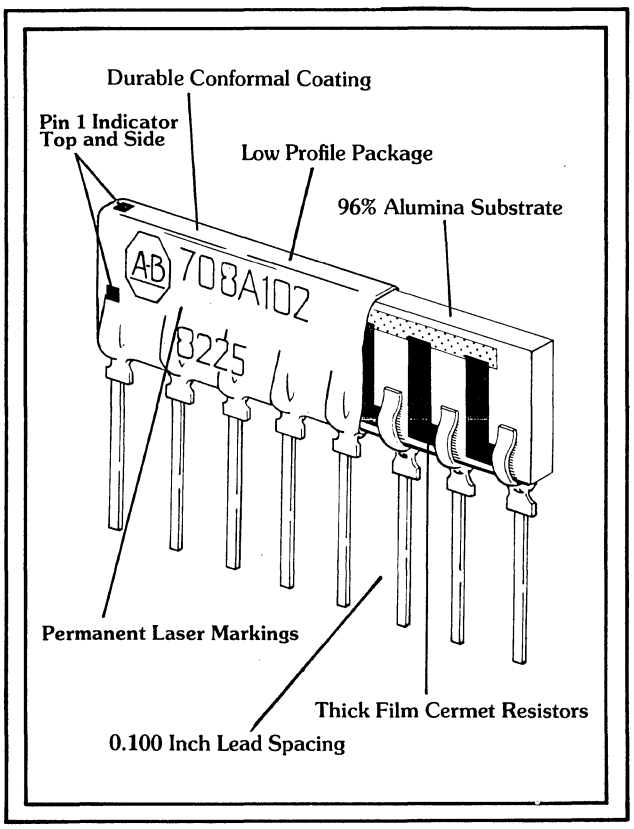
C-SIP
Single In-Line Package

Series 700 Conformal Coated Cermet Resistor Networks

FEATURES

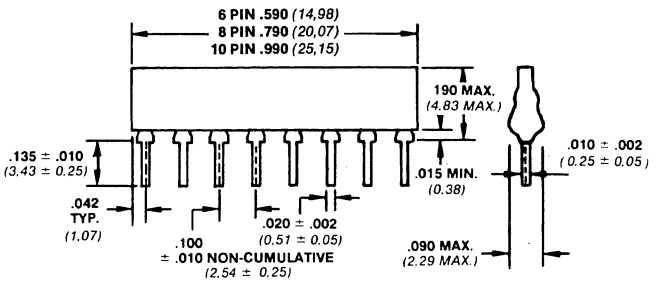
- 96% Alumina Substrate
- Permanently Laser Marked
- Part Markings — Side and Top
- 0.100 Inch (2,54mm) Lead Spacing
- Low Package Height
  0.190 Inch (4,8mm)
- 6, 8 and 10 Pins
- Durable Conformal Coating
- Standard Circuits
- High Quality

For more information request Publication EC5440-2.1



DIMENSIONS

Low profile 700 series

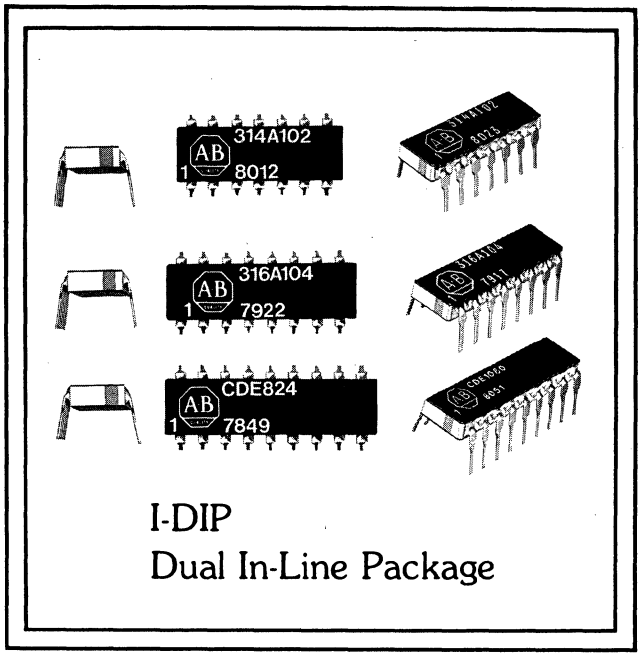


NOT TO SCALE

Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.

Applications

— Pull-up and pull-down arrays
— Transmission line terminators
— Current limiting resistors
— ECL terminating networks



I-DIP
Dual In-Line Package

Series 314, 316 Cermet Resistor Networks

FEATURES

- Solid Ceramic Body
- Solder Coated Leads
- 0.100 Inch (2,54mm) Lead Spacing
- Low Profile
- 14, 16 and 18 Pin Construction
- Automatically Insertable

For more information request Publication EC5410-2.1.

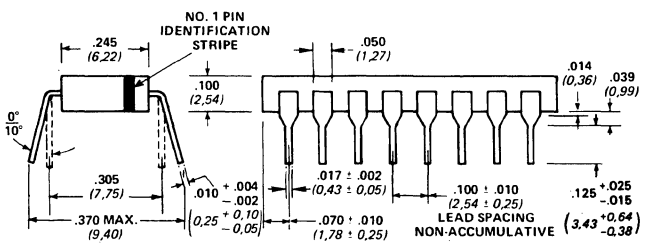
Standard network applications

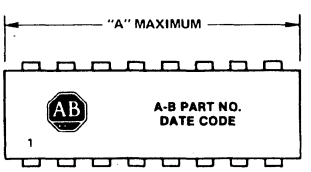
NETWORK								
314A 316A	314B 316B	314E 316E	316LR8 316L08 314L10	314M110 314M120 314M125	314M130	316T110	314X101 316X101	314Z
APPLICATIONS								
Pull-Up Resistor Arrays for Unused TTL Gates Parallel High Speed Circuitry Wired OR Configurations Pull-Down Applications TTL-MOS Interfacing Digital Pulse Squaring	Transmission Line Termination Power Gate Pull-Up Current Limiting Logic Level Translation	Digital Line Termination ECL and TTL Applications	8 BIT R/2R Ladder 10 BIT R/2R Ladder Network for D/A and A/D Converter with Bi Polar or CMOS Switches	Complement the 7520 Series of Core Memory Sense Amps	Core-Memory Sense Line Applications with Two 711 Dual Voltage Comparators	TTL to ECL Translator Network	Interconnect Networks Shorting Applications Matrix Interconnections Test Plugs	Fixed Voltage Attenuation with Impedance Matching

DIMENSIONS

"A" Maximum		Number of Leads
Decimal	Metric	
.745	18,92	14
.845	21,46	16
.945	24,00	18

Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.





TOLERANCES

Dimensional Tolerance ± .005 (0,13)
Angular Tolerance ± 5° Except as Specified.

NOT TO SCALE

Standard Markings
A-B Logo
A-B Part Number
Date Code
Pin #1

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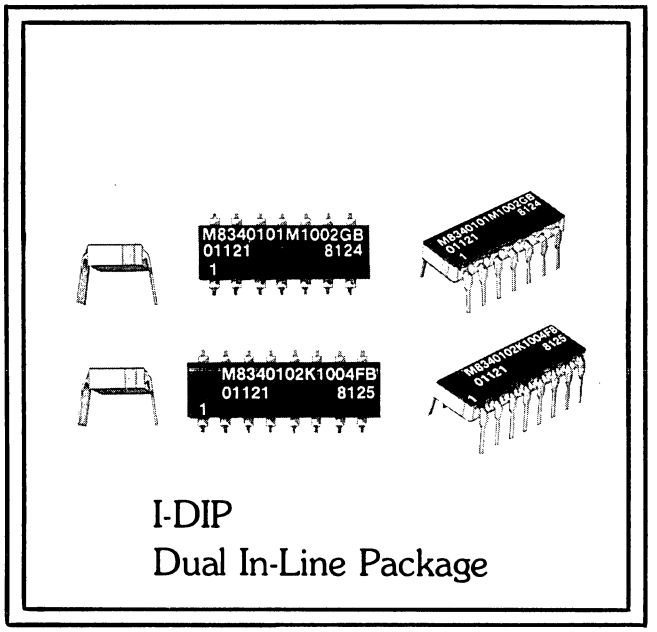


I-DIP
Dual In-Line Package

Series 514, 516 Military Resistor Networks MIL-R-83401

FEATURES

- Solid Ceramic Body
- Solder Coated Leads
- 100% Screened per MIL-R-83401
- Low Profile
- 14 and 16 Pin Construction
- Automatically Insertable
- MIL-R-83401 Qualified

For more information request Publication EC5430-2.1.

General capabilities

Package Style Number of Pins

M83401	Description
01	14 pin DIP
02	16 pin DIP

Schematic Circuit Layout

M83401	Description
A	Isolated resistors
B	Resistors with a common buss

Characteristic Temperature Coefficient

M83401	Description
K	±100 ppm/°C
M	±300 ppm/°C

Tolerance

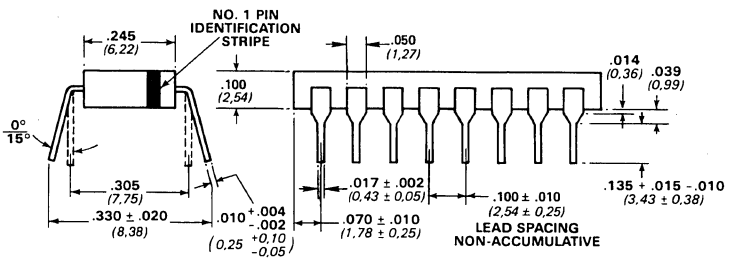
M83401	Description
F	±1%
G	±2%
J	±5%

Resistance Range

33 ohms to 1 megohm

DIMENSIONS

"A" Maximum		Number of Leads
Decimal	Metric	
.745	18,92	14
.845	21,46	16

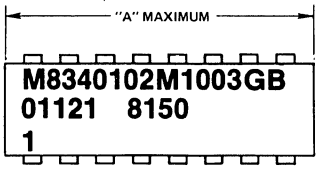


Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.

TOLERANCES

Dimensional Tolerance ±.005 (0,13)
Angular Tolerance ±5° Except as Specified.

NOT TO SCALE



Standard Markings
Military Part Number
Federal Source Code
Date Code
Pin 1

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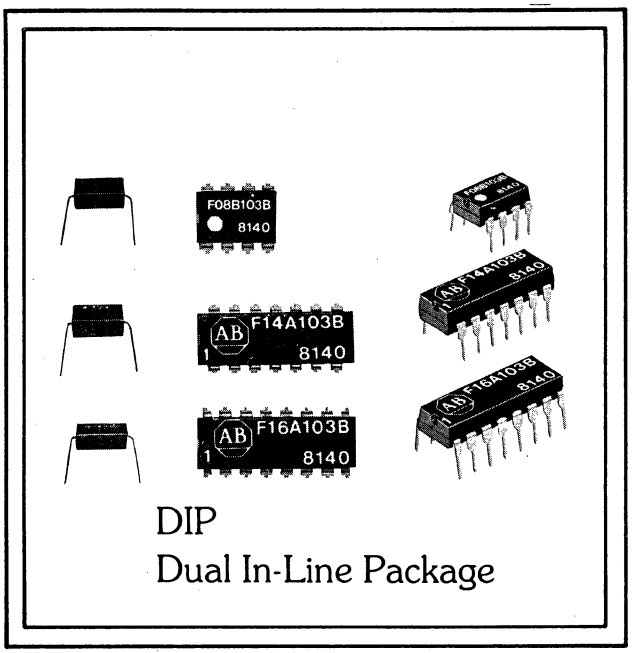


Series F08, F14, F16 Thin Film Resistor Networks

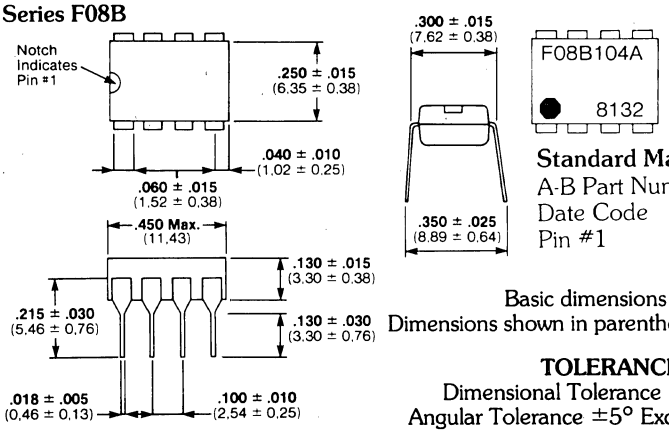
FEATURES

- 99.5% Alumina Substrate
- Molded Epoxy DIP Package
- 0.100 Inch (2,54mm) Lead Spacing
- Low Profile
- 8, 14 and 16 Pin Construction
- Automatically Insertable
- Meets Specifications of Characteristic V of MIL-R-83401

For more information request Publication EC5512-2.1.

DIMENSIONS

Series F08B



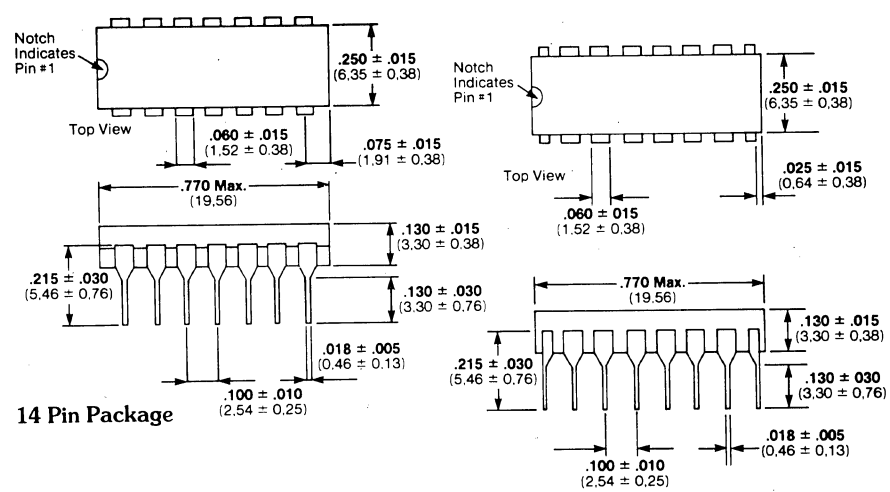
Standard Marking
A-B Part Number
Date Code
Pin #1

Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.

TOLERANCES
Dimensional Tolerance ±.005 (0,13)
Angular Tolerance ±5° Except as Specified.

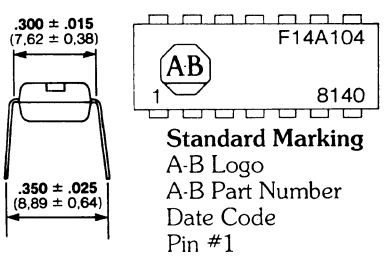
NOT TO SCALE

Series F14A, F14B, F16A, and F16B



Standard network applications

NETWORK	
F14A F16A	F08B F14B F16B
APPLICATIONS	
Pull-Up Resistor Arrays for Open TTL Gates	Matched Pairs
Parallel High Speed Circuitry	Current Limiting
Wired OR Configurations	Transmission Line Termination
Pull-Down Applications	Power Gate Pull-Up
TTL-MOS Interfacing	Logic Level Translation
Digital Pulse Squaring	



Standard Marking
A-B Logo
A-B Part Number
Date Code
Pin #1

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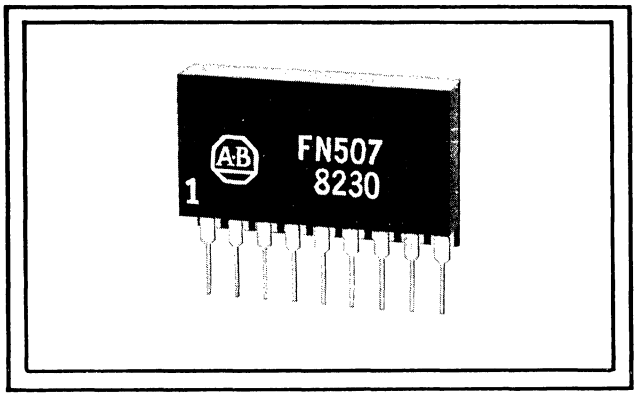
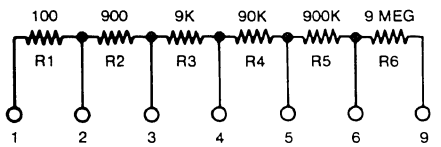


Series FN507 Precision Voltage Divider

Network schematic



Applications

— Input attenuation
— Range selection
— Digital instrumentation
— Digital voltmeters
— Digital multimeters

Standard
Thin Film Resistor Networks

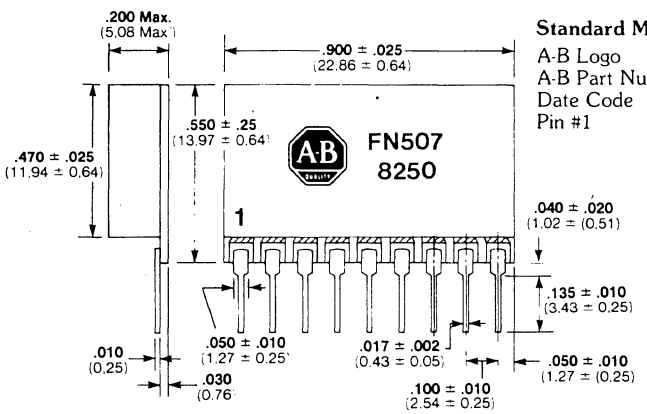
FEATURES

- 10 Megohms Range
- 4 or 5 Decades Attenuation
- .03% Ratios
- 0 to 1000 Volts
- ±5 ppm/°C Tracking 1K, 10 K, 100K and 1M to 10M

For more information request Publication EC5515-2.1.

DIMENSIONS

Packaged ceramic SIP FN507



Standard Markings
A-B Logo
A-B Part Number
Date Code
Pin #1

Basic dimensions in inches.
Dimensions shown in parentheses are in millimeters.

TOLERANCES
Dimensional Tolerance ±.015 (0,38)
Except as Specified.

NOT TO SCALE

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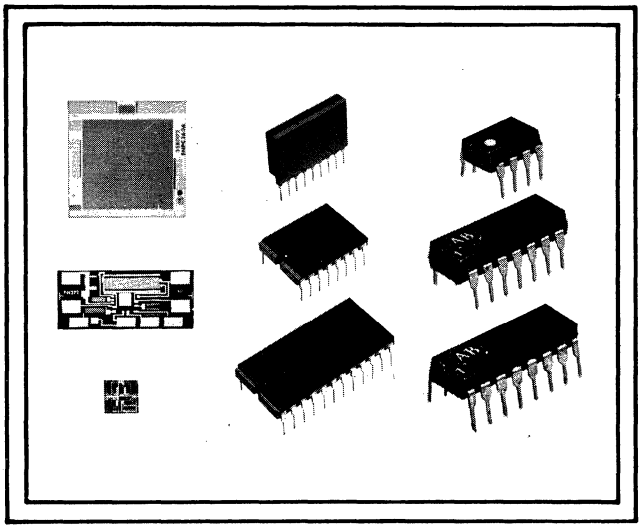
Milwaukee, Wisconsin 53204



Series FC, FG

Precision Thin Film Custom Resistor Networks

FEATURES

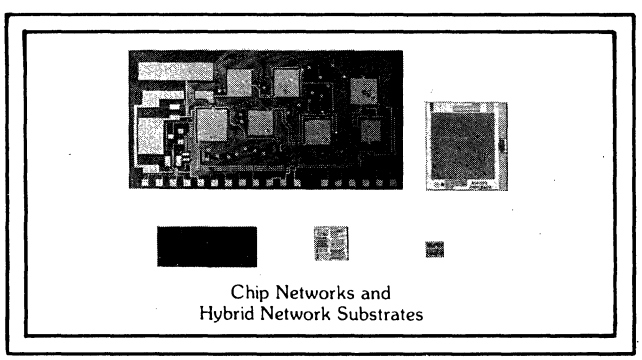
- 1K Ohms to 10 Megohms
- ± 0.015% Tolerance
- ± 0.015% Ratio
- ± 25 ppm/°C TCR
- ± 5 ppm/°C TCR Tracking
- SIP Package (ceramic)
- DIP Packages (molded and ceramic)
- Chip Resistor Networks (alumina or glass)
- Hybrid Network Substrates (alumina or glass)

For more information request Publication EC5510-2.1.

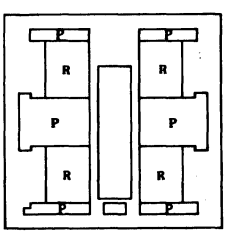
Applications

These precision networks are ideally suited for use on any electronic equipment requiring close tolerances and/or low temperature coefficient resistors. Some of these applications are listed below.

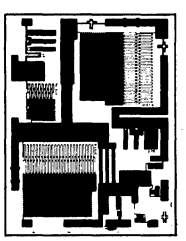
— Ladder networks
— Digital multimeters
— Current summing applications
— Precision attenuators
— A/D and D/A converters
— Communication equipment
— Precision voltage dividers
— Telemetry equipment
— Coding and decoding circuitry
— Measurement bridges
— Paging systems



Chip Networks and
Hybrid Network Substrates



Chip Network



Hybrid Network Substrate

Hybrid network substrates — Allen-Bradley hybrid network substrates contain resistors, bonding pads and interconnections used in producing hybrid networks. Allen-Bradley does not manufacture complete hybrid circuits, but does manufacture the basic hybrid network substrates.

Termination and bonding pad material — Gold, with a minimum thickness of 5000A, is used for all termination pads, bonding pads and interconnections. This material is compatible with ultrasonic and thermocompression bonding methods for attaching gold or aluminum wire, integrated circuit dice, LID's or beam leaded IC's. Chip capacitors can be attached by reflow solder methods.

Substrate material — Glass: Corning 7059 glass (Barium Alumino Silicate - electrically inert [Alkali-free]) .032 ± .005 inch (0,81 ± 0,13mm) thick. Ceramic: 99.5% Alumina, .010 ± .001 inch (2,54 ± 0,3mm) thick.

User trimmable option — Chip and hybrid network resistors can be trimmed to tolerance by Allen-Bradley or, if needed, resistors can be

designed for active trimming by the user during final hybrid assembly operations to meet predetermined functional requirements. The amount of adjustment available is dependent on the initial resistance value, resolution, final value and available substrate area. The active trimming results in a positive resistance change only and can be done by mechanical methods or a laser. These networks are referred to as user trimmable resistor networks.

Standard substrate sizes (in inches) —

.150 x .150	.350 x .150	.200 x .200	.600 x .200
.250 x .150	.450 x .150	.400 x .200	.250 x .250

Bonding pad sizes — 5 mils x 5 mils minimum.

Resistance range — 1K ohms to 10 megohms.

Tolerances — Absolute: as low as ± 0.015% at + 25°C. Ratio: as low as ± 0.015% at + 25°C.

TCR — ± 25 ppm/°C
TCRT — ± 5 ppm/°C

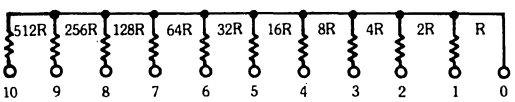
Temperature ranges of operation — −55°C to +125°C or 0°C to +70°C. Other ranges available.

Power rating — Up to 50mw per resistor.

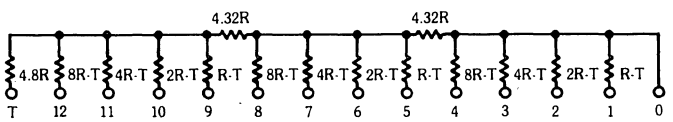
DIAGRAMS

Thin film custom resistor network suggestions

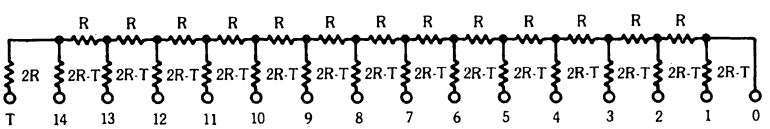
A/D — D/A Converter Networks



Binary Code — Summing Ladder Network

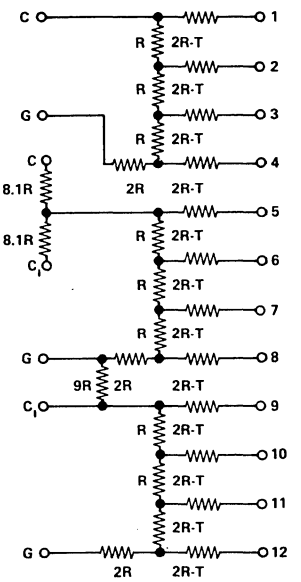


1-2-4-8 BCD Code Ladder Network

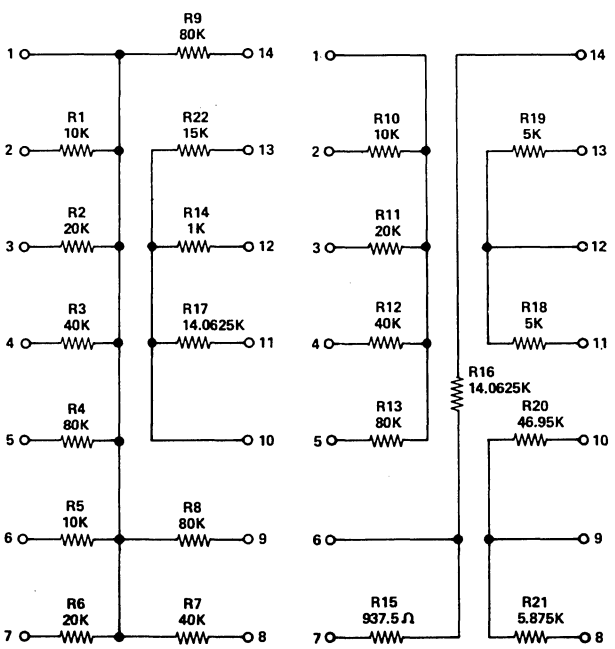


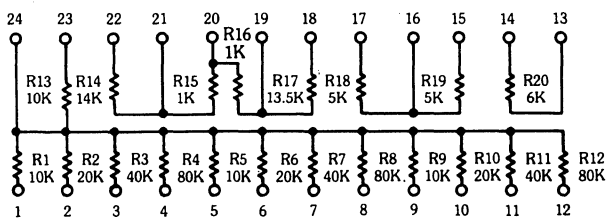
Binary Code — R/2R Voltage Ladder Network

1-2-4-8 BCD Code Ladder Network



A/D - D/A Converter Networks for use with integrated circuit quad current switches





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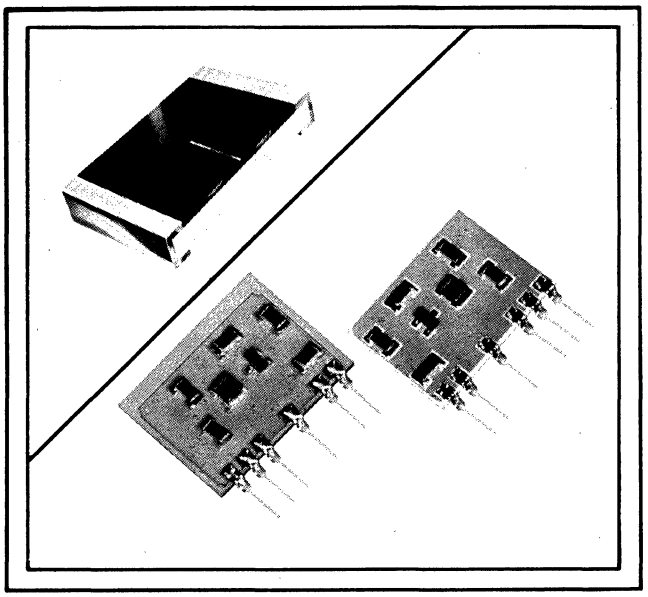
Type BC Chip Resistor

1/8 Watt at 70° C
±5%, 200 PPM/° C
±1%, 100 PPM/° C
Zero Ohm Jumper



FEATURES

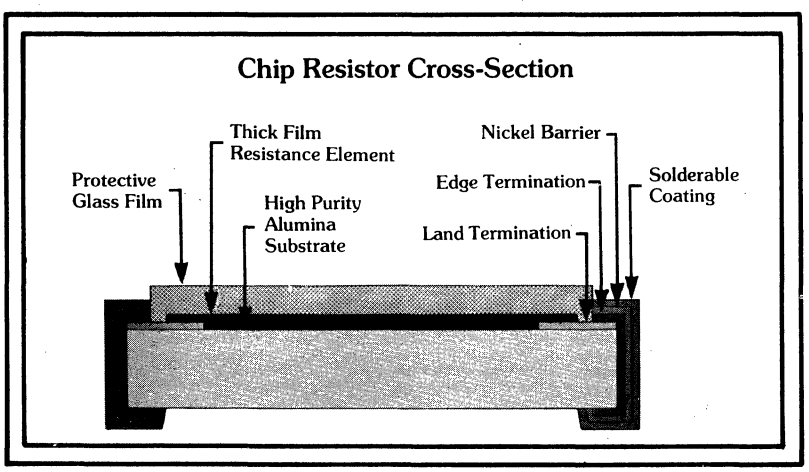
- Thick Film Resistance Element
- High Purity Alumina Substrate
- Glass Passivated
- Tight TCR
- Standard Size, 1.6 x 3.2 x 0.6 mm
- Wrap-around Termination
- Inner Electrode Protection
- Wave or Reflow Solderable
- Surface Attachable

For more information request Publication EC5110-2.1.

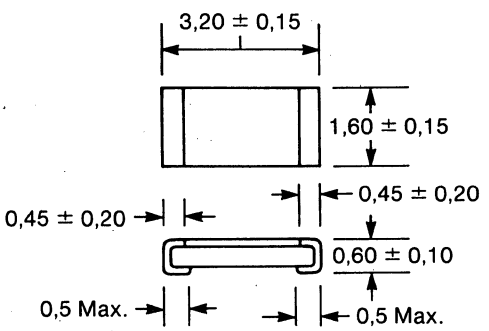
Nominal resistance range -
5% - 10 ohms to 2.2 megohms, E24 series
1% - 49.9 ohms to 2.2 megohms, E96 series.
Higher values available upon request.

Standard Resistance Values — 5% (E24)					
10	15	22	33	47	68
11	16	24	36	51	75
12	18	27	39	56	82
13	20	30	43	62	91

Standard Resistance Values — 1% (E96)											
10.0	12.1	14.7	17.8	21.5	26.1	31.6	38.3	46.4	56.2	68.1	82.5
10.2	12.4	15.0	18.2	22.1	26.7	32.4	39.2	47.5	57.6	69.8	84.5
10.5	12.7	15.4	18.7	22.6	27.4	33.2	40.2	48.7	59.0	71.5	86.6
10.7	13.0	15.8	19.1	23.2	28.0	34.0	41.2	49.9	60.4	73.2	88.7
11.0	13.3	16.2	19.6	23.7	28.7	34.8	42.2	51.1	61.9	75.0	90.9
11.3	13.7	16.5	20.0	24.3	29.4	35.7	43.2	52.3	63.4	76.8	93.1
11.5	14.0	16.9	20.5	24.9	30.1	36.5	44.2	53.6	64.9	78.7	95.3
11.8	14.3	17.4	21.0	25.5	30.9	37.4	45.3	54.9	66.5	80.6	97.6



DIMENSIONS



Note: All dimensions in millimeters.

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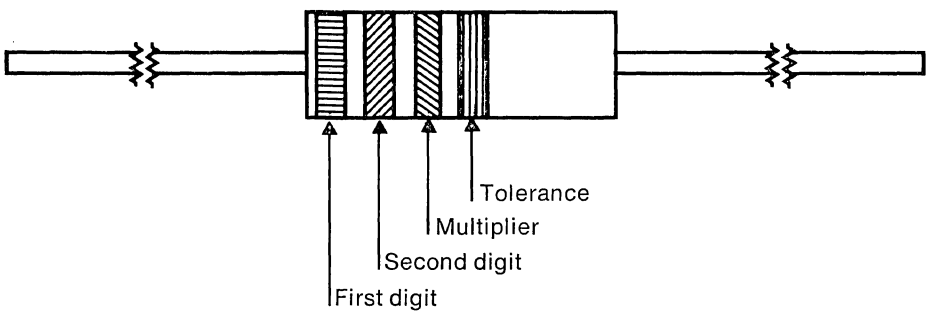
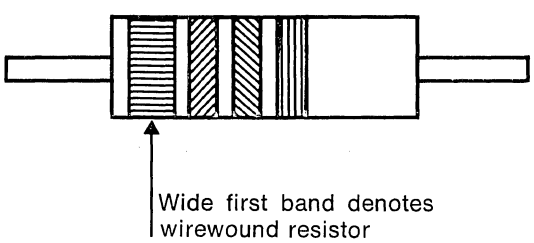
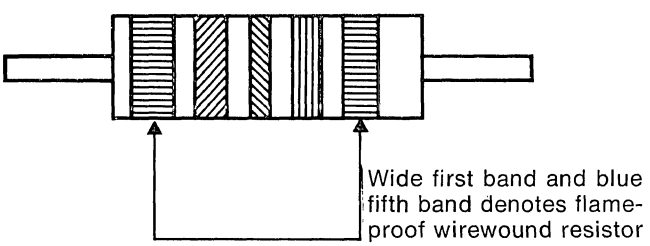
MINIGLOSSARY
RESISTOR COLOR CODES

EIA/MIL Resistor Color Codes



Color code for general-purpose industrial resistors

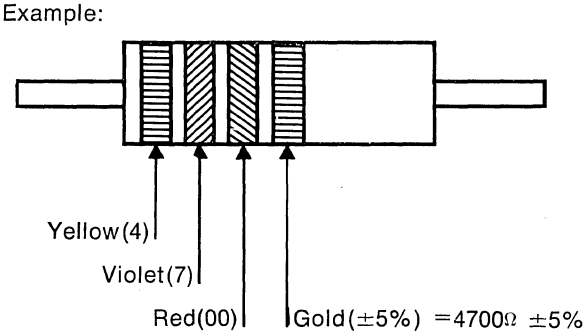




Color code for general-purpose wirewound resistors

Color	Significant digit	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1000	± 3%
Yellow	4	10,000	± 4%
Green	5	100,000	—
Blue	6	1,000,000	—
Violet	7	10,000,000	—
Gray	8	—	—
White	9	—	—
Gold	—	0.1	± 5%
Silver	—	0.01	±10%
No color	—	—	±20%

Example:



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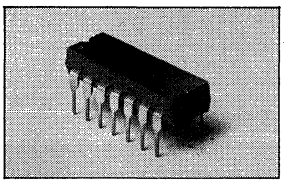
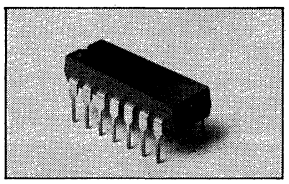
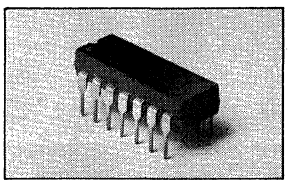
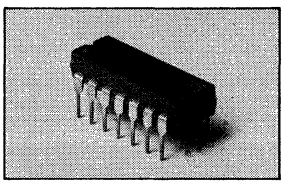
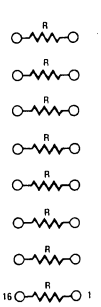
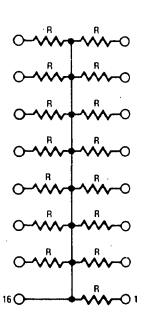
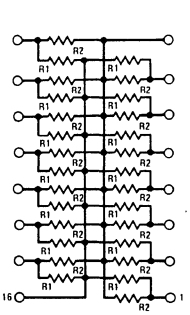
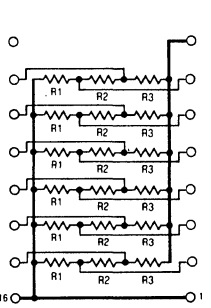
BOURNS® DIP RESISTOR NETWORKS

4114R-001 4116R-001	4114R-002 4116R-002	4114R-003 4116R-003	4116R-008
dual-in-line isolated resistor circuits	dual-in-line bussed resistor circuits	dual-in-line terminator	TTL to ECL translator

	4114R-001 4116R-001	4114R-002 4116R-002	4114R-003 4116R-003	4116R-008
Resistance Range	22Ω-2.2 MegΩ	22Ω-2.2 MegΩ	R1/R2 Combinations are 160/240Ω 180/390Ω 220/270Ω 220/390Ω 330/390Ω 330/470Ω 3K/6.2K	R1 | R2 | R3 180Ω | 270Ω | 820Ω
Temperature	−55°C to +150°C Ambient	−55°C to +150°C Ambient	−55°C to +150°C Ambient	−55°C to +150°C Ambient
Resistance Tolerance	±2Ω (22Ω to 99Ω) ±2% (100Ω to 220KΩ) ±5% above 220KΩ	±2Ω (22Ω to 99Ω) ±2% (100Ω to 220KΩ) ±5% above 220KΩ	±5%	±2% or ±2Ω
Insulation Resistance	10,000 MegΩ Min.	10,000 MegΩ Min.	10,000 MegΩ Min.	10,000 MegΩ Min.
Power Rating @ 75°C	(Package) 14 Pin 2 Watts 16 Pin - 2.25 Watts Single Resistor 0.25 Watt	(Package) 14 Pin 2 Watts 16 Pin - 2.25 Watts Single Resistor 0.125 Watt	(Package) 14 Pin 2 Watts Per Pair 0.25 Watt Package (16 Pin) 2.25 Watts Per Pair 0.25 Watt	Package: 2.0 Watts Single Resistor 0.125 Watt
Temperature Coefficient	±250 PPM/°C	±250 PPM/°C	±250 PPM/°C	±250 PPM/°C
Standard Load Life	±1.0%	±1.0%	±1.0%	±1.0%
Schematic (Highest pin configurations shown)				

Custom Resistor Networks are available in both DIP and SIP Configurations

Specifications subject to change without notice.

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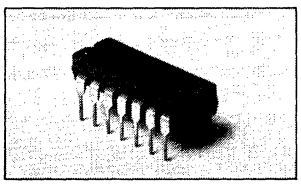
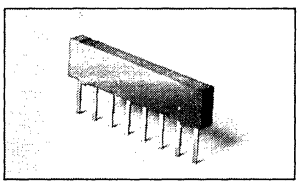
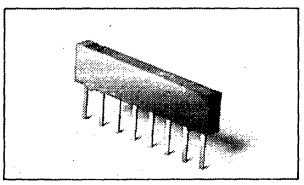
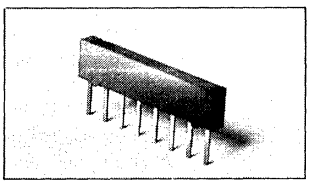
BOURNS® MODEL 4300 SERIES MOLDED SIP NETWORKS

4114R-064 **4116R-064** logic memory network	**4306R-101** **4308R-101** **4310R-101** single-in-line bussed	**4306R-102** **4308R-102** **4310R-102** single-in-line isolated	**4306R-104** **4308R-104** **4310R-104** single-in-line dual terminator

Pass Thru	Pull-Up
* R1	* R2
20Ω	1K
30Ω	1K
40Ω	1K

−55°C to +150°C Ambient

±2Ω or ±2% whichever is greatest

10,000 MegΩ Min.

(Package) 14 Pin 2 Watts, 16 Pin 2.25 Watts. Single Resistor 0.125 Watt

±250 PPM/°C

±1.0%

22Ω to 2.2 MegΩ

−55°C to +150°C Ambient

±2Ω (22Ω to 99Ω)
±2% (100Ω to 220KΩ)
±5% above 220KΩ

10,000 MegΩ Min.

	6	8	10
	Watt		
Package	0.75	1.0	1.25
Single	0.2	0.2	0.2

±250 PPM/°C

±1.0%

22Ω to 2.2 MegΩ

−55°C to +150°C Ambient

±2Ω (22Ω to 99Ω)
±2% (100Ω to 220KΩ)
±5% above 220KΩ

10,000 MegΩ Min.

	6	8	10
	Watt		
Package	0.75	1.0	1.25
Single	0.3	0.3	0.3

±250 PPM/°C

±1.0%

R1	R2
180Ω	390Ω
220Ω	270Ω
220Ω	330Ω
3000Ω	6200Ω

−55°C to +150°C Ambient

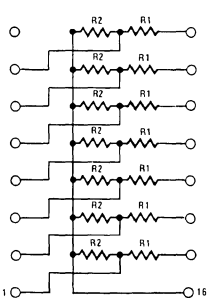
±5%

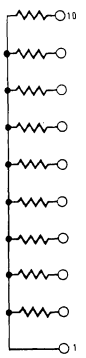
10,000 MegΩ Min.

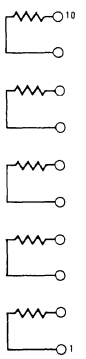
	6	8	10
	Watt		
Package	0.75	1.0	1.25
Pair	0.25	0.25	0.25

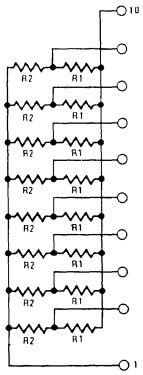
±250 PPM/°C

±1.0%









* Other values available.

Specifications subject to change without notice.

BOURNS INC
NETWORKS DIVISION, 12155 MAGNOLIA AVENUE, RIVERSIDE, CA 92503
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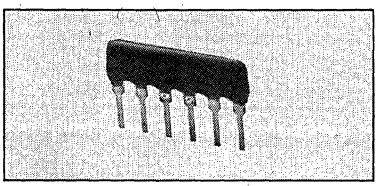
BOURNS® MODEL 4600 SERIES CONFORMAL COATED SIP NETWORKS

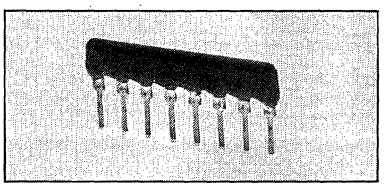
4605X-101
4606X-101
4607X-101
4608X-101
4609X-101

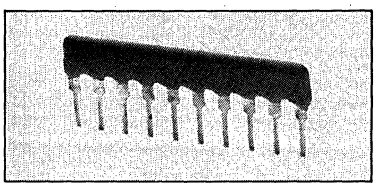
4610X-101
4611X-101
4612X-101
single-in-line
bussed

4606X-102
4608X-102
4610X-102
4612X-102
single-in-line
isolated

4606X-104-R1/R2
4608X-104-R1/R2
4610X-104-R1/R2
single-in-line
dual terminator

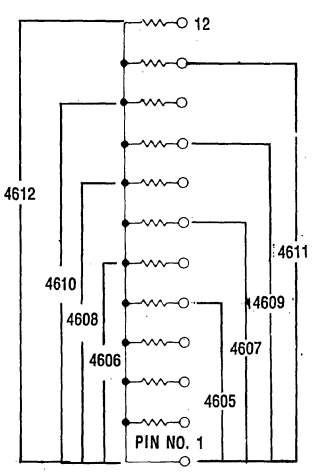


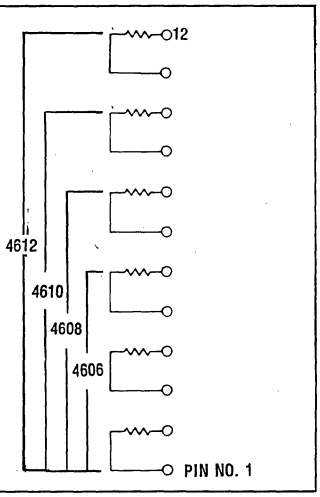


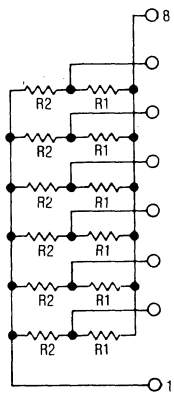


Resistance Range	22Ω to 2.2 MegΩ	22Ω to 2.2 MegΩ	R1/R2 Combinations: 160/240Ω, 180/390Ω, 220/270Ω, 220/390Ω, 330/390Ω, 330/470Ω, 3K/6.2K
Temperature	−55°C to +125°C Ambient	−55°C to +125°C Ambient	−55°C to +125°C Ambient
Resistance Tolerance	±2Ω (22Ω to 99Ω) ±2% (100Ω to 220KΩ) ±5% above 220KΩ	±2Ω (22Ω to 99Ω) ±2% (100Ω to 220KΩ) ±5% above 220KΩ	±5%
Insulation Resistance	10,000 MegΩ Minimum	10,000 MegΩ Minimum	10,000 MegΩ Minimum
Power Rating (Watts) @ 75°C	Package: 5 (.625), 6 (.750), 7 (.875), 8 (1.0); Single: 0.2, 0.2, 0.2, 0.2 Package: 9 (1.125), 10 (1.250), 11 (1.375), 12 (1.50); Single: 0.2, 0.2, 0.2, .02	Package: 6 (0.75), 8 (1.0), 10 (1.25), 12 (1.5); Single: .3, .3, .3, .3	Package: 6 (0.75), 8 (1.0), 10 (1.25); Pair: .25, .25, .25
Temperature Coefficient	±100 PPM/°C	±100 PPM/°C	±100 PPM/°C
Standard Load Life	± 1.0%	± 1.0%	± 1.0%

Schematics







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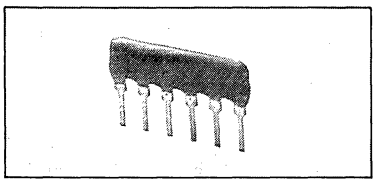
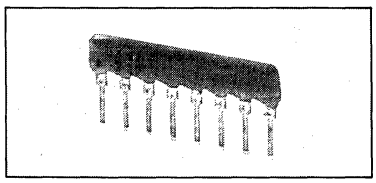
Resistor Networks Competitive Cross-Reference Guide
BOURNS® MODEL 4600 SERIES CONFORMAL COATED SIP NETWORKS

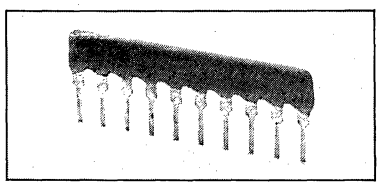
4606X-101
4608X-101
4610X-101
single-in-line
bussed



4606X-102
4608X-102
4610X-102
single-in-line
isolated



4606X-104-R1/R2
4608X-104-R1/R2
4610X-104-R1/R2
single-in-line
dual terminator



	6 Pins, 5 Resistors Pin 1 Common	6 Pins, 3 Resistors Isolated	6 Pins, 8 Resistors Dual Terminator	8 Pins, 7 Resistors Pin 1 Common	8 Pins, 4 Resistors Isolated	8 Pins, 12 Resistors Dual Terminator	10 Pins, 9 Resistors Pin 1 Common	10 Pins, 5 Resistors Isolated	10 Pins, 16 Resistors Dual Terminator
BOURNS (Conformal Low Profile)	4606X-101-XXX ③	4606X-102-XXX ③	4606X-104-XXX/XXX ③	4608X-101-XXX ④	4608X-102-XXX ④	4608X-104-XXX/XXX ④	4610X-101-XXX ⑤	4610X-102-XXX ⑤	4610X-104-XXX/XXX ⑤
ALLEN-BRADLEY	906AXXX 106AXXX 206AXXX 406AXXX	906BXXX 106BXXX 206BXXX 406BXXX	106EXXXXXX 206EXXXXXX 406EXXXXXX 906EXXXXXX	908AXXX 108AXXX 208AXXX 408AXXX	908BXXX 108BXXX 208BXXX 408BXXX	108EXXXXXX 208EXXXXXX 408EXXXXXX 908EXXXXXX	110AXXX 210AXXX 410AXXX 910AXXX	110BXXX 210BXXX 410BXXX 910BXXX	110EXXXXXX 210EXXXXXX 410EXXXXXX 910EXXXXXX
BECKMAN ①	L06-1-RXXX 783-1-RXXX 763-1-RXXX	L06-3-RXXX 783-3-RXXX 763-3-RXXX	L06-5-RXXX/XXX 783-5-RXXX/XXX 763-5-RXXX/XXX	L08-1-RXXX 764-1-RXXX 784-1-RXXX	L08-1-RXXX 764-3-RXXX 784-3-RXXX	L08-5-RXXX/XXX 764-5-RXXX/XXX 784-5-RXXX/XXX	L10-1-RXXX 785-1-RXXX 765-1-RXXX	L10-3-RXXX 785-3-RXXX 765-3-RXXX	L10-5-RXXX/XXX 785-5-RXXX/XXX 765-5-RXXX/XXX
CENTRA LAB	HC21-06-XXX HC31-06-XXX HF21-06-XXX HF31-06-XXX	HC22-06-XXX HC32-06-XXX HF22-06-XXX HF32-06-XXX		HC21-08-XXX HC31-08-XXX HF21-08-XXX HF31-08-XXX	HC22-08-XXX HC32-08-XXX HF22-08-XXX HF32-08-XXX		HC21-10-XXX HC31-10-XXX HF21-10-XXX HF31-10-XXX	HC22-10-XXX HC32-10-XXX HF22-10-XXX HF32-10-XXX	
CTS ①	750-61-RXXX	750-63-RXXX		750-81-RXXX	750-83-RXXX	750-85-R-XXX/XXX	750-101-RXXX	750-103-RXXX	750-105-R-XXX/XXX
DALE	CSC06A-01XXX CSP06E-01XXX CSP06G-01XXX SIP06A-01XXX	CSC06A-03XXX CSP06E-03XXX CSP06G-03XXX SIP06A-03XXX	CSC06A-05-XXX/XXX	CSC08A-01XXX CSP08E-01XXX CSP08G-01XXX SIP08A-01XXX	CSC08A-03XXX CSP08E-03XXX CSP08G-03XXX SIP08A-03XXX	CSC05XXX/XXX	CSC10A-01XXX CSP10E-01XXX CSP10G-01XXX SIP10A-01XXX	CSC10A-03XXX CSP10E-03XXX CSP10G-03XXX SIP10A-03XXX	CSC10A-05-XXX/XXX
DALE MSP, MSM ②	06A01-XXX 06C01-XXX	06A03-XXX 06C03-XXX	06A05-XXX/XXX	08A01-XXX 08C01-XXX	08A03-XXX 08C03-XXX	08A05-XXX	10A01-XXX 10C01-XXX	10A03-XXX 10C03-XXX	10A05-XXX/XXX
MEPCO ELECTRA	9N06XXXXGL002 9S06XXXXGL002 S06AZE-XXX	9N06XXXXGL001 9S06XXXXGL001		9N08XXXXGL002 9S08XXXXGL002 S08AZG-XXX	9N08XXXXGL001 9S08XXXXGL001		9N10XXXXGL002 9S10XXXXGL002 S10AZ1-XXX	9N10XXXXGL001 9S10XXXXGL001	
SPRAGUE	256CFXXXX2PD 216CFXXXX2PD	256CFXXXX2SR 216CFXXXX2SR		420CHXXXX2PD 256CHXXXX2PD 216CHXXXX2PD	420CHXXXX2SR 256CHXXXX2SR 216CHXXXX2SR	216CHXXXX2TR 216CHXXXX2TRA 216CHXXXX2TRB 420CHXXXX2TR 420CHXXXX2TRA 420CHXXXX2TRB	256CKXXXX2PD 216CKXXXX2PD	256CKXXXX2SR 216CKXXXX2SR	
MURATA	RSC6X-XXX	RSC6Y-XXX	RSC6Z-XXX/XXX	RSC8X-XXX	RSC8Y-XXX	RSC8Z-XXX/XXX	RSC10X-XXX	RSC10Y-XXX	RSC10Z-XXX/XXX
CORNING	MC6001XXX MM6001XXX LC6001XXX LM6001XXX	MC6002XXX MM6002XXX LC6002XXX LM6002XXX	MC6003XXX/XXX MM6003XXX/XXX LC6003XXX/XXX LM6003XXX/XXX	MC8001XXX MM8001XXX LC8001XXX LM8001XXX	MC8002XXX MM8002XXX LC8002XXX LM8002XXX	MC8003XXX/XXX MM8003XXX/XXX LC8003XXX/XXX LM8003XXX/XXX	MC0001XXX MM0001XXX LC0001XXX LM0001XXX	MC0002XXX MM0002XXX LC0002XXX LM0002XXX	MC0003XXX/XXX MM0003XXX/XXX LC0003XXX/XXX LM0003XXX/XXX

NOTES:

① "XXX" denotes resistance value (Beckman and CTS) or code (Bourns and all others).
②MIL Part. Bourns offers commercial replacement.
③Rated .75 watts at 75°C.
④Rated 1.0 watts at 75°C.
⑤Rated 1.25 watts at 75°C.

Tolerance indicators, usually added as a suffix to the basic P/N when the tolerance is different from the mfr. standard tolerance.

F= ± 1%
G= ± 2%
J= ± 5%
K= ± 10%
M= ± 20%

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

High Performance Film Resistors

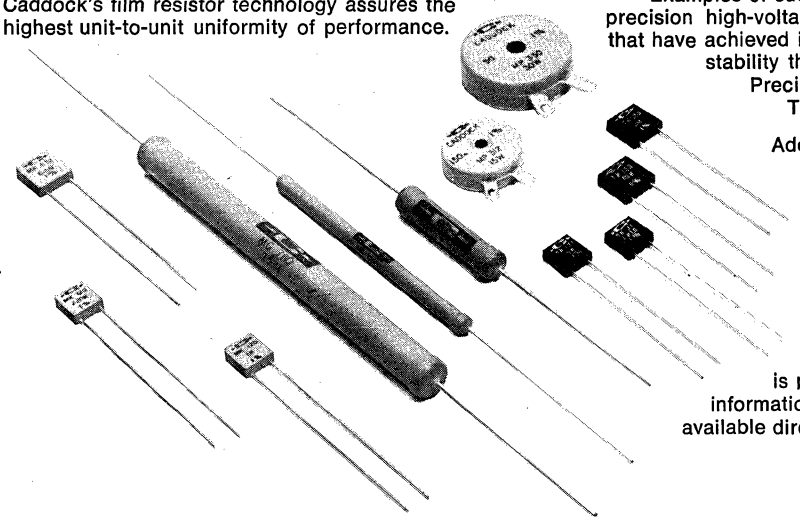
This 20th Edition of the Caddock Electronics General Catalog describes over 150 in-production models of precision discrete resistors and resistors networks that utilize Caddock's high-stability, extended-life Micronox® and Tetrinox™ resistance films. With 20 years of experience and an exceptional record of in-circuit performance and reliability, Caddock Electronics continues to lead the industry in the development, production and on-time delivery of high performance film resistors.

Caddock's Advanced Resistor Technology Provides Many Exceptional Performance Advantages:

Caddock's advanced resistor technology began in 1962 with the introduction of Micronox® harsh-environment high-power and high-voltage resistors. The Caddock technology was further extended in 1975 with the development of the Tetrinox™ resistance system that made possible the introduction of low TC, ultra-stable resistors and resistor networks.

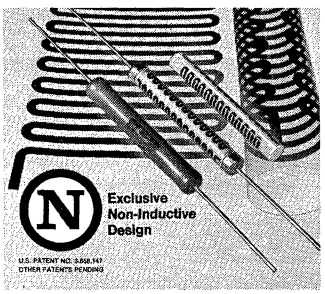
These technological advances have provided the electronics industry with a selection of precision resistor types that achieve many high-performance advantages:

- **Precision** — Tolerances as close as 0.01%.
- **Long-Term Stability** — Better than 0.005% per 1000 hours of operation under full load operating conditions.
- **Higher Power Ratings** — Up to five times higher than other resistor technologies.
- **High Operating Temperatures** — Up to +275°C.
- **Ultra-Low Temperature Coefficients** — Standard to less than 10 PPM/°C and custom values as low as 2 PPM/°C.
- **Unit-to-Unit Uniformity** — The inherent consistency of Caddock's film resistor technology assures the highest unit-to-unit uniformity of performance.



Caddock's Exclusive Non-Inductive Performance Is Available in Both High-Power and High-Voltage Micronox® Film Resistors.

For wide-band, high frequency applications, the advantages of Caddock's Exclusive Non-Inductive Design are available in most models of Micronox® resistors. This special serpentine pattern provides for neighboring lines to carry currents in opposite directions, thereby achieving maximum cancellation of flux fields over the entire length of the resistor.



The result is a truly non-inductive resistor that is about as inductive as a straight piece of wire the length of the resistor body. This efficient design means faster settling times and minimum distortion in all types of high frequency circuits.

The High-Performance Capabilities of Caddock Film Resistors Can Provide Improved Accuracy and Stability to Precision Circuitry:

Because of the special advantages of Caddock's resistance film technology, Caddock High Performance Film Resistors are often specified in the precision circuits that ultimately establish the overall accuracy and stability of the equipment.

Examples of such applications include many types of precision high-voltage supplies and voltage references that have achieved improved accuracy and extended-life stability through the use of Caddock Type MG Precision High-Voltage Resistors and Type T912 Precision Resistor Networks.

Additional examples of the application of this advanced resistor technology include the industry-wide use of Caddock Type 1776 and Type 1787 Precision Decade Divider Resistors in the signal input circuits of laboratory and bench-type digital voltage and current measuring instruments.

An introduction and index to these Caddock resistor technologies is provided on the next page. Additional information and technical assistance is also available directly from our technical staff.

We welcome your call.

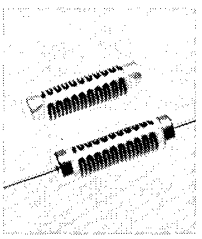
CADDOCK
ELECTRONICS, INCORPORATED.

High Performance Film Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Micronox® Resistance Films

For harsh environmental conditions, Caddock Micronox® resistors are truly unsurpassed. Produced by firing complex-oxide Micronox® resistance films onto ceramic core materials at temperatures above +1400°F, these precision resistors can withstand extremes of temperature, thermal shock, overvoltage and input power.



The result is a family of high voltage, high power precision resistors with an exceptional combination of performance advantages:

- **High Power Ratings** — to 30 watts.
- **High Voltage Ratings** — to 30,000 volts.
- **High Stability** — as close as 0.01% per 1000 hours in 50,000 hour extended life.
- **High Operating Temperatures** — up to +275°C.
- **A Wide Range of Resistance Values In Many Sizes** — from 30 ohms to 2000 Megohms.

These performance advantages make Caddock Micronox® film resistors ideal for use in many types of electronic circuitry, including —

- **Voltage Reference Circuits**
- **High Power Density Packaging**
- **Precision Feedback Circuits**
- **Matched TC Resistor Pairs**

Type MG Precision High-Voltage Resistors
Highest stability at continuous operation to 30,000 volts in single-resistor values as high as 2000 Megohms.

Pages 1•1920 and 1•1921

Type MS and MR Power Film Resistors
Power ratings to 15 watts at 6000 volts in a single axial-lead resistor - plus, Non-Inductive Performance is available.

Pages 1•1922 and 1•1923

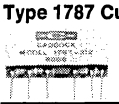
Type ML and MM Precision Film Resistors
Molded case encapsulation to meet high temperature industrial and aerospace requirements.

Page 1•1924

Type MP Chassis Mounted Power Film Resistors
High power density in both 15 and 30 watt ratings with center-screw chassis mounting.
Page 1•1925

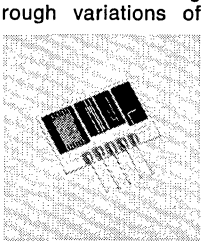
Type MK Low Cost Precision Film Resistors

.75 watt rating at +125° C. Resistance range from 30 ohms to 100 Megohms.
Pages 1•1926 and 1•1927

Type 1787 Current Shunt Resistor Networks

2-, 3- and 4-decade input networks for accurate current sensing in multi-range instrumentation.
Pages 1•1928 and 1•1929

Tetrinox™ Resistance Films

In high-accuracy instrumentation where outstanding circuit performance is required through variations of temperature and through long-term operation, Caddock Tetrinox™ resistance films are the answer.



Constructed with advanced technology complex-oxide resistance films that are fired onto ceramic substrates, Caddock Tetrinox™ film resistors provide a unique combination of performance characteristics:

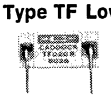
- **Ultra-Low Absolute and Ratio TC** — standard to less than 5 PPM/°C.
- **Ultra-Precision** — tolerances as tight as 0.01%.
- **High Resistance Range** — values to 10 Megohms in a miniature package.
- **Ultra-Stable in Loadlife** — ratio stability to within ±0.01% per 2000 hours.

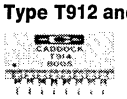
This special combination of advantages make Caddock Tetrinox™ film resistors the optimum choice in many high stability applications, including —

- **Input Voltage Dividers in Precision Laboratory Instrumentation**
- **Precision Bridge Circuits**
- **Precision Voltage Reference Circuits.**
- **Ultra-Stable Voltage Dividers.**
- **Ultra-Low Power Precision Circuitry.**
- **Decade Resistance Networks.**

Type 1776 Precision Decade Resistor Voltage Dividers

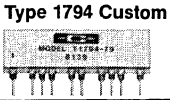
33 models of decade voltage dividers for accurate voltage-division in multi-range digital instrumentation.
Pages 1•1930 and 1•1931

Type TF Low TC Ultra-Precision Film Resistors

The cost-effective replacement for precision high-value wire-wound resistors.
Page 1•1932

Type T912 and T914 Precision Resistor Networks

Resistor pairs and quads with ultra-precision ratio characteristics for analog circuits.
Page 1•1933

Type TK Temp-Stable Precision Film Resistors.

Temperature coefficients to less than 5 PPM/° C in single resistor values as high as 10 Megohms.
Pages 1•1934 and 1•1935

Type 1794 Custom Precision SIP Resistor Networks

Resistor networks with custom package size and custom performance.
Page 1•1936

If you should need additional information on any type of Caddock resistor, please call or write to our engineering and manufacturing offices in Riverside, California.

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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MG Precision High-Voltage Resistors

Highest Long-Term Stability Combined with Precision Tolerances and TC of 80 PPM/° C.

Caddock's Micronox® resistance films are the source of the Type MG Precision High Voltage Resistors' outstanding combination of performance features:

- Single-resistor values as high as 2000 Megohms.
- Maximum continuous operating voltages as high as 30,000 volts.
- Overvoltage capabilities of 150% of the standard working voltages for all models and values.
- Resistance Tolerances from ± 1.0% to ± 0.1%.
- Standard temperature coefficient of 80 PPM/°C in combination with resistance tolerances as tight as ±0.1%.

– plus

- Typical extended life stability of 0.02% per 1000 hours as demonstrated by reliability testing.

This exceptional performance has been proven through many years of use in equipment that demands the highest reliability and stability, including TWT amplifiers, X-ray systems, geophysical instruments and medical electronics.

Special High-Voltage Pulse Performance

All power ratings and maximum working voltage ratings are for continuous duty. These ratings are based on pre-stress voltage levels applied during the manufacturing process to provide for stable resistor performance even under momentary overload conditions.

Maximum working voltages up to 60% higher than the values listed in the table can be achieved through special factory conditioning, provided the power ratings are not exceeded. To specify maximum working voltages above the values listed in the table, add a "-15" to the model number (Example: MG750-15) and identify the overvoltage value with the initial order. (Note that the standard overload and overvoltage ratings do not apply to the "-15" resistors.)

Non-Inductive Performance

Caddock's patented Exclusive Non-Inductive Design uses a serpentine resistive pattern that provides for neighboring lines to carry currents in opposite directions, thereby achieving maximum cancellation of flux fields over the entire length of the resistor. This efficient non-inductive construction is accomplished without derating of any performance advantages.

Most models are available with Caddock's Patented Non-Inductive Design. To specify this performance, add an "N" to the standard model number. (Example: MG750N)

Model No.	Wattage	Max. Continuous Oper. Volt	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance		Dimensions		
						Min.	Max.	A	B	C
MG650	.5	600	225°C	750	80	200Ω	5 Meg	.313 ±.020	.094 ±.015	.025 ±.002
MG655	.5	600	225°C	750	80	200Ω	8 Meg	.313 ±.030	.109 ±.025	.025 ±.002
MG660	.6	1,000	225°C	750	80	400Ω	10 Meg	.500 ±.030	.094 ±.015	.025 ±.002
MG680	.8	2,000	225°C	750	80	600Ω	20 Meg	.750 ±.030	.094 ±.015	.025 ±.002
MG710	1.0	4,000	225°C	750	80	800Ω	50 Meg	1.000 ±.040	.094 ±.015	.025 ±.002
MG712	.6	1,000	225°C	750	80	800Ω	20 Meg	.400 ±.060	.140 ±.030	.025 ±.002
MG714	1.0	1,000	225°C	750	80	200Ω	20 Meg	.562 ±.060	.150 ±.030	.032 ±.002
MG715	1.0	2,000	225°C	750	80	400Ω	50 Meg	.750 ±.060	.140 ±.030	.025 ±.002
MG716	1.5	4,000	225°C	750	80	600Ω	75 Meg	1.000 ±.060	.140 ±.030	.025 ±.002
MG717	1.5	2,000	225°C	750	80	600Ω	75 Meg	.710 ±.050	.240 ±.030	.040 ±.002
MG721	2.0	4,000	225°C	750	80	200Ω	100 Meg	1.000 ±.050	.240 ±.030	.040 ±.002
MG730	3.0	6,000	225°C	1000	80	500Ω	250 Meg	1.500 ±.080	.240 ±.030	.040 ±.002
MG735	3.6	10,000	225°C	1000	80	750Ω	300 Meg	2.000 ±.080	.240 ±.030	.040 ±.002
MG745	5.0	15,000	225°C	1000	80	1K	500 Meg	3.000 ±.100	.240 ±.030	.040 ±.002
MG750	5.0	10,000	225°C	1000	80	400Ω	500 Meg	2.125 ±.060	.315 ±.030	.040 ±.002
MG780	7.5	15,000	225°C	1000	80	600Ω	750 Meg	3.125 ±.060	.315 ±.030	.040 ±.002
MG785	8.0	20,000	225°C	1000	80	800Ω	1000 Meg	4.000 ±.120	.315 ±.030	.040 ±.002
MG810	10.0	25,000	225°C	1000	80	1K	1250 Meg	5.000 ±.120	.315 ±.030	.040 ±.002
MG815	15.0	30,000	225°C	1000	80	1K	2000 Meg	6.000 ±.120	.350 ±.040	.040 ±.002

†Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C

Specifications

Resistance Tolerance: ±1% (tolerances to 0.1% on special order).

Insulation Resistance: 100 megohms, minimum.

Overload/Overvoltage: 5 times rated power with applied voltage not to exceed 1.5 times maximum continuous operating voltage for 5 seconds. ΔR, 0.8% max.

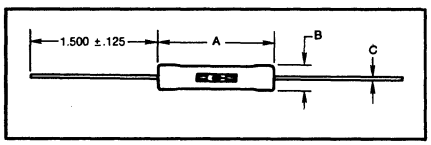
Thermal Shock: MIL-STD-202, Method 107, Cond. C, ΔR, 0.5% max.

Moisture Resistance: MIL-STD-202, Method 106, ΔR, 0.8% max.

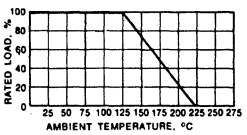
Loadlife: 1000 hours at rated power, ΔR 0.8% max.

Lead Material: Gold Plated.

Encapsulation: Silicone Conformal.

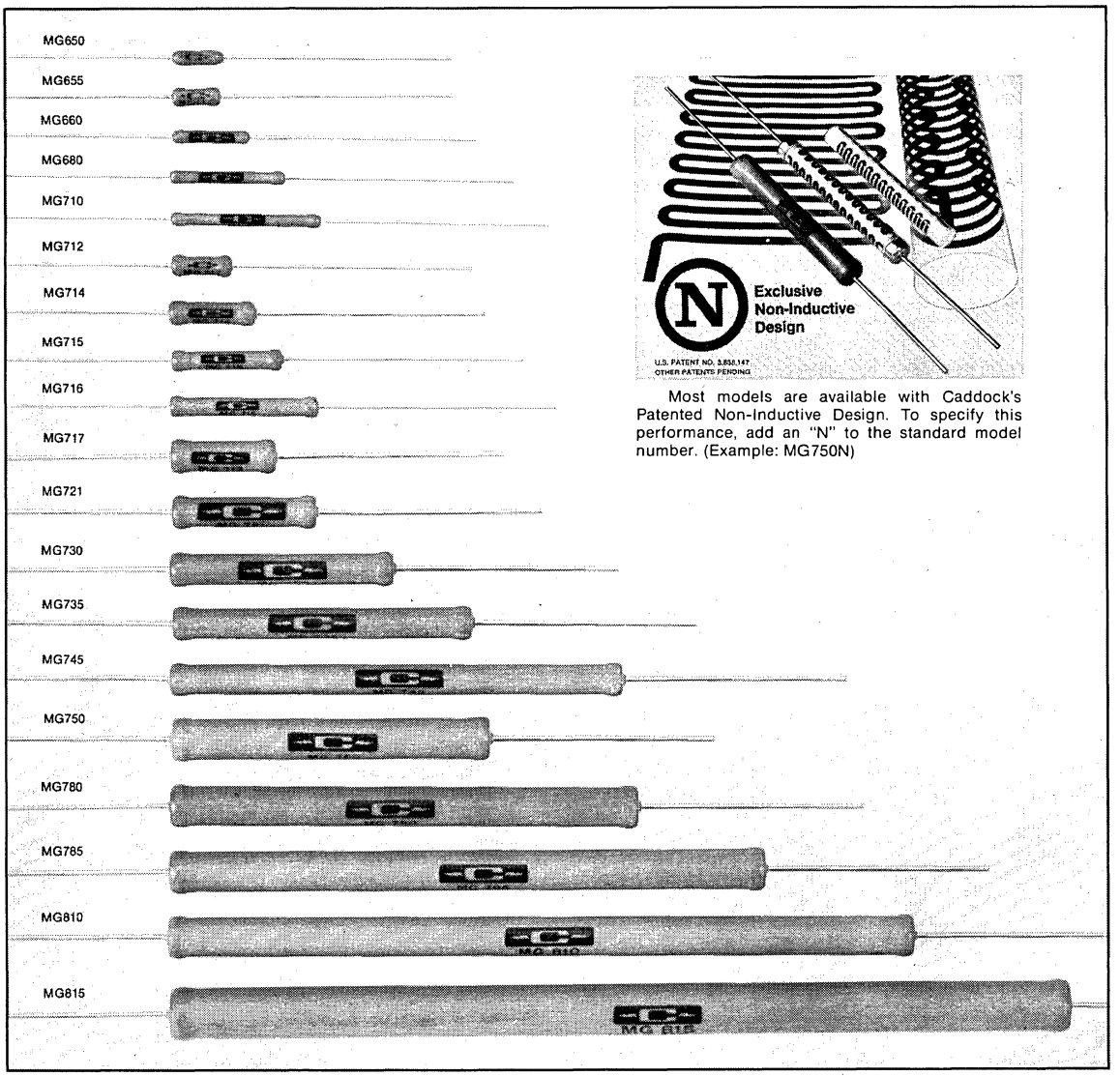


Derating Curve:



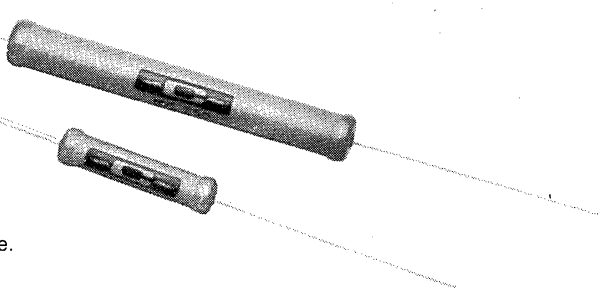
Type MG Precision High-Voltage Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS



Most models are available with Caddock's Patented Non-Inductive Design. To specify this performance, add an "N" to the standard model number. (Example: MG750N)

Matched Type MG Resistor Sets with Tight Ratio Tolerances and Ratio TC Tracking.



The temperature coefficients of Caddock Micronox® resistance films can be controlled to provide matched sets of Type MG resistors with tight ratio TC from -55° C to +105° C.

For high voltage divider applications, ±2% ratio tolerance and 25 PPM/° C ratio tracking is available.

For low voltage, high resistance applications - such as electrometer circuits or high-gain amplifiers - ±0.1% ratio tolerance and 10 PPM/° C ratio tracking is available.

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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MR & MS Power Film Resistors

Power Film Resistor Family with Wide Resistance Range and +275° C Maximum Temperature.

With power ratings to 15 watts and voltage ratings as high as 6000 volts in an axial-lead resistor with values to 30 Megohms, the Type MS Power Film Resistors deliver the performance capabilities that can simplify circuit design and reduce equipment cost and complexity.

Type MS Power Film Resistors provide all these features in a single resistor:

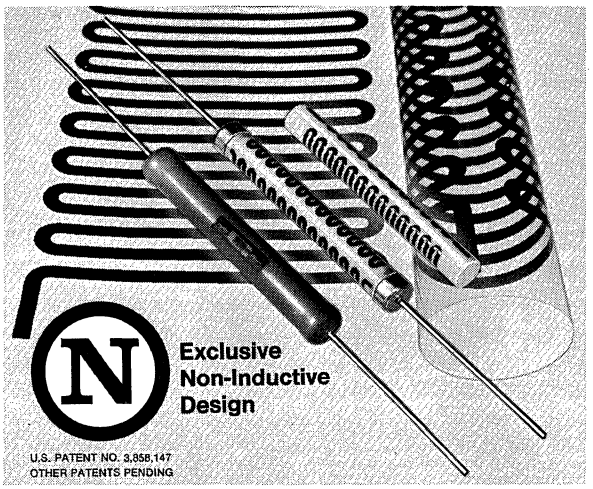
- Full power and voltage ratings, without derating —
  - for non-inductive performance.
  - for high resistance values that extend the critical resistance value up to 10 times.
- Higher voltage ratings without the limitations of minimum wire size and spacing.
- Excellent long-term stability.
  Tests demonstrate typical stability of 0.05% per 1000 hours over extended life.

Micronox® Resistance Films

Type MS performance begins with Micronox® resistance films, the basic element in every Caddock resistor. Produced exclusively by Caddock Electronics, these proven complex oxide films have been used reliably for 20 years in Caddock's precision power resistor products.

Micronox® resistance films are fired directly onto a ceramic core, in air, at 1400° F. These resistance films have demonstrated outstanding stability when exposed to a high ambient temperature, thermal shock and high power densities.

This unique approach to precision power resistors opens new design possibilities by providing wider resistance range, precise temperature characteristics, and higher temperature and power handling capability.



There's no derating of performance when you specify Caddock's Exclusive Non-Inductive Design.

When non-inductive performance is specified, we produce these power film resistors with a serpentine resistive pattern that provides for neighboring lines to carry currents in opposite directions, thereby achieving maximum cancellation of flux fields over the entire length of the resistor.

The result is a truly non-inductive resistor that is about as inductive as a straight piece of wire the length of the resistor body. This efficient design means faster settling times and minimum distortion in all types of high frequency circuits.

Non-inductive construction is available in most models. Specify by adding "N" suffix to Model Number. (Example: MS 310N)

Carefully Controlled Manufacturing and Test Procedures Assure Compliance with Strict Quality Control Requirements

Manufacturing Control

In addition to these procedures, all Type MS Resistors are produced under strict manufacturing controls with processes which include power conditioning, overvoltage conditioning and maximum temperature conditioning.

Quality Control

From the certification and testing of all materials to the supervision of manufacturing processes, all Caddock Type MS and MR Power Film Resistors are produced under procedures that have been approved for conformance to the requirements of NASA NHB5300.4(1C) and MIL-I-45208 in many recent surveys.

Reliability Verification

Type MS Resistors are included in the Caddock Reliability Testing Program. Conformance to specification parameters including Extended Life, Shock, Vibration and Humidity are verified on a periodic basis. Data from MS resistors can be compared by similarity to other Caddock resistor types, since Type ML, MM, MS, MP, MG and MK represent an identical combination of materials —aluminum oxide substrate, Micronox® resistance film and silicone insulating coating.

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Type MR & MS Power Film Resistors

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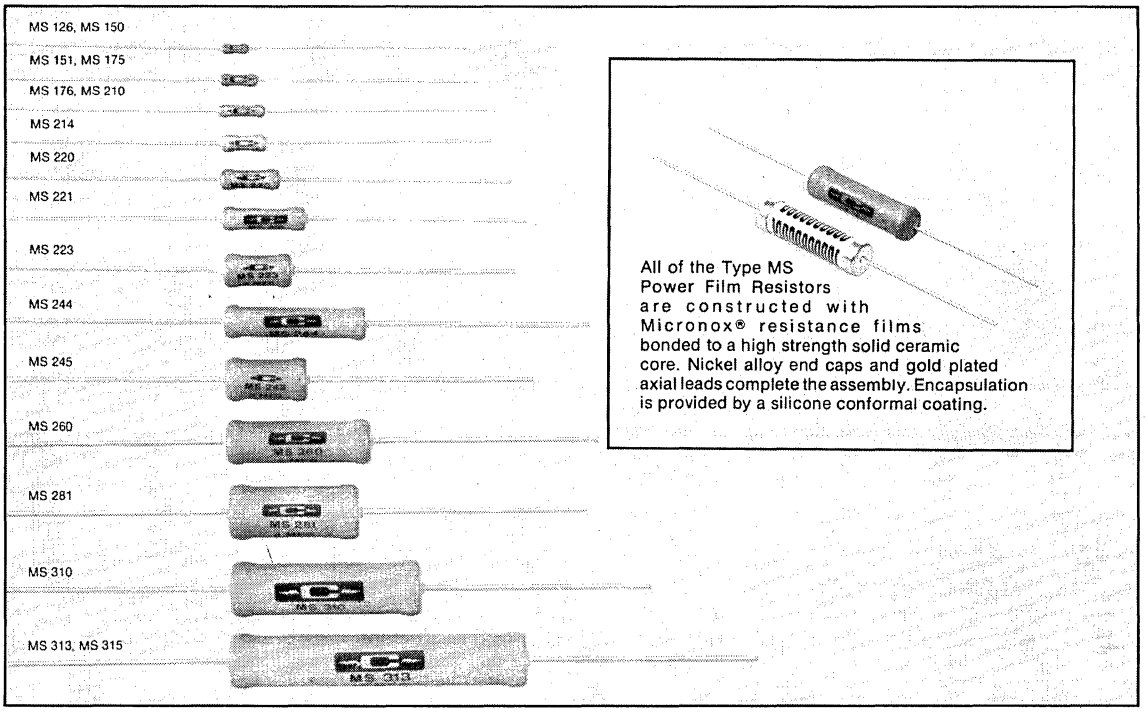
HIGH PERFORMANCE FILM RESISTORS



All of the Type MS Power Film Resistors are constructed with Micronox® resistance films bonded to a high strength solid ceramic core. Nickel alloy end caps and gold plated axial leads complete the assembly. Encapsulation is provided by a silicone conformal coating.

Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance Min.	Resistance Max.	Dimensions A	Dimensions B	Dimensions C	Encapsulation	Leadwire
MR 129	.25	200	275°C	500	150	50Ω	500 K	.188 ±.020	.070 ±.015	.020 ±.002	Silicone Conformal	Nickel
MR 154	.40	300	275°C	750	150	50Ω	1 Meg	.250 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Nickel
MR 178	.60	500	275°C	750	150	50Ω	3 Meg	.313 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Nickel
MS 126	.25	200	275°C	500	50	30Ω	1 Meg	.188 ±.020	.070 ±.015	.020 ±.002	Silicone Conformal	Gold Plated
MS 150	.5	—	275°C	500	50	30Ω	2 K	.188 ±.020	.070 ±.015	.020 ±.002	Silicone Conformal	Gold Plated
MS 151	.5	300	275°C	750	50	30Ω	2 Meg	.250 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Gold Plated
MS 175	.75	—	275°C	750	50	30Ω	2 K	.250 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Gold Plated
MS 176	.75	500	275°C	750	50	45Ω	5 Meg	.313 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Gold Plated
MS 210	1.0	—	275°C	750	50	45Ω	3 K	.313 ±.020	.094 ±.015	.025 ±.002	Silicone Conformal	Gold Plated
MS 214	1.0	500	275°C	750	50	45Ω	5 Meg	.313 ±.030	.109 ±.025	.025 ±.002	Silicone Conformal	Gold Plated
MS 220	2.0	1000	275°C	800	50	45Ω	10 Meg	.400 ±.060	.140 ±.030	.025 ±.002	Silicone Conformal	Gold Plated
MS 221	3.0	1000	275°C	800	50	45Ω	10 Meg	.575 ±.050	.165 ±.030	.032 ±.002	Silicone Conformal	Gold Plated
MS 223	3.0	800	275°C	1000	50	30Ω	4 Meg	.480 ±.060	.230 ±.030	.040 ±.002	Silicone Conformal	Gold Plated
MS 244	4.0	2000	275°C	1000	50	45Ω	15 Meg	.950 ±.060	.230 ±.030	.040 ±.002	Silicone Conformal	Gold Plated
MS 245	4.0	800	275°C	1000	50	30Ω	6 Meg	.570 ±.060	.300 ±.030	.040 ±.002	Silicone Conformal	Gold Plated
MS 260	6.0	2000	275°C	1000	50	45Ω	15 Meg	.970 ±.060	.300 ±.030	.040 ±.002	Silicone Conformal	Gold Plated
MS 281	8.0	2000	275°C	1000	50	45Ω	8 Meg	.910 ±.060	.350 ±.040	.040 ±.002	Silicone Conformal	Gold Plated
MS 310	10.0	4500	275°C	1000	50	45Ω	20 Meg	1.25 ±.070	.350 ±.040	.040 ±.002	Silicone Conformal	Gold Plated
MS 313	12.5	6000	275°C	1000	50	50Ω	30 Meg	2.00 ±.080	.350 ±.040	.040 ±.002	Silicone Conformal	Gold Plated
MS 315	15.0	—	275°C	1000	50	50Ω	1 Meg	2.00 ±.080	.350 ±.040	.040 ±.002	Silicone Conformal	Gold Plated

†Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C

Specifications

Resistance Tolerance: ±1% (tolerances to 0.1% on special order).

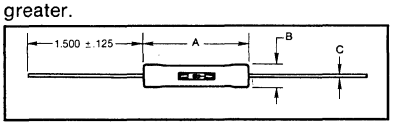
Insulation Resistance: 100 megohms, minimum.

Overload/Overvoltage: 5 times rated power with applied voltage not to exceed 1.5 times maximum continuous operating voltage for 5 seconds. ΔR, 0.5% max. or 0.5 ohms max., whichever is greater.

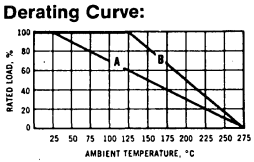
Thermal Shock: MIL-STD-202, Method 107, Cond. C, ΔR, 0.5% max. or 0.5 ohms max., whichever is greater.

Moisture Resistance: MIL-STD-202, Method 106, ΔR, 0.5% max. or 0.5 ohms max., whichever is greater.

Loadlife: 1000 hours at rated power, ΔR 0.5% max. or 0.5 ohms max., whichever is greater.



Derating Curve:



A – all MS models except MS 126, MS 151, MS 176.

B – MS 126, MS 151, MS 176, MR 129, MR 154, MR 178.

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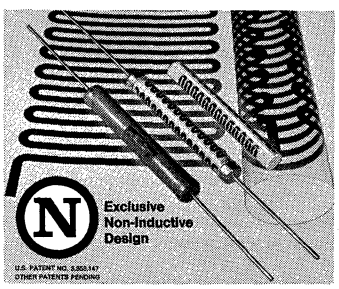
CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type ML & MM Precision Film Resistors

High-Temperature Resistors for Geophysical, Aerospace and Industrial Requirements.

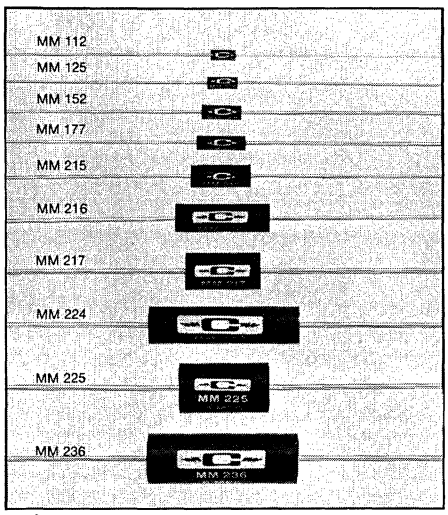
Type MM and ML resistors have a proven performance history in industrial, computer, military and space applications. With power ratings up to 3 watts and resistance values to 15 megohms, these outstanding resistors are ideal for applications requiring tolerances as close as 0.1% and extended life stability of 0.1% per 1000 hours.

The Type MM Precision Film Resistors provide a maximum operating temperature range of +275°C and both the Type MM and the Type ML have temperature coefficients of only 50 PPM/°C over the range from -15°C to +105°C.



Construction includes Micronox® resistance films fired onto a high strength solid ceramic core. End cap construction and a molded case completes the resistor assembly and provides increased resistance to abrasion and solvents.

Caddock's Exclusive Non-Inductive Performance can also be specified for most of these resistors by adding the "N" suffix to the model number. (Example: MM 236N)



Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance Min.	Resistance Max.	Dimensions A	Dimensions B	Dimensions C	Encapsulation
MM 112	.12	200	275°C	400	50	45Ω	500 K	.160 ±.010	.065 ±.010	.016 ±.002	Black Molded Type
MM 125	.25	200	275°C	500	50	30Ω	1 Meg	.188 ±.020	.070 ±.015	.020 ±.002	Black Molded Type
MM 152	.4	300	275°C	750	50	30Ω	2 Meg	.250 ±.020	.094 ±.006	.025 ±.002	Black Molded Type
MM 177	.6	500	275°C	750	50	45Ω	5 Meg	.313 ±.020	.094 ±.006	.025 ±.002	Black Molded Type
MM 215	1.0	800	275°C	1000	50	45Ω	10 Meg	.400 ±.020	.150 ±.010	.025 ±.002	Black Molded Type
MM 216	1.5	1000	275°C	1000	50	45Ω	10 Meg	.625 ±.030	.190 ±.020	.032 ±.002	Black Molded Type
MM 217	1.5	800	275°C	1500	50	30Ω	4 Meg	.500 ±.030	.250 ±.020	.040 ±.002	Black Molded Type
MM 224	2.0	2000	275°C	1500	50	45Ω	15 Meg	1.00 ±.030	.250 ±.020	.040 ±.002	Black Molded Type
MM 225	2.0	800	275°C	2000	50	30Ω	6 Meg	.600 ±.030	.330 ±.020	.040 ±.002	Black Molded Type
MM 236	3.0	2000	275°C	2000	50	45Ω	15 Meg	1.00 ±.030	.330 ±.020	.040 ±.002	Black Molded Type
ML 104	.08	200	175°C	400	50	50Ω	300 K	.160 ±.010	.065 ±.010	.016 ±.002	Transfer Molded Type
ML 114	.15	200	175°C	500	50	50Ω	500 K	.188 ±.020	.070 ±.015	.020 ±.002	Transfer Molded Type
ML 124	.25	300	175°C	750	50	50Ω	600 K	.250 ±.020	.094 ±.006	.025 ±.002	Transfer Molded Type
ML 131	.4	500	175°C	750	50	50Ω	1 Meg	.313 ±.020	.094 ±.006	.025 ±.002	Transfer Molded Type
ML 181	.6	600	175°C	750	50	50Ω	5 Meg	.400 ±.020	.150 ±.010	.025 ±.002	Transfer Molded Type
ML 212	1.0	1000	175°C	1000	50	45Ω	10 Meg	.625 ±.030	.190 ±.020	.032 ±.002	Transfer Molded Type
ML 213	1.0	800	175°C	1500	50	30Ω	4 Meg	.500 ±.030	.250 ±.020	.040 ±.002	Transfer Molded Type
ML 218	1.25	2000	175°C	1500	50	45Ω	15 Meg	1.00 ±.030	.250 ±.020	.040 ±.002	Transfer Molded Type
ML 219	1.25	800	175°C	2000	50	30Ω	6 Meg	.600 ±.030	.330 ±.020	.040 ±.002	Transfer Molded Type
ML 226	2.0	2000	175°C	2000	50	45Ω	15 Meg	1.00 ±.030	.330 ±.020	.040 ±.002	Transfer Molded Type

†Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C

Specifications

Resistance Tolerance: ±1% (tolerances to 0.1% on special order).

Insulation Resistance: 100 megohms, minimum.

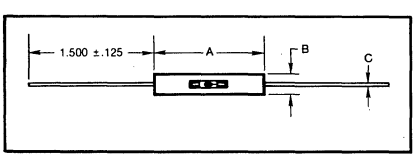
Overload/Overvoltage: 5 times rated power with applied voltage not to exceed 1.5 times maximum continuous operating voltage for 5 seconds. ΔR, 0.5% max. or 0.5 ohms max., whichever is greater.

Thermal Shock: MIL-STD-202, Method 107, Cond. F, ΔR, 0.2% max. or 0.5 ohms max., whichever is greater.

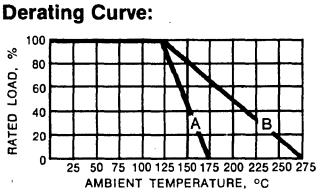
Moisture Resistance: MIL-STD-202, Method 106, ΔR, 0.5% max. or 0.5 ohms max., whichever is greater.

Loadlife: 1000 hours at rated power, ΔR 0.5% max. or 0.5 ohms max., whichever is greater.

Lead Material: Gold Plated.



Derating Curve:



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Type MP Chassis Mounted Power Film Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MP Chassis Mounted Power Film Resistors are made with Micronox® resistance films fired onto a ceramic substrate which is thermally bonded to an anodized aluminum base. By mounting this assembly directly to a metal surface for improved heat transfer, the high power capabilities of these unique resistors can provide increased packaging densities in many types of electronic equipment.

The special performance features of the Type MP Power Film Resistors include:

- Two case sizes that provide 15 watt and 30 watt ratings.
- Single-screw mounting to simplify attachment to the chassis or other heat conducting surface.
- A molded silicone case that encapsulates the resistor assembly to meet stringent environmental specifications.
- Extended-life stability better than 0.01% per 1000 hours has been demonstrated through a 5½ year, 50,000 hour program of continuous load-life testing.

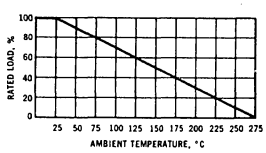
Detailed information on power ratings versus ambient temperature and chassis area has been provided on this page. A detailed report on the results of extended-life stability tests is available from the applications engineering group at Caddock Electronics, Inc.

Model No.	Power Rating†	Max. Voltage	Diel. Str.	High Temp. TC‡	Resistance Range		Dimensions				Terminals
					Min.	Max.	A	B	C	D	
MP312	15 Watts	300	600	50	10Ω	200 K	.600	.188	.185	.092	Gold Plated Solder Lugs
MP330	30 Watts	450	1000	50	10Ω	200 K	.850	.250	.250	.142	Gold Plated Solder Lugs

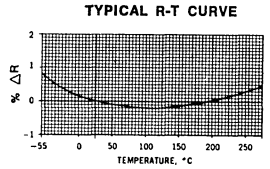
† Power rating based on chassis mounting with MP 312 on a 6" x 4" x 2" x .040" aluminum chassis and MP 330 on a 5" x 7" x 2" x .040" aluminum chassis.

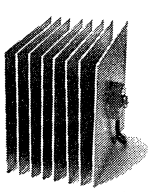
‡ TC: 50 ppm referenced to 25°C, ΔR taken at +150°C and +275°C. (Low temp. TC will be nominally −85 ppm/°C at −55°C. See typical R-T curve.)

DERATING CURVE



TYPICAL R-T CURVE

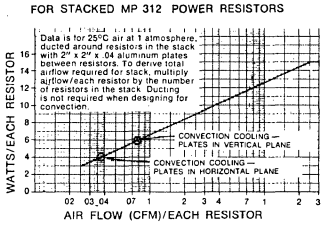




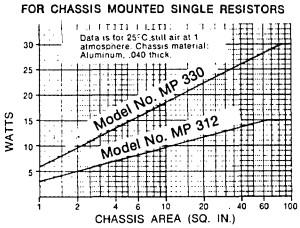
Stacked Type MP assemblies — constructed by bolting resistors between aluminum heat dissipating plates — provide a simple means of further improving packaging densities.

These charts of power ratings versus ambient temperature and chassis area show the high power levels that can be achieved with forced air cooling and with convection cooling in either vertical or horizontal orientation.

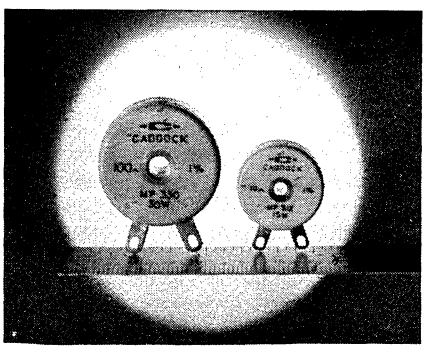
POWER RATING
FOR STACKED MP 312 POWER RESISTORS



POWER RATING
FOR CHASSIS MOUNTED SINGLE RESISTORS



U.S. Patent No's 3,636,493 and 3,649,944 Other patents pending.



SPECIFICATIONS

Resistance Tolerance: ±1% standard (Other tolerances on special order.)

Insulation Resistance: 10,000 Megohms, dry. Method — Mil-R-18546D, para. 4.6.8.

Solderability: Per Mil-R-18546D, para. 3.7, para. 4.6.4.

Terminal Strength: Per Mil-Std-202, Method 211, Cond. A (Pull Test), 5 lbs., and Cond. B (Bend Test). Max. ΔR, .2% or .2Ω, whichever is greater.

Thermal Shock: Per Mil-R-18546D, para. 4.6.9, max. ΔR, .5% or .2Ω, whichever is greater.

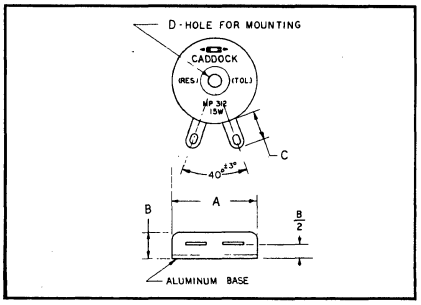
Momentary Overload: 2 times rated power or 1.5 times max. allowable working voltage, whichever gives the lower power, for 5 seconds. Max. ΔR, .5% or .2Ω, whichever is greater.

Moisture Resistance: Mil-Std-202, Method 106B, less steps 7a and 7b, max. ΔR, .5% or .2Ω, whichever is greater.

Life: Per Mil-R-18546D, para. 4.6.12, 1,000 hrs., Max. ΔR, 1% or .2Ω, whichever is greater.

Shock, Medium Impact: 50G, per Mil-Std-202, Method 205, Cond. C.

Vibration, High Frequency: Per Mil-Std-202, Method 204, Cond. B, Max. ΔR .2% or .2Ω, whichever is greater, through shock and vibration sequence.



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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MK Low Cost Precision Film Resistors

Radial-Lead Resistors with Resistance Range from 10 ohms to 100 Megohms.

Here are the low cost precision resistors that provide high density packaging in large volume printed circuit applications. Available in two miniature rectangular package configurations with standard lead spacings, Type MK Precision Film Resistors now cover the entire resistance range from 10 ohms to 100 Megohms.

Constructed with Caddock Micronox® resistance films fired onto a solid ceramic substrate, Type MK Precision Film Resistors combine all of these outstanding advantages:

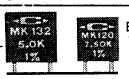
- ±1% resistance tolerance is standard and tolerances to ±0.1% are available on special order.
- Operating temperatures are from -55° C to +175° C.
- Full power rating at +125° C.
- Temperature Coefficient is only 50 PPM/° C up to 10 Megohms and 80 PPM/° C up to 100 Megohms, referenced to 25° C with the ΔR taken at -15° C and +105° C.
- Extended life stability is typically better than 0.1% per 1000 hours.
- Caddock's Non-Inductive Performance provides greater pulse fidelity and wider bandwidths in high frequency circuits.

This combination of performance advantages in a small, standardized case can simplify many engineering and production problems:

One size of Type MK resistor can replace many sizes of axial lead resistors.

This table of "RN" style axial lead resistors shows the many sizes and power ratings that can be replaced with either of the two models of Type MK Precision Film Resistors within the maximum allowable voltage ratings.

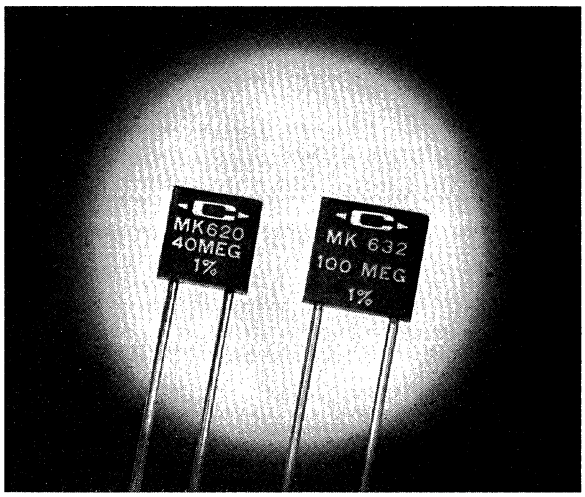
Comparison of Type MK and "RN" Ratings and Dimensions

Resistor Type	Power Rating	Maximum Resistance	Mounting Hole Spacing	
MK 120 or MK 620	**.50 WT.**	**40 Megohms**	**.150**	 Even the smallest Type MK resistor can replace all of these RN type resistors.
MK 132 or MK 632	**.75 WT.**	**100 Megohms**	**.200**	
RN50	.05 WT	1 Megohm	.400	
RN 55	.10 WT	5 Megohms	.500	
RN60	.125 WT	10 Megohms	.625	
RN65	.25 WT	20 Megohms	.875	
RN70	.50 WT	40 Megohms	1.000	

All outline drawings full size — dimensions in inches.

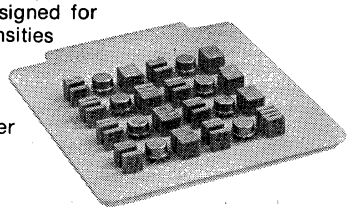
The largest Type MK — rated at .75 watt — requires less board space than even the 1/20th watt RN50.

The smallest Type MK — rated at .5 watt — provides power dissipation **equal** to the RN70 resistor. The RN70 resistor requires a mounting hole spacing of 1" and a side-to-side spacing of .250 inches, resulting in a total mounting area of .25 square inches — **10 times the area required for a .75 watt Type MK resistor!**



One standard resistor configuration can simplify board layouts.

With the exceptionally wide range of resistances that are available in each model of Type MK Precision Film Resistors, circuits can now be designed for maximum packaging densities without the need for leaving extra space where resistor value changes can require larger resistors or non-uniform lead spacings.



Standardization of resistor size can speed assembly procedures and reduce procurement costs.

The standardization of resistor size can pay additional dividends by simplifying assembly procedures. The radial leads do not require additional bending prior to insertion, and the standard lead spacing can reduce the time required for assembly.

The combination of higher power rating and smaller size can also lower procurement costs. By reducing the wide variety of sizes and types of axial lead resistors to a single, 'standardized' resistor type, unit prices can be lowered and inventory problems simplified.

Low Quantity Prices — Fast Delivery

Quantity prices for Type MK Precision Film Resistors are low, with many values priced under 60 cents each in medium-to-large production orders.

A pricing schedule for all values and models of Type MK Precision Film Resistors is available upon request. For specific price and delivery information, call or write to the main offices of Caddock Electronics in Riverside, California.

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Type MK Low Cost Precision Film Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MK Precision Film Resistors — Standard Resistance Range

Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance Min.	Resistance Max.	Dimensions	Encapsulation	Leadwire
MK 120	.5	200	175°C	300	50	30 Ω	2 Meg.	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
MK 132	.75	400	175°C	400	50	30 Ω	5 Meg.	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper

Resistance Tolerance: ±1% (tolerance to ±.1% on special order).
Operating Temperature: −55°C to 175°C.
Overload: 5 times rated power for 5 seconds, R shift .15% max., or .2 ohms max., whichever is greater.
Overvoltage: 1.5 times max. voltage for 5 seconds, R shift .15% max., or .2 ohms max., whichever is greater.
Thermal Shock: Mil-Std-202, Method 107, Cond. B, shift .2% max., or .2 ohms, max., whichever is greater.
Moisture Resistance: Mil-Std-202, Method 106, R shift .5% max., or .2 ohms, whichever is greater.
Loadlife: 1000 hours at rated power, R shift .4% max., or .2 ohms, whichever is greater.
Insulation Resistance: 10,000 Megohms, minimum.

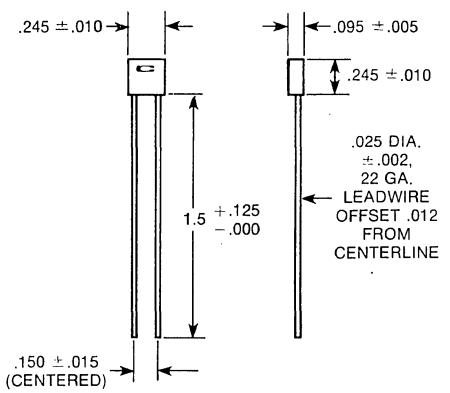
Type MK Precision Film Resistors — Extended Resistance Range

Model No.	Wattage	Max. Voltage	Oper. Temp. (Max.)	Dielect. Str'gth	TC ppm/°C†	Resistance Min.	Resistance Max.	Dimensions	Encapsulation	Leadwire
MK 620	.5	200	175°C	300	80	2 Meg.	40 Meg.	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
MK 632	.75	400	175°C	400	80	5.1 Meg.	100 Meg.	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper

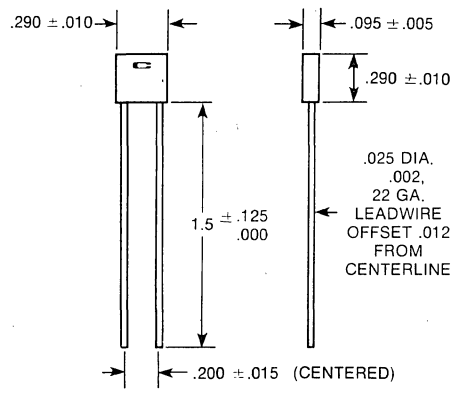
Resistance Tolerance: ±1% (consult factory for tighter tolerances).
Operating Temperature: −55°C to 175°C.
Overvoltage: 1.5 times max. voltage for 5 seconds, R shift .5% max.
Thermal Shock: Mil-Std-202, Method 107, Cond. B, R shift .5% max.
Moisture Resistance: Mil-Std-202, Method 106, R shift .5% max.
Loadlife: 1000 hours at rated power, R shift .5% max.
Insulation Resistance: 10,000 Megohms, minimum.

†Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C

Case "A"
Model MK 120 and MK 620



Case "B"
Model MK 132 and MK 632



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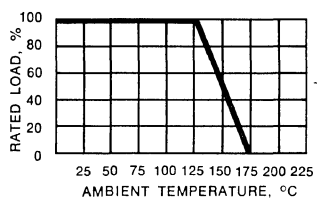
DERATING CURVE



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HIGH PERFORMANCE FILM RESISTORS

Type 1787 Current Shunt Resistor Networks

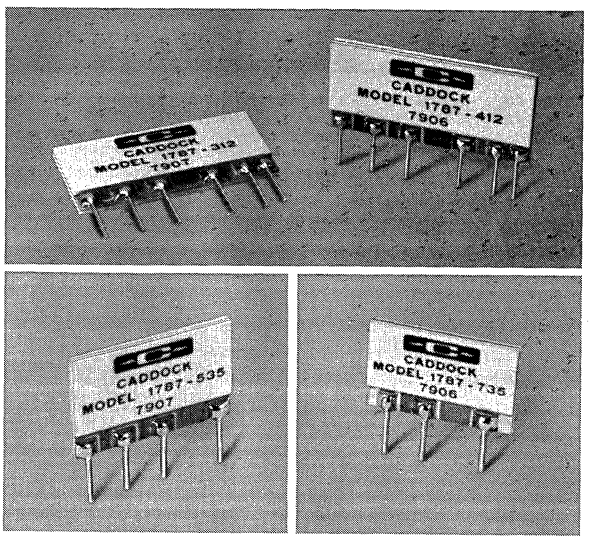
Accurate Current Sensing in Multi-Range Instrumentation

Type 1787 Current Shunt Resistor Networks utilize Caddock's Micronox® resistance films and advanced high thru-put laser manufacturing capabilities to achieve many vital advantages in precision current measurement circuits, including laboratory and bench-type digital instrumentation:

- The thin-profile single-package configuration replaces as many as four discrete current shunt resistors.
- The monolithic construction and standardized lead spacing simplifies installation.
- Caddock Micronox® resistance films provide exceptional stability for improved long-term measurement accuracy.

Eighteen standard models in six network arrangements provide the specific accuracy and resistance values required for a wide range of current measuring instruments and circuits.

Prototype quantities of most models of the Type 1787 Current Shunt Resistor Networks can be delivered from stock to within 6 weeks ARO.



Model No.	Resistance Values				Power Rating Watts				Max. Power Rating Watts Total Pkg.	Fig.	Absolute Resistance Tolerance % ①	Maximum Absolute TC ppm/°C ②	Absolute Stability Max. % Change In Resistance Value	
	R_A	R_B	R_C	R_D	R_A	R_B	R_C	R_D					Load Life ③	Shelf Life ④
1787—31	999.9 Ω	99.9 Ω	9.9 Ω	0.9 Ω	0.25	0.25	0.50	1.0	1.0	1	0.25	80	0.05	0.03
1787—312	999.9 Ω	99.9 Ω	9.9 Ω	0.9 Ω	0.25	0.25	0.50	1.0	1.0	1	0.10	80	0.03	0.02
1787—41	1000 Ω	100 Ω	10 Ω	1 Ω	0.25	0.25	0.50	1.0	1.0	2	0.25	80	0.05	0.03
1787—412	1000 Ω	100 Ω	10 Ω	1 Ω	0.25	0.25	0.50	1.0	1.0	2	0.10	80	0.03	0.02
1787—5	999 Ω	99 Ω	9 Ω	N/A	0.25	0.25	0.75	N/A	0.75	3	0.25	50	0.04	0.02
1787—53	999 Ω	99 Ω	9 Ω	N/A	0.25	0.25	0.75	N/A	0.75	3	0.10	50	0.02	0.01
1787—535	999 Ω	99 Ω	9 Ω	N/A	0.25	0.25	0.75	N/A	0.75	3	0.05	50	0.02	0.01
1787—5352	999 Ω	99 Ω	9 Ω	N/A	0.25	0.25	0.75	N/A	0.75	3	0.02	50	0.01	0.01
1787—6	1000 Ω	100 Ω	10 Ω	N/A	0.25	0.25	0.75	N/A	0.75	4	0.25	50	0.04	0.02
1787—64	1000 Ω	100 Ω	10 Ω	N/A	0.25	0.25	0.75	N/A	0.75	4	0.10	50	0.02	0.01
1787—645	1000 Ω	100 Ω	10 Ω	N/A	0.25	0.25	0.75	N/A	0.75	4	0.05	50	0.02	0.01
1787—6452	1000 Ω	100 Ω	10 Ω	N/A	0.25	0.25	0.75	N/A	0.75	4	0.02	50	0.01	0.01
1787—7	99 Ω	9 Ω	N/A	N/A	0.25	0.75	N/A	N/A	0.75	5	0.25	50	0.04	0.02
1787—73	99 Ω	9 Ω	N/A	N/A	0.25	0.75	N/A	N/A	0.75	5	0.10	50	0.02	0.01
1787—735	99 Ω	9 Ω	N/A	N/A	0.25	0.75	N/A	N/A	0.75	5	0.05	50	0.02	0.01
1787—7352	99 Ω	9 Ω	N/A	N/A	0.25	0.75	N/A	N/A	0.75	5	0.02	50	0.01	0.01
1787—13	99.9 Ω	9.9 Ω	0.9 Ω	N/A	0.25	0.50	1.0	N/A	1.0	6	0.25	100	0.05	0.03
1787—132	99.9 Ω	9.9 Ω	0.9 Ω	N/A	0.25	0.50	1.0	N/A	1.0	6	0.10	100	0.03	0.02

① **Absolute Resistance Tolerance:** Tolerance of R_A, R_B, R_C or R_D when measured in accordance with proper Figure No

② **Absolute Temperature Coefficient:** Temperature coefficient of R_A, R_B, R_C or R_D from 0°C to 70°C, referenced to +25°C.

③ **Load Life:** Stability of R_A, R_B, R_C or R_D with full power applied individually for 2000 hours at +70°C.

④ **Shelf Life:** Stability of R_A, R_B, R_C or R_D for six months at shelf conditions.

Storage Temperature: −55°C to +105°C.

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Type 1787 Current Shunt Resistor Networks

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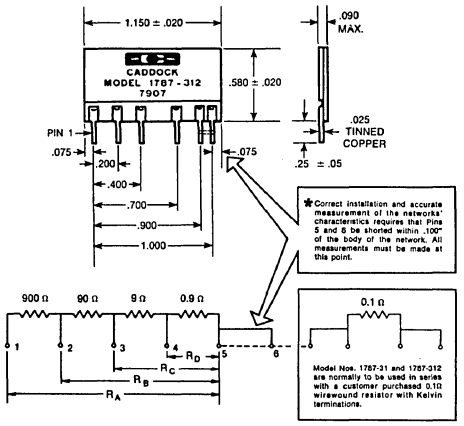
HIGH PERFORMANCE FILM RESISTORS

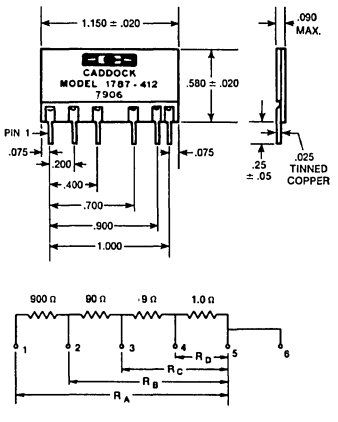
Figure 1 — Model Nos. 1787-31 and 1787-312



Model Nos. 1787-31 and 1787-312 Measurement Connections

Resistances		Kelvin Connections			
"R"	Total Value	Sense Lead P_1	Current Lead C_1	Current Lead C_2	Sense Lead P_2
R_A	999.9 Ω	Pin 1	Pin 1	Pin 5 ★	Pin 6 ★
R_B	99.9 Ω	Pin 1	Pin 2	Pin 5 ★	Pin 6 ★
R_C	9.9 Ω	Pin 1	Pin 3	Pin 5 ★	Pin 6 ★
R_D	0.9 Ω	Pin 1	Pin 4	Pin 5 ★	Pin 6 ★

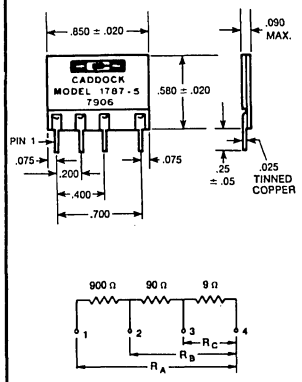
Figure 2 — Model Nos. 1787-41 and 1787-412



Model Nos. 1787-41 and 1787-412 Measurement Connections

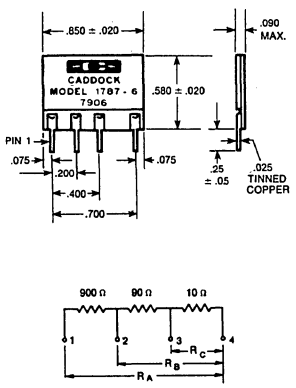
Resistances		Kelvin Connections			
"R"	Total Value	Sense Lead P_1	Current Lead C_1	Current Lead C_2	Sense Lead P_2
R_A	1000 Ω	Pin 1	Pin 1	Pin 5	Pin 6
R_B	100 Ω	Pin 1	Pin 2	Pin 5	Pin 6
R_C	10 Ω	Pin 1	Pin 3	Pin 5	Pin 6
R_D	1 Ω	Pin 1	Pin 4	Pin 5	Pin 6

Figure 3 — Model Nos. 1787-5, 1787-53, 1787-535 and 1787-5352



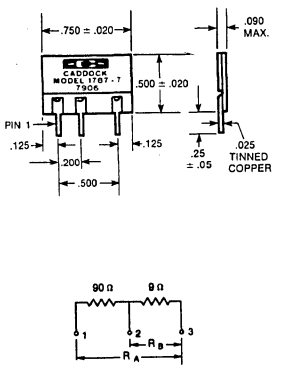
Resistances	
"R"	Total Value
R_A	999 Ω
R_B	99 Ω
R_C	9 Ω

Figure 4 — Model Nos. 1787-6, 1787-64, 1787-645 and 1787-6452



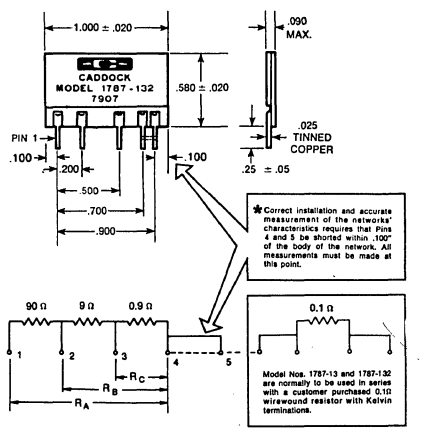
Resistances	
"R"	Total Value
R_A	1000 Ω
R_B	100 Ω
R_C	10 Ω

Figure 5 — Model Nos. 1787-7, 1787-73, 1787-735 and 1787-7352



Resistances	
"R"	Total Value
R_A	99 Ω
R_B	9 Ω

Figure 6 — Model Nos. 1787-13 and 1787-132



Model Nos. 1787-13 and 1787-132 Measurement Connections

Resistances		Kelvin Connections			
"R"	Total Value	Sense Lead P_1	Current Lead C_1	Current Lead C_2	Sense Lead P_2
R_A	99.9 Ω	Pin 1	Pin 1	Pin 4 ★	Pin 5 ★
R_B	9.9 Ω	Pin 1	Pin 2	Pin 4 ★	Pin 5 ★
R_C	0.9 Ω	Pin 1	Pin 3	Pin 4 ★	Pin 5 ★

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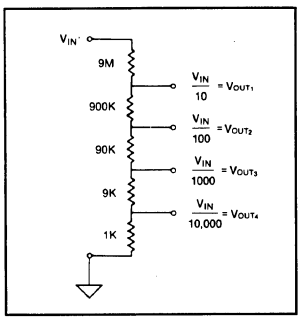
HIGH PERFORMANCE FILM RESISTORS

Type 1776 Precision Decade Resistor Voltage Dividers

Input Voltage Dividers for Digital Multimeters and Range-Switching Instruments.

Produced with Caddock Tetrinox® resistance films to achieve an exceptional combination of accuracy, temperature stability and long-term stability, these edge-mount precision decade resistor voltage dividers are now being widely specified for use in the input signal circuits of bench and laboratory digital instruments.

In addition to requiring less board space, these compact resistor networks deliver higher performance than selected discrete resistor sets and thin-film networks.



The 33 standard models in the expanded 'family' of Type 1776 resistor networks now include —

- 3-, 4- and 5-decade voltage dividers with ratios from 10:1 to 10,000:1
- 1,200 volts continuous ratings and overvoltage to 2,000 volts.
- Many combinations of ratio and absolute tolerances and ratio and absolute TC.

For complete information on quantity price and delivery, call our main offices in Riverside, California.

Model No.	Resistance Values					Fig.	Voltage Rating ⑦	Absolute Tolerance %	Ratio Tolerance % ①	Absolute TC ppm/°C	Ratio TC ppm/°C ②	Voltage Coefficient of Ratio ppm/volt ③	Ratio Stability % Change in Ratio		
	R_1	R_2	R_3	R_4	R_5								Load Life ④	Shelf Life ⑤	Overvoltage ⑥
1776 – 9	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.1	30	10	0.02	0.01	0.005	0.01
1776 – 91	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.05	30	10	0.02	0.01	0.005	0.01
1776 – 912	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.02	30	5	0.02	0.01	0.005	0.01
1776 – 82	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.25	30	25	0.3	0.04	0.02	0.04
1776 – 8	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.1	30	25	0.2	0.02	0.01	0.02
1776 – 81	9.9 Meg	90 K	10 K	—	—	1	1200	0.25	0.05	30	25	0.2	0.02	0.01	0.02
1776 – 1	9 Meg	900 K	90 K	10 K	—	2	1200	0.25	0.05	30	10	0.02	0.01	0.005	0.01
1776 – 14	9 Meg	900 K	90 K	10 K	—	2	1200	0.25	0.1	30	10	0.02	0.01	0.005	0.01
1776 – 72	9 Meg	900 K	90 K	10 K	—	2	1200	0.25	0.25	30	30	0.3	0.04	0.02	0.04
1776 – 7	9 Meg	900 K	90 K	10 K	—	2	1200	0.25	0.1	30	25	0.2	0.02	0.01	0.02
1776 – 71	9 Meg	900 K	90 K	10 K	—	2	1200	0.25	0.05	30	25	0.2	0.02	0.01	0.02
1776 – 10*	9 Meg	900 K	90 K	10 K	—	4	1200	+0, −0.5	0.1	30	10	0.02	0.01	0.005	0.01
1776 – 105*	9 Meg	900 K	90 K	10 K	—	4	1200	+0, −0.5	0.1	30	5	0.02	0.01	0.005	0.01
1776 – 532	900 K	90 K	9 K	900	—	5	300	0.25	0.25	25	25	0.4	0.04	0.02	0.04
1776 – 53	900 K	90 K	9 K	900	—	5	300	0.1	0.1	25	25	0.3	0.02	0.01	0.02
1776 – 542	900 K	90 K	9 K	1 K	—	5	300	0.25	0.25	25	25	0.4	0.04	0.02	0.04
1776 – 54	900 K	90 K	9 K	1 K	—	5	300	0.1	0.1	25	25	0.3	0.02	0.01	0.02
1776 – 63	900 K	90 K	9 K	900	—	6	300	0.1	0.1	25	10	0.3	0.01	0.005	0.01
1776 – 64	900 K	90 K	9 K	1 K	—	6	300	0.1	0.1	25	10	0.3	0.01	0.005	0.01
1776 – 232	9 Meg	900 K	90 K	9 K	900	3	1200	0.25	0.25	50	50	0.3	0.04	0.02	0.04
1776 – 23	9 Meg	900 K	90 K	9 K	900	3	1200	0.1	0.1	50	50	0.2	0.02	0.01	0.02
1776 – 231	9 Meg	900 K	90 K	9 K	900	3	1200	0.1	0.05	50	50	0.2	0.02	0.01	0.02
1776 – 242	9 Meg	900 K	90 K	9 K	1 K	3	1200	0.25	0.25	50	50	0.3	0.04	0.02	0.04
1776 – 24	9 Meg	900 K	90 K	9 K	1 K	3	1200	0.25	0.1	50	50	0.2	0.02	0.01	0.02
1776 – 241	9 Meg	900 K	90 K	9 K	1 K	3	1200	0.25	0.05	50	50	0.2	0.02	0.01	0.02
1776 – 732	9 Meg	900 K	90 K	9 K	900	7	1200	0.25	0.25	50	50	0.5	0.04	0.02	0.04
1776 – 73	9 Meg	900 K	90 K	9 K	900	7	1200	0.1	0.1	50	50	0.5	0.04	0.02	0.04
1776 – 742	9 Meg	900 K	90 K	9 K	1 K	7	1200	0.25	0.25	50	50	0.5	0.01	0.02	0.01
1776 – 74	9 Meg	900 K	90 K	9 K	1 K	7	1200	0.25	0.1	50	50	0.5	0.04	0.02	0.04
1776 – 832	9 Meg	900 K	90 K	9 K	900	8	1200	0.25	0.25	50	50	0.5	0.04	0.02	0.04
1776 – 83	9 Meg	900 K	90 K	9 K	900	8	1200	0.1	0.1	50	50	0.5	0.04	0.02	0.04
1776 – 842	9 Meg	900 K	90 K	9 K	1 K	8	1200	0.25	0.25	50	50	0.5	0.04	0.02	0.04
1776 – 84	9 Meg	900 K	90 K	9 K	1 K	8	1200	0.25	0.1	50	50	0.5	0.04	0.02	0.04

*Resistors Isolated

① **Ratio Tolerance:** Maximum ratio difference between any two resistors in the network.

② **Ratio Temperature Coefficient:** Ratio track between any two resistors in the network from 0°C to +70°C.

③ **Voltage Coefficient of Ratio (ppm/volt):** R_1 in series with any combination of R_2, R_3, R_4 and R_5, 100 volts to 1200 volts.

④ **Load Life:** Ratio stability of resistance under full load. 1200 volts DC applied to all resistors in series for 2000 hours at +70°C.

⑤ **Shelf Stability of Ratio:** Six months at shelf conditions.

⑥ **Overvoltage:** Maximum voltage of 1.67 times rated DC voltage. Volts DC or peak AC applied to R_1 and any combination of R_2, R_3, R_4, and R_5 in series with R_1 for 10 seconds.

⑦ **Voltage Rating:** DC or RMS AC voltage applied to all resistors in series.

Storage Temperature: −55°C to +85°C.

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Type 1776 Precision Decade Resistor Voltage Dividers

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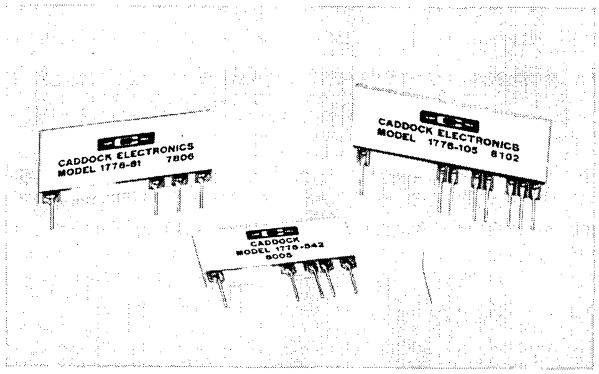


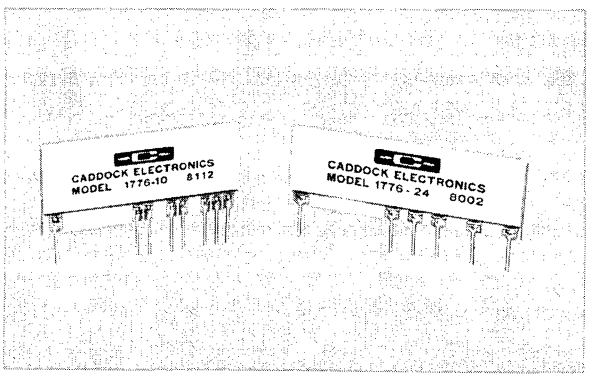


Figure 1

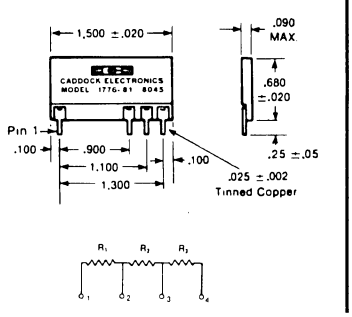


Figure 2

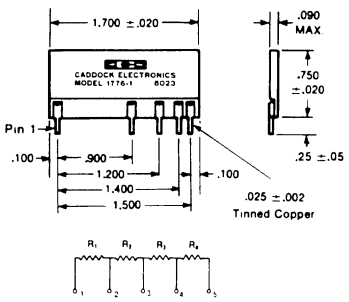


Figure 3

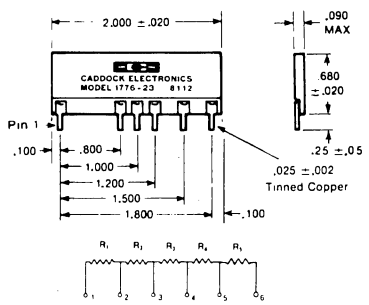


Figure 4

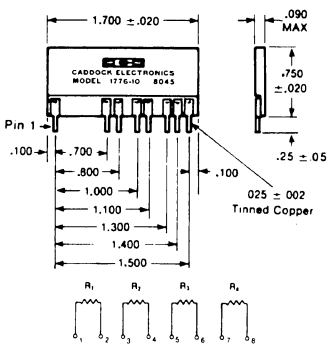


Figure 5

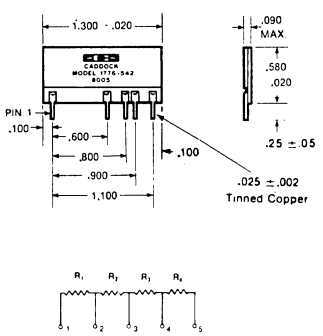


Figure 6

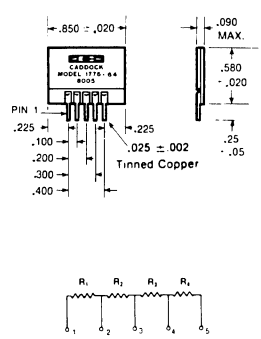


Figure 7

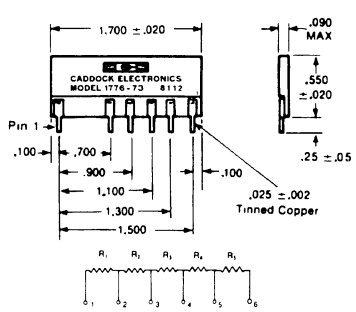
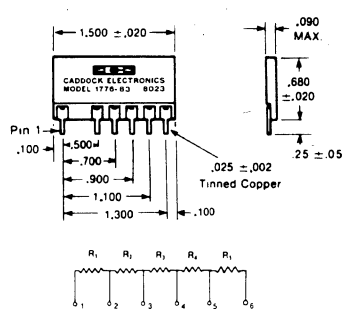


Figure 8



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HIGH PERFORMANCE FILM RESISTORS

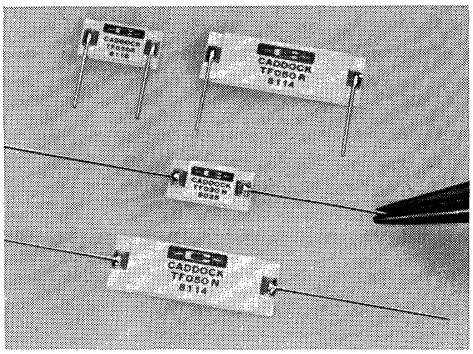
Type TF Low TC Ultra-Precision Film Resistors

Absolute TC to 5 PPM/°C — Values from 1 kohm to 125 Megohms — Absolute Tolerance to ±0.01%.

Type TF precision resistors employ the Caddock Tetrinox® resistance films — the resistance system that sets a new standard for high value, ultra-stable precision resistors that provide an exceptional combination of performance characteristics:

- **Ultra-Precision** – Seven standard resistance tolerances from ±1% to ±0.01%
- **A Wide Range of Resistance Values** – from 1 kohm to 125 Megohms.
- **Low Temperature Coefficients** – 5 PPM/°C, 10 PPM/°C and 15 PPM/°C.
- **Long-Term Stability** – to 0.01% per 1000 hours.

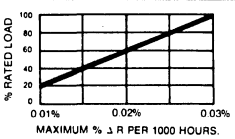
This completely new approach to quantity production of ultra-precision resistors is the result of combining our unique complex-oxide technology with an advanced high thru-put laser manufacturing capability.



Type TF - Standard Resistance Range - 1 kohm to 10 Megohms.

Model Number		Wattage @ +70°C.	Maximum Continuous Oper. Voltage	Resistance		Dimensions	
Axial Leads	Radial Leads			Min.	Max.	A	B
TF 020 N	TF 020 R	.33	300	1 K	2 Meg	.75 ±.020	.375 ±.020
TF 050 N	TF 050 R	.75	1400	10 K	10 Meg	1.5 ±.020	.50 ±.020

Load Stability:



Shelf Life: Typically 0.005% per year.

Type TF - Extended Resistance Range - 2 Megohms to 125 Megohms.

Model Number		Wattage @ +70°C.	Maximum Continuous Oper. Voltage	Resistance		Dimensions	
Axial Leads	Radial Leads			Min.	Max.	A	B
TF 626 N	TF 626 R	.33	300	2.01 Meg	35 Meg	.75 ±.020	.375 ±.020
TF 656 N	TF 656 R	.75	1400	10.01 Meg	125 Meg	1.5 ±.020	.50 ±.020

Load Stability: 1000 hours at rated voltage at +70° C, maximum ΔR 0.03%.

Shelf Life: Typically 0.010% per year.

Specifications

Apply to all Type TF resistor models

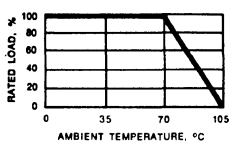
Absolute Temperature Coefficient: 5 PPM/°C, 10 PPM/°C or 15 PPM/°C. Referenced to 25°C, ΔR taken at -15°C and +105°C.

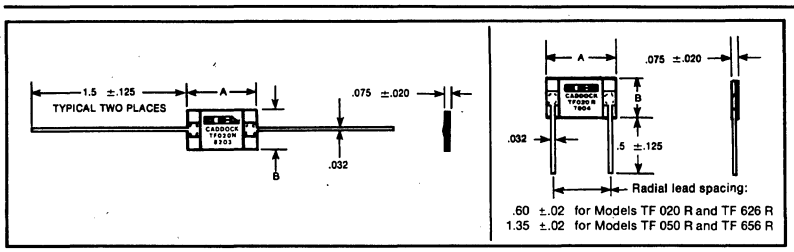
Resistance Tolerance: ±0.01%, ±0.025%, ±0.05%, ±0.10%, ±0.25%, ±0.50%, ±1.0%.

Storage Temperature: -55°C to +105°C.

Leadwire: Tinned Copper.

Derating Curve:





Ordering Information

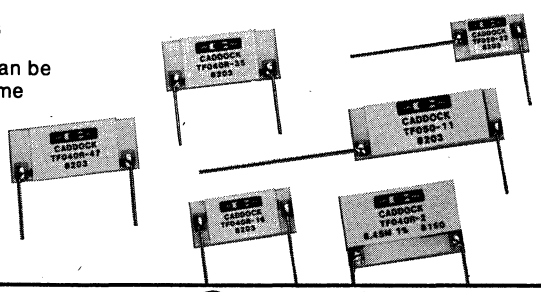
TF050R - 10 Meg - 0.01% - 10 PPM/°C

- Model Number
- Resistor Value
- Tolerance
- Temperature Coefficient

Custom Type TF Resistors

Additional cost savings can be realized when your high volume ultra-precision Type TF resistor is optimized for:

- Voltage rating.
- Power rating.
- Mechanical configuration.
- Ratio matched sets.



And for special requirements, custom Type TF resistors are available with:

- TCs of 5 ppm/°C, 10 ppm/° C 15 ppm/°C or 25 ppm/°C.
- Shelf stability of 0.0025% per year.

Type TF resistors can also be produced with custom-spaced radial leads that will plug directly into your existing circuit layouts.

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Type T912 and T914 Precision Resistor Networks

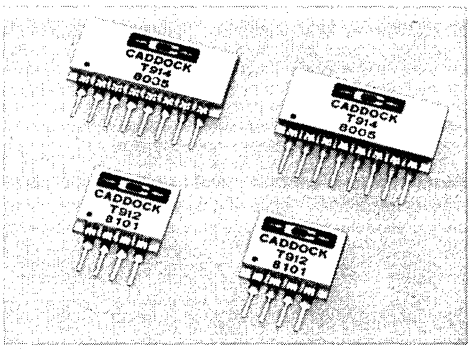
CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Resistor Pairs and Quads with Matched Characteristics for Precision Analog Circuits.

Type T912 and T914 Precision Resistor Networks are constructed with Caddock Tetrinox® resistance films to achieve the matched resistor characteristics and stability required by highly accurate amplifier circuits, voltage reference circuits and precision bridge circuits.

- **Ratio Tolerances** – from ±0.1% to ±0.01%.
- **Ratio Temperature Coefficients** – 10 PPM/° C, 5 PPM/° C or 2 PPM/° C.
- **Absolute Temperature Coefficient** – 25 PPM/° C.
- **Ratio Stability of Resistance at Full Load for 2000 hours** – Within ±0.01%.
- **Shelf Life Stability of Ratio for 6 Months** – Within ±0.005%.

Both the T912 and T914 are available in 14 standard resistance values between 1000 ohms and 1 Megohm. Caddock's high thru-put manufacturing capability assures delivery of prototype and large-volume production quantities from stock to within 6 weeks after receipt of order.



Standard Type T912 and T914 Precision Resistor Networks

In addition to the 14 standard **equal value** models of the Type T912 and T914, the Type T912 can also be ordered with —

- **10:1 resistance ratio** — for use with gain-setting amplifiers.
- **9:1 resistance ratio** — for use in voltage reference dividers.

T912 - A 10K - 010 - 02

Model Number

Ratio Code Letter: *

A - T912 with R_1:R_2 where R_2 = 10R_1

1K:10K	5K:50K	20K:200K	40K:400K
2K:20K	10K:100K	25K:250K	50K:500K
			100K:1 Megohm

B - T912 with R_1:R_2 where R_2 = 9R_1

1K:9K	5K:45K	20K:180K	40K:360K
2K:18K	10K:90K	25K:225K	50K:450K
			100K:900K

No Letter — T912 with R_1 = R_2

No Letter — T914 with R_2 = R_2 = R_3 = R_4

Ratio Temperature Track:* (0° C to 70° C)
-10 = 10 PPM/° C -05 = 5 PPM/° C
-02 = 2 PPM/° C

Ratio Tolerance:* -100 = 0.1% -020 = 0.02%
-050 = 0.05% -010 = 0.01%

Standard Resistance Values:* (R_1)

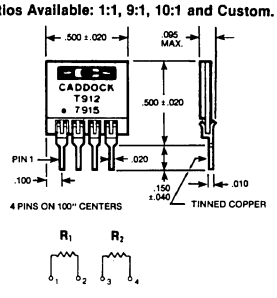
1K	10K	40K	200K	500K
2K	20K	50K	250K	1 Meg.
5K	25K	100K	400K	

Special or mixed resistance values are available as custom networks. See the custom section at the bottom of this page.

*(This information appears on the back side of the network)

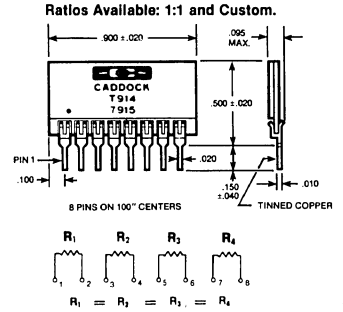
Type T912

Ratios Available: 1:1, 9:1, 10:1 and Custom.



Type T914

Ratios Available: 1:1 and Custom.



Specifications

Absolute Tolerance: 0.1% for all resistors.

Absolute Temperature Coefficient: ±25 PPM/° C. Referenced to 25° C, ΔR taken at 0° C and 70° C.

Voltage Rating: 30 Volts DC or RMS AC applied to R_1, R_2, R_3, or R_4.

Power Rating: 0.10 watt applied to R_1, R_2, R_3, R_4 (not to exceed rated voltage).

Package Power Rating: Type T912, 0.200 watt. Type T914, 0.400 watt.

Storage Temperature: -55° C to +105° C.

Insulation Resistance Between Isolated Pins: Pin 2 to Pin 3, Pin 4 to Pin 5, or Pin 6 to Pin 7, 1000 Megohms, minimum.

Dielectric Strength Between Isolated Pins: 50 volts RMS AC.

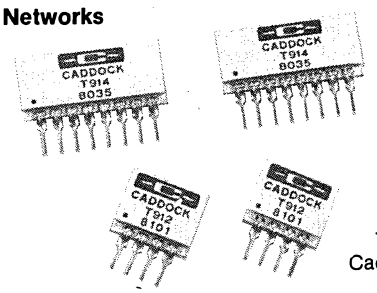
Ratio Stability Under Load: Ratio change between any two resistors in the network under full load for 2000 hours at 70° C, 0.01% maximum.

Shelf Stability of Ratio: Six months at shelf conditions, 50 PPM.

Custom Model T912 and T914 Precision Resistor Networks

For applications requiring non-standard resistance values, the T912 and T914 custom configurations can include these special features:

- Mixed resistance values with a maximum ratio of 250-to-1. (Example: 1.0 Megohm and 4K)
- Absolute TC as low as 15 PPM/° C.
- Ratio TC as low as 2 PPM/° C.
- Custom voltage ratings.
- Matched resistors of any special value between 1K and 2 Megohms.



Identification of the electrical characteristics of each T912 and T914 resistor network is included on the back side of the network.

For performance, price and availability of custom T912 and T914 resistor networks, contact Caddock Electronics' main offices in Riverside, California.

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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

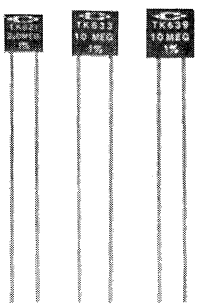
Type TK Temp-Stable Precision Film Resistors

Small Package with Low TC of 10 PPM/°C and Resistance Range from 1 kohm to 10 Megohms.

Caddock introduces a new design element for precision electronic circuitry — an advanced technology breakthrough that solves many critical circuit stability problems — the **Type TK Temp-Stable Precision Film Resistors with the Tetrinox® resistance system.**

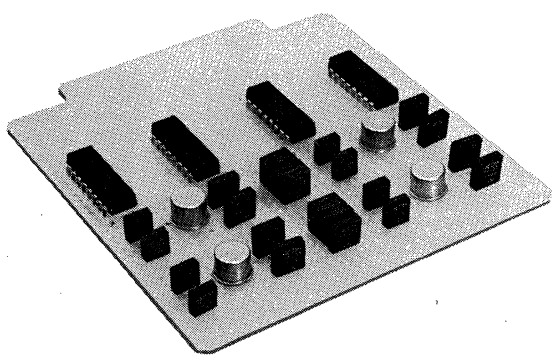
Type TK Temp-Stable Precision Film Resistors provide a combination of performance advantages never before available in a resistive component:

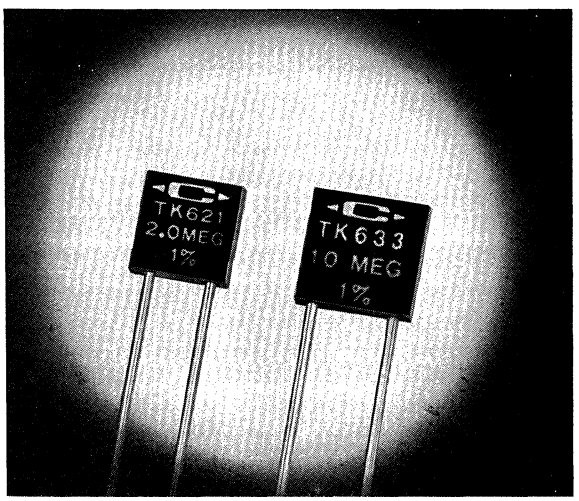
- **Temperature Stability** — better than 10 PPM/°C over the entire temperature range from −55°C to +125°C!
- **Long-Term Absolute Stability** — better than ±0.05% per 2000 hours of operation.
- **Extended Resistance Range** — from 1000 ohms to 10 Megohms.
- **Precision Tolerances** — ±1% is standard, and tolerances as close as ±0.05% are available.
- **Wide Operating Temperature Range**—from −55°C to +175°C.
- **Small Size** — with two miniature rectangular cases for maximum packaging density and minimum mounting area.
- **High Power Density** — with power ratings of .2 watt and .3 watt in molded cases, the largest of which is a standard CK 06 package.
- **Highest Performance-to-Cost Ratio** — with many values priced below $2.00 each in 1000 lot quantities.



(Photos show resistors full size)

Building on 20 years of experience with our unique complex-oxide technology, Caddock has perfected the Tetrinox® resistance system — the first high resistance system to provide a TC that is well within 10 PPM/°C and that is also essentially linear over the entire temperature range from −55°C to +125°C.





The exceptional performance of Type TK resistors can achieve improvements in many circuit applications:

Low TC "Matched-Pair" Voltage Dividers Can be Assembled Without Pre-Selection of Resistors.

An important application for Type TK resistors is in "matched-pair" voltage dividers where the low 5 PPM/°C temperature coefficient provides ratio tracking of less than 10 PPM/°C without resistor pre-selection or special testing.

With factory selection, Type TK resistor pairs can be matched to within 1 PPM/°C.

Extended Resistance Range Reduces Power Requirements

Because the Type TK resistors provide resistance values as high as 10 Megohms — values that are up to 100 times higher than other types of ultra-low TC resistors — engineers can now design precision circuits with lower current drain and lower power requirements.

High Density Packaging

The radial lead mounting and small rectangular case of Type TK resistors permits high packaging densities in low profile electronic circuitry. And because both models of Type TK resistors are available in an exceptionally wide range of resistances, lead spacing and mounting space can be standardized.

For additional information on the Type TK resistors for your high stability circuits, contact the engineering staff of Caddock Electronics in Riverside, California. They can assist you in determining the exact temperature coefficient and tolerances your application requires, and will provide both evaluation and production quantities of these new resistors on fast-delivery schedules.

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Type TK Temp-Stable Precision Film Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type TK Temp-Stable Precision Film Resistors — Standard Resistance Range

Model No.	Temperature Coefficient ppm/°C †	Resistance		Wattage @ +125°C	Max. Working Voltage	Dielect. Str'gth	Dimensions	Encap-sulation	Leadwire
		Min.	Max.						
TK121	5, 10 or 20	1K	500K	.2	200	300	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
TK133	5, 10 or 20	1K	1.5 Meg.	.3	300	400	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper
TK139	5, 10 or 20	1K	1.5 Meg.	.3	300	400	Ref. Case "C" Dwg.	Transfer Molded Type	Tinned Copper

† Specify TC when ordering. 10 PPM/°C is standard.

Resistance Tolerance: ±1% Standard. (Tolerances to ±0.05% on special order.)

Operating Temperature: −55°C to +175°C.

TC Temperature Range: −55°C to +125°C.

Overload:* 6.25 times rated power for 5 seconds at voltages not to exceed 1.5 times maximum rated working voltage, R shift less than 0.05%.

Thermal Shock: Mil-Std-202, Method 107, Condition B, R shift less than 0.05%.

Low Temperature Operation:* R shift less than 0.02%.

Dielectric Withstanding Voltage:* R shift less than 0.02%.

Moisture Resistance:* Mil-Std-202, Method 106, R shift less than 0.02%.

Load Life:* 2000 hours at +125°C, R shift less than 0.05%.

Shelf Life (Typical): 25 ppm/year.

Insulation Resistance: 10,000 Megohms.

Vibration:* R shift less than 0.01%.

Shock:* R shift less than 0.02%.

*Test methods per specifications and procedures of Mil-R-55182/9.

Type TK Temp-Stable Precision Film Resistors — Extended Resistance Range

Model No.	Temperature Coefficient ppm/°C †	Resistance		Wattage @ +125°C	Max. Working Voltage	Dielect. Str'gth	Dimensions	Encap-sulation	Leadwire
		Min.	Max.						
TK621	5, 10 or 20	501K	2 Meg	Limited by Maximum Working Voltage	200	300	Ref. Case "A" Dwg.	Transfer Molded Type	Tinned Copper
TK633	5, 10 or 20	1.51 Meg.	10 Meg.		300	400	Ref. Case "B" Dwg.	Transfer Molded Type	Tinned Copper
TK639	5, 10 or 20	1.51 Meg.	10 Meg.		300	400	Ref. Case "C" Dwg.	Transfer Molded Type	Tinned Copper

† Specify TC when ordering. 10 PPM/°C is standard.

Resistance Tolerance: ±1% Standard. (Tolerances to ±0.05% on special order.)

Operating Temperature: −55°C to +175°C.

TC Temperature Range: −55°C to +105°C.

Overload:* 1.5 times maximum rated working voltage for 5 seconds, R shift less than 0.2%.

Thermal Shock: Mil-Std-202, Method 107, Condition B, R shift less than 0.1%.

Low Temperature Operation:* R shift less than 0.05%.

Dielectric Withstanding Voltage:* R shift less than 0.05%.

Moisture Resistance:* Mil-Std-202, Method 106, R shift less than 0.05%.

Load Life:* 2000 hours at +125°C, R shift less than 0.2%.

Shelf Life (Typical): 200 ppm/year.

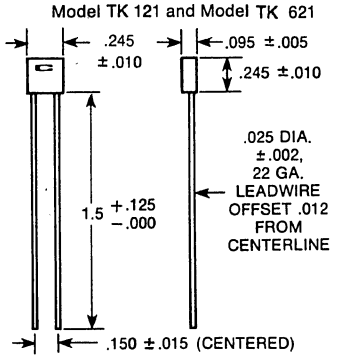
Insulation Resistance: 10,000 Megohms.

Vibration:* R shift less than 0.05%.

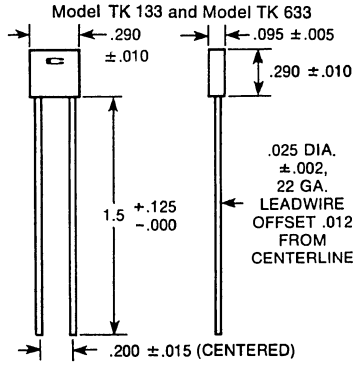
Shock:* R shift less than 0.05%.

*Test methods per specifications and procedures of Mil-R-55182/9.

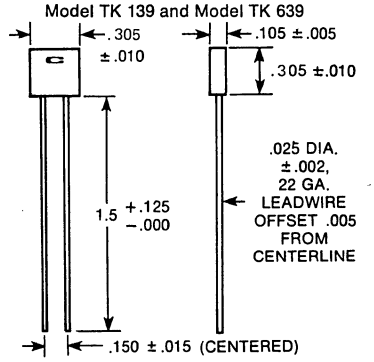
Case "A"
Model TK 121 and Model TK 621



Case "B"
Model TK 133 and Model TK 633



Case "C"
Model TK 139 and Model TK 639

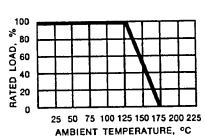


Ordering Information

TK633 - 10 Meg - 0.1% - 10 PPM/°C

- Model Number
- Resistor Value
- Tolerance
- Temperature Coefficient

Derating Curve:



APPLIES TO ALL MODELS OF TYPE TK RESISTORS

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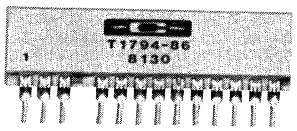
CADDOCK
HIGH PERFORMANCE FILM RESISTORS

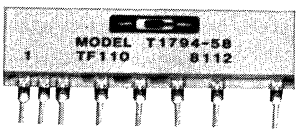
Type T1794 Custom Precision SIP Resistor Networks

Resistor Networks with Custom Package Size and Custom Performance.

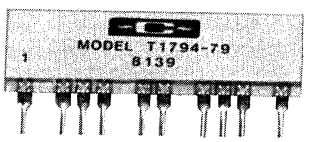
For precision analog designs with special circuit requirements Caddock Type T1794 Custom Precision SIP Resistor Networks are available with performance that includes —

- From 2 to 15 resistors per assembly.
- Absolute tolerances from 1.0% to 0.01%.
- Custom voltage and power ratings.
- Resistance values from 500 ohms to 10 Megohms.
- Absolute temperature coefficients from 15 PPM/°C to 50 PPM/°C.
- Ratio stability of resistance at full load for 2000 hours to within ± 0.01%.
- Shelf life stability of ratio for six months to within ±0.005%.

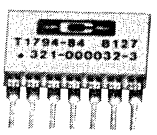


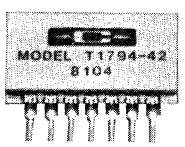


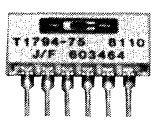
The unique thin-profile, single-in-line edge-mount package design allows the wide range of flexibility necessary to blend the performance of Tetrinox® resistance technology with particular circuit specifications to arrive at the final network package size, pin spacing and pin style.



In addition to the normal upright configuration with SIP-socket pin spacing, special low-profile packages with extended leads and right-angle leads are also available.





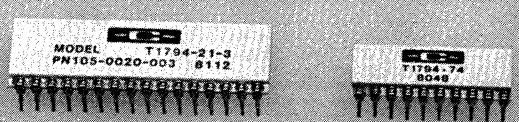


By optimizing both performance and configuration many designers find that these precision networks can achieve savings in both component cost and insertion costs — even in production-lot quantities as low as 1000 units.

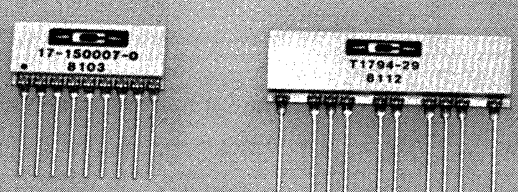
A large part of our high thru-put manufacturing capacity is now committed to the production of these custom precision resistor networks. Custom network designs for requirements that range from 500 networks per year to over 400,000 networks per year are now in production.

For immediate engineering information on the custom precision resistor network configuration that can best meet your needs, call or write to our Applications Engineering Group in Riverside, California, and we will be pleased to provide both technical performance and pricing information.

Optional Pin Styles



Low-profile, single-in-line package with one row of right-angle pins.



SIP package with extra-long pin length.

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High Performance Film Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

The outstanding levels of performance and reliability that Caddock resistors provide is maintained through a continuous program of testing and process control that includes every step in the production process.

Manufacturing Control

Our manufacturing controls include processes for power conditioning, over-voltage conditioning and maximum temperature conditioning. We also perform many in-process tests to verify the performance levels and consistency of all of our resistor types, and to screen out defects not detectable by visual inspection.

Quality Control

The Caddock Quality Control System covers every step in the manufacturing process from the examination of incoming raw materials to the final testing and packaging of each resistor.

To meet the most stringent QC requirements, Caddock's Quality Control Procedures have been approved as being in conformance to the requirements of NASA NHB5300.4(1C) and MIL-1-45208 in recent surveys.

Reliability Verification

In addition to the tests for tolerance, stability and temperature characteristics that are part of our normal manufacturing procedures, we also perform semi-annual reliability tests to confirm compliance to our exacting product specifications.

The flow diagram of the Caddock Reliability Test Program illustrates the sequence of the eleven tests in this program.

The test procedures in the Caddock Reliability Testing Specification 271-02 generally follow the format of MIL-R-55182 and MIL-Std-202. The results of these tests may be used to qualify Caddock resistors for substitution in existing designs.

Reliability Test Summary — "Caddock Report No. 1".

To provide electronic engineers with actual stability data — data that can be used to determine actual improvements in circuit performance — we have compiled test results taken since 1972 from our continuing reliability program.

Of the eleven tests in this program, we have graphically summarized data from the six tests that measure resistor stability under conditions most important to circuit designers:

1 — Temperature Cycling Tests

2 — Overload Tests

3 — 2000 Hour Load-Life Tests

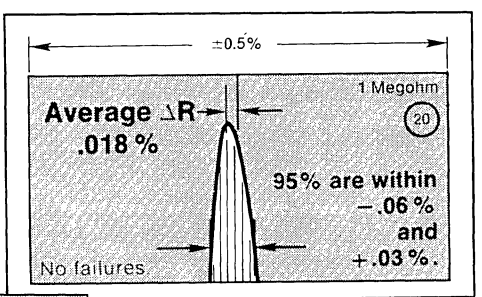
4 — Moisture Resistance Tests

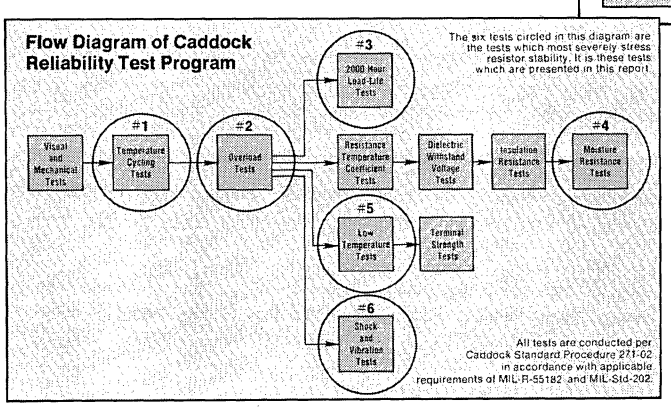
5 — Low Temperature Operation

6 — Shock and Vibration Tests

This stability data appears in a series of 96 graphs that show the actual stability of 740 Caddock High Performance Film Resistors.

The individual and average resistance change is also shown in these graphs for the low, high and 'critical' values, to provide data that can be used to pre-determine actual circuit performance and long-term equipment specifications.





A copy of the 12-page brochure describing the results of these reliability and stability tests is available from the main offices of Caddock Electronics, Inc. in Riverside, California.

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

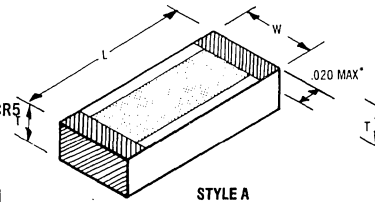
YIG yttrium iron garnet

CAL-R, INC. THICK FILM

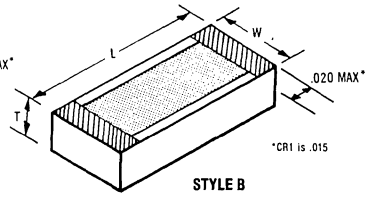
CERMET CHIP RESISTORS

ELECTRICAL

Resistance Range: 10 ohms to 40 megohms
Tolerance: 1% (F), 2% (G), 5% (J), 10% (K) standard and 20% (M)
Power Rating: 100 Milliwatts CR1, 200 Milliwatts CR2. 250 Milliwatts CR3 & 300 Milliwatts CR4, 350 Milliwatts CR5
Short Time Overload: Less than 0.50% ΔR
Temperature Coefficient of Resistance: ±150 ppm standard thru 1 megohm; ±350 ppm 1.1 megohm thru 10 megohms; ±50 ppm available 100 ohms thru 750K ohms. All TCR ratings as measured from −55°C to +125°C with 25°C reference point.
Standard MIL Decade Values: 10 ohms thru 20 megohms.



STYLE A



STYLE B

SIZE	LENGTH (L) ±.005	WIDTH (W) ±.005	THICKNESS (T) ±.003
CR1	.050	.040	.012
CR2	.075	.050	.016
CR3	.100	.050	.016
CR4	.150	.050	.016
CR5	.225	.075	.016
CR1010	.100	.100	.029
CR1025	.100	.025	.020
CR2010	.200	.100	.020
CR3535	.035	.035	.015
CR5025	.050	.030	.020
CR5050	.050	.050	.020

ENVIRONMENTAL

Operating Temperature: −55°C to +125°C.
Moisture Resistance: Less than 1% change when tested per method 106 of MIL-STD 202.
Life: Less than 1% change when tested per method 108D (+85°C) of MIL-STD 202.
MIL Specifications: Designed to meet MIL-R-55342 requirements.

MECHANICAL

Construction: 96% Alumina substrate with proprietary Cermet resistance element and specified termination material.

Terminations: STYLES
A 3 sided wrap-around
B Top termination

MATERIAL
A Palladium silver
B Platinum gold
C Gold
D Platinum silver
E palladium gold
Solder termination available
S1 — 60/40 S2 — SN62

CAL-R CHIP NUMBERING SYSTEM

SIZE	TERMINATION		VALUE * (OHMS)	TOLERANCE	TCR
	STYLE	MATERIAL			
CR1	A	A	1002	K	150

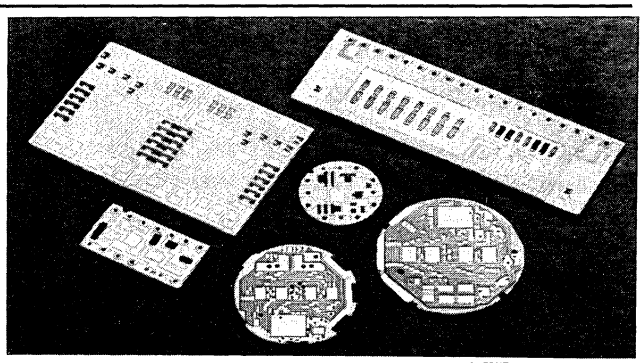
* The first 3 digits represent significant figures; the last digit specifies the number of zeros to follow.
Tolerance code: F −1%, G −2%, J −5%, K −10% & M −20%

PRECISION THICK FILM NETWORKS

Cal-R thick Film Passive Systems develops and produces, to customer requirements, packaged resistor networks including digital to analog A-D binary ladders (through 12 bits), BCD bipolar ladders and custom precision resistor networks.

Cal-R manufactures ceramic substrates for the Digital Watch market and custom R-C networks for hi-rel and commercial applications.

Cal-R thick film resistor compositions fused to a high purity 96% aluminum substrate insure low thermal gradients, high thermal stability and matched electrical characteristics.

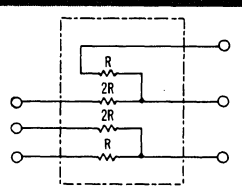


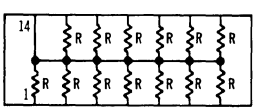
ELECTRICAL SPECIFICATIONS

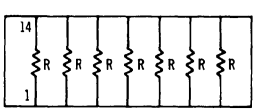
CHARACTERISTICS	DUAL and SINGLE IN-LINE AND FLATPACK RESISTOR NETWORKS	LADDER NETWORKS
Resistance Range	10 ohms to 1 megohm	10 ohms to 1 megohm
Temperature Coefficient	±150 PPM/°C STD ±50 PPM/°C Avail.	±150 PPM/°C STD ±50 PPM/°C Avail.
Tracking to:	15 PPM/°C	5 PPM/°C

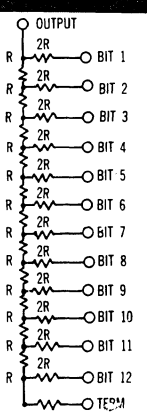
GENERAL SPECIFICATIONS

Operating Temperature Range: −55°C to +125°C
Storage Temperature Range: −65°C to +150°C
Stability To: 25 PPM/year
Settling To: 50 nSec.
Fast Rise Time
Minimum size for maximum efficiency and quality.
All networks are 100% inspected to applicable requirements (MIL-Specs or inhouse).
All resistance parameters meet or exceed the performance requirements of MIL-R-55342A when applicable.









CAL-R, INC. 1601 Olympic Blvd., Santa Monica, California 90404 • (213) 450-1761 • TWX 910-343-6966
WIREWOUND RESISTORS • THICK FILM • THERMISTORS

CAL-R® INC. WIRE WOUND RESISTORS

PRECISION POWER RESISTORS

FEATURES

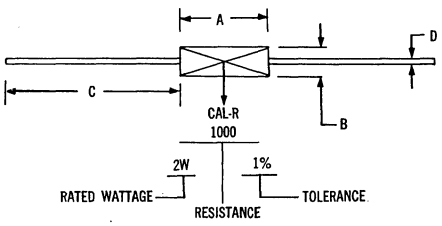
1. Copperweld leads standard. Nickel A or Alloy 180 available.
2. Core-alumina and steatite ceramics.
3. Silicone coating to give maximum wire protection and extra high resistance to moisture.
4. Failure rates of less than .006% per 1000 hours @ +25°C with 60% confidence.

ELECTRICAL CHARACTERISTICS

A. TOLERANCES: 5.0% to .01%. 1% standard for off-shelf delivery. Special matching available to .001% tolerance.
B. TEMPERATURE COEFFICIENT: 20 ppm/degree C standard. Special T.C.'s to 5 ppm/degree C available.
C. Dielectric strength greater than 1000 V.A.C.
D. Special configurations available on request.
E. SA (X) Types Thermal shock proof from 275°C to —55°C.
F. SAV (X) Types Thermal shock proof from 350°C to —55°C.
G. STABILITY: consistent with tolerances, all parts stabilized in production. Less than 0.1% drift in 2000 hours operation at full Cal-R wattage rating for 1% tolerance parts.
H. RESISTANCE RANGES: .05 ohms to 250K ohms.
I. INDUCTIVE TYPES: Single layer space wound with largest wire permissible.
J. Non-inductive Types feature dual balanced windings for minimum inductance.

ENVIRONMENTAL

Meet or exceed applicable paragraphs of MIL-R-26E and MIL-R-39007.



STANDARD RESISTANCE & TOLERANCE RANGES

*Type SA and SAX (Non-induct)	1 Rated Wattage	*Type SAV and SAVX (Non-induct)	2 Rated Wattage	MIL Equiv. MIL-R-26E & 39007	Dimensions A ± .062	B ± .032 3	C ± .062	D ± .002	4 Tolerances & Max. Resistance Based on .0007 Min. Wire Dia. 1% & Higher	.5%, .25%, .1% & .05%
SA 01	.4	SAV 03	.5		.250	.078	1½	.020 24 Ga.	1.4KΩ	950Ω
SA 02	.5	SAV 06	.6	RW 81U RWR 81	.250	.085	1½	.020 24 Ga.	2KΩ	1.2KΩ
SA 04	.75	SAV 09	.9		.312	.078	1½	.020 24 Ga.	3KΩ	1.3KΩ
SA 05	.8	SAV 12	1.2		.312	.094	1½	.020 24 Ga.	4.9KΩ	2.4KΩ
SA 10	.9	SAV 22	2.2		.344	.094	1½	.020 24 Ga.	5KΩ	2.5KΩ
SA 15	1.0	SAV 25	2.5	RW 70U RW 80U RWR 80	.406	.094	1½	.020 24 Ga.	7KΩ	3.5KΩ
SA 17	1.0	SAV 26	2.6		.531	.094	1½	.020 24 Ga.	10KΩ	5KΩ
SA 20	2.0	SAV 33	3.0		.500	.156	1½	.032 20 Ga.	15KΩ	7.5KΩ
SA 30	2.5	SAV 41	4.1	RW 69V	.500	.188	2	.032 20 Ga.	20KΩ	10KΩ
SA 31	3.0	SAV 45	4.5	RWR 89 RW 79U	.560	.187	2	.032 20 Ga.	25KΩ	12KΩ
SA 32	2.0	SAV 46	4.6	RWR 71	.812	.188	2	.032 20 Ga.	40KΩ	20KΩ
SA 35	3.0	SAV 52	5.2		.625	.250	2	.040 18 Ga.	35KΩ	17KΩ
SA 50	5.0	SAV 74	7.4	RWR 74 RW 74U RWR 84	.875	.312	2	.040 18 Ga.	60KΩ	30KΩ
SA 55	5.5	SAV 82	8.2	RW 67V	1.00	.313	2	.040 18 Ga.	70KΩ	35KΩ
SA 70	7.0	SAV 96	9.6		1.219	.312	2	.040 18 Ga.	90KΩ	45KΩ
SA 95	9.5	SAV 106	11.0	RW 55V	1.375	.469	1½	.040 18 Ga.	160KΩ	80KΩ
SA 100	10.0	SAV 145	14.5	RWR 78 RW 78U RW 68V	1.781	.375	2	.040 18 Ga.	200KΩ	100KΩ
SA 125	12.5	SAV 150	15.0	RW 56V	2.000	.469	1½	.040 18 Ga.	250KΩ	140KΩ

*—Available in Noninductive (code symbol "X").

1 —Nominal, based on maximum 275°C. Hot spot at 25°C. Ambient. (char. U)
2 —Nominal, based on maximum 350°C. Hot spot at 25°C. Ambient. (char. V).
3 —Tolerance for noninductive types below 150Ω ±.062.
4 —Noninductive maximum resistances are one-half of listed values.

WHEN ORDERING SPECIFY: TYPE, WATTAGE, RESISTANCE AND TOLERANCE.

POWER RESISTORS

FOUR STANDARD MC TYPE RESISTOR SPECIFICATIONS IN MIL-R SIZES

OUTSTANDING FEATURES

1. Copperweld leads hot tin dipped for maximum solderability.
2. Completely welded construction terminal to terminal.
3. High density extruded aluminum housing provides superior heat conduction.
4. Housing deep finned for maximum heat dissipation under natural and forced convection.
5. Windings—High uniformity single layer space wound, designed to give maximum core coverage for even heat dissipation. MCX (non-inductive) types have dual balanced windings for minimum inductance.
6. Core—Steatite ceramic, centerless ground for uniformity.
7. Silicone coated resistance element to give maximum wire protection and extra high resistance to moisture.

ELECTRICAL CHARACTERISTICS

Tolerances—5.0% to .05%, 1% standard for off-shelf delivery.

Temperature Coefficient—20 ppm/degree C standard. Special T.C.'s to 5 ppm/degree C available.

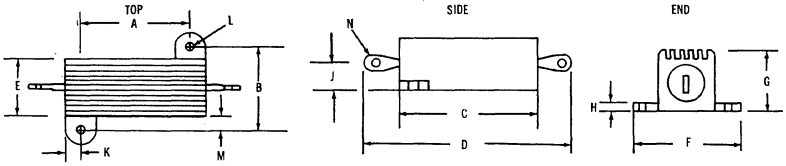
Dielectric strength greater than 1000 V.A.C. on MC-100 and MC-250, and greater than 2000 V.A.C. on MC-500.

Dielectric Test—performed on 100% basis.

Stability—consistent with tolerances, all parts stabilized in production. Less than 0.5% drift in 1000 hours operation at full Cal-R wattage rating for 1% tolerance parts. Resistance ranges—.05 ohms to 210K ohms.

ENVIRONMENTAL

Meet or exceed all requirements of MIL-R-18546D, including "N" characteristic and MIL-R-39009.



DIMENSIONS

Type	A	B	C	D	E	F	G	H	J	K	L	M	N
MC-80	.444	.490	.600	1.125	.334	.646	.317	.075	.139	.078	.093	.078	.050
MC-100	.562	.625	.750	1.375	.438	.873	.408	.094	.172	.093	.093	.094	.086
MC-250	.719	.781	1.063	1.938	.500	1.094	.531	.094	.219	.171	.125	.141	.086
MC-500	1.563	.844	1.969	2.781	.563	1.156	.625	.094	.281	.203	.125	.141	.086
TOL. ±	.005	.005	.016	.063	.031	.031	.031	.016	.031	.010	.005	.016	.015

STANDARD RESISTANCE & TOLERANCE RANGES

Type	Mil Equiv. Mil-R-18546C Mil-R-39009	Cal-R Watts Normal Rating	Watts Mil-R Rating	TOLERANCES AND MAXIMUM RESISTANCES* 1% Up	.5%	.25%	.1%	.05%
MC-80 (X)	RE 60 (N), RER 40, RER 60	8	5	.5 Ω to 20 K Ω	1 Ω to 10 K Ω	2.5 Ω to 10 K Ω	3 Ω to 10 K Ω	5 Ω to 10 K Ω
MC-100 (X)	RE 65 (N), RER 45, RER 65	10	10	.5 Ω to 25 K Ω	1 Ω to 10 K Ω	2.5 Ω to 10 K Ω	3 Ω to 10 K Ω	5 Ω to 10 K Ω
MC-250 (X)	RE 70 (N), RER 50, RER 70	25	20	.1 Ω to 70 K Ω	.2 Ω to 30 K Ω	.3 Ω to 30 K Ω	.5 Ω to 30 K Ω	1 Ω to 30 K Ω
MC-500 (X)	RE 75 (N), RER 55, RER 75	50	30	.1 Ω to 200 K Ω	.2 Ω to 80 K Ω	.3 Ω to 80 K Ω	.5 Ω to 80 K Ω	1 Ω to 80 K Ω

Available in Noninductive (code symbol "X"—Cal-R) (code symbol "N"—Mil)

*Noninductive maximum resistances are one-half of listed values.

CAL-R, INC. WIRE WOUND RESISTORS

POWER RESISTORS ... Cont'd.

T-5 (5 WATTS) OUTSTANDING FEATURES

1. Copperweld leads hot tin dipped — Gold plated DUMET or "A" nickel available.
2. High density extruded aluminum housing provides superior heat conduction.
3. Housing deep finned for maximum heat dissipation.
4. Windings — high uniformity single layer space wound, designed to give maximum core coverage for even heat dissipation. T5X (non-inductive) types have dual balanced windings for minimum inductance.
5. Core — Alumina ceramic, centerless ground for uniformity.

T-3 (3 WATTS) OUTSTANDING FEATURES

1. Windings — Reverse pie wound — all pies filled for maximum heat dissipation.
2. Unique recessed end cap designed to isolate winding termination from all lead stress.
3. Protective overcoating covering entire resistor before molding insures maximum protection and secures winding without introducing stress.
4. Resistor element encased in nonburning epoxy by transfer molding techniques.
5. Copperweld leads hot tin dipped standard — Gold plated DUMET or "A" nickel available.

STANDARD RESISTANCE & TOLERANCE RANGES

Type	Normal Rating	Weight	Tolerances and Maximum Resistances 1% UP	.5%	.25%	.1%	.05%
T5	5 WATTS	.8 gr	1Ω-5K	1Ω-5K	5Ω-3K	10Ω-2.5K	10Ω-2.5K
T3*	3 WATTS	.8 gr	3K-300K	3K-300K	3K-300K	3K-300K	3K-300K

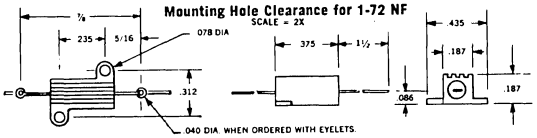
*200 VAC MAX.

T-5 ELECTRICAL CHARACTERISTICS

TOLERANCES: 5.0% to .05%. 1% standard for off-shelf delivery.
TEMPERATURE COEFFICIENT: 30 ppm/°C standard. Special T.C.'s to 5 ppm/°C available.
STABILITY: consistent with tolerances, all parts stabilized in production. Less than 0.5% drift in 1000 hours operation at full CAL-R wattage rating for 1% tolerance parts.
RESISTANCE RANGES: .5 ohms to 3 K ohms.
DIELECTRIC STRENGTH: greater than 500 V.A.C.
DIELECTRIC TEST: performed on 100% basis.

T-3 ELECTRICAL CHARACTERISTICS

TOLERANCE: 1 to .005% absolute. To .002% matching tolerance for matched sets.
TEMPERATURE COEFFICIENT: 10 ppm/°C is standard. Special TCs in ranges from +6000 ppm to 2 ppm/°C available.
STABILITY: consistent with tolerances. All parts stabilized in production, including 1% parts. Components available with stability of .002% per year.
WINDINGS: multiple pie reversed type to minimized inductance. Special windings available to provide fast rise times.
RESISTANCE: Ranges 3 K ohms to 300 K ohms.
MAXIMUM WORKING VOLTAGE: 200V.



PRECISION RESISTORS

OUTSTANDING FEATURES

1. All pies filled for maximum heat dissipation.
2. Unique recessed end cap designed to isolate winding termination from all lead stress.
3. Terminals welded to end cap for maximum strength — will withstand 15 lbs. linear pull.
4. Double slots tangent to mandrel to prevent shorting between pie windings eliminating space-wasting construction features or the need for insulating tape.
5. Protective overcoating covering entire resistor before molding insures maximum moisture protection and secures winding without introducing stress.
6. Standard leads — copperweld hot tin dipped or annealed Dumet gold plated.
7. Special matching available to .001% tolerance.

ELECTRICAL CHARACTERISTICS

TOLERANCE: 1 to .005% absolute. To .002% matching tolerance for matched sets.

TEMPERATURE COEFFICIENT: 10 ppm/°C is standard. Special TCs in ranges from +6000 ppm to 2 ppm/°C available.

STABILITY: consistent with tolerances. All parts stabilized in production, including 1% parts. Components available with stability of .002% per year.

WINDINGS: multiple pie reversed type to minimized inductance (except on Miniature Series). Special windings available to provide low rise times.

RESISTANCE: Ranges 1 ohm to 10 megohms.

PHYSICAL CHARACTERISTICS

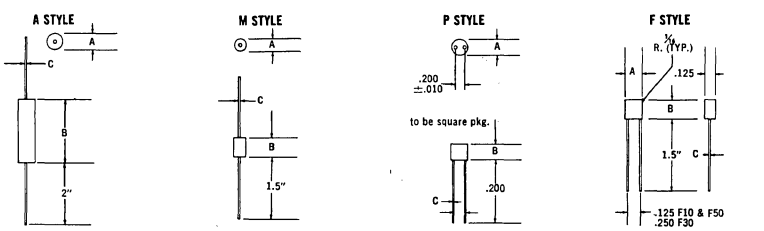
MATERIAL: Hi-Temp epoxy with matching coefficient of expansion between core and case. Leads are gold over Dumet.

ENVIRONMENTAL

Meet or exceed all requirements of MIL-R-93C and MIL-R-39005.

STANDARD RESISTANCE & TOLERANCE RANGES

CAL-R Part No.	Dimensions "A" ±.010	"B" ±.010	"C"	Rated Wattage	MIL Equiv. MIL-R-93C MIL-R-39005	Tolerances and Maximum Resistances ±1%	±.5%	±.1%	±.05%	±.01%
M10	.080	.200	.016 #26 AWG	.05		100Ω100K	300Ω-80K	1K-80K	3K-50K	1.0K-25K
M20	.100	.200	.016 #26 AWG	.06		25Ω-150K	50Ω-100K	100Ω-100K	500Ω-80K	2.5K-50K
M30	.125	.250	.020 #24 AWG	.08		10Ω-250K	20Ω-250K	80Ω-250K	300Ω-200K	1.5K-150K
M40 M41*	.125	.375	.020 #24 AWG	.10		10Ω-400K	20Ω-400K	80Ω-400K	300Ω-300K	1.K-200K
A2525	.250	.250	.032 #20 AWG	.2	RBR75	10Ω-750K	20Ω-750K	50Ω750K	200Ω-650K	1.K-500K
A2535	.250	.350	.032	.25	RBR56	10Ω-1MEG	20Ω-1MEG	50Ω-1MEG	200Ω-1MEG	800Ω-800K
A2537	.250	.375	.032	.25	RB56	10Ω-1MEG	20Ω-1MEG	50Ω-1MEG	200Ω-1MEG	800Ω-800K
A2550	.250	.500	.032	.25	RB55 RBR55	10Ω-2.5MEG	20Ω-2.5M	50Ω-2.5M	100Ω-2.5M	500Ω-2.5M
A2575	.250	.750	.032	.35	RB54 RBR54	5Ω-3M	10Ω-3M	50Ω-3M	100Ω-3M	500Ω-3M
A25100	.250	1.00	.032	.4		5Ω-3.5M	10Ω-3.5M	50Ω-3.5M	100Ω-3.5M	500Ω-3.5M
A3775	.375	.750	.032	.5	RB53 RBR53	5Ω-4M	10Ω-4M	50Ω-4M	100Ω-4M	400Ω-3M
A37100	.375	1.00	.032	1.0	RB52 RBR52	2Ω-5.5M	4Ω-5.5M	20Ω-5.5M	50Ω-5.5M	300Ω-4.5M
A5050	.500	.500	.032	.5		10Ω-4M	20Ω-4M	50Ω-4M	100Ω-4M	400Ω-3M
A5062	.500	.625	.032	.5						
A5070	.812	.312	.032	.5	RBR76	5Ω-5.5M	10Ω-5.5M	50Ω-5.5M	100Ω-5.5M	400Ω-4.5M
A50100	.500	1.00	.032	1.0	RB57 AFRT14	1Ω-7MEG	5Ω-7M	20Ω-7MEG	50Ω-7MEG	200Ω-5MEG
P2531	.250	.312	.025 #22 AWG	.12		10Ω-1MEG	20Ω-1M	50Ω-1M	100Ω-1M	800Ω-800K
P3750	.375	.500	.025	.35		5Ω-1.5M	10Ω-1.5M	30Ω-1.5M	100Ω-1.5M	800Ω-1.MEG
F10	.250	.250	.032 #20 AWG	.125		10Ω-750K	20Ω-750K	50Ω-750K	200Ω-650K	1.K-500K
F30	.500	.250	.032	.25		10Ω-1M	20Ω-1MEG	50Ω-1M	200Ω-1M	800Ω-800K
F50	.250	.500	.032	.25		5Ω-1.3M	10Ω-1.3M	20Ω-1.3M	100Ω-1.3M	200Ω-1.M



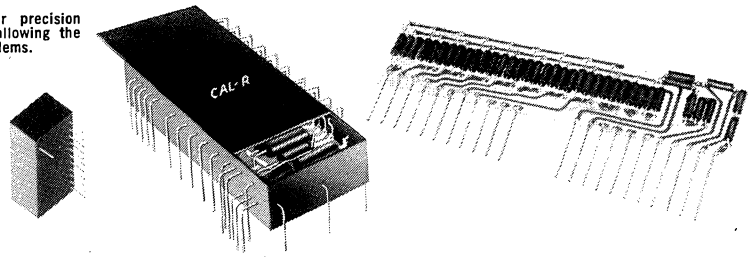
* NON INDUCTIVE

PRECISION RESISTOR NETWORKS

Cal-R engineers, specialists in advanced network design, offer precision assemblies, packaged to meet the most exacting specifications, allowing the circuit designer maximum freedom without costly packaging problems.

GENERAL SPECIFICATIONS

RESISTOR VALUES: From 1 ohm thru 5 megohms
FULL SCALE ACCURACY: to .005%
TEMPERATURE COEFFICIENT TRACKING: to 1 PPM/°C.
TEMPERATURE COEFFICIENT ABSOLUTE: to 2 PPM/°C.
AMBIENT TEMPERATURE RANGE: —55°C to +125°C.
STANDARD TEMPERATURE COEFFICIENT: 0 to ±10 PPM.
STABILITY: to 10 PPM per year.
FAST RECOVERY TIME: to within .02% of final value within 100 ns.



CAL-R, INC.
1601 Olympic Blvd., Santa Monica, California 90404 • (213) 450-1761 • TWX 910-343-6966
WIREWOUND RESISTORS • THICK FILM • THERMISTORS

CARBORUNDUM NON-INDUCTIVE POWER RESISTORS

Choose Type SP for great A-C power handling capability, whether it be at power frequency or many megahertz.

Choose Type A when high resistance is required in a high power non-inductive resistor.

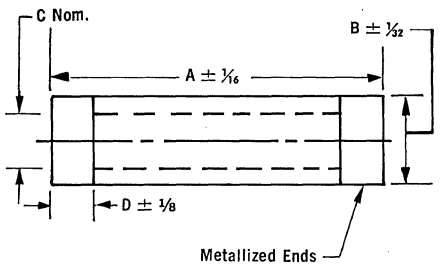
Choose Type AS for its ability to absorb huge amounts of energy and for its non-inductive property at high voltage.

CHARACTERISTICS	Type SP	Type AS	Type A
Maximum Operating Temperature: °C	350	230 150*	230
Temperature Coefficient: Percent per degree C, −55°C to maximum rated temperature	0.075	0.075	0.10
Voltage Coefficient: Maximum percent per kilovolt per inch active length (overall length less termination)	1.0	1.0	—
Short Time Overload: Maximum percent change after 5 cycles 10 times rated power, 5 seconds on, 90 seconds off	2.0	2.0	—
Moisture Resistance: Maximum percent change when tested per MIL-STD-202 method 103	2.5	2.5	2.5

*with mylar insulation

STANDARD SIZES
(Special sizes are also available: consult factory.)

Type	A	B	C (SP & AS)	C (A)	D
884 SP	2.0	0.50	0.22	—	0.25
885 SP, AS, & A	2.5	0.75	0.50	0	0.50
886 SP, AS, & A	5.0	0.75	0.50	0	0.62
887 SP, AS, & A	6.0	1.00	0.75	0.5	0.50
888 SP, AS, & A	8.0	1.00	0.75	0.5	0.88
889 SP, AS, & A	12.0	1.00	0.75	0.5	0.88
890 SP, AS, & A	18.0	1.00	0.75	0.5	0.88
891 SP	18.0	2.00	1.50	—	1.00
892 SP	24.0	2.00	1.50	—	1.00



Type/Size	Resistance Available (ohms) Premium to	Standard to	Premium to		Average Power @ 40°C (watts)	Peak Energy (Joules)	Peak Voltage (AIR) (Volts)
2" long x ½" diameter							
884SP	1.0	5.0	100	200	22.5	250	1,000
2½" long x ¾" diameter							
885SP	1.0	5.0	82.0	130	45	250	1,000
885AS	6.0	100	1000	1200	15	2,500	4,000
885AS..D	6.0	100	1000	1200	10	2,500	8,000*
885A		1500	220K		15	750	3,750
5" long x ¾" diameter							
886SP	1.0	5.0	180	330	90	500	4,000
886AS	15.0	220	2200	3300	30	5,000	10,000
886AS..D	15.0	220	2200	3300	19.5	5,000	20,000*
886A		3900	390K		30	1,500	10,000
6" long x 1" diameter							
887SP	1.0	5.0	82.0	330	150	1,600	4,000
887AS	12.0	100	2200	3300	50	15,000	15,000
887AS..D	12.0	100	2200	3300	32.5	15,000	30,000*
887A		3900	390K		50	6,000	12,000
8" long x 1" diameter							
888SP	1.0	5.0	120	390	190	2,100	6,000
888AS	15.0	150	2700	3900	75	20,000	22,500
888AS..D	15.0	150	2700	3900	49	20,000	45,000*
888A		4700	470K		60	7,500	15,000
12" long x 1" diameter							
889SP	1.0	10.0	180	680	275	3,200	10,000
889AS	25.0	220	5000	6800	100	35,000	37,500
889AS..D	25.0	220	5000	6800	65	35,000	75,000*
889A		8200	680K		90	12,500	25,000
18" long x 1" diameter							
890SP	1.0	10.0	270	1000	375	4,200	16,000
890AS	40.0	330	8500	10K	150	50,000	60,000
890AS..D	40.0	330	7500	10K	98	50,000	120,000*
890A		12K	750K	1Meg	125	20,000	40,000
18" long x 2" diameter							
891SP	1.0	10.0	75.0	450	750	15,000	16,000
24" long x 2" diameter							
892SP	1.0	10.0	100	600	1000	17,500	22,000

* Type AS with dielectric coating: Add "D" as last character in part number.

Carborundum Resistant Materials Company
Electric Products Division, Post Office Box 339, Niagara Falls, N.Y. 14302
Tel: (716) 278-2521 • Telex: 91-555 (CARBO GLO NGF)

CARBORUNDUM

CARBORUNDUM NON-INDUCTIVE POWER RESISTORS FOR SPECIAL PROBLEM SOLUTIONS

Now available are 1¼" and 1½" diameter cylindrical resistors to provide higher single resistor average and peak power ratings.

ELECTRICAL SPECIFICATIONS

Type	Size	Resistance Available (ohms) Premium to	Standard to	Premium to		Average Power @ 40°C (watts)	Peak Energy (Joules)	Peak Voltages (AIR) (KV)
987AS	6"L x 1¼"D	7	75	1100	1350	65	24,000	15-30
1087AS	6"L x 1½"D	5	50	1000	1200	70	37,000	15-30
988AS	8"L x 1¼"D	9	100	1600	2400	80	30,000	22.5-45
1088AS	8"L x 1½"D	6.5	65	1300	1875	100	46,000	22.5-45
989AS	12"L x 1¼"D	14	125	2800	3600	125	47,000	37.5-75
1089AS	12"L x 1½"D	9	90	1800	2500	150	75,000	37.5-75
990AS	18"L x 1¼"D	22	180	4100	5500	190	75,000	60-120
1090AS	18"L x 1½"D	15	150	2700	3800	225	119,000	60-120
991AS	24"L x 1¼"D	30	270	5600	7500	250	105,000	82.5-165
1091AS	24"L x 1½"D	20	200	3600	4800	300	164,000	82.5-165

TYPE 234 AND 231 RESISTORS

Carborundum type 234 and 231 resistors are a small size non-inductive bulk type resistor (there are no spirals or windings), capable of dissipating a full 10 watts of power (Type SP) or absorbing 500 Joules of energy (Type AS).

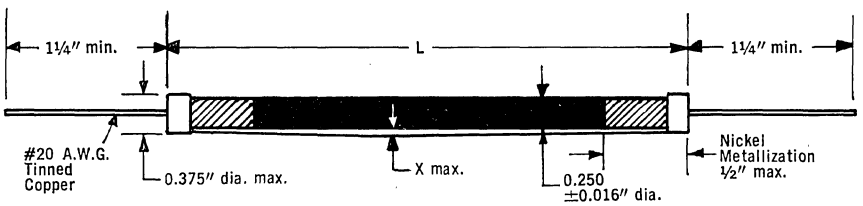
234 — ¼" x 1"
231 — 5/32" x ¾"

Specifications	234SP	234AS	231SP	231AS
Resistance, ohms ±5%, ±10%, ±20%	1-330	12-5000	1-1000	25-6250
Peak Voltage	500 Volts	2.5kv	375 Volts	1.5kv
Power at 40°C	10 Watts	3 Watts	2.5 Watts	1.5 Watts
Derate Linearly to 0 Watts at	350°C	230°C	350°C	230°C
Max operating temperature	350°C	230°C	350°C	230°C
Peak Energy	30 Joules	500 Joules	15 Joules	75 Joules

Characteristics	234SP	234AS	231SP	231AS
Short Time Oveload • 10 Cycles of 1000% rated power • 5 sec. on, 90 sec. off	5% max.	1% max.	3.5% max.	1% max.
Life test 1000hr rated power	5% max.	5% max.	5% max.	5% max.
Temperature Coefficient	±.075% /C	±.15% /C	±.075% /C	±.15% /C

TYPE AS "PENCIL-SHAPED" STYLE

The high-energy absorbing characteristic of the Carborundum type AS material is available in these pencil-shaped resistors to offer the unique non-inductive high-voltage properties in a compact easily wired configuration.



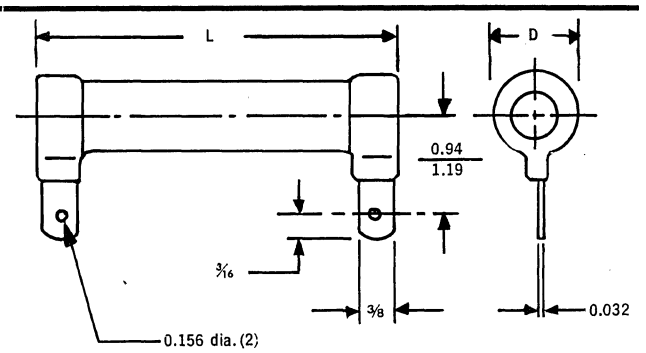
Type No.	L +0.25 −0	X	Resistance Available (ohms) Premium to	Standard to	Premium to		Average Power @ 40°C (watts)	Peak Energy (joules)	Peak Voltage (volts)
104 AS	4	0.08	55	420	9,000	18,000	9	1,200	9,000
106 AS	6	0.12	90	700	15,000	30,000	13	1,900	15,000
109 AS	9	0.16	150	1,150	25,000	48,000	20	3,000	25,000

TYPE AS EPOXY COATED STYLE

Carborundum Type AS High-Energy Ceramic Resistors are available with an epoxy polyurethane coating which protects the resistors body from contaminants. Its is especially useful where the resistor is employed in an application where it is not protected from a dirty ambient atmosphere or where it is immersed in a cooling or dielectric fluid.

In air the coated resistor can safely dissipate 75% of the power dissipated by an uncoated part.

The overall length, L, of the coated resistor is approximately 0.25" longer than the uncoated part; the diameter, D, is approximately 0.30" greater.



Carborundum Resistant Materials Company
Electric Products Division, Post Office Box 339, Niagara Falls, N.Y. 14302
Tel: (716) 278-2521 • Telex: 91-555 (CARBO GLO NGF)

CARBORUNDUM

CARBORUNDUM NON-INDUCTIVE POWER RESISTORS FOR SPECIAL PROBLEM SOLUTIONS

TYPE AS DISC AND WASHER STYLES

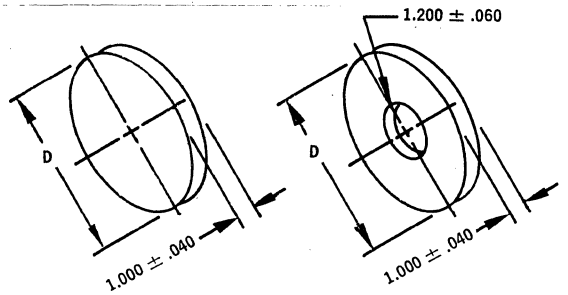
Carborundum Type AS Disc and Washer Ceramic Resistors are a bulk-type low resistance element, and therefore have the ability to absorb instantaneously great surges of energy with virtually zero inductance.

Maximum Peak Voltage: 5000 volts.

Maximum Temperature: 230°C.

Power Rating: In free air, parts will safely dissipate 2.5 watts per square inch of surface area at 40°C.

Temperature Coefficient of Resistance: −0.1%/°C to 0.0%/°C.



Style		Diameter "D" (inches)	Peak Energy (joules)	Available Resistances	
				Minimum	Maximum
911DS	Solid Disc	1.60 ± 0.06	9,000	1.6	800
912DS	Solid Disc	2.37 ± 0.06	21,000	0.7	90
913DS	Solid Disc	3.00 ± 0.08	33,000	0.5	56
914DS	Solid Disc	3.75 ± 0.08	52,500	0.3	36
913WS	Washer	3.00 ± 0.08	27,600	0.5	78
914WS	Washer	3.75 ± 0.08	47,000	0.3	40
915WS	Washer	4.37 ± 0.08	65,500	0.2	28
916WS	Washer	4.75 ± 0.08	79,500	0.2	24

CARBORUNDUM® VARISTORS

Standard varistors described below have a 10% tolerance on voltage. Also available: leadless discs and rods, voltages specified at intermediate values or at other currents, and voltage tolerances of ±15% and ±20%. Available at extra cost: voltage tolerances of ±5% and ±7%, color coding, and special coatings.

Standard rod varistors have a blue epoxy coating. Available at extra cost: formed leads for printed circuit board insertion.

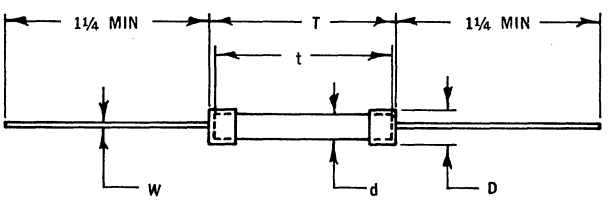


Figure 1

Standard disc varistors have a black flame-retardant PVC coating. Also available: Glyptal coating and kinked leads for printed circuit board insertion.

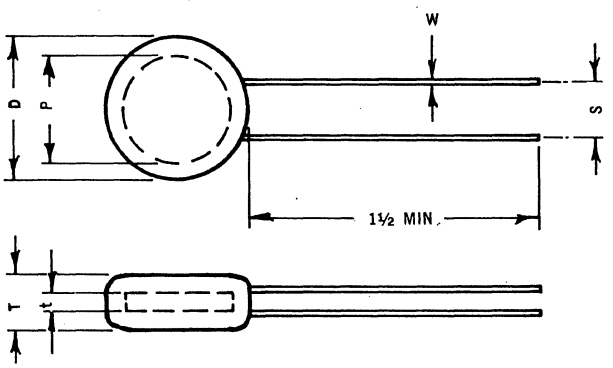


Figure 2

VOLTAGES AVAILABLE

	Carborundum Style Number	Volts ±10% at 1.0 MA	Volts at 1.0 MA Volts at .1 MA	Peak Voltage	Power Watts	d ±.030	t ±.030	D max.	T max.	w nom.	s nom.
ROD STYLES (Figure 1)	231BNR4-	100-750	2.1-1.7	800	0.750	0.156	0.625	0.250	0.812	0.032	—
	233BNR4-	68-710	2.1-1.7	800	1.000	0.250	0.625	0.375	0.812	0.032	—
	234BNR4-	135-1050	2.2-1.7	1500	1.500	0.250	1.000	0.375	1.188	0.032	—
	Carborundum Style Number	**Volts ±10% at 1.0 MA**	**Volts at 1.0 MA Volts at .1 MA**	**Peak Voltage**	**Power Watts**	**d ±.030**	**t ±.030**	**D max.**	**T max.**	**w nom.**	**s nom.**
DISC STYLES (Figure 2)	551BNR2-	9-88	2.4-1.8	100	0.250	0.250	0.062	0.400	0.350	0.020	0.125
	432BNR2-	6-90	2.9-1.7	100	0.500	0.500	0.062	0.650	0.350	0.032	0.250
	379BNR2-	12-180	2.9-1.7	200	0.500	0.500	0.125	0.650	0.400	0.032	0.250
	328BNR2-	2-80	3.0-1.7	100	0.750	0.750	0.062	0.900	0.350	0.032	0.375
	925BNR2-	12-160	2.4-1.7	150	0.750	0.750	0.100	0.900	0.380	0.032	0.375
	Carborundum Style Number	**Volts ±10% at 5.0 MA**	**Volts at 5.0 MA Volts at .5 MA**	**Peak Voltage**	**Power Watts**	**d ±.030**	**t ±.030**	**D max.**	**T max.**	**w nom.**	**s nom.**
	923BNR2-	13-150	2.2-1.7	150	1.500	1.000	0.100	1.150	0.380	0.040	0.375
	463BNR2-	10-190	2.2-1.7	200	1.500	1.000	0.125	1.150	0.400	0.040	0.375
	927BNR2-	9-140	2.7-1.9	150	2.250	1.250	0.100	1.400	0.380	0.040	0.375

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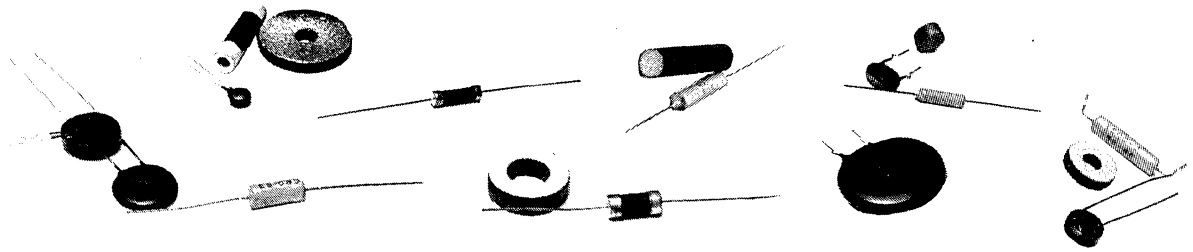
CARBORUNDUM

CARBORUNDUM® VARISTORS



Carborundum silicon carbide varistors are voltage-dependent resistors which are offered in a wide variety of configurations, including discs, rods, and washers. In addition to the sizes shown on these pages, rods are available up to 18 inches in length, washers are available up to 3½ inches in diameter. Typical uses include limitation of peak discharges, spike suppression, stabilization of voltages, and generation of nonlinear functions.

Varistors are specified by the voltage measured across them, suitably toleranced, at some constant current. The slope of the voltage-current characteristic is most often given by the maximum voltage ratio for two specified currents.

In general the characteristic for a varistor may be approximated by the equation:

$$i = Ke^n$$

where i and e are instantaneous current and voltage respectively, K is a proportionality constant, and n is an exponent applicable in the range in which the varistor is used: most often it is between 3 and 5.

The silicon carbide varistor is a "forgiving" component. When hit by a voltage surge, the energy is absorbed throughout its body, not at a junction. A voltage surge beyond the design level causes substantial increase in current and energy absorption, but not a catastrophic failure.

SMALL DISC VARISTORS

Carborundum Part Number	Volts ±10% @ 1.0 ma.	Volts @ 1.0 ma. ÷ Volts @ 0.1 ma. (maximum)
432BNR2-406	6.8	2.70
432BNR2-407	8.2	2.60
432BNR2-408	10.0	2.50
432BNR2-409	12.0	2.35
432BNR2-410	15.0	2.20
432BNR2-411	18.0	2.10
432BNR2-412	22.0	2.00
432BNR2-413	27.0	1.90
432BNR2-414	33.0	1.84
432BNR2-416	47.0	1.80
432BNR2-418	68.0	1.76
432BNR2-420	100.0	1.72
379BNR2-410	15.0	2.50
379BNR2-412	22.0	2.40
379BNR2-414	33.0	2.30
379BNR2-415	39.0	2.20
379BNR2-416	47.0	2.10
379BNR2-417	56.0	2.00
379BNR2-418	68.0	1.95
379BNR2-419	82.0	1.90
379BNR2-420	100.0	1.84
379BNR2-421	120.0	1.78
379BNR2-422	150.0	1.74
379BNR2-423	180.0	1.70
328BNR2-400	2.2	3.60
328BNR2-401	2.7	3.40
328BNR2-402	3.3	3.20
328BNR2-403	3.9	3.00
328BNR2-404	4.7	2.80
328BNR2-405	5.6	2.60
328BNR2-406	6.8	2.50
328BNR2-407	8.2	2.40
328BNR2-408	10.0	2.30
328BNR2-409	12.0	2.20
328BNR2-410	15.0	2.10
328BNR2-411	18.0	2.00
328BNR2-412	22.0	1.95
328BNR2-413	27.0	1.90
328BNR2-414	33.0	1.85
328BNR2-416	47.0	1.76

LARGE DISC VARISTORS

Carborundum Part Number	Volts ±10% @ 5.0 ma.	Volts @ 5.0 ma. ÷ Volts @ 0.5 ma. (maximum)
463BNR2-410	15.0	2.40
463BNR2-412	22.0	2.20
463BNR2-414	33.0	2.10
463BNR2-415	39.0	2.02
463BNR2-416	47.0	1.98
463BNR2-417	56.0	1.94
463BNR2-418	68.0	1.90
463BNR2-419	82.0	1.86
463BNR2-420	100.0	1.82
463BNR2-421	120.0	1.78
463BNR2-422	150.0	1.74
463BNR2-423	180.0	1.70
927BNR2-408	10.0	2.90
927BNR2-409	12.0	2.80
927BNR2-410	15.0	2.70
927BNR2-411	18.0	2.60
927BNR2-412	22.0	2.50
927BNR2-413	27.0	2.40
927BNR2-414	33.0	2.30
927BNR2-416	47.0	2.20

ROD VARISTORS

Carborundum Part Number	Volts ±10% @ 1.0 ma.	Volts @ 1.0 ma. ÷ Volts @ 0.1 ma. (maximum)
233BNR4-417	56.0	2.50
233BNR4-418	68.0	2.40
233BNR4-419	82.0	2.30
233BNR4-420	100.0	2.20
233BNR4-421	120.0	2.10
233BNR4-422	150.0	2.00
233BNR4-423	180.0	1.90
233BNR4-424	220.0	1.82
233BNR4-425	270.0	1.78
233BNR4-426	330.0	1.76
233BNR4-428	470.0	1.74
233BNR4-430	680.0	1.70
234BNR4-426	330.0	2.00
234BNR4-427	390.0	1.90
234BNR4-428	470.0	1.80
234BNR4-429	560.0	1.77
234BNR4-430	680.0	1.74
234BNR4-431	820.0	1.70
234BNR4-432	1000.0	1.68

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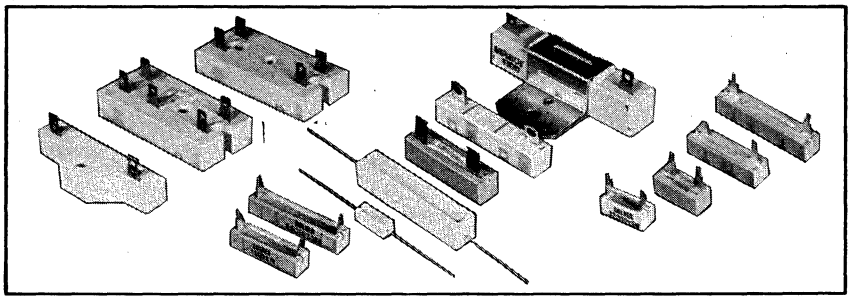
CARBORUNDUM

COLBER RESISTORS

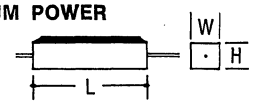
WIRE WOUND / TEMPERATURE SENSITIVE / CERAMIC ENCAPSULATED / FUSISTORS (FUSEABLE RESISTORS)



The resistance elements of the Colber resistors are uniformly and tightly wound on glass fiber cores using premium quality wires. Tinned steel or brass terminals are secured to the element by automatic assembly equipment. The high degree of automation used in manufacturing this resistor allows you to use a high quality wire wound unit at a cost of approximately two cents.

RESISTORS FIXED WIRE WOUND

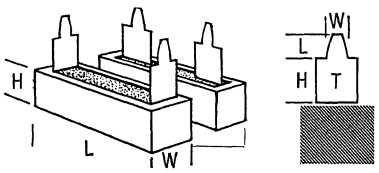
MEDIUM POWER



Part No.	Wattage Rating	L± 1/16"	H± 1/32"	W± 1/32"	Resist. Ranges (OHMS) Standard Temp. Coefficients .06%/°C	.03%/°C
CW2	2	45/64	1/4	1/4	.07-.2	.22-1.5k
CW3	3	7/8	5/16	5/16	.1-.27	.3-2.5k
CW5	5	7/8	3/8	3/8	.1-.27	.3-2.5k
CW7	.7	1 25/64	11/32	3/8	.22-.7	.75-6k
CW10	10	1 7/8	11/32	3/8	.35-.9	1-8k
CW15	15	1 7/8	1/2	1/2	.35-.9	1-8k
CW20	20	2 1/2	1/2	1/2	.5-1.35	1.5-13k
CW25	25	2 1/2	5/8	5/8	—	4-400

Consult Factory for Lower Values and Special Temperature Coefficients.

ENCAPSULATED RESISTORS



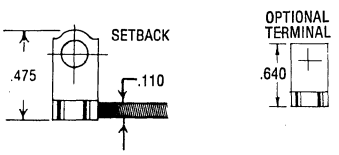
1. **Terminals** — Brass, tin plated, Parallel or perpendicular to the case.
2. **Body**—Ceramic Case, Inorganic, Fireproof Fill.
3. **Resistive Element** — High quality Colber type as in all our resistors.
4. **Tolerance** — 10% Standard, 5% Available.

TERMINAL DIMENSIONS

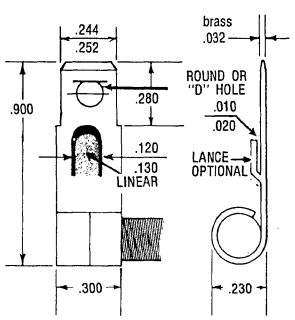
T	H	L	W
.150	.040 Ref.	.120	.055
.150	.250 Ref.	.180	.055
.150	.280 Ref.	.180	.055

STANDARD COLBER RESISTORS

Approximately 4 watts per inch

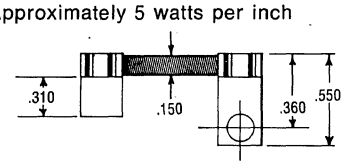


QUICK CONNECTION



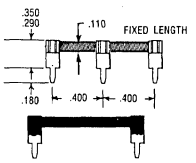
INTERMEDIATE COLBER RESISTORS

Approximately 5 watts per inch

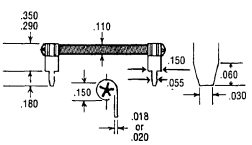


PRINTED CIRCUIT COLBER RESISTORS

Approximately 4 watts per inch



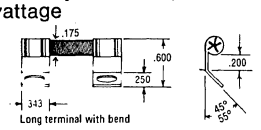
EPOXY COATED OR UNCOATED

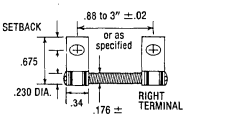


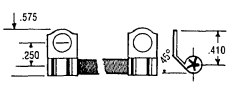
SHORTER AND LONGER TERMINALS AVAILABLE

HIGH WATTAGE COLBER RESISTORS

Approximately 6 watts per inch high wattage







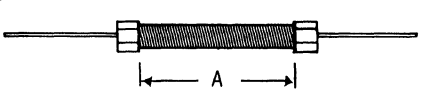
WITH OR WITHOUT BEND

Setback	Left Mounting Hole	Right Mounting Hole
.115	.155 × 1.31	.155 × .131
.125	.125 Dia.	.125 Dia.
.155	.200 × .220	.200 × .220
.155	.135	No Hole
.250	.200 × .225	.200 × .225
	.155 × .131	.155 × .131
.317	.135 × .160	.135 Dia.
.317	.200 × .225	.200 × .225
.317	.131 Dia.	.131 Dia.

Note: Any hole combination available with additional minor tooling.

AXIAL LEAD COLBER RESISTORS

TYPE AL — WIRE WOUND



LEAD SIZES AVAILABLE:
.032 × 1⅜ Tinned Copper
.032 × 1½ Tinned Copper
.032 × 1 11/16 Tinned Copper
.036 × 1 11/16 Tinned Copper
.040 × 1 11/16 Tinned Copperweld
.040 × 1⅞ Tinned Copperweld

LEAD MATERIAL:
Copper — Oxygen free, dead soft, Tinned Copperweld — Steel core, copper clad, Tinned.

CORE MATERIAL:
Silicone impregnated, braided fiberglas.

RESISTANCE TOLERANCE:
±10% Standard
±5% Available

STANDARD SIZES
(alternate sizes available):

"A" Dimension	Wattage Rating	Resistance Ranges (OHMS) Standard Temperature Coefficients .06%/°C	.03%/°C
AL-2 .280" (min.)	1.1	.07-.2	.22-1.5k
AL-5 .400"	1.6	.1-.27	.3-2.5k
AL-6 .650"	2.6	.16-.44	.45-4k
AL-7 .925"	3.7	.22-.7	.75-6k
AL-10 1.400"	5.6	.35-.9	1-8k
AL-20 2.000" (max.)	8.	.5-1.35	1.5-13k

the Colber Corporation

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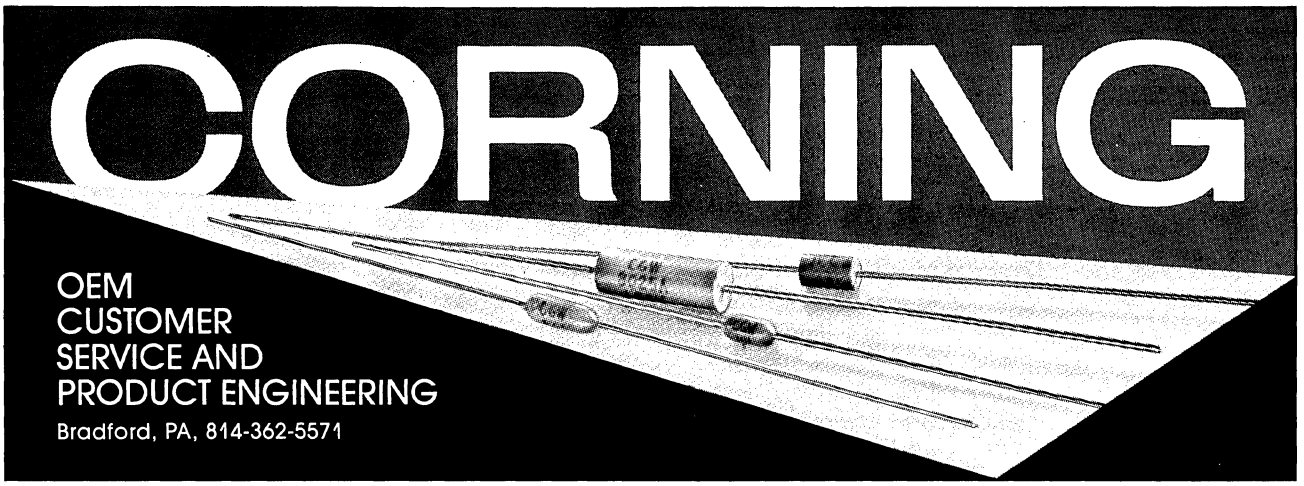

RESISTORS

Precision Metal Film
RN, E Series (±25 ppm/°C.) MIL-R-10509
RN, C Series (±50 ppm/°C.) MIL-R-10509
RN, D Series (±100 ppm/°C.) MIL-R-10509

Established Reliability Metal Film
RNC Series (±25, ±50, ±100 ppm/°C.) . . MIL-R-55182
RLR Series (±100 ppm/°C.) MIL-R-39017

Semi-precision Metal Film
RL Series (±100, ±200 ppm/°C.) MIL-R-22684
C Series (±100, ±200 ppm/°C.) . . . . . COMMERCIAL

Flameproof Metal Film
FP Series . . . . . COMMERCIAL

Low-OHM Metal Film
FL and LO Series . . . . . COMMERCIAL

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OR	Salem, Jas. J. Backer Co.	503-362-0717
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CA	Santa Clara, Schweber Electronics	408-496-0200
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CAN	Vancouver, BC, Future Electronics	604-438-5545
CAN	Downsview, Ont., Future Electronics	416-663-5563
CAN	Ottawa, Ont., Future Electronics	613-820-8313
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CO	Denver, Ragon Electronics	303-744-1992
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KS	Overland Park, Schweber Electronics	913-492-2921
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MI	Livonia, Schweber Electronics	313-528-8100
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NC	Greensboro, Hammond Electronics	919-275-6391
NC	Raleigh, RESCO	919-781-5700
NC	Raleigh, Schweber Electronics	919-976-0000
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OH	Solon, Arrow Electronics, Inc.	216-248-3990
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OH	Dayton, Pioneer Standard Electronics	513-236-9900
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OH	Dayton, Schweber Electronics	513-439-1800
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TX	Austin, Pioneer Standard Electronics	512-835-4000
TX	Dallas, Pioneer Standard Electronics	214-386-7300
TX	Houston, Pioneer Standard Electr.	713-988-5555
TX	Austin, Schweber Electronics	512-458-8253
TX	Dallas, Schweber Electronics	214-661-5010
TX	Houston, Schweber Electronics	713-784-3600
TX	Dallas, Solid State Electronics	214-438-5700
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WA	Bellevue, Bell Industries	206-747-1515
WA	Bellevue, Wyle Distribution Group	206-453-8300
WI	Madison, Arrow Electronics, Inc.	608-273-4977
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EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

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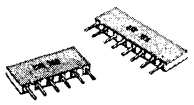
WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

SINGLE-IN-LINE CERMET RESISTOR NETWORKS

750 SERIES SINGLE-IN-LINE CERMET RESISTOR NETWORKS

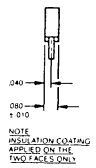


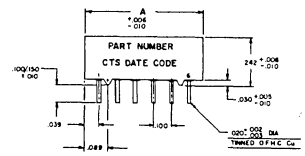
- 6, 8 and 10-pin modules on .100″ lead centers
- Resistance: 32Ω - 220 KΩ* ±2% (for 750-85 Series, see table below schematic)
- Power ratings @ 70°C per module: 6 pin .9 watt; 8 pin 1.1 watt; 10 pin 1.5 watt
- Typical TC: ±100 ppm°C

FEATURES:

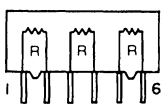
- Low profile construction
- High reliability
- Alumina substrate
- Low cost automatic insertion and handling

No. of Pins	A
6	.578
8	.778
10	.987

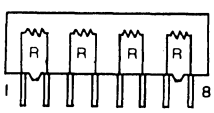




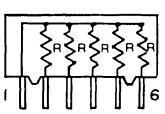
GENERAL TOLERANCES: Decimal dimensions ±.005″



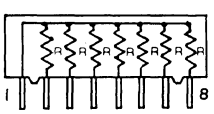
6 PIN — 3 RESISTORS
PART NUMBER
750-63-R (VALUE)



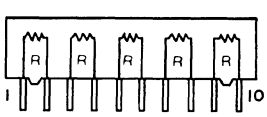
8 PIN — 4 RESISTORS
PART NUMBER
750-83-R-(VALUE)



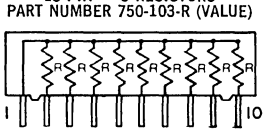
6 PIN — 5 RESISTORS
PART NUMBER
750-61-R (VALUE)



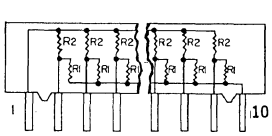
8 PIN — 7 RESISTORS
PART NUMBER
750-81-R (VALUE)



10 PIN — 5 RESISTORS
PART NUMBER 750-103-R (VALUE)



10 PIN — 9 RESISTORS
PART NUMBER 750-101-R (VALUE)



8 PIN — 12 RESISTORS
PART NUMBER 750-85 — 750-85-R (R1/R2)

10 PIN — 16 RESISTORS
PART NUMBER 750-105 — 750-105R (R1/R2)

R1/R2 Ohms	Thevenin Impedance
180/390	123Ω
220/330	132Ω
330/390	180Ω
330/470	195Ω

Resistance Value, Tolerance	6 Pin, 3 Resistor	6 Pin, 5 Resistor	8 Pin, 4 Resistor	8 Pin, 7 Resistor	10 Pin, 5 Resistor	10 Pin, 9 Resistor
33Ω±2%	750-63-R33Ω	750-61-R33Ω	750-83-R33Ω	750-81-R33Ω	750-103-R33Ω	750-101-R33Ω
47Ω±2%	—	—	750-83-R47Ω	—	750-103-R47Ω	750-101-R47Ω
51Ω±2%	—	750-61-R51Ω	—	750-81-R51Ω	—	750-101-R51Ω
56Ω±2%	—	—	750-83-R56Ω	750-81-R56Ω	—	750-101-R56Ω
62Ω±2%	—	—	—	—	—	750-101-R62Ω
68Ω±2%	750-63-R68Ω	750-61-R68Ω	750-83-R68Ω	750-81-R68Ω	750-103-R68Ω	750-101-R68Ω
75Ω±2%	—	—	750-83-R75Ω	750-81-R75Ω	—	—
82Ω±2%	—	750-61-R82Ω	750-83-R82Ω	750-81-R82Ω	—	—
91Ω±2%	—	750-61-R91Ω	—	750-81-R91Ω	—	—
100Ω±2%	750-63-R100Ω	750-61-R100Ω	750-83-R100Ω	750-81-R100Ω	750-103-R100Ω	750-101-R100Ω
110Ω±2%	—	750-61-R110Ω	—	750-81-R110Ω	—	—
120Ω±2%	—	750-61-R120Ω	750-83-R120Ω	750-81-R120Ω	750-103-R120Ω	750-101-R120Ω
150Ω±2%	750-63-R150Ω	750-61-R150Ω	750-83-R150Ω	750-81-R150Ω	—	—
160Ω±2%	—	750-61-R160Ω	—	750-81-R160Ω	—	750-101-R160Ω
180Ω±2%	—	750-61-R180Ω	750-83-R180Ω	750-81-R180Ω	750-103-R180Ω	750-101-R180Ω
200Ω±2%	—	750-61-R200Ω	—	750-81-R200Ω	—	—
220Ω±2%	750-63-R220Ω	750-61-R220Ω	750-83-R220Ω	750-81-R220Ω	750-103-R220Ω	750-101-R220Ω
240Ω±2%	—	750-61-R240Ω	—	—	—	—
270Ω±2%	—	750-61-R270Ω	750-83-R270Ω	750-81-R270Ω	750-103-R270Ω	750-101-R270Ω
330Ω±2%	750-63-R330Ω	750-61-R330Ω	750-83-R330Ω	750-81-R330Ω	750-103-R330Ω	750-101-R330Ω
360Ω±2%	—	750-61-R360Ω	—	—	—	—
390Ω±2%	—	750-61-R390Ω	—	750-81-R390Ω	—	750-101-R390Ω
430Ω±2%	—	750-61-R430Ω	—	750-81-R430Ω	—	—
470Ω±2%	750-63-R470Ω	750-61-R470Ω	750-83-R470Ω	750-81-R470Ω	750-103-R470Ω	750-101-R470Ω
500Ω±2%	—	750-61-R500Ω	—	750-81-R500Ω	—	750-101-R510Ω
510Ω±2%	—	750-61-R510Ω	—	750-81-R510Ω	—	—
560Ω±2%	—	—	—	750-81-R560Ω	750-103-R560Ω	750-101-R560Ω
680Ω±2%	750-63-R680Ω	750-61-R680Ω	750-83-R680Ω	750-81-R680Ω	750-103-R680Ω	750-101-R680Ω
820Ω±2%	—	—	—	750-81-R820Ω	—	750-101-R820Ω
910Ω±2%	—	—	—	750-81-R910Ω	—	—
1KΩ±2%	750-63-R1KΩ	750-61-R1KΩ	750-83-R1KΩ	750-81-R1KΩ	750-103-R1KΩ	750-101-1RKΩ
1.1KΩ±2%	—	—	—	—	—	750-101-R1.1KΩ
1.2KΩ±2%	—	750-61-R1.2KΩ	750-83-R1.2KΩ	750-81-R1.2KΩ	—	750-101-R1.2KΩ
1.33KΩ±2%	—	750-61-R1.33KΩ	—	—	—	—
1.5KΩ±2%	750-63-R1.5KΩ	750-61-R1.5KΩ	750-83-R1.5KΩ	750-81-R1.5KΩ	750-103-R1.5KΩ	750-101-R1.5KΩ
2KΩ±2%	750-63-R2KΩ	750-61-R2KΩ	750-83-R2KΩ	750-81-R2KΩ	—	750-101-R2KΩ
2.2KΩ±2%	750-63-R2.2KΩ	750-61-R2.2KΩ	750-83-R2.2KΩ	750-81-R2.2KΩ	750-103-R2.2KΩ	750-101-R2.2KΩ
2.7KΩ±2%	—	750-61-R2.7KΩ	—	750-81-R2.7KΩ	—	—
3KΩ±2%	—	—	750-83-R3KΩ	750-81-R3KΩ	—	—
3.3KΩ±2%	750-63-R3.3KΩ	750-61-R3.3KΩ	750-83-R3.3KΩ	750-81-R3.3KΩ	750-103-R3.3KΩ	750-101-R3.3KΩ
3.9KΩ±2%	—	—	—	750-81-R3.9KΩ	—	—
4.7KΩ±2%	750-63-R4.7KΩ	750-61-R4.7KΩ	750-83-R4.7KΩ	750-81-R4.7KΩ	750-103-R4.7KΩ	750-101-R4.7KΩ
5.1KΩ±2%	—	750-61-R5.6KΩ	750-83-R5.1KΩ	—	—	—
5.6KΩ±2%	—	—	750-83-R5.6KΩ	750-81-R5.6KΩ	—	750-101-R5.6KΩ
6.8KΩ±2%	750-63-R6.8KΩ	750-61-R6.8KΩ	750-83-R6.8KΩ	750-81-R6.8KΩ	750-103-R6.8KΩ	750-101-R6.8KΩ
10KΩ±2%	750-63-R10KΩ	750-61-R10KΩ	750-83-R10KΩ	750-81-R10KΩ	750-103-R10KΩ	750-101-R10KΩ
12KΩ±2%	—	—	—	—	—	750-101-R12KΩ
15KΩ±2%	750-63-R15KΩ	750-61-R15KΩ	750-83-R15KΩ	750-81-R15KΩ	750-103-R15KΩ	750-101-R15KΩ
16KΩ±2%	—	—	—	—	—	—
18KΩ±2%	—	—	—	750-81-R18KΩ	—	—
20KΩ±2%	—	—	750-83-R20KΩ	—	—	—
22KΩ±2%	750-63-R22KΩ	750-61-R22KΩ	750-83-R22KΩ	750-81-R22KΩ	750-103-R22KΩ	750-101-R22KΩ
33KΩ±2%	750-63-R33KΩ	750-61-R33KΩ	750-83-R33KΩ	750-81-R33KΩ	750-103-R33KΩ	750-101-R33KΩ
47KΩ±2%	750-63-R47KΩ	750-61-R47KΩ	750-83-R47KΩ	750-81-R47KΩ	750-103-R47KΩ	750-101-R47KΩ
56KΩ±2%	—	—	—	750-81-R56KΩ	—	750-101-R56KΩ
68KΩ±2%	750-63-R68KΩ	750-61-R68KΩ	750-83-R68KΩ	750-81-R68KΩ	750-103-R68KΩ	—
100KΩ±2%	750-63-R100KΩ	750-61-R100KΩ	750-83-R100KΩ	750-81-R100KΩ	750-103-R100KΩ	750-101-R100KΩ
120KΩ±2%	—	—	750-83-R120KΩ	—	—	—
150KΩ±2%	750-63-R150KΩ	750-61-R150KΩ	750-83-R150KΩ	750-81-R150KΩ	—	750-101-R150KΩ
220KΩ±2%	750-63-R220KΩ	750-61-R220KΩ	750-83-R220KΩ	750-81-R220KΩ	—	750-101-R220KΩ

NOTE: Additional resistance values are constantly being added. Please contact your local CTS Industrial Distributor to check availability of values not shown above.

ORDERING INFORMATION: Place orders using the following address:

CTS OF BERNE, INC., 406 Parr Rd., Berne, IN 46711

• (219) 589-8220 • TWX 810-323-1580

CTS OF BERNE, INC.

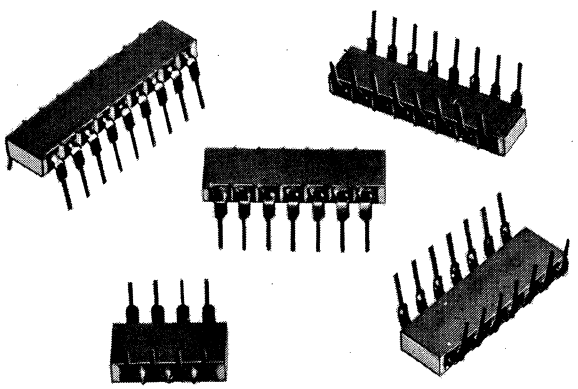
SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

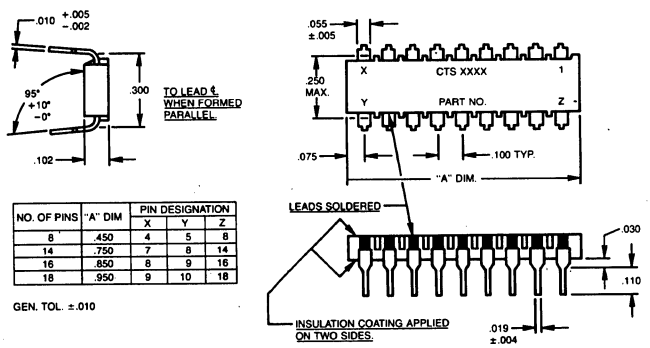
WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

DUAL-IN-LINE CERMET RESISTOR NETWORKS

CERMET RESISTOR NETWORKS (Available with capacitor chips and/or active devices*)

CTS Series 760 Dual-In-Line cermet resistor networks are available in 8, 14, 16, and 18 lead styles. CTS now offers you a choice of four popular space-saver packages. All are designed to simplify automatic insertion along with IC's and other DIP products for reduced costs. Easy to hand mount, too. Available without cover coat, so you can trim for circuit balance in your own plant. Choose from standard circuits available off-the-shelf for immediate delivery or custom designed to your specifications.





NO. OF PINS	"A" DIM	PIN DESIGNATION X	Y	Z
8	.450	4	5	8
14	.750	7	8	14
16	.850	8	9	16
18	.950	9	10	18

GEN. TOL. ±.010

Environmental Performance Characteristics

Test	Allowable Resistance Change CTS Max△ R	CTS Avg. △ R
Load Life: 1,000 hrs., 0.1 watt per resistor at 70°C	±0.50%	±0.20%
Moisture Resistance: 0.1 rated wattage at 70°C, 90-98% humidity, 1,000 hrs.	±0.50%	±0.20%
Insulation Resistance: Measured wet after moisture resistance test, 200 VDC	Greater than 1000 megohms	
Low Temperature Exposure: −63°C, 4 hrs.	±0.25%	±0.10%
Thermal Shock: 5 cycles, −63°C to +125°C, no load	±0.25%	±0.10%
Short Time Overload: 2.5 times rated voltage, 5 sec.	±0.25%	±0.05%
Terminal Strength: 5 lb. tensile & compression, 30 sec.	±0.25%	±0.03%
Effect of Soldering: 60/40 solder, 246°C, 2 sec.	±0.25%	±0.05%

FEATURES:

- Low height profile
- .100″ lead spacing
- High overload capabilities
- 8, 14, 16 & 18 pin constructions
- Compatible with automatic insertion equipment
- 2 watt power capabilities
- Reduced insertion time
- Available with capacitors and/or active devices*

ELECTRICAL AND MECHANICAL SPECIFICATIONS:

Description: 8, 14, 16, and 18 pin dual-in-line modules on .100″ lead centers.

Standard Resistance Range: 22Ω through 1 MegΩ.

Special Resistance Range: Below 22Ω and above 1 MegΩ.

Resistance Matching (2 like resistors):
50Ω to 30KΩ — 0.5%
30KΩ to 250KΩ — 1%
250KΩ to 3 MegΩ — 2.5%

Ratio Matching:
50Ω to 30KΩ — ±1%
30KΩ to 250KΩ — ±2%
250KΩ to 3 MegΩ — ±5%

Wattage Rating @ 70°C per module: 8 pin - .75 watt; 14 pin - 1.5 watts; 16 pin - 1.75 watts; 18 pin - 2.0 watts.

Standard Temperature Coefficient: ±300 ppm/°C.

Special Temperature Coefficient: to ±100 ppm/°C.

Temperature Coefficient Tracking: Available to 50 ppm/°C.

Standard Resistance Tolerance: ±5%.

Special Resistance Tolerance: ±1% or ½Ω (whichever is greater).

Substrate Material: Alumina.

Resistor Material: Cermet - thick film.

Insulation Coating: Organic - epoxy phenolic.

Lead Material: Solder coated copper.

Solder: 60/40 Tin/Lead.

Lead Strength: 5# pull.

* Active devices added by CTS Microelectronics, Inc., Lafayette, Indiana.

ORDERING INFORMATION: Place orders using following address: CTS OF BERNE, INC., 406 Parr Rd., Berne, Ind. 46711 • (219) 589-8220 • TWX 810-323-1580

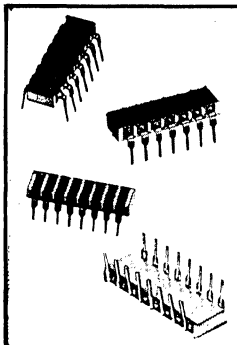
CTS OF BERNE, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

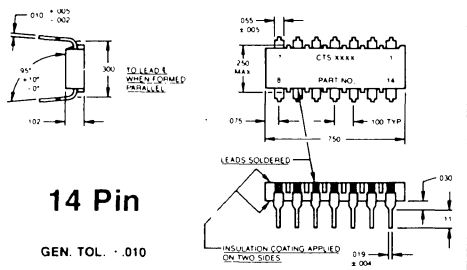
760 SERIES 14/16 LEAD DUAL-IN-LINE CERMET RESISTOR NETWORKS

DUAL-IN-LINE CERMET RESISTOR NETWORKS



CTS Series	Description	Element Type	Resistance Range & Tol.	Power Rating (Watts)	Typical TC
760-3 760-1 760-5	14 Pin Module on .100" x .300" DIP Centers	Cermet	22Ω-220KΩ*±2%	1.5 @ 70°C per module	±100 ppm/°C
761-3 761-1 761-5	16 Pin Module on .100" x .300" DIP Centers	Cermet	68Ω-220KΩ*±2%	1.75 @ 70°C per module	±100 ppm/°C

Prices		
1-99	100-499	500-999
$1.15	$ .93	$ .66
1.20	.95	.68
2.15	1.75	1.25
$1.20	$ .95	$ .68
1.25	.98	.70
2.30	1.88	1.34

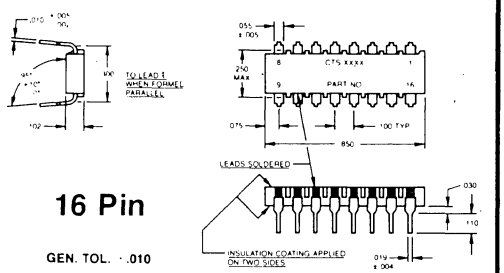


14 Pin

GEN. TOL. ± .010

FEATURES:

- **Low cost automatic insertion and handling**
- **High overload capabilities**
- **Low height profile**
- **Package compatibility with monolithic packages**
- **.100" lead spacing**



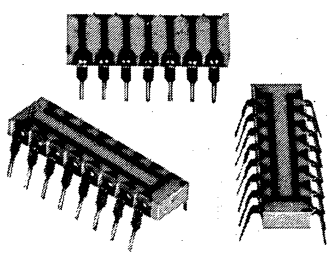
16 Pin

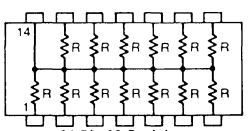
GEN. TOL. ± .010

CONDUCTOR MODULES

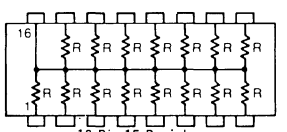
Eliminate time consuming installation of jumper wires.

Density of Jumpers:
Depending on number of pins, screened on both sides of substrate. Built to customer specifications and requirements.



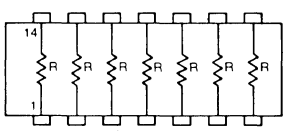


14 Pin-13 Resistors
Part Number 760-1-R+value

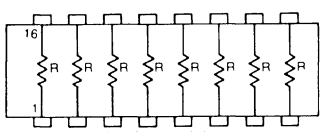


16 Pin-15 Resistors
Part Number 761-1-R+value

APPLICATIONS: MOS/ROM pull-up/pull-down; Open collector pull-up; "Wired OR" pull-up; Power driver pull-up; High speed parallel pull-up; TTL unused gate pull-up; TTL input pull-down; Digital pulse squaring.

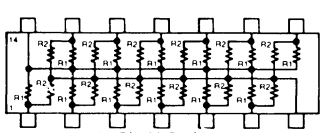


14 Pin-7 Resistors
Part Number 760-3-R+value

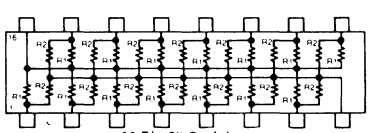


16 Pin-8 Resistors
Part Number 761-3-R+value

APPLICATIONS: "Wired OR" pull-up; Power driver pull-up; Power gate pull-up; Line termination; Long-line impedance balancing; LED current limiting; ECL output pull-down resistors; TTL input pull-down.



14 Pin-24 Resistors
Part Number 760-5-R+values



16 Pin-28 Resistors
Part Number 761-5-R+values

Resistance Values R1/R2	Part Numbers	
220Ω/270Ω	760-5-R220/270	761-5-R220/270
220Ω/330Ω	760-5-R220/330	761-5-R220/330
1.5K/3.3K	760-5-R1.5/3.3K	761-5-R1.5K/3.3K

Other combinations available upon request

Pulse Squaring TTL Terminators

CTS Terminator networks consist of two resistor pairs of the above value combinations. The resistors are connected together in series with a common line for power and a common line for ground. The junction of each pair is brought out to a separate terminal.

CTS OF BERNE, INC.

ORDERING INFORMATION: Place orders using following address: CTS OF BERNE, INC., 406 Parr Rd., Berne, Ind. 46711 • (219) 589-8220 • TWX 810-323-1580

CTS OF BERNE, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA
WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

SINGLE-IN-LINE CERMET RESISTOR NETWORKS

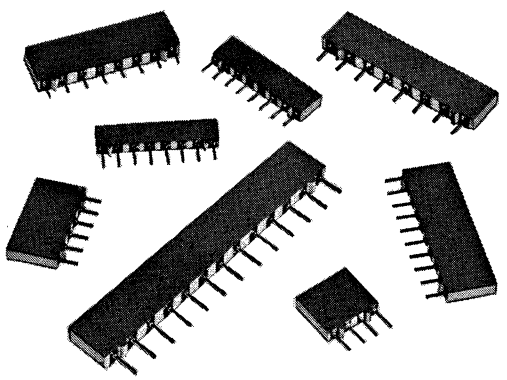
CERMET RESISTOR NETWORKS (Available with capacitor chips and/or active devices)*

CTS . . . Leader in the field of **Low Profile** space-saving Cermet Resistor Modules. Readily recognizable because of the familiar CTS Blue.

As is well illustrated, these modules have been specifically designed to save space.

So if you want to reduce the size of your design or add more complex circuitry without increasing size, CTS rates top consideration.

Most appealing is the fact that "The Little Blue Brick" is an extensive "Off The Shelf" item with CTS.



750 Series

FEATURES:

- Compact edge mount modules
- Ultra high stability and reliability
- Automatic insertion capabilities
- Reduced insertion time
- Fewer items to inventory
- Space savings over individual resistors
- Available with capacitors and/or active devices*
- Available with .100" and .125" lead centers

ELECTRICAL AND MECHANICAL SPECIFICATIONS:

Description: Cermet thick film single-in-line resistor networks.

Standard Resistance Range: 33Ω through 1 MegΩ.

Special Resistance Range: Below 33Ω and above 1 MegΩ.

Resistance Matching (2 like resistors):
50Ω to 30KΩ — 0.5%
30KΩ to 250KΩ — 1%
250KΩ to 3 MegΩ —2.5%

Ratio Matching:
50Ω to 30KΩ — ±1%
30KΩ to 250KΩ — ±2%
250KΩ to 3 MegΩ —±5%

Standard Temperature Coefficient: ±250 ppm/°C.

Special Temperature Coefficient: ±100 ppm/°C.

Temperature Coefficient Tracking: Available to 50 ppm/°C.

Standard Resistance Tolerance: ±5%.

Special Resistance Tolerance: to ±0.5% or ½Ω (whichever is greater

Substrate Material: Alumina.

Resistor Material: Cermet - thick film.

Insulation Coating: Organic - epoxy phenolic.

Lead Material: Solder coated copper.

Solder: 60/40 Tin/Lead.

Lead Strength: 5# pull.

Wattage Rating @ 70°C (see chart below).

Environmental Performance Characteristics

For units less than .340" high, refer to page 8 for performance characteristics. Test	Allowable Resistance Change CTS Max△ R	CTS Avg. △ R
Load Life: 1,000 hrs., 0.1 watt per resistor at 70°C	±0.40%	±0.20%
Moisture Resistance: 0.1 rated wattage at 70°C, 90-98% humidity, 1,000 hrs.	±0.50%	±0.20%
Insulation Resistance: Measured wet after moisture resistance test, 200 VDC	Greater than 1000 megohms	
Low Temperature Exposure: −63°C, 4 hrs.	±0.10%	±0.04%
Thermal Shock: 5 cycles, −63°C to +125°C, no load	±0.10%	±0.03%
Short Time Overload: 2.5 times rated voltage, 5 sec.	±0.25%	±0.05%
Terminal Strength: 5 lb. tensile & compression, 30 sec.	±0.10%	±0.03%
Effect of Soldering: 60/40 solder, 246°C, 2 sec.	±0.10%	±0.05%

Lead Centers	Ht. of Module (Max.)	Number of Pins										
		2	4	5	6	7	8	9	10	11	12	13
.100	(.250)	—	—	—	.9	—	1.1	1.3	1.5	—	—	—
.100	(.350)	—	.7	—	1.0	—	1.3	—	2.0	2.3	2.5	—
.125	(.350)	.5	1.0	—	1.5	—	2.0	—	2.5	—	3.0	—

* Active devices added by CTS Microelectronics, Inc., Lafayette, Indiana.

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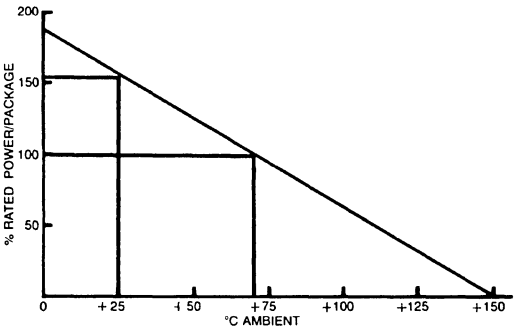
CTS OF BERNE, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

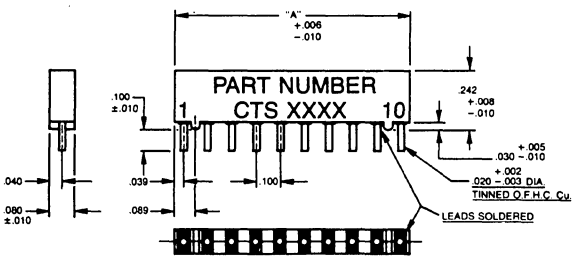
WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

SINGLE-IN-LINE CERMET RESISTOR NETWORKS



TYPICAL DERATING CURVE FOR CTS 750 SERIES

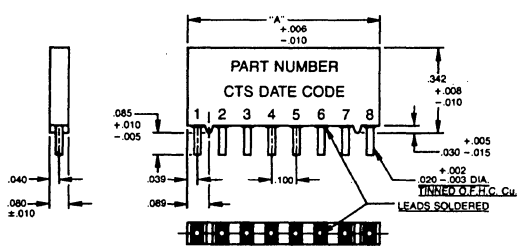
NO. OF PINS	"A" DIMENSION
6	.578
8	.778
9	.878
10	.978



NOTE:
INSULATION COATING APPLIED ON THE TWO FACES ONLY.

GEN. TOL. ±.005

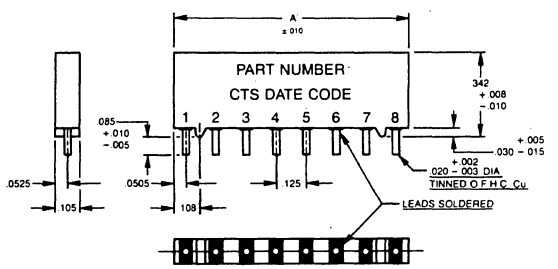
NO. OF PINS	"A" DIMENSION
4	.378
6	.578
8	.778
10	.978
11	1.078
12	1.178



NOTE:
INSULATION COATING APPLIED ON THE TWO FACES ONLY.

GEN. TOL. ±.005

NO. OF PINS	"A" DIMENSION
2	.228
4	.478
6	.728
8	.978
10	1.228
12	1.478



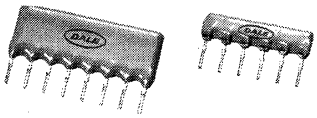
NOTE:
INSULATION COATING APPLIED ON THE TWO FACES ONLY.

GEN. TOL. ±.005

ORDERING INFORMATION: Place orders using following address: CTS OF BERNE, INC., 406 Parr Rd., Berne, Ind. 46711 • (219) 589-8220 • TWX 810-323-1580

DALE®

SERIES CSC
Thick Film SIP Resistor Network



Choice of: .195" [4.95] "A" and .350" [8.89] "C" maximum seated heights.

SPECIFICATIONS

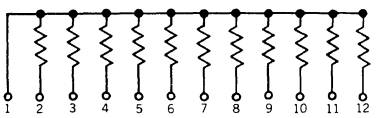
Resistance Range: 10Ω to 3.3 Megohms

Resistance Tolerance: ±2% standard. ±1%, ±5%, ±10% and ±20% available

Resistance Temperature Coefficient: ±100 PPM/°C (−55°C to +125°C) typical

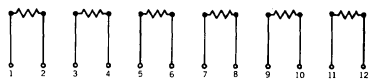
Terminals: Tin plated copper alloy

Body: High alumina. Resistors epoxy coated



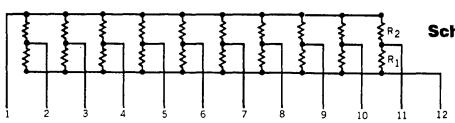
Schematic 01

(Available in 4, 5, 6, 7, 8, 9, 10, 11 or 12 pin package)



Schematic 03

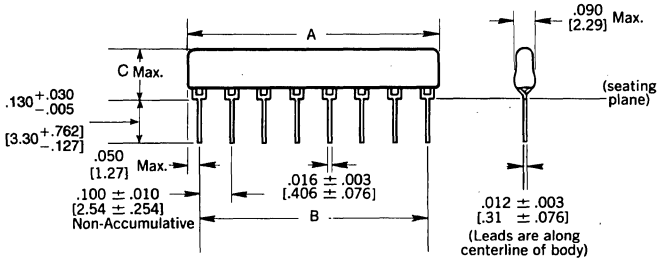
(Available in 4, 6, 8, 10 or 12 pin package)



Schematic 05

(Available in 4, 5, 6, 7, 8, 9, 10, 11 or 12 pin package)

DIMENSIONAL AND TERMINAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

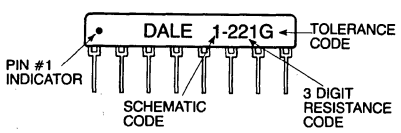


TYPE	A (Max.)	B	C (Max.)
CSC04	.390 [9.91]	.300 [7.62]	
CSC05	.490 [12.45]	.400 [10.16]	
CSC06	.590 [14.99]	.500 [12.70]	
CSC07	.690 [17.54]	.600 [15.24]	"A" Profile = .195 [4.95]
CSC08	.790 [20.07]	.700 [17.78]	"C" Profile = .350 [8.89]
CSC09	.890 [22.61]	.800 [20.32]	
CSC10	.990 [25.15]	.900 [22.86]	
CSC11	1.090 [27.69]	1.000 [25.40]	
CSC12	1.190 [30.23]	1.100 [27.94]	

01 and 03 SCHEMATIC
STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

56	180	510	2K	4.7K	15K	47K
100	220	560	2.2K	6.8K	18K	100K
120	330	1K	2.7K	10K	22K	220K
150	470	1.5K	3.3K	12K	27K	1 Meg.

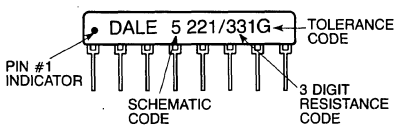
MARKING (Minimum Information)



05 SCHEMATIC
STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

R1/R2	Zo	R1/R3	Zo	R1/R3	Zo
220/270	121	330/390	179	1.5K/3.3K	1031
180/390	123	330/470	194		
220/330	132	330/680	222		

MARKING (Minimum Information)



HOW TO ORDER

01 and 03 SCHEMATIC

CSC	08	A	01	-101	G
SERIES	NUMBER OF PINS	PACKAGE CODE	SCHEMATIC	RESISTANCE VALUE	TOLERANCE

PACKAGE CODE: **A** = .195" [4.95] height; .100" [2.54] lead spacing. **C** = .350" [8.89] height; .100" [2.54] lead spacing.

RESISTANCE VALUE: First two digits (3 for "F" tolerance) are significant. Last digit specifies the number of zeros.

TOLERANCE: **F** = ±1%, **G** = ±2%*, **J** = ±5%*, **K** = ±10%, **M** = ±20%

*NOTE: 05 Schematic limited to "G" and "J" tolerances.

05 SCHEMATIC

CSC	08	A	05	-221 / 331	G
SERIES	NUMBER OF PINS	PACKAGE CODE	SCHEMATIC	RESISTANCE VALUE R1 / RESISTANCE VALUE R2	TOLERANCE

PACKAGE CODE: **A** = .195" [4.95] height; .100" [2.54] lead spacing. **C** = .350" [8.89] height; .100" [2.54] lead spacing.

RESISTANCE VALUE: First two digits are significant figures. The third digit specifies the number of zeros to follow.

TOLERANCE: **G** = ±2%, **J** = ±5%

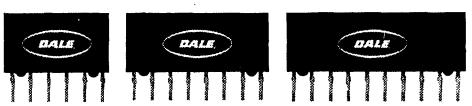
For complete information, write or phone

DALE ELECTRONICS, INC., Box 26950. El Paso. TX 79926 • Phone 915-592-3253

DALE SERIES MSP

Thick Film SIP Resistor Network

MSPXXA, .195" [4.95] above board



MSPXXC, .350" [8.89] above board

SPECIFICATIONS

ELECTRICAL

Resistance Range: 10Ω to 3.3 Megohms

Resistance Tolerances: ±2% standard. ±1%, ±5%, ±10%, ±20% available.

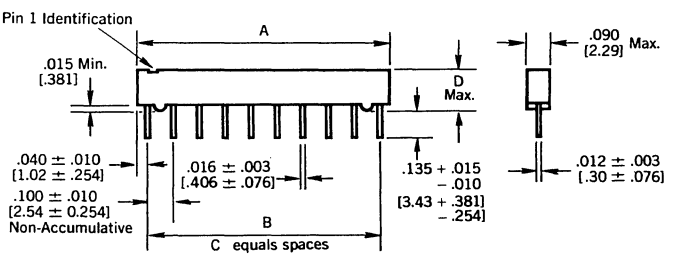
Temperature Coefficient: ±100 PPM/°C (−55°C to +125°C) standard

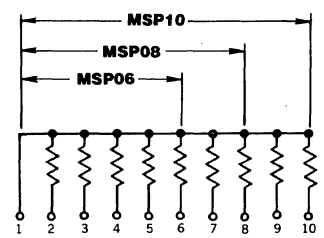
Terminals: Tin plated copper alloy

DIMENSIONAL AND TERMINAL CONFIGURATIONS

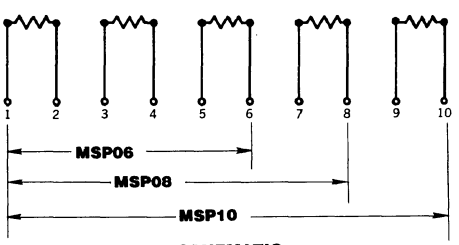
[Numbers in brackets indicate millimeters]

TYPE	A (Max.)	B	C	D
MSP06	.590 [14.99]	.500 [12.70]	5	.195" [4.95] for MSPXXA .350" [8.89] for MSPXXC
MSP08	.790 [20.07]	.700 [17.78]	7	
MSP10	.990 [25.15]	.900 [22.86]	9	





01 SCHEMATIC



03 SCHEMATIC

STOCK VALUES

(2% tolerance)

*22Ω	120Ω	560Ω	2.7KΩ	12KΩ	68KΩ
33Ω	150Ω	680Ω	3.3KΩ	15KΩ	82KΩ
39Ω	180Ω	820Ω	3.9KΩ	18KΩ	100KΩ
47Ω	220Ω	1KΩ	4.7KΩ	22KΩ	*120KΩ
56Ω	270Ω	1.2KΩ	5.6KΩ	27KΩ	*150KΩ
68Ω	330Ω	1.5KΩ	*6.0KΩ	33KΩ	*180KΩ
82Ω	390Ω	1.8KΩ	6.8KΩ	39KΩ	220KΩ
100Ω	470Ω	2.0KΩ	8.2KΩ	47KΩ	330KΩ
*110Ω	510Ω	2.2KΩ	10KΩ	56KΩ	*470KΩ

*MSPXXA only

1 Meg.

HOW TO ORDER

MSP	08	A	01	-101	G
SERIES	NUMBER OF PINS	PACKAGE CODE	SCHEMATIC	RESISTANCE VALUE	TOLERANCE

A = .195" [4.95] height; .100" [2.54] lead spacing.
C = .350" [8.89] height; .100" [2.54] lead spacing.

First two digits are significant. (3 for "F" tolerance.) Last digit specifies the number of zeros.

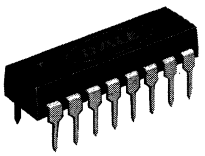
F = ±1%
G = ±2%
J = ±5%
K = ±10%
M = ±20%

For complete information, write or phone
DALE ELECTRONICS, INC., Box 26950, El Paso, TX 79926 • Phone 915-592-3253

DALE®

SERIES MDP

Thick Film DIP Resistor Network



SPECIFICATIONS

ELECTRICAL

Resistance Range: 10Ω to 3.3 Megohms

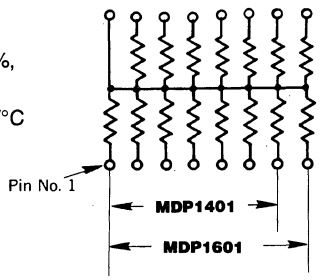
Resistance Tolerance: ±2% standard. ±1%, ±5%, ±10%, ±20% available.

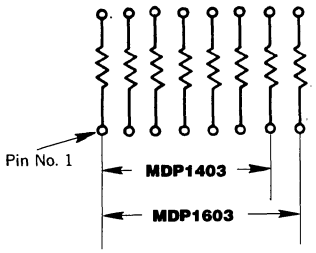
Resistance Temperature Coefficient: ±100 PPM/°C (−55°C to +125°C) standard

Terminals: Tin plated copper alloy

Body: Molded epoxy

STANDARD SCHEMATICS

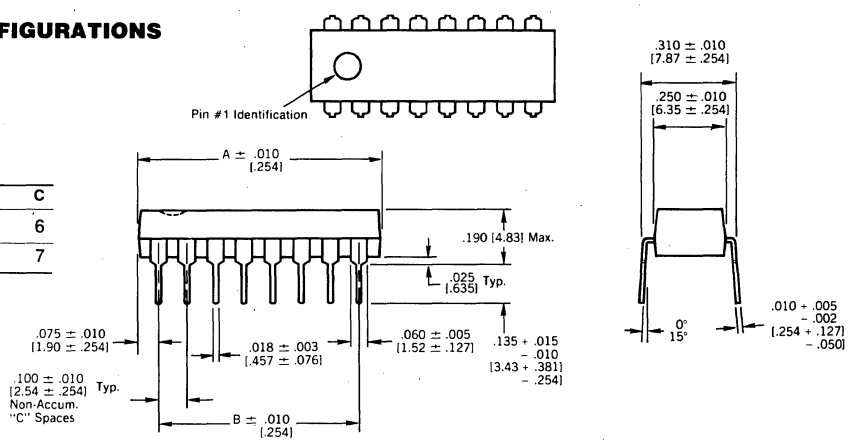




DIMENSIONS AND TERMINAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

TYPE	A	B	C
MDP14	.750 [19.05]	.600 [15.24]	6
MDP16	.850 [21.59]	.700 [17.78]	7



STOCKED RESISTANCE VALUES IN OHMS ("G" Tolerance)

Other Values from 10Ω to 1 Megohm Available

MODEL MDP1401 and MDP1403

22	51	120	300	680	1.6K	3.9K	8.2K	20K	100K
24	56	130	330	750	1.8K	4.3K	9.1K	22K	120K
27	62	150	360	820	2.0K	4.7K	10K	27K	150K
30	68	160	390	910	2.2K	5.1K	11K	33K	180K
33	75	180	430	1K	2.4K	5.6K	12K	39K	220K
36	82	200	470	1.1K	2.7K	6.0K	13K	47K	330K
39	91	220	510	1.2K	3.0K	6.2K	15K	56K	470K
43	100	240	560	1.3K	3.3K	6.8K	16K	68K	1 Meg.
47	110	270	620	1.5K	3.6K	7.5K	18K	82K	

MODEL MDP1601 and MDP1603

		510	2.2K	12K	82K
22	110	560	2.7K	15K	100K
33	120	680	3.3K	18K	120K
39	150	820	3.9K	22K	150K
47	180	1K	4.7K	27K	180K
56	220	1.2K	5.6K	33K	220K
62	270	1.5K	6.0K	39K	330K
68	330	1.8K	6.8K	47K	470K
82	390	2.0K	8.2K	56K	680K
100	470		10K	68K	1 Meg.

HOW TO ORDER

MDP	14	03	−101	G
SERIES	NUMBER OF PINS	SCHEMATIC	RESISTANCE VALUE	TOLERANCE

First 2 digits (3 for "F" tolerance) are significant figures, last digit specifies number of zeros to follow.

F = ±1% **K** = ±10%
G = ±2% **M** = ±20%
J = ±5%

EXAMPLE:

MDP1403-101G = A dual-in-line thick film resistor network with 14 pins on .100 [2.54] centers, 03 schematic, resistance of 100 ohms and tolerance of ±2%.

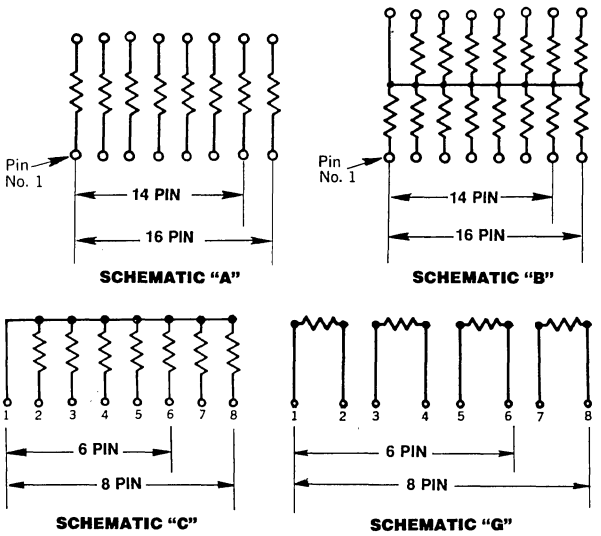
For complete information, write or phone
DALE ELECTRONICS, INC., Box 26950, El Paso, TX 79926 • Phone 915-592-3253

DALE®

MIL-R-83401, STYLE RZ

MILITARY QUALIFIED
Thick Film Resistor Networks

APPROVED SCHEMATIC ALTERNATIVES



SPECIFICATIONS (Applicable to all styles)

ELECTRICAL

Resistance Range: 10Ω to 1 Megohm standard.

Resistance Tolerances: ±1%, ±2%, ±5%

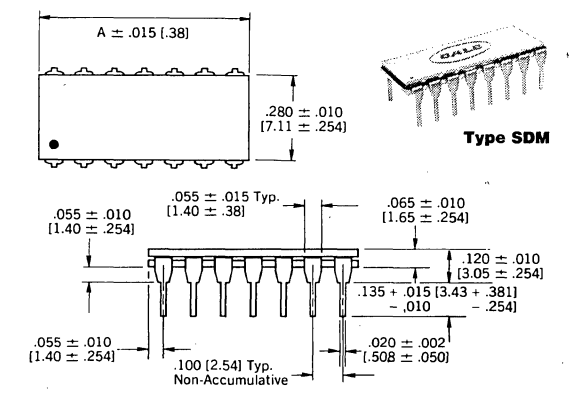
Temperature Coefficient: "M" = ±300 PPM/°C; "K" = ±100 PPM/°C over the temperature range of −55°C to +125°C (+25°C reference).

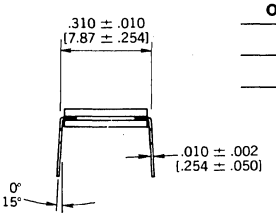
DUAL IN LINE

M8340101 = 14 PIN
M8340102 = 16 PIN

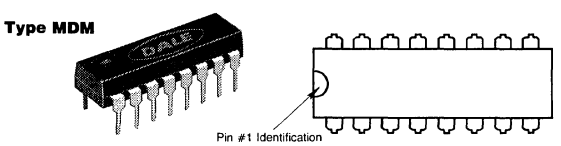
MIL P/N	MIL. STYLE	DALE TYPE	MILITARY RES. RANGE TOLERANCE ±1%, ±2%, ±5%
M8340101 M XXXXX A	RZ010	SDM14-01	10Ω-1 Meg.
		MDM14-03	10Ω-100K
M8340101 K XXXXX A	RZ010	SDM14-01	10Ω-1 Meg.
M8340101 M XXXXX B	RZ010	SDM14-02	10Ω-1 Meg.
		MDM14-01	10Ω-100K
M8340101 K XXXXX B	RZ010	SDM14-02	10Ω-1 Meg.
M8340102 M XXXXX A	RZ020	SDM16-01	10Ω-1 Meg.
		MDM16-03	10Ω-100K
M8340102 K XXXXX A	RZ020	SDM16-01	10Ω-1 Meg.
M8340102 M XXXXX B	RZ020	SDM16-02	10Ω-1 Meg.
		MDM16-01	10Ω-100K
M8340102 K XXXXX B	RZ020	SDM16-02	10Ω-1 Meg.

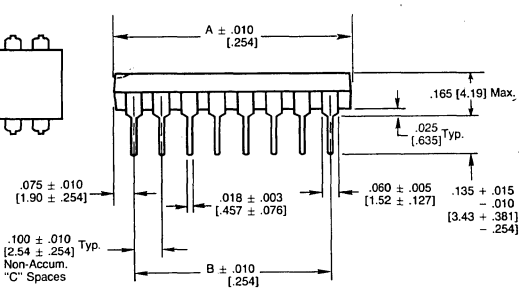
DIMENSIONAL AND TERMINAL CONFIGURATIONS
[Numbers in brackets indicate millimeters]

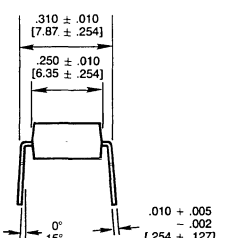




NO. OF PINS	A
14	.710 [18.0]
16	.810 [20.6]







NO. OF PINS	A	B	C
14	.750 [19.05]	.600 [15.24]	6
16	.850 [21.59]	.700 [17.78]	7

STOCK VALUES

Available from stock in these standard values (±2% tolerance A and B schematic)
Characteristic "M" (±300 PPM/°C) Type MDM not available in 470K and 1 Meg.

39Ω	100Ω	220Ω	510Ω	2.2K	5.1K	20K	470K
51Ω	120Ω	270Ω	680Ω	3.0K	5.6K	22K	1 Meg.
56Ω	150Ω	330Ω	1.0K	3.3K	6.8K	30K	
68Ω	180Ω	390Ω	1.5K	3.9K	10K	47K	
75Ω	200Ω	470Ω	2.0K	4.7K	15K	100K	

For complete information, write or phone
DALE ELECTRONICS, INC., Box 26950, El Paso, TX 79926 • Phone 915-592-3253

FLAT PACK M8340103 = 14 PIN

MIL P/N	MIL. STYLE	DALE TYPE	MILITARY RES. RANGE TOLERANCE ±1%, ±2%, ±5%
M8340103 M XXXXX A	RZ030	DFM14-01	10Ω-1 Meg.
		DFM14-11	10Ω-1 Meg.
M8340103 K XXXXX A	RZ030	DFM14-01	10Ω-1 Meg.
		DFM14-11	10Ω-1 Meg.
M8340103 M XXXXX B	RZ030	DFM14-02	10Ω-1 Meg.
		DFM14-12	10Ω-1 Meg.
M8340103 K XXXXX B	RZ030	DFM14-02	10Ω-1 Meg.
		DFM14-12	10Ω-1 Meg.

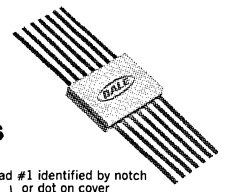
Leads: -01, -02 = gold plated; -11, -12, = tin lead plated

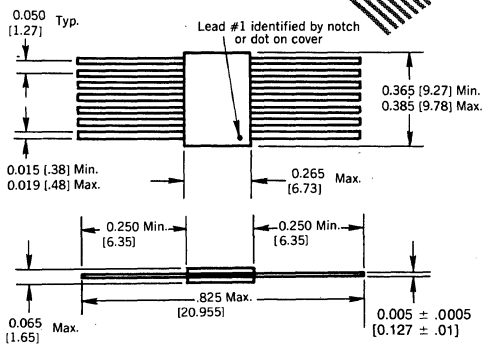
STOCK VALUES

Available from stock in these standard values (±2% tolerance, A and B schematics, Characteristic "M", ±300 PPM/°C):

100Ω	330Ω	510Ω	1.0K	2.0K	3.0K	4.7K	6.8K	22K
200Ω	470Ω	680Ω	1.5K	2.2K	3.3K	5.1K	10K	100K

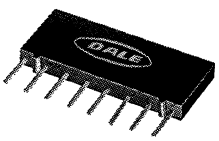
DIMENSIONAL AND TERMINAL CONFIGURATIONS





SINGLE IN LINE M8340105 = 8 PIN M8340104 = 6 PIN

MIL P/N	MIL. STYLE	DALE TYPE	MILITARY RES. RANGE TOLERANCE ±1%,±2%, ±5%
M8340104 M XXXXX C	RZ040	MSM06C-01	10Ω-1 Meg.
M8340104 K XXXXX C	RZ040	MSM06C-01	10Ω-1 Meg.
M8340104 M XXXXX G	RZ040	MSM06C-03	10Ω-1 Meg.
M8340104 K XXXXX G	RZ040	MSM06C-03	10Ω-1 Meg.
M8340105 M XXXXX C	RZ050	MSM08C-01	10Ω-1 Meg.
M8340105 K XXXXX C	RZ050	MSM08C-01	10Ω-1 Meg.
M8340105 M XXXXX G	RZ050	MSM08C-03	10Ω-1 Meg.
M8340105 K XXXXX G	RZ050	MSM08C-03	10Ω-1 Meg.



NO. OF PINS	A	B	C
6	.583 ± .015 [14.81 ± .38]	.500 [12.70]	5
8	.783 ± .015 [19.89 ± .38]	.700 [17.78]	7

Note: Dale will be supplying MIL-R-83401/6, /7, /8, /9 effective September 1, 1983.

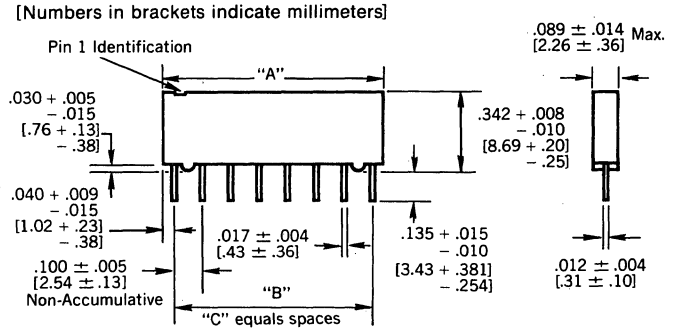
STOCK VALUES

Available from stock in these standard values (±2% tolerance, C and G schematics, Characteristic "M", ±300 PPM/°C):

33Ω	330Ω	2.0K	22K
39Ω	470Ω	2.2K	47K
47Ω	510Ω	3.3K	56K
68Ω	560Ω	4.7K	82K
82Ω	680Ω	5.6K	100K
100Ω	820Ω	6.8K	220K
150Ω	1.0K	8.2K	470K
220Ω	1.5K	10K	1 Meg.

DIMENSIONAL AND TERMINAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]



HOW TO ORDER—Military Part Number

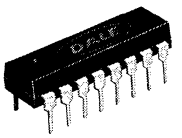
M8340104	K	1003	G	G
DETAIL SPEC. NO.	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE	SCHEMATIC
M8340103 = 14 Pin DIP RZ030 **M8340104** = 6 Pin SIP RZ040 **M8340105** = 8 Pin SIP RZ050	**"K"** = ±100 PPM/°C **"M"** = ±300 PPM/°C	The first three digits are significant figures and the last digit specifies the number of zeros to follow.	**F** = ±1% **G** = ±2% **J** = ±5%	

EXAMPLE:

M8340104K1003GG = A single-in-line resistor network with 6 pins and a T.C.R. of ±100 PPM/°C, resistance value of 100K ohms, tolerance of 2% and "G" schematic.

For complete information, write or phone
DALE ELECTRONICS, INC., Box 26950, El Paso, TX 79926 • Phone 915-592-3253

RESISTOR/CAPACITOR NETWORKS



FEATURES

- 14 and 16 pin DIP models
- 4 thru 12 pin SIP models
- Applications include AC coupling, line matching, line termination, bypassed pull-up, supply filtering, CKT bias and coupling.

GENERAL SPECIFICATIONS

	RESISTORS	*CAPACITORS		
		NPO	BX	X7R
Value Range (SIP)	10Ω - 3.3 meg	100pf - 4700pf	500pf - 0.1μf	500pf - 0.1μf
(DIP)	10Ω - 3.3 meg	100pf - 2700pf	500pf - 0.1μf	500pf - 0.1μf
Tolerances	±2% standard, ±1%, ±5%, ±10%, ±20% available	±5% & ± 10%	±10% & ±20%	±10% & ±20%
Temperature Characteristics (−55°C to + 125°C)	±100ppm/°C Typical	±30ppm/°C	±15% @ OVDC & ±15%, −25% @ rated VDC	±15%
Voltage Rating	100VDC	50VDC	50VDC	50VDC
Dissipation Factor (1 VRMS @ 1 KHZ)	N/A	0.1% max	2.5% max	3.0% max
Operating Temperature Range	−55°C to +125°C			

*Capacitors tested at 1 Vrms @ 1 KHZ @ 25°C

Dale R/C networks can be supplied with the same proven thick film circuit materials as those qualified to MIL-R-83401 and capacitors are available to EIA RS 198 or MIL-C-55681 specifications.

Combinations of capacitor characteristics NPO, BX and X7R dielectrics within the same package are possible with a wide range of resistance values.

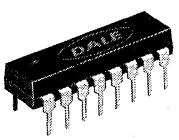
DIMENSIONS: For reference, Dale R/C networks have the same basic dimensions as the Dale thick film networks listed elsewhere in this section.

SIP = Dale CSC coated styles
DIP = Dale MDP molded styles

For complete information, write or phone
DALE ELECTRONICS, INC., Box 26950, El Paso, TX 79926 • Phone 915-592-3253

THIN FILM RESISTOR NETWORKS

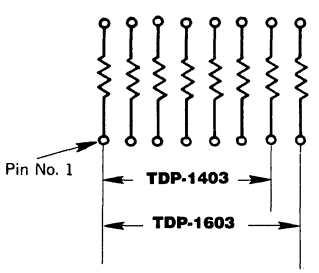
SERIES TDP: 14 and 16 pin DIP models



SPECIFICATIONS

Resistance Range: 100Ω to 100KΩ
Resistance Tolerance: 2%, 1%, .5%, .1%
Ratio Match: .05%, .1%, .5%
Resistance Temperature Coefficient: ±25 PPM/°C; ±10 PPM/°C available (−55°C to +125°C)
TC Tracking: ±5 PPM/°C (−55°C to +125°C)
Package Power Rating: .7 Watt/Package @ 25°C
Resistor Power Rating: .1 Watt/Resistor at 25°C
Voltage Coefficient of Resistance: <5 PPM/V typical
Maximum Operating Voltage: 100 VDC
Operating Temperature Range: −55°C to +125°C
Terminals: Solder Coated Copper Alloy
Body: Molded Epoxy
Resistive Material: Nichrome film

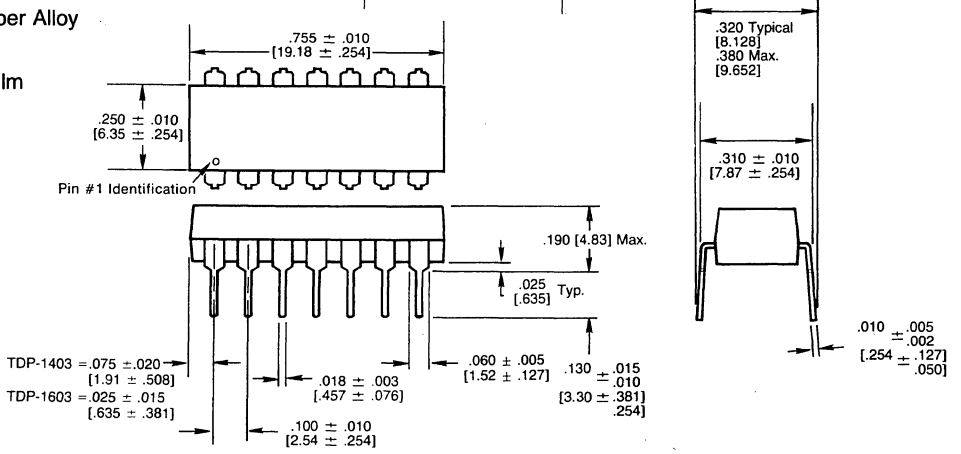
STANDARD SCHEMATICS



APPLICATIONS

- Precision voltage/current dividers
- Differential, instrumentation and summing amplifiers
- Converter ladder, scaling and range setting
- Oscillators and active filters

DIMENSIONS



NOTE:
Other Dale thin film products include thin film chips, including styles compatible with chip carrier and custom packages. Consult factory.

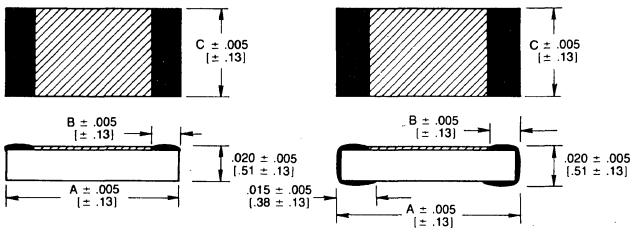
For complete information, write or phone
DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, Nebraska 68701 • Phone 402-371-0080

DALE® THICK FILM CHIP RESISTORS

Series RCM and RCWM
Established Reliability
Military Qualification MIL-R-55342/2, /3, /4, /6

Series RC and RCW
Commercial

DIMENSIONAL AND TERMINAL CONFIGURATIONS
[Numbers in brackets indicate millimeters.]



RC and RCM (One-surface termination)

RCW and RCWM (Wrap-around termination)

FEATURES
- Allows wide design flexibility for use with hybrid circuitry
- One-surface and wrap-around teminations
- Choices of sizes and power ratings
- Dale has complete capability to develop specific reliability programs designed to customer requirements
- Custom sizes can be designed for special applications

RCM and RCWM SPECIFICATIONS
ELECTRICAL
Resistance and Tolerance Range:
RCM/RCWM550: 10Ω to 300K, ±1%, 2%, 5% and 10%
10Ω to 500K, ±5% and 10%
RCM/RCWM575 and 5100:
10Ω to 500K, ±1%, 2%, 5% and 10%
10Ω to 1 Meg., ±5% and 10%
RCM/RCWM5150 10Ω to 1 Meg., ±1%, 2%, 5% and 10%

Resistance Temperature Coefficient:
(−55°C to +125°C) "M" = ± 300 PPM/°C
"K" = ± 100 PPM/°C

Power Rating: Maximum at +70°C
RCM/RCWM550 = 50 MW
RCM/RCWM575 = 100 MW
RCM/RCWM5100 = 100 MW
RCM/RCWM5150 = 150 MW

RC and RCW SPECIFICATIONS
ELECTRICAL
Resistance Range:
RC/RCW550: 5Ω to 2 Meg.
RC/RCW575: 5Ω to 5 Meg.
RC/RCW5100: 10Ω to 10 Meg.
RC/RCW5150: 10Ω to 15 Meg.
RC/RCW1100: 5Ω to 5 Meg.
RC/RCW7225: 10Ω to 15 Meg.
RC/RCW2010: 10Ω to 15 Meg.
RC/RCW2512: 10Ω to 15 Meg.

Resistance Tolerance: ±1%, ±2%, ±5%, ±10%, ±20%

Resistance Temperature Coefficient:
(−55°C to +125°C) ±200 PPM/°C

Power Rating (@ 70°C) and Maximum Operating Voltage:
RC/RCW550 = 100 MW, 50 VDC
RC/RCW575 = 150 MW, 70 VDC
RC/RCW5100 = 200 MW, 100 VDC
RC/RCW5150 = 350 MW, 125 VDC
RC/RCW1100 = 400 MW, 100 VDC
RC/RCW7225 = 600 MW, 200 VDC
RC/RCW2010 = 800 MW, 200 VDC
RC/RCW2512 = 1000 MW, 200 VDC

Operating Temperature Range: −55°C to +125°C

MILITARY STYLE	DALE TYPE	A (Length)	B	C (Width)
RM0505	RCM550	.050 [1.27]	.010 [.25]	.050 [1.27]
	RCWM550	.055 [1.40]		
RM0705	RCM575	.075 [1.91]	.015 [.38]	.050 [1.27]
	RCWM575	.080 [2.03]		
RM1005	RCM5100	.100 [2.54]	.015 [.38]	.050 [1.27]
	RCWM5100	.105 [2.67]		
RM1505	RCM5150	.150 [3.81]	.015 [.38]	.050 [1.27]
	RCWM5150	.155 [3.94]		

Type	A (Length)	B	C (Width)
RC550	.050 [1.27]	.010 [.25]	.050 [1.27]
RCW550	.055 [1.40]	.010 [.25]	.050 [1.27]
RC575	.075 [1.91]	.015 [.38]	.050 [1.27]
RCW575	.080 [2.03]	.015 [.38]	.050 [1.27]
RC5100	.100 [2.54]	.015 [.38]	.050 [1.27]
RCW5100	.105 [2.67]	.015 [.38]	.050 [1.27]
RC5150	.150 [3.81]	.015 [.38]	.050 [1.27]
RCW5150	.155 [3.94]	.015 [.38]	.050 [1.27]
RC1100	.100 [2.54]	.015 [.38]	.100 [2.54]
RCW1100	.105 [2.67]	.015 [.38]	.100 [2.54]
RC7225	.225 [5.72]	.015 [.38]	.075 [1.91]
RCW7225	.230 [5.84]	.015 [.38]	.075 [1.91]
RC2010	.200 [5.08]	.015 [.38]	.100 [2.54]
RCW2010	.205 [5.21]	.015 [.38]	.100 [2.54]
RC2512	.250 [6.35]	.015 [.38]	.125 [3.18]
RCW2512	.255 [6.48]	.015 [.38]	.125 [3.18]

HOW TO ORDER—Military Part Number

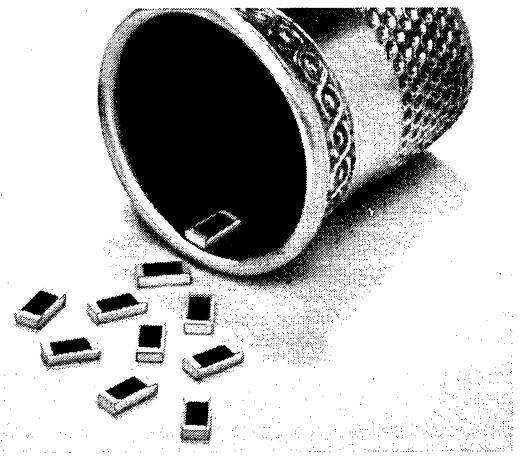
M55342/2	M	1003	F	S	M
DETAIL SPEC. NO.	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE	TERMINATION	FAILURE RATE
M55342/2 = RM0505 M55342/6 = RM0705 M55342/3 = RM1005 M55342/4 = RM1505	**M** = ±300 PPM/°C **K** = ±100 PPM/°C	The first two digits (three for "F" tolerance) are significant figures and the last digit specifies the number of zeros to follow.	**F** = ±1% **G** = ±2% **J** = ±5% **K** = ±10%	**S** = Pre-tinned one-surface. **R** = Pre-tinned wrap-around. **T** = Untinned one-surface. **U** = Untinned wrap-around.	**M** = 1%/1000 hours **P** = 0.1%/1000 hours **R** = 0.01%/1000 hours

HOW TO ORDER: RC and RCW—Commercial Styles

RC	5100	103	G	41
STYLE	SIZE	RESISTANCE CODE	TOLERANCE	TERMINATION CODE
RC = One-surface termination. **RCW** = Wrap-around termination	550 1100 575 7225 5100 2010 5150 2512	The first two digits (three for "F" tolerance) are significant figures and the last digit specifies the number of zeros to follow.	**F** = ±1% **G** = ±2% **J** = ±5% **K** = ±10% **M** = ±20%	No Code = Solder Pre-tinned (standard) **20** = Gold (RC only) **40** = Platinum Gold **41** = Platinum Silver **42** = Palladium Silver

For complete information, write or phone
DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, Nebraska 68701 • Phone 402-371-0080

COMMERCIAL
THICK FILM CHIP RESISTORS



DALE SERIES CRC

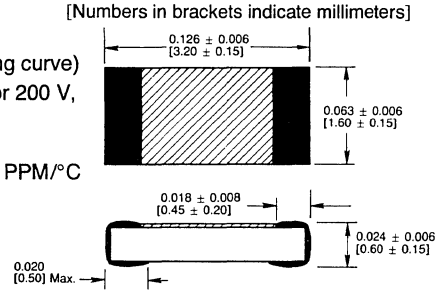
FEATURES

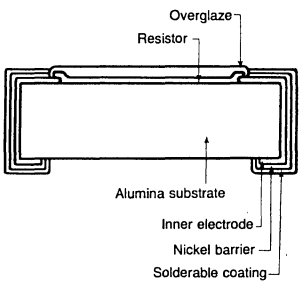
- Internationally standardized size
- Automatic placement compatibility
- Flow solderable • Thick film resistance element
- Wraparound termination • Inner electrode protection

ELECTRICAL SPECIFICATIONS

Resistance Range: 10Ω to 2.2 Meg.
Zero ohm jumper
Standard Tolerance: ±2%, ±5%
Power Rating: 1/8 Watt @ 70°C
Maximum Ambient Temperature: 125°C (see derating curve)
Rated Continuous Working Voltage: $\sqrt{0.125 \times R}$ or 200 V, whichever is less (R = nominal resistance value)
Temperature Range: −55°C to +125°C
Temperature Coefficient: (−55°C to + 125°C) ±200 PPM/°C

DIMENSIONAL SPECIFICATIONS:
[Numbers in brackets indicate millimeters]





HOW TO ORDER

CRC	W	1206	182	G	B
SERIES	STYLE	SIZE	RESISTANCE VALUE	TOLERANCE	PACKAGING
	W = Wrap around termination		First two digits are significant; last digit is the multiplier (1800Ω is illustrated).	G = ±2% J = ±5%	T = Standard 8mm reel B = Standard bulk

ESTABLISHED RELIABILITY
HERMETICALLY SEALED METAL FILM RESISTORS

MIL-R-55182, TYPE RNR, S LEVEL
DALE TYPE SE

FEATURES

• Meets requirements of MIL-R-55182 • Verified Failure Rate • Very low noise • Controlled temperature coefficient of resistance • Excellent high frequency characteristics • Ceramic-to-metal sealed construction • Final protective coat of special epoxy provides a smooth, non-porous envelope • Leads are OFHC tinned copper • 100% stabilization and screening tests. Group A testing, if desired, to customer requirements • Traceability of materials and processing • Monthly acceptance testing • Dale has complete capability to develop specific reliability programs designed to customer requirements • Extensive stocking program at distributors and factory

TEMPERATURE COEFFICIENT CODE

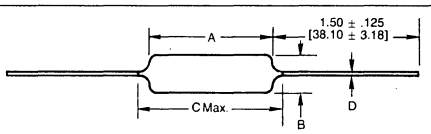
MIL. CODE	SE TYPE CODE	TEMPERATURE COEFFICIENT
E	C-3	0±25ppm/°C
C	C-2	0±50ppm/°C

TOLERANCE CODES

B	0.1%
D	0.5%
F	1.0%

STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	MIL. TYPE	125°C RATING	MAX. WEIGHT (Grams)	MAX. WORKING VOLTAGE	RESISTANCE RANGE
SE-1/10	RNR55	1/10W	.498	200	24.9 to 200K
SE-1/8	RNR60	1/8W	.552	250	24.9 to 499K
SE-1/4	RNR65	1/4W	1.370	300	24.9 to 1.0 Meg.



PHYSICAL CONFIGURATIONS

DALE TYPE	DIM. A	DIM. B	DIM. C MAX.	DIM. D
SE-1/10	.261±.020 [6.63±.51]	.130±.010 [3.30±.254]	.345 [8.76]	.025 (22 Awg) [.635]
SE-1/8	.360±.020 [9.14±.51]	.140±.015 [3.56±.331]	.437 [11.1]	.025 (22 Awg) [.635]
SE-1/4	.636±.020 [16.15±.51]	.215±.020 [5.46±.51]	.750 [19.05]	.025 (22 Awg) [.635]

For complete information, write or phone
DALE ELECTRONICS, INC., 2300 Riverside Blvd.. Norfolk. NE 68701 • Phone 402-371-0080

MIL-R-55182, TYPE RNC

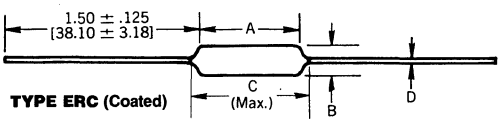
DALE TYPE ERC and EMF

Established Reliability Metal Film—Coated and Molded

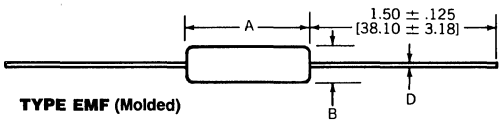
STANDARD ELECTRICAL SPECIFICATIONS RNC Types in Stock (S Level)

	DALE TYPE	MIL. TYPE*	70°C RATING	125°C RATING	MAX. WT. (Grams)	MAX. WORKING VOLTAGE	RESISTANCE RANGE (Ohms)** T-1(K)	T-2(H)	T-9(J)
Coated	ERC 50	RNC50	1/10 W	1/20 W	.11	200	10-796K	10-796K	10-796K
	ERC 55	RNC55	1/8 W	1/10 W	.35	200	10-2 Meg.	10-2 Meg.	10-2 Meg.
	ERC 60	RNC60	1/4 W	1/8 W	.75	250	10Ω-3.01 Meg.	10Ω-3.01 Meg.	10Ω-3.01 Meg.
Molded	EMF 50	RNC50	1/10 W	1/20 W	.11	200	10 to 796K	10 to 796K	10 to 796K
	EMF 55	RNC55	1/8 W	1/10 W	.35	200	10 to 1.21 Meg.	10 to 1.21 Meg.	10 to 1.21 Meg.
	EMF 60	RNC60	1/4 W	1/8 W	.45	250	10 to 3.01 Meg.	10 to 3.01 Meg.	10 to 3.01 Meg.
	EMF 65	RNC65	1/2 W	1/4 W	.84	300	30.1 to 3.01 Meg.	49.9 to 3.01 Meg.	49.9 to 3.01 Meg.
	EMF 70	RNC70	3/4 W	1/2 W	1.6	350	49.9 to 2.49 Meg.	49.9 to 2.49 Meg.	49.9 to 2.49 Meg.
	EMF 75	—	—	1 W	4.4	500	24.9 to 4.02 Meg.	49.9 to 2.61 Meg.	49.9 to 2.61 Meg.

*ERC and EMF include RNR, RNN and RNC Mil. Types. Standard Resistance Tolerances: .1%(B), .5%(D) and 1%(F). .1% not applicable to characteristic K.
**Consult factory for values on QPL.



TYPE ERC (Coated)



TYPE EMF (Molded)

PHYSICAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

TYPE	DIM. A	DIM. B	DIM. C (Max.)	DIM. D
ERC 50	.150 ± .020 [3.81 ± .51]	.070 ± .010 [1.78 ± .25]	.244 [6.20]	.016 Dia. [.406]
ERC 55	.250 + .031 − .046 [6.35 + .79 − 1.17]	.091 ± .009 [2.31 ± .23]	.325 [8.26]	.025 Dia. [.635]
ERC 60	.375 ± .062 [9.53 ± 1.57]	.145 ± .016 [3.68 ± .41]	.475 [12.07]	.025 Dia. [.635]
EMF 50	.150 ± .020 [3.81 ± .508]	.070 ± .010 [1.78 ± .254]	—	.016 [.406]
EMF 55	.260 ± .010 [6.60 ± .254]	.097 ± .005 [2.46 ± .127]	—	.025 [.635]
EMF 60	.406 ± .015 [10.31 ± .381]	.135 ± .010 [3.43 ± .254]	—	.025 [.635]
EMF 65	.593 ± .015 [15.06 ± .381]	.203 ± .015 [5.16 ± .381]	—	.025 [.635]
EMF 70	.730 ± .020 [18.54 ± .508]	.250 ± .015 [6.35 ± .381]	—	.032 [.813]
EMF 75	1.093 ± .020 [27.76 ± .508]	.375 ± .015 [9.53 ± .381]	—	.032 [.813]

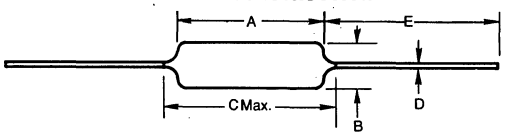
MIL-R-39017, TYPE RLR

S LEVEL

DALE TYPE ERL

Established Reliability Metal Film

COATED CONSTRUCTION



STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	MIL. TYPE	70°C RATING	MAX. WEIGHT (Grams)	MAX. WORKING VOLTAGE	RES. RANGE* T-1 (100 PPM)
ERL-05	RLR-05	1/8 W	.11	200	4.7Ω to 300K
ERL-07	RLR-07	1/4 W	.35	250	10 to 10 Meg.
ERL-20	RLR-20	1/2 W	.75	350	4.3 to 3.01 Meg.

*Consult factory for values on QPL. Standard Resistance Tolerances: 1%(F), 2%(G), 5%(J).

PHYSICAL CONFIGURATIONS [Numbers in brackets indicate millimeters]

TYPE	DIM. A	DIM. B	DIM. C	DIM. D	DIM. E
ERL-05	.150 ± .020 [3.81 ± .508]	.066 ± .008 [1.68 ± .20]	.187 [4.75] Max.	.016 [.406]	1.25 ± .266 [31.75 ± 6.76]
ERL-07	.250 ± .031 .046 [6.35 ± .79 1.17]	.090 ± .008 [2.29 ± .20]	.300 [7.62] Max.	.025 [.635]	1.50 ± .125 [38.10 ± 3.18]
ERL-20	.375 ± .041 [9.53 ± 1.04]	.138 ± .023 [3.51 ± .58]	.450 [11.43] Max.	.032 [.813]	1.50 ± .125 [38.10 ± 3.18]

Termination: Standard lead material is solder-coated copper. (Solderable and weldable per MIL-STD-1276, Type C.)

For complete information, write or phone

DALE ELECTRONICS, INC., 2300 Riverside Blvd.. Norfolk. Nebraska 68701 • Phone 402-371-0080

DALE®

MIL-R-10509, TYPE RN
MIL-R-22684, TYPE RL

Higher Commercial Ratings (See Chart)

DALE TYPE CMF COATED METAL FILM RESISTORS

FEATURES

- Higher commercial wattage ratings
- Very low noise
- Very low voltage coefficient
- Controlled temperature coefficient
- Close tracking of temperature coefficient
- Excellent high frequency characteristics
- Flame retardant epoxy coating

STANDARD ELECTRICAL SPECIFICATIONS

	MILITARY QUALIFIED			COMMERCIAL**	
WATTAGE	MIL-R-10509 70°C (D)	MIL-R-10509 125°C (C & E)	MIL-R-22684 70°C	70°C	125°C
1/20	—	CMF-50 (RN-50)	—	CMF-50	CMF-50
1/10	—	CMF-55 (RN-55)	—	CMF-50, 55	CMF-50, 55
1/8	CMF-55 (RN-55)	CMF-60 (RN-60)	—	CMF-50, 55, 60	CMF-50, 55, 60
1/4	CMF-60 (RN-60)	CMF-65 (RN-65)	CMF-07 (RL-07)	CMF-55, 60, 65, 07	CMF-55, 60, 65
1/2	CMF-65 (RN-65)	—	CMF-20 (RL-20)	CMF-55, 60, 65, 20	CMF-60, 65
3/4	—	—	—	CMF-60*, 65*	CMF-65*
1	—	—	—	CMF-65*	—

*.032 [.813] Lead. **Derate all commercial ratings linearly to zero power at 165°C.

TEMPERATURE COEFFICIENT CODE

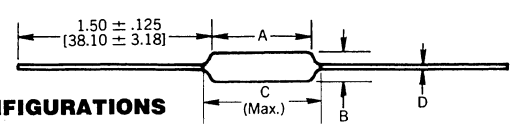
COMMERCIAL T.C. CODE	10509 MIL. CHAR.	TEMPERATURE COEFFICIENT	TEMPERATURE RANGE
T-1	D	0 ± 100 PPM/°C	−55°C to +175°C
T-2	C	0 ± 50 PPM/°C	−55°C to +175°C
T-9	E	0 ± 25 PPM/°C	−55°C to +175°C
T-00	MIL-R-22684	0 ± 200 PPM/°C	−55°C to +150°C

TOLERANCE:
CMF-50, 55, 60 and 65 types are available in the following standard tolerances: Tolerances of ±1%(F) and ±0.5%(D) are available over the entire ohmic range. Tolerances of ±0.25% and ±0.1% are available only in T-2 and T-9 temperature coefficients and over the ohmic range specified in the T-9 column. CMF-07 and CMF-20 are available in 2% or 5% only.

ELECTRICAL SPECIFICATIONS

		DALE MILITARY APPROVED VALUE RANGE				DALE COMMERCIAL VALUE RANGE			
DALE TYPE	MAXIMUM WORKING VOLTAGE	MIL-R-10509 CHAR. D	MIL-R-10509 CHAR. C	MIL-R-10509 CHAR. E	MIL-R-22684	T-0	T-1	T-2	T-9
CMF-50	200	—	10Ω-100KΩ	10Ω-100KΩ	—	10Ω-796KΩ	10Ω-796KΩ	10Ω-500KΩ	10Ω-500KΩ
CMF-55	250	10Ω-301K	49.9Ω-100KΩ	49.9Ω-100KΩ	—	1Ω-15 Meg.	5Ω-15 Meg.	10Ω-10 Meg.	24.9Ω-2.5 Meg.
CMF-07	250	—	—	—	51Ω-150KΩ	1Ω-15 Meg.	5Ω-15 Meg.	—	—
CMF-60	300	10Ω-1 Meg.	49.9Ω-499KΩ	49.9Ω-499KΩ	—	1Ω-22 Meg.	5Ω-22 Meg.	10Ω-10 Meg.	24.9Ω-2.5 Meg.
CMF-20	350	—	—	—	4.3Ω-470KΩ	1Ω-22 Meg.	5Ω-22 Meg.	—	—
CMF-65	350	10Ω-2 Meg.	49.9Ω-1 Meg.	49.9Ω-1 Meg.	—	1Ω-22 Meg.	5Ω-22 Meg.	10Ω-10 Meg.	24.9Ω-2.5 Meg.

PHYSICAL CONFIGURATIONS



TYPE	DIM. A	DIM. B	DIM. C (Max.)	DIM. D
CMF-50	.150 ± .020 [3.81 ± .508]	.065 ± .015 [1.65 ± .381]	.244 [6.20]	.016 ± .002 [.406 ± .051]
CMF-55	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]	.025 ± .002 [.635 ± .051]
CMF-60	.344 ± .031 [8.74 ± .787]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	*.025 ± .002 [.635 ± .051]
CMF-65	.562 ± .031 [14.27 ± .787]	.180 ± .015 [4.57 ± .381]	.687 [17.45]	*.025 ± .002 [.635 ± .051]
CMF-07	.240 ± .020 [6.10 ± .508]	.090 ± .008 [2.29 ± .203]	.278 [7.06]	.025 ± .002 [.635 ± .051]
CMF-20	.375 ± .031 [9.53 ± .787]	.145 ± .015 [3.68 ± .381]	.425 [10.80]	.032 ± .002 [.813 ± .051]

*Available with .032 [.813] lead.

For complete information, write or phone
DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, Nebraska 68701 • Phone 402-371-0080

DALE®

DALE TYPE CCF-07 and CCF-55 METAL FILM RESISTORS

Coated, Commercial, 1%, 2% Tolerance

BULK PACK OR TAPE AND REEL PACKAGING

FEATURES

- 1/4 watt at 70°C power rating
- CCF-07 = 2% tolerance, CCF-55 = 1% tolerance
- 100 PPM/°C temperature coefficient
- Superior electrical performance. CCF-55 meets or exceeds MIL-R-22684 (RL07) and MIL-R-10509 (RN55D). CCF-07 meets electrical requirements of MIL-R-22684 (RL07)
- Flame retardant epoxy conformal coating
- Color band marking for ease of identification after mounting

SPECIFICATIONS

ELECTRICAL

Resistance Range: 10Ω to 1 Megohm

Resistance Tolerance: ±1% (CCF-55) ±2% (CCF-07)

Resistance Temperature Coefficient: ±100 PPM/°C (CCF-07 = −65°C to +150°C; CCF-55 = −65°C to +165°C)

Resistor Power Rating: 1/4 watt at +70°C

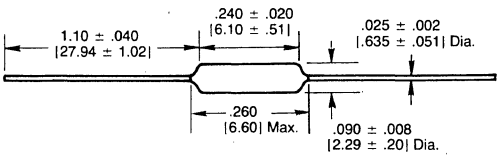
Maximum Working Voltage: 250 VRMS

Insulation Resistance: 10,000 Megohms

Operating Temperature Range: CCF-07 = −65°C to +150°C; CCF-55 = −65°C to +165°C

PHYSICAL CONFIGURATION

[Numbers in brackets indicate millimeters]



RESISTANCE VALUES

The **Dale CCF-07** is available in the standard 24 resistance values per decade. The **Dale CCF-55** is available in the standard 96 resistance values per decade. Values are obtained from the appropriate decade table by multiplying by powers of 10. Example: 24 = 24 ohms, 240 ohms, 2.4K, 24K or 240K.

CCF-07			CCF-55										
10	22	47	10.0	12.1	14.7	17.8	21.5	26.1	31.6	38.3	46.4	56.2	68.1	82.5
11	24	51	10.2	12.4	15.0	18.2	22.1	26.7	32.4	39.2	47.5	57.6	69.8	84.5
12	27	56	10.5	12.7	15.4	18.7	22.6	27.4	33.2	40.2	48.7	59.0	71.5	86.6
13	30	62	10.7	13.0	15.8	19.1	23.2	28.0	34.0	41.2	49.9	60.4	73.2	88.7
15	33	68	11.0	13.3	16.2	19.6	23.7	28.7	34.8	42.2	51.1	61.9	75.0	90 9
16	36	75	11.3	13.7	16.5	20.0	24.3	29.4	35.7	43.2	52.3	63.4	76.8	93.1
18	39	82	11.5	14.0	16.9	20.5	24.9	30.1	36.5	44.2	53.6	64.9	78.7	95.3
20	43	91	11.8	14.3	17.4	21.0	25.5	30.9	37.4	45.3	54.9	66.5	80.6	97.6

HOW TO ORDER

CCF-07 CCF-55	241 3010	G F
MODEL NUMBER	RESISTANCE VALUE	TOLERANCE
	First two digits are significant for CCF-07; first three digits for CCF-55. Last digit specifies the number of zeros.	**F** = ±1% **G** = ±2%

EXAMPLE: **CCF-07 241G** = A 1/4 watt metal film resistor with ±100 PPM/°C T.C., resistance of 240 ohms and tolerance of ±2%.

CCF-55 3010F = A 1/4 watt metal film resistor with ±100 PPM/°C T.C., resistance of 301 ohms and tolerance of ±1%.

For complete information, write or phone
DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, Nebraska 68701 • Phone 402-371-0080

DALE®

DALE TYPE PTF COATED PRECISION THIN FILM

Low T.C.—Tight Tolerance

FEATURES

- Performance exceeds MIL-R-55182 requirements
- Extremely low temperature coefficients of resistance
- Very low noise and voltage coefficient
- Wide precision resistance range in small package
- 100% laser spiralled
- Very good high frequency characteristics
- Proprietary epoxy coating provides superior moisture protection
- Acceptance testing available
- Can replace wirewound bobbins

MATERIAL

Element: Precision deposited nickel-chrome alloy with controlled annealing

Core: Fire-cleaned high purity ceramic

Encapsulant: Specially formulated epoxy compounds. Coated construction.

Termination: Standard lead material is solder-coated copper. Solderable and weldable per MIL-STD-1276, Type C.

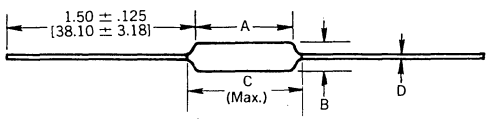
STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	85°C RATING	MAX. WT. (Grams)	MAX. WORKING VOLTAGE	RESISTANCE RANGE
PTF 51	1/20 W	.11	200	50Ω to 100K
PTF 56	1/8 W	.35	300	50Ω to 499K
PTF 65	1/4 W	.75	500	50Ω to 1 Meg.

Standard tolerances from 1% to .01%.

PHYSICAL CONFIGURATIONS

TYPE	DIM. A	DIM. B.	DIM. C (MAX.)	DIM. D
PTF 51	.150 ± .020 [3.81 ± .51]	.070 ± .010 [1.78 ± .25]	.200 [5.08]	.016 [.406]
PTF 56	.250 + .031 − .046 [6.35 + .79 − 1.17]	.091 ± .009 [2.31 ± .23]	.300 [7.62]	.025 [.635]
PTF 65	.375 ± .062 [9.53 ± 1.57]	.145 ± .016 [3.68 ± .41]	.475 [12.07]	.025 [.635]



TEMPERATURE COEFFICIENT CODE −20° to +85°C

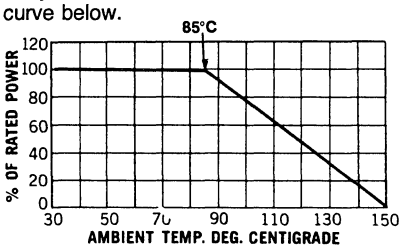
T.C. CODE	TEMPERATURE COEFFICIENT
T-10	0 ± 15 PPM/°C
T-13	0 ± 10 PPM/°C
T-16	0 ± 5 PPM/°C

PERFORMANCE DATA

TEST per MIL-R-55182 (Exceptions Noted)	MAX. ΔR (Typical Test Lots)	SPECIFICATION
Thermal Shock (−55°C to +85°C)	0.02%	MIL-STD-202, Method 107
Moisture	0.08%	MIL-STD-202, Method 106
Resistance to Solder Heat	0.02%	MIL-STD-202, Method 210
Dielectric Withstanding	0.01%	MIL-STD-202, Method 301 & 105
Short Time Overload	0.01%	MIL-R-10509, Para. 4.6.6
Damp Heat	0.08%	IEC Publication #68-2-3 (56 days)
Low Temperature Operation	0.02%	MIL-R-55182, Para. 4.7.9
Life (1000 hours rated power @ 85°C)	0.04%	MIL-R-55182, Para. 4.7.17

DERATING

Dale PTF resistors have an operating temperature range of −55°C to +150°C. They must be derated according to the curve below.



MATCHED SETS — NETWORKS

Dale's many years of experience in matching resistors for sets and networks, combined with the superb performance of the PTF product, provide the best and most economical solution to your precision resistor requirements. Why? Because most applications for precision resistors depend on two or more discretes having an initial tolerance ratio and a resistance tracking capability over temperature rather than each discrete resistor meeting the absolute requirements of the application.

Cost savings approaching 50% can be realized when relatively tight matching requirements are specified while permitting the absolute parameters of the discrete resistors to have more relaxed specifications.

Dale application engineers are available to assist you in specifying your requirements in the most economical way possible.

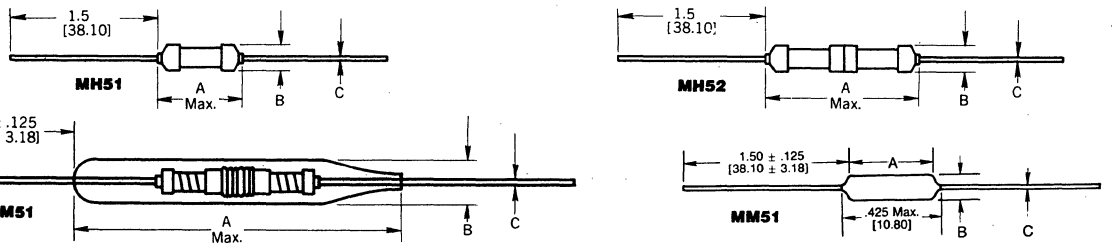
For complete information, write or phone

DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, NE 68701 • Phone 402-371-0080

DALE®

DALE TYPE MH51, MH52, M51, MM51 OXIDE RESISTORS

Ultra High Value



STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	WATTS @ 40°C	MAX. VOLT	DIMENSIONS A	B	C	RESISTANCE RANGE
MH51	¼	1500	.55 [13.97]	.140 ± .010 [3.56 ± .254]	.025 [.635]	60M-50KM
*M51	½	500	1.88 [47.75]	.220 ± .010 [5.59 ± .254]	.020 [.508]	60M-1000KM
MH52	½	3000	.95 [24.13]	.140 ± .020 [3.56 ± .508]	.025 [.635]	60M-50KM
MM51	¼	3000	.375 ± .031 [9.53 ± .79]	.145 ± .015 [3.68 ± .38]	.032 [.812]	30M-500KM

*Type M51 available to 10,000 KM on special order. Type M51 at 1.69 [42.93] length also available on special order.

SPECIFICATIONS

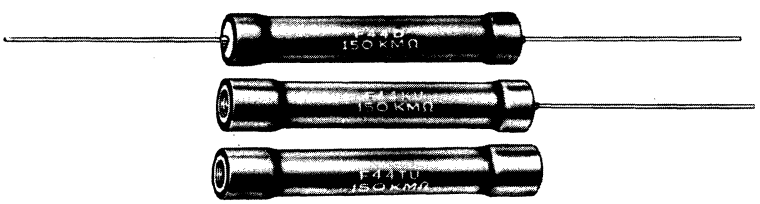
ELECTRICAL

Tolerance: M51 = 1%, 2%, 5%, 10%. MH51 = 10%, 20%. MM51 = 10%, 20%. MH52 = 1%, 2%, 5%.

Temperature Coefficient: 10^7-10^9 = 1500 PPM/°C; Over 10^9-10^{11} = 2000 PPM/°C; Over 10^{11}-10^{12} = 2800 PPM/°C. (T.C.'s are typical only and are ALWAYS NEGATIVE.)

DALE TYPE F43, F44 METAL FILM

(Pulse Loading – Surge Discharge)



STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	40°C WATTAGE RATING	WORKING* VOLTAGE	PULSE VOLTAGE	TEMP. RISE	TOLERANCE	RESISTANCE RANGE (Ohms) Min.	Max.
F43D	1/2	4KV	15KV	26°C	±2%	2 Meg.	3KM
F43KU	1/2	4KV	15KV	26°C	±5%	2 Meg.	50KM
F43TU	1/2	4KV	15KV	26°C	±10%		
F44D	1	14KV	50KV	36°C	±2%	2 Meg.	10KM
F44KU	1	14KV	50KV	36°C	±5%	2 Meg.	150KM
F44TU	1	14KV	50KV	36°C	±10%		

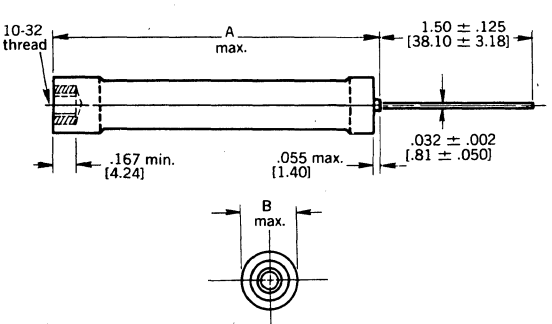
*Working Voltage: F-43-4KV at 32 Megohms and over. F-44-14KV at 200 Megohms and over. Resistors may be operated at double wattage rating at 25°C ambient with typical load life of ΔR<2% after 2000 hours.

Temperature Coefficient: −1200 to −2000 PPM/°C Typical.

PHYSICAL CONFIGURATIONS

TYPE	TERMINATION	DIMENSIONS A	B
F43D	Standard Wire Leads	1.094 [27.79]	.312 [7.92]
F43KU	Comb. Lead/Threaded Cap	1.188 [30.18]	.312 [7.92]
*F43TU	Threaded Caps, both ends	1.280 [32.51]	.312 [7.92]
F44D	Standard Wire Leads	2.000 [50.80]	.312 [7.92]
F44KU	Comb. Lead/Threaded Cap	2.094 [53.19]	.312 [7.92]
*F44TU	Threaded Caps, both ends	2.187 [55.55]	.312 [7.92]

*10-32 x 5/16 [7.94] Coupling Stud supplied with each unit



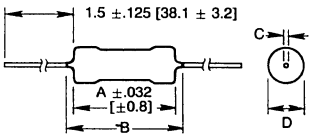
For complete information, write or phone

DALE ELECTRONICS, INC., 2300 Riverside Blvd., Norfolk, Nebraska 68701 • Phone 402-371-0080

DALE® METAL OXIDE HIGH VOLTAGE RESISTORS

RNX and ROX SERIES

Numbers in Brackets Indicate Millimeters



FEATURES

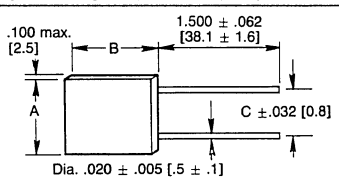
- Silicone coating (Epoxy available) • RNX Ratings to 2W, 6KV • ROX Ratings to 10W, 45KV
- Low TC: ±200 PPM/°C Standard, ±50 PPM/°C, ±100 PPM/°C available

PRECISION TYPES (±1%, ±2%, ±5%, ±10%)

DALE TYPE *	Power (watts) @ 125°C	Voltage Rating	RESISTANCE (Ohms) Min.	Max.	DIMENSIONS A Max.	B Max.	C	D
RNX-1/4	0.25	0.75KV	1K	100M	0.270 [6.9]	0.320 [8.1]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-3/8	0.5	1.5KV	1K	500M	0.400 [10.2]	0.470 [11.9]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-1/2	0.6	1.5KV	1K	1.5G	0.525 [13.3]	0.595 [15.1]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-3/4	1.0	2.0KV	1.2K	2.5G	0.775 [19.7]	0.845 [21.5]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-1	1.25	4.0KV	1.5K	3G	1.025 [26.0]	1.095 [27.8]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-1-1/4	1.5	5.0KV	1.7K	4G	1.275 [32.4]	1.345 [34.2]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
RNX-1-1/2	2.0	6.0KV	2K	5G	1.525 [38.7]	1.595 [40.5]	.025 [0.64]	.135 ± .015 [3.43 ± 0.38]
ROX-3/4	1.5	5.0KV	1K	4G	0.800 [20.3]	0.884 [22.5]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-1	2.0	7.5KV	1K	5G	1.050 [26.7]	1.134 [28.8]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-1-1/2	2.5	11.0KV	1.5K	7.5G	1.550 [39.4]	1.634 [41.5]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-2	3.0	15.0KV	2K	10G	2.050 [52.1]	2.134 [54.2]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-3	5.0	22.5KV	3K	15G	3.050 [77.5]	3.134 [79.6]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-4	6.0	30.0KV	4K	20G	4.050 [102.9]	4.134 [105.0]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-5	8.0	37.5KV	5K	25G	5.050 [128.3]	5.134 [130.4]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]
ROX-6	10.0	45.0KV	6K	30G	6.050 [153.7]	6.134 [155.8]	.032 [0.81]	.270 ± .015 [6.86 ± 0.38]

*Leads are OFHC tinned copper.

FLAT STYLE, FHV & RFX SERIES



FEATURES

- Epoxy Coating • Ratings to 5W, 25KV
- Low TC: ±200 PPM/°C Standard, ±100 PPM/°C available

PRECISION TYPES (±1%, ±2%, ±5%, ±10%)

DALE TYPE*	Power (watts) @ 25°C	Voltage Rating	RESISTANCE (Ohms) Min.	Max.	DIMENSIONS A Max.	B Max.	C
FHV-1/2	0.5	1.5KV	10K	500M	0.350 [8.9]	0.350 [8.9]	0.200 [5.1]
FHV-1	1.6	3.5KV	10K	2G	0.520 [13.2]	0.520 [13.2]	0.360 [9.1]
FHV-2	4.0	7.5KV	20K	10G	1.020 [25.9]	0.520 [13.2]	0.860 [21.8]
FHV-3	5.0	25KV	30K	10G	2.070 [52.6]	0.750 [19.1]	1.880 [47.8]
RFX-1/2	0.25	3.75KV	100	10G	0.570 [14.5]	0.210 [5.3]	0.415 [10.5]
RFX-1	0.8	7.5KV	100	2G	1.070 [27.2]	0.280 [7.1]	0.890 [22.6]
RFX-1-1/2	1.5	11.25KV	100	5G	1.570 [39.9]	0.330 [8.4]	1.390 [35.3]
RFX-2	2.0	15.0KV	100	8G	2.070 [52.6]	0.330 [8.4]	1.880 [47.8]

*Leads are OFHC tinned copper. FHV Series terminals are tinned brass (.020 x 0.10 x 0.250).

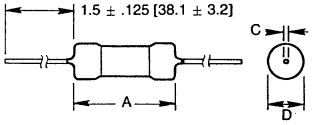
DALE® METAL ALLOY HIGH VOLTAGE RESISTORS

HVW, MVW and HVX SERIES

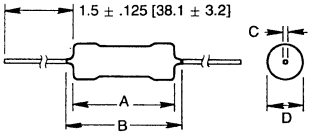
FEATURES

- HVW and MVW = Uncoated; HVX = Silicone coated
- HVW & MVW Ratings to 2.6W, 15KV, ±5%; HVX Ratings, to 5W, 15KV, ±5%
- Axial leads—HVW and HVX = tinned copper MVW = Copperweld

HVW/MVW Uncoated



HVX Coated



HVW/MVW (Uncoated) SEMI-PRECISION TYPES* (±5%, ±10%, ±20%)

DALE TYPE	Power (watts) @ 200°C	Voltage Rating	RESISTANCE (Ohms) Min.	Max.	DIMENSIONS A Max.	C	D Max.
HVW-1/2	0.5	3.5KV	500	25M	0.631 [16.0]	.032 [0.81]	0.155 [3.94]
MVW-1/2	0.5	3.5KV	500	25M	0.631 [16.0]	.032 [0.81]	0.155 [3.94]
HVW-3/4	1.0	7.5KV	1K	50M	0.968 [24.6]	.032 [0.81]	0.155 [3.94]
MVW-3/4	1.0	7.5KV	1K	50M	0.968 [24.6]	.032 [0.81]	0.155 [3.94]
HVW-1	1.2	7.5KV	1K	100M	0.968 [24.6]	.032 [0.81]	0.275 [6.99]
HVW-2	2.6	15.0KV	1K	200M	2.090 [53.1]	.032 [0.81]	0.275 [6.99]

*Consult factory for closer tolerance. Leads are OFHC tinned copper.

HVX (Silicone Coated)

DALE TYPE	Power (watts) @ 70°C	Voltage Rating	RESISTANCE (Ohms) Min.	Max.	DIMENSIONS A Max.	B Max.	C	D Max.
HVX-1/2	1.0	3.5KV	500	25M	0.631 [16.0]	0.680 [17.3]	.032 [0.81]	0.180 [4.57]
HVX-3/4	1.5	7.5KV	1K	50M	0.968 [24.6]	1.062 [27.0]	.032 [0.81]	0.180 [4.57]
HVX-1	2.5	7.5KV	1K	100M	0.968 [24.6]	1.062 [27.0]	.032 [0.81]	0.310 [7.87]
HVX-2	5.0	15.0KV	1K	200M	2.090 [53.1]	2.200 [55.9]	.032 [0.81]	0.310 [7.87]

For complete information, write or phone
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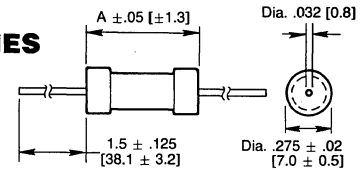
DALE® CARBON FILM HIGH VOLTAGE RESISTORS

Numbers in Brackets Indicate Millimeters

T SERIES



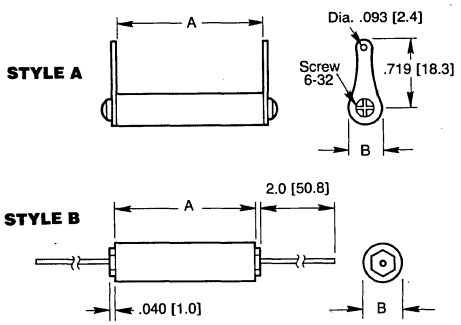
FEATURES

- Low cost, cap and lead type
- Ratings to 3W, 15KV, ±5%
- Supplied with mylar protective sleeve .002" [.05] thick

GENERAL PURPOSE TYPES (±5%, ±10%, ±15%, ±20%)

DALE TYPE	Power (watts) @ 25°C	Voltage Rating	RESISTANCE (Ohms) Min.	RESISTANCE (Ohms) Max.	DIMENSION A
TAEW	0.5	3.0KV	1M	1G	0.80 [20.3]
TAFW	1.0	5.0KV	1M	1G	1.05 [26.7]
TAKW	1.5	7.5KV	1M	1G	1.55 [39.4]
TAOW	2.0	10.0KV	1M	1G	2.05 [52.1]
TAQW	2.5	12.5KV	1M	1G	2.55 [64.8]
TARW	3.0	15.0KV	1M	1G	3.05 [77.5]

B, E, F, H SERIES*



FEATURES

- Single units to 10W, 40KV, ±3%
- Matched pairs (BP) to 20W, 80KV, ±1%
- Radial lug or axial lead
- Supplied with mylar protective sleeve .002" [.05] thick
- Series B is general purpose. Also available encapsulated (Series E); non-inductive, varnish coated (Series F); high megohm, varnish coated (Series H).

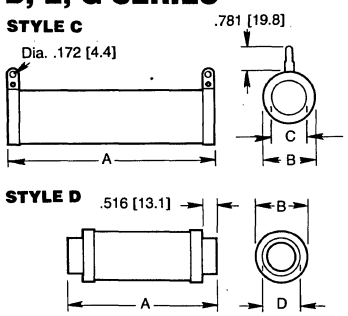
Style B axial leads are #20 AWG tinned copper. Dimensional tolerances are ±.016" [.4] or ±1%, whichever is greater.

GENERAL PURPOSE TYPES (±3%, ±5%, ±10%, ±15%)

DALE* TYPE	Power (watts) @ 25°C	Voltage Rating	RESISTANCE (Ohms) Min.	RESISTANCE (Ohms) Max.	Style	DIMENSIONS A	DIMENSIONS B
( ) AEW	0.5	2.5KV	20	1T	B	0.75 [19.1]	0.250 [6.4]
( ) AKW	1.0	5.0KV	25	5T	B	1.50 [38.1]	0.250 [6.4]
( ) BF	1.0	3.5KV	20	25T	A	1.00 [25.4]	0.313 [8.0]
( ) BFW	1.0	3.5KV	20	25T	B	1.00 [25.4]	0.313 [8.0]
( ) BM	2.0	7.5KV	25	50T	A	1.75 [44.5]	0.313 [8.0]
( ) BMW	2.0	7.5KV	25	50T	B	1.75 [44.5]	0.313 [8.0]
( ) BR	3.0	15.0KV	35	100T	A	3.00 [76.2]	0.313 [8.0]
( ) BRW	3.0	15.0KV	35	100T	B	3.00 [76.2]	0.313 [8.0]
( ) BV	5.0	30.0KV	60	100T	A	5.50 [139.7]	0.313 [8.0]
( ) FQ	4.0	15.0KV	20	100T	A	2.50 [63.5]	0.563 [14.3]
( ) FT	6.0	25.0KV	25	100T	A	4.00 [101.6]	0.563 [14.3]
( ) FW	10.0	40.0KV	40	100T	A	6.50 [165.1]	0.563 [14.3]

*(First letter of nomenclature is variable: B, E, F or H)

D, E, G SERIES*



FEATURES

- Ratings to 100W, 125KV, ±3%
- Radial bands or ferrule terminals
- Standard models varnish coated; vinyl protective sleeve available.
- Series D is general purpose. Also available encapsulated (Series E) or in non-inductive, varnish coated (Series G) styles.

Consult factory for complete information including other series to meet your needs.

GENERAL PURPOSE TYPES (±3%, ±5%, ±10%, ±15%)

DALE* TYPE	Power (Watts) @ 25°C	Voltage Rating	RESISTANCE (Ohms) Min.	RESISTANCE (Ohms) Max.	Style	DIMENSIONS A	DIMENSIONS B	DIMENSIONS C	DIMENSIONS D
( ) JU	10	25KV	20	100G	C	4.500 [114.3]	.750 [19.1]	0.500 [12.7]	N/A
( ) PW	20	35KV	20	100G	C	6.500 [165.1]	1.125 [28.6]	0.750 [19.1]	N/A
( ) PW-1	20	35KV	20	100G	D	7.687 [195.2]	1.125 [28.6]	N/A	0.812 [20.6]
( ) PX	30	65KV	30	100G	C	10.500 [266.7]	1.125 [28.6]	0.750 [19.1]	N/A
( ) PX-1	30	65KV	30	100G	D	11.687 [296.8]	1.125 [28.6]	N/A	0.812 [20.6]
( ) VY	60	90KV	35	100G	C	14.500 [368.3]	1.500 [38.1]	1.250 [28.6]	N/A
( ) VY-1	60	90KV	35	100G	D	15.687 [398.4]	1.500 [38.1]	N/A	1.141 [29.0]
( ) ZW	35	40KV	20	100G	C	6.500 [165.1]	2.000 [50.8]	1.563 [39.7]	N/A
( ) ZW-1	35	40KV	20	100G	D	7.687 [195.2]	2.000 [50.8]	N/A	1.141 [29.0]
( ) ZZ	100	125KV	30	100G	C	18.500 [469.9]	2.000 [50.8]	1.563 [39.7]	N/A
( ) ZZ-1	100	125KV	30	100G	D	19.687 [500.0]	2.000 [50.8]	N/A	1.141 [29.0]

Dimensional tolerances are ±.016" [.4] or ±1%, whichever is greater. *(First letter of nomenclature is variable: D, E, G)

For complete information, write or phone

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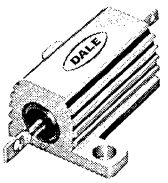
DALE® PRECISION POWER WIREWOUND RESISTORS

MIL-R-18546D, TYPE RE

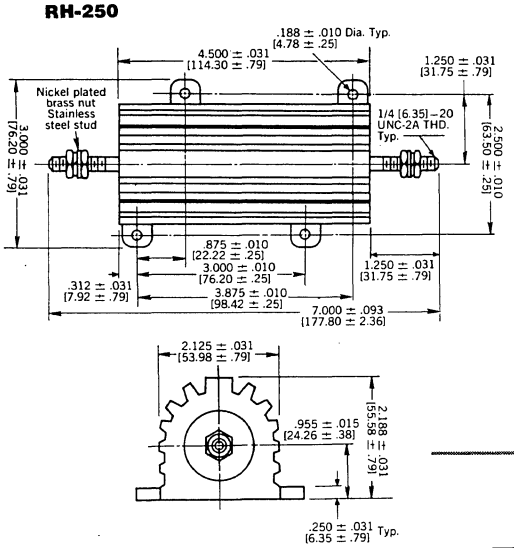


DALE TYPE RH, ALUMINUM HOUSED
Chassis Mount

STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	MIL-R-18546 TYPE	POWER RATING (Watts)		RESISTANCE RANGE (Ohms) MIL. Range shown in bold face		MAX. WORKING VOLTAGE	MAX. WEIGHT (Grams)	STANDARD TEMPERATURE COEFFICIENT VALUE RANGES (Ohms) *		
		DALE	MIL	.05%, .1%, .25%	.5%, 1%, 3%			±50 PPM	±30 PPM	±20 PPM
RH-5	**RE-60G**	7.5 (5)	5	1 to 6.5K	.1 to 24.5K **.1 to 3.32K**	160	3	1 to 9.9	10 to 49	50 to 24.5K
RH-10	**RE-65G**	12.5 (10)	10	1 to 12.7K	.008 to 47.1K **.1 to 5.62K**	265	6	1 to 9.9	10 to 79	80 to 47.1K
RH-25	**RE-70G**	25	20	.5 to 25.7K	.01 to 95.2K **.1 to 12.1K**	550	13	1 to 9.9	10 to 169	170 to 95.2K
RH-50	**RE-75G**	50	30	.5 to 73.4K	.01 to 273K **.1 to 39.2K**	1250	28	1 to 9.9	10 to 469	470 to 273K
RH-100	**RE-77G**	100	75	.3 to 50K	.05 to 59K **.05 to 29.4K**	1900	400	1 to 99	100 to 949	950 to 50K
RH-250	**RE-80G**	250	120	.3 to 75K	.1 to 75K **.1 to 35.7K**	2300	800	1 to 99	100 to 999	1K to 75K

RH-250

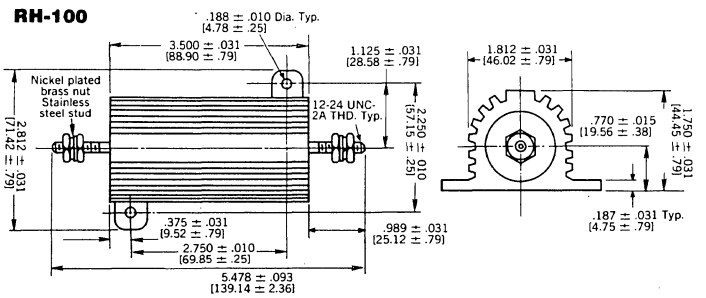


*1Ω to .95Ω = ±100 PPM; .01Ω to .099Ω = ±150 PPM.

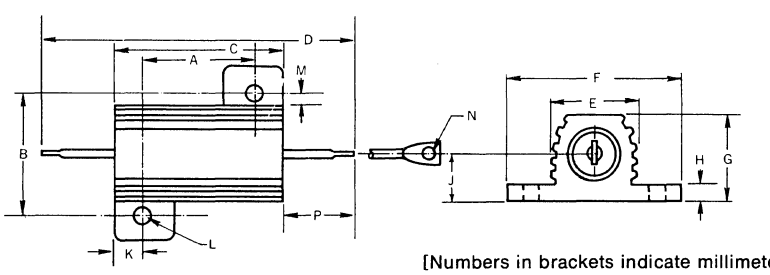
These resistors are also available in non-inductive (NH) styles.
Several modifications of housing and terminals are available.

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

RH-100



RH-5 thru RH-50



DIMENSIONS

[Numbers in brackets indicate millimeters]

TYPE	A	B	C	D	E	F	G	H	J	K	L	M	N	P
RH-5	.444 ± .005 [11.28 ± .127]	.490 ± .005 [12.45 ± .127]	.600 ± .031 [15.24 ± .787]	1.125 ± .062 [28.58 ±1.58]	.334 ± .015 [8.48 ± .381]	.646 ± .015 [16.41 ± .381]	.320 ± .015 [8.13 ± .381]	.065 ± .010 [1.65 ± .254]	.133 ± .010 [3.38 ± .254]	.078 ± .010 [1.98 ± .254]	.093 ± .005 [2.36 ± .127]	.078 ± .015 [1.98 ± .381]	.050 ± .005 [1.27 ± .127]	.262 ± .062 [6.65 ±1.58]
RH-10	.562 ± .005 [14.27 ± .127]	.625 ± .005 [15.88 ± .127]	.750 ± .031 [19.05 ± .787]	1.375 ± .062 [34.93 ± 1.58]	.420 ± .015 [10.67 ± .381]	.800 ± .015 [20.32 ± .381]	.390 ± .015 [9.91 ± .381]	.075 ± .010 [1.90 ± .254]	.165 ± .010 [4.19 ± .254]	.093 ± .010 [2.36 ± .254]	.093 ± .005 [2.36 ± .127]	.102 ± .015 [2.59 ± .381]	.086 ± .005 [2.18 ± .127]	.312 ± .062 [7.92 ± 1.58]
RH-25	.719 ± .005 [18.26 ± .127]	.781 ± .005 [19.84 ± .127]	1.062 ± .031 [26.97 ± .787]	1.938 ± .062 [49.23 ± 1.58]	.550 ± .015 [13.97 ± .381]	1.080 ± .015 [27.43 ± .381]	.546 ± .015 [13.87 ± .381]	.088 ± .010 [2.24 ± .254]	.231 ± .010 [5.87 ± .254]	.172 ± .010 [4.37 ± .254]	.125 ± .005 [3.18 ± .127]	.115 ± .015 [2.92 ± .381]	.086 ± .005 [2.18 ± .127]	.438 ± .062 [11.13 ± 1.58]
RH-50	1.563 ± .005 [39.70 ± .127]	.844 ± .005 [21.44 ± .127]	1.968 ± .031 [49.99 ± .787]	2.781 ± .062 [70.64 ± 1.58]	.630 ± .015 [16.00 ± .381]	1.140 ± .015 [28.96 ± .381]	.610 ± .015 [15.49 ± .381]	.088 ± .010 [2.24 ± .254]	.260 ± .010 [6.60 ± .254]	.196 ± .010 [4.98 ± .254]	.125 ± .005 [3.18 ± .127]	.107 ± .015 [2.72 ± .381]	.086 ± .005 [2.18 ± .127]	.406 ± .062 [10.31 ± 1.58]

For complete information, write or phone
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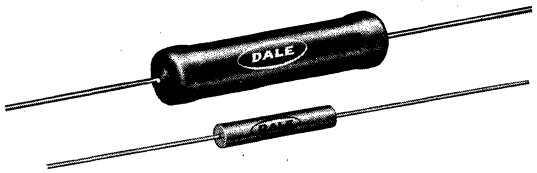
DALE® PRECISION POWER WIREWOUND RESISTORS

MIL-R-26, TYPE RW

DALE TYPE RS, AXIAL LEAD

Silicone Coated and Molded



STANDARD ELECTRICAL SPECIFICATIONS

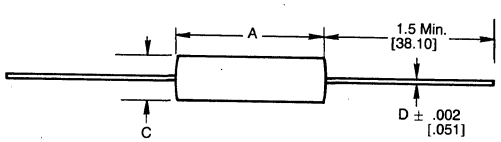
DALE TYPE	MIL-R-26 TYPE	DALE RATING U .05% thru 5%	DALE RATING V 3% & 5%	RESISTANCE RANGE (Ohms) MIL. Range shown in bold face .05%	.1%	.25%	.5%, 1%, 3%, 5%	MAX.* WORKING VOLTAGE U	MAX.* WORKING VOLTAGE V	MAX. WT. GRAMS
RS-1/4	—	.4 W	—	1-1K	.499-1K	.499-3.4K	.1-3.4K	20	—	.21
RS-1/2	—	.75 W	—	1-1.3K	.499-1.3K	.499-4.9K	.1-4.9K	29	—	.23
RS-1A	RW-70	1.0 W 1.0 W	—	1-2.74K	.499-2.74K **.499-2.74K**	.499-10.4K **.499-2.74K**	.1-10.4K **.1-2.74K**	52	—	.34
RS-2	—	4.0 W	5.5 W	.499-12.7K	.499-12.7K	.1-47.1K	.1-47.1K	210	250	2.1
RS-2B**	RW-79	3.0 W 3.0 W	3.75 W	.499-6.5K	.499-6.5K **.499-6.49K**	.1-24.5K **.1-6.49K**	.1-24.5K **.1-6.49K**	140	157	.70
RS-2C	—	2.5 W	3.25 W	.499-8.6K	.499-8.6K	.1-32.3K	.1-32.3K	138	157	1.6
RS-2C-17	—	2.5 W	3.25 W	.499-8.6K	.499-8.6K	.1-32.3K	.1-32.3K	138	157	1.6
RS-5**	—	5.0 W	6.5 W	.499-25.7K	.499-25.7K	.1-95.2K	.1-95.2K	360	410	4.2
RS-5-69	RW-74	5.0 W 5.0 W	6.5 W	.499-24.5K	.499-24.5K **.499-24.3K**	.1-91.0K **.1-24.3K**	.1-91.0K **.1-24.3K**	350	400	4.2
RS-7	—	7.0 W	9.0 W	.499-41.4K	.499-41.4K	.1-154K	.1-154K	504	576	4.7
RS-10	—	10 W	13W	.499-73.4K	.499-73.4K	.1-273K	.1-273K	858	978	9.0
RS-10-38	RW-78	10 W 10 W	13 W	.499-71.5K	.499-71.5K **.499-71.5K**	.1-265K **.1-71.5K**	.1-265K **.1-71.5K**	846	966	9.0

*Max. working voltage determined at .0008 dia. wire resistance values.
**Values available down to .005Ω in 1%, 3% and 5% tolerances.

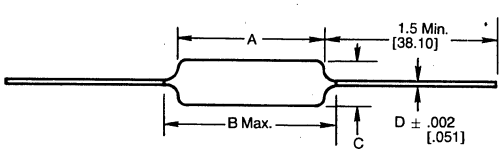
NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

PHYSICAL CONFIGURATIONS

MOLDED MODEL



COATED MODEL



DIMENSIONAL SPECIFICATIONS

[Numbers in brackets indicate millimeters]

	TYPE	DIM. A	DIM. B	DIM. C	DIM. D
MOLDED MODELS	RS-1/4	.250 ± .015 [6.35 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	RS-1/2	.312 ± .015 [7.92 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	RS-1A	.422 ± .015 [10.72 ± .381]	—	.110 ± .015 [2.79 ± .381]	.020 [.508]
COATED MODELS	RS-2	.625 ± .062 [15.88 ± 1.58]	.765 [19.43]	.250 ± .031 [6.35 ± .787]	.040 [1.02]
	RS-2B	.560 ± .062 [14.22 ± 1.58]	.622 [15.80]	.187 ± .031 [4.75 ± .787]	.032 [.813]
	RS-2C	.500 ± .062 [12.7 ± 1.58]	.593 [15.06]	.218 ± .031 [5.54 ± .787]	.040 [1.02]
	RS-2C-17	.500 ± .062 [12.7 ± 1.58]	.593 [15.06]	.218 ± .031 [5.54 ± .787]	.032 [.813]
	RS-5	.875 ± .062 [22.23 ± 1.58]	1.000 [25.4]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-5-69	.875 ± .062 [22.23 ± 1.58]	.937 [23.80]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-7	1.218 ± .062 [30.94 ± .158]	1.281 [30.94]	.312 ± .031 [7.92 ± .787]	.040 [1.02]
	RS-10	1.780 ± .062 [45.21 ± 1.58]	1.875 [47.63]	.375 ± .031 [9.53 ± .78]	.040 [1.02]
	RS-10-38	1.780 ± .062 [45.21 ± 1.58]	1.842 [46.79]	.375 ± .031 [9.53 ± .78]	.040 [1.02]

For complete information, write or phone
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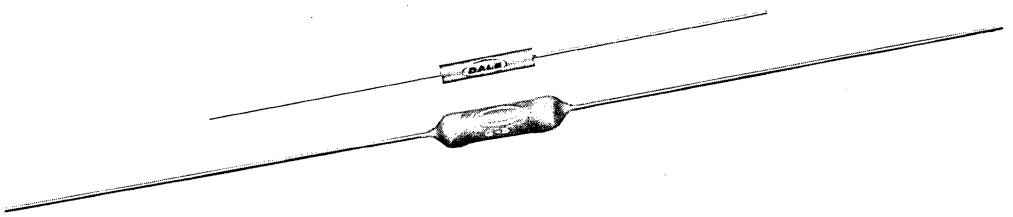
DALE® PRECISION POWER WIREWOUND RESISTORS

MIL-R-26E, TYPE RW

DALE TYPE G, AXIAL LEAD

Silicone Coated and Molded



STANDARD ELECTRICAL SPECIFICATIONS

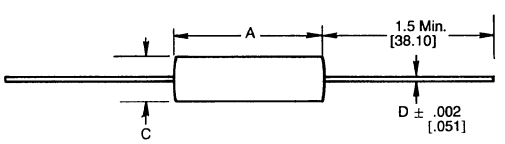
DALE TYPE	MIL-R-36 TYPE	DALE RATING U .05% thru 5%	DALE RATING V 3% & 5%	RESISTANCE RANGE (Ohms) MIL. Range shown in bold face .05%	.1%	.25%	.5%, 1%, 3%, 5%	MAX.* WORKING VOLTAGE U	MAX.* WORKING VOLTAGE V	MAX. WT. GRAMS
G-1-80		1.0 W	—	1-1K	.499-1K	.499-3.4K	.1-3.4K	33	—	.20
	RW-81	1.0 W	—		**.499-1K**	**.499-1K**	**.1-1K**	33	—	.20
G-2	—	1.5 W	—	1-1.3K	.499-1.3K	.499-4.9K	.1-4.9K	42	—	.21
G-3-80		2.0 W	—	1-2.74K	.499-2.74K	.499-10.4K	.1-10.4K	80	—	.34
	RW-80	2.0 W	—		**.499-2.74K**	**.499-2.74K**	**.1-2.74K**	80	—	.34
G-5	—	4.0 W	5 W	.499-6.5K	.499-6.5K	.1-24.5K	.1-24.5K	162	184	.80
G-5C	—	5 W	7 W	.499-8.6K	.499-8.6K	.1-32.3K	.1-32.3K	194	230	1.2
G-10	—	7 W	10 W	.499-25.7K	.499-25.7K	.1-95.2K	.1-95.2K	425	508	3.6

*Maximum Working Voltage determined at .0008 dia. wire resistance values.

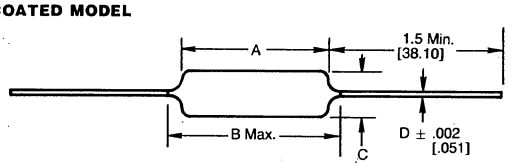
PHYSICAL CONFIGURATIONS

[Numbers in brackets indicate millimeters]

MOLDED MODEL



COATED MODEL



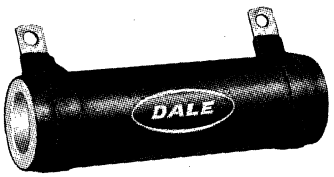
	TYPE	DIM. A	DIM. B	DIM. C	DIM. D
MOLDED MODELS	G-1-80	.250 ± .015 [6.35 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	G-2	.312 ± .015 [7.92 ± .381]	—	.078 ± .015 [1.98 ± .381]	.020 [.508]
	G-3-80	.422 ± .015 [10.72 ± .381]	—	.110 ± .015 [2.79 ± .381]	.020 [.508]
COATED MODELS	G-5	.562 ± .062 [14.27 ± 1.58]	.640 [16.26]	.188 ± .032 [4.78 ± .813]	.032 [.813]
	G-5C	.500 ± .062 [12.7 ± 1.58]	.593 [15.06]	.218 ± .032 [5.54 ± .813]	.040 [1.02]
	G-10	.875 ± .062 [22.23 ± 1.58]	1.000 [25.4]	.312 ± .032 [7.92 ± .813]	.040 [1.02]

NOTE: All resistance ranges shown conform to military specifications unless otherwise indicated.

For complete information, write or phone
DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

DALE® INDUSTRIAL POWER WIREWOUND RESISTORS

DALE TYPE HL, TUBULAR



For inexpensively dissipating larger amounts of power in DC or low frequency AC circuits.

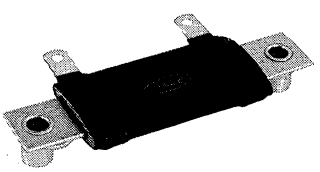
Applications include:
- Grid resistor
- Voltage dropping resistor
- High voltage bleeder resistors in power supplies
- Bias supply resistor
- Voltage divider networks
- Filament dropping resistor
- Load resistor
- Shunt resistor

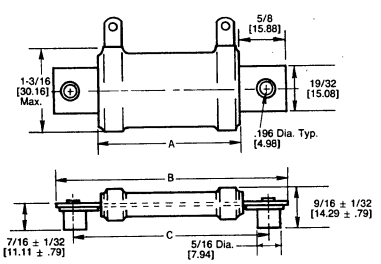
STANDARD TYPE SPECIFICATIONS

TYPE	WATTAGE RATING	DALE MAX.* RESISTANCE	MAX. WORKING VOLTAGE	TERMINAL SETBACK ±1/32 [.79]	CORE DIMENSIONS LENGTH ±1/16 [1.59]	CORE DIMENSIONS O.D.	CORE DIMENSIONS I.D. ±1/32 [.79]	STANDARD TERMINAL** DESIGNATION	MOUNTING HARDWARE OPTIONS
HL-12	12	70K	500	3/32 [2.38]	1-3/4 [44.45]	5/16 [7.94]	3/16 [4.76]	05	101, 204, 301
HL-20	20	120K	880	3/32 [2.38]	2 [50.80]	7/16 [11.11]	5/16 [7.94]	02	101, 203, 301
HL-25	25	155K	1.3K	3/32 [2.38]	2 [50.80]	9/16 [14.29]	5/16 [7.94]	06	101, 203, 301
HL-50	50	385K	1.9K	3/32 [2.38]	4 [101.60]	9/16 [14.29]	5/16 [7.94]	06	101, 203, 301
HL-100	100	870K	2.5K	1/8 [3.18]	6-1/2 [165.10]	3/4 [19.05]	1/2 [12.70]	06	102, 206, 303
HL-175	175	1.7 Meg.	5.2K	7/32 [5.56]	8-1/2 [215.90]	1-1/8 [28.58]	3/4 [19.05]	07	103, 205, 303
HL-225	225	2.1 Meg.	6.1K	7/32 [5.56]	10-1/2 [266.70]	1-1/8 [28.58]	3/4 [19.05]	07	103, 205, 303

*Minimum resistance is .1 ohm for all models.
**Contact factory for optional, non-standard terminals, including quick disconnect types.

DALE TYPE HL, FLAT





FLAT TYPE SPECIFICATIONS

TYPE	WATTAGE RATING	MAX.* RESISTANCE	MAX. WORKING VOLTAGE	TERMINAL SETBACK ±1/32 [.79]	DIMENSIONS A ±1/16 [1.59]	DIMENSIONS B ±1/16 [1.59]	DIMENSIONS C ±1/32 [.79]	STANDARD TERMINAL** DESIGNATION
HL-24	30	55K	800	5/64 [1.98]	1-1/4 [31.75]	2-1/2 [63.50]	2 [50.80]	09
HL-35	40	135K	1.4KV	5/64 [1.98]	2 [50.80]	3-1/4 [82.55]	2-3/4 [69.85]	09
HL-55	55	300K	1.8KV	5/64 [1.98]	3-1/2 [88.90]	4-3/4 [120.65]	4-1/4 [107.95]	09
HL-95	95	550K	2.6KV	5/64 [1.98]	6 [152.40]	7-1/4 [184.15]	6-3/4 [171.45]	09

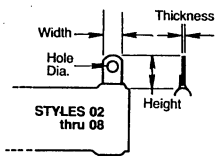
*Minimum resistance is .1 ohm for all models.
**Contact factory for optional, non-standard terminals, including quick disconnect types.

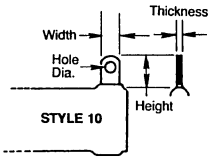
For complete information, write or phone
DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

DALE®

TERMINAL SPECIFICATIONS

Terminals for HL, HLM and HLW Power Wirewound Resistors





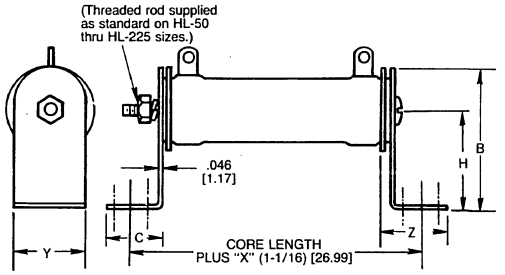
All terminals will be supplied in tinned finish (Z) unless otherwise specified. Optional finishes are nickel plated (N) for HL's, bare alloy 180 (W) for HLW lead styles. Specify proper suffix in part number designation when ordering.

TERMINAL DIMENSIONS

TERMINAL DESIGNATION	02	05	06	07	09	10	A1, R1	A2, R2
WIDTH	3/16 [4.76]	3/16 [4.76]	1/4 [6.35]	3/8 [9.52]	3/16 [4.76]	1/8 [3.18]	1-1/2" [38.10] 18 AWG Lead	1-1/2" [38.10] 20 AWG Lead
HEIGHT	13/32 [10.32]	7/16 [11.11]	9/16 [14.29]	5/8 [15.88]	1/2 [12.70]	3/16 [4.76]		
HOLE DIA.	.093 [2.36]	.104 [2.64]	.166 [4.22]	.173 [4.39]	.104 [2.64]	.063 [1.60]		
THICKNESS	.020 [.51]	.020 [.51]	.020 [.51]	.020 [.51]	.020 [.51]	.030 [.76]		

MOUNTING SPECIFICATIONS

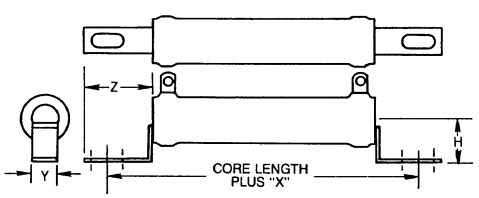
HORIZONTAL THRU-BOLT



Note: Flat washers are supplied on resistor cores through 9/16 [14.29] diameter.

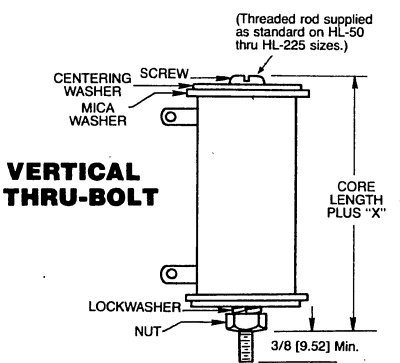
BRACKET TYPE	X	Y	Z	H	MOUNTING SLOT	C	B
101	1-1/16 [26.99]	1/2 [12.70]	55/64 [21.83]	1 [25.40]	7/32 x 7/16 [5.56 x 11.11]	3/4 [19.05]	1-3/8 [34.92]
102	1-1/16 [26.99]	3/4 [19.05]	55/64 [21.83]	1-1/4 [31.75]	7/32 x 7/16 [5.56 x 11.11]	3/4 [19.05]	1-3/4 [44.45]
103	1-1/16 [26.99]	1-1/4 [31.75]	1 [25.40]	1-1/2 [38.10]	9/32 x 9/16 [7.14 x 14.29]	7/8 [22.22]	2-1/8 [53.98]

PUSH-IN



BRACKET TYPE	X	H	Y	Z	HOLE
203	5/8 [15.88]	43/64 [17.06]	1/4 [6.35]	15/32 [11.91]	.161 Dia. [4.09]
204	3/8 [9.52]	9/32 [7.14]	1/4 [6.35]	11/32 [8.73]	.144 Dia. [3.66]
205	13/16 [20.64]	1-25/64 [35.32]	1/2 [12.70]	11/16 [17.46]	.196 x .260 [4.98 x 6.60]
206	23/32 [18.26]	31/32 [24.61]	3/8 [9.52]	5/8 [15.88]	.196 x .375 [4.98 x 9.52]

VERTICAL THRU-BOLT



Note: Flat washers are supplied on resistor cores through 9/16 [14.29] diameter.

BRACKET TYPE	X (Approximate)	THREAD
301	7/16 [11.11]	8-32
303	1/4 [6.35]	10-32

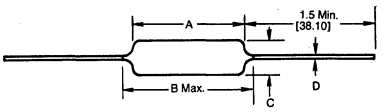
[Numbers in brackets indicate millimeters]

For complete information, write or phone

DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

DALE® INDUSTRIAL POWER WIREWOUND RESISTORS

DALE TYPE CW, COATED, AXIAL LEAD



STANDARD ELECTRICAL SPECIFICATIONS

DALE TYPE	MIL. TYPE	POWER RATING (Max. Hot Spot) 275°C	350°C	MIL.	RESISTANCE RANGE (Mil. Range shown in bold face)	MAX. WT. (Grams)	MAX.* WORKING VOLTAGE 275°C	350°C
CW-2	—	4.0	5.5	—	.1Ω to 22K	2.1	200	235
CW-2B**	—	3.0	3.75	—	.1Ω to 11K	.70	125	140
CW-2C	—	2.5	3.25	—	.1Ω to 15K	1.6	130	150
CW-2C-1	**RW-69**	2.5	3.25	3.0	.1Ω to 15K **.1Ω to 2K**	1.6	130	150
CW-2C-14	—	2.5	3.25	—	.1Ω to 15K	1.6	130	150
CW-5**	—	5.0	6.5	—	.1Ω to 45K	4.2	320	365
CW-5-2	—	4.0	5.0	—	.1Ω to 30K	4.2	240	265
CW-5-3	—	5.0	6.5	—	.1Ω to 45K	4.2	320	365
CW-5-5	**RW-67**	5.0	6.5	6.5	.1Ω to 45K **.1Ω to 8.2K**	4.2	320	365
CW-7	—	7.0	9.0	—	.1Ω to 75K	4.7	460	520
CW-10	—	10.0	13.0	—	.1Ω to 130K	9.0	765	875
CW-10-3	—	10.0	13.0	—	.1Ω to 130K	9.0	765	875
CW-10-4	**RW-68**	10.0	13.0	11.0	.1Ω to 130K **.1Ω to 20K**	9.0	765	875

*Maximum working voltage determined at .0008" diameter wire resistance values.
**Values available down to .005Ω in 10% tolerance.

Tolerance: Standard tolerance is ±5% 1 ohm and above, ±10% below 1 ohm, ±3% available.

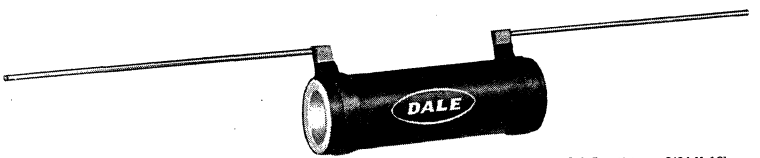
Temperature Coefficient: ±90 PPM/°C below 1Ω; ±50 PPM/°C 1Ω to 9.9Ω; ±30 PPM/°C 10Ω and above.

Lead Material: Standard material is tinned copperweld

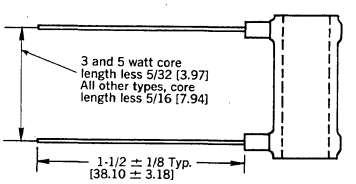
DIMENSIONAL SPECIFICATIONS

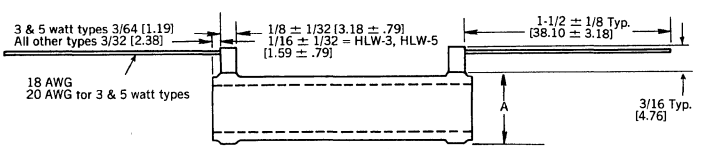
DALE TYPE	A ±.062 [1.57]	B (Max.)	C ± .032 [.81]	D ±.002 [.051]
CW-2	.625 [15.88]	.765 [19.43]	.250 [6.35]	.040 [1.02]
CW-2B	.562 [14.27]	.622 [15.80]	.188 [4.78]	.032 [.81]
CW-2C	.500 [12.70]	.593 [15.06]	.218 [5.54]	.040 [1.02]
CW-2C-1	.500 [12.70]	.593 [15.06]	.218 [5.54]	.032 [.81]
CW-2C-14	.500 [12.70]	.593 [15.06]	.218 [5.54]	.032 [.81]
CW-5	.875 [22.22]	1.000 [25.40]	.312 [7.92]	.040 [1.02]
CW-5-2	.875 [22.22]	1.000 [25.40]	.250 [6.35]	.032 [.81]
CW-5-3	.875 [22.22]	1.000 [25.40]	.312 [7.92]	.032 [.81]
CW-5-5	.875 [22.22]	1.000 [25.40]	.312 [7.92]	.040 [1.02]
CW-7	1.218 [30.94]	1.281 [32.54]	.312 [7.92]	.040 [1.02]
CW-10	1.781 [45.24]	1.875 [47.62]	.375 [9.52]	.040 [1.02]
CW-10-3	1.781 [45.24]	1.875 [47.62]	.375 [9.52]	.032 [.81]
CW-10-4	1.781 [45.24]	1.875 [47.62]	.375 [9.52]	.040 [1.02]

DALE TYPE HLW, TUBULAR, AXIAL LEAD



Lug-attached leads to facilitate direct electrical connection by soldering.





STANDARD ELECTRICAL SPECIFICATIONS

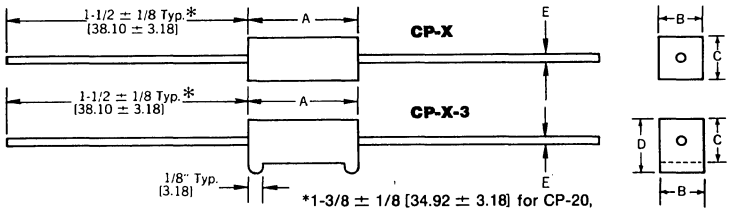
DALE TYPE	WATTAGE RATING	MAX. RESISTANCE*	LENGTH ±1/16 [1.59]	CORE O.D.	CORE I.D. ± 1/32 [.79]	A (Max.)	AXIAL TERMINAL DESIGNATION	RADIAL TERMINAL DESIGNATION	MOUNTING HARDWARE
HLW-3	3	6K	7/16 [11.11]	13/64 [5.16]	1/8 [3.18]	19/64 [7.54]	A2	R2	–
HLW-5	5-1/4	15K	5/8 [15.88]	1/4 [6.35]	1/8 [3.18]	11/32 [8.73]	A2	R2	–
HLW-6	8	25K	1 [25.40]	5/16 [7.94]	3/16 [4.76]	13/32 [10.32]	A1	R1	101, 204, 301
HLW-12	12	70K	1-3/4 [44.45]	5/16 [7.94]	3/16 [4.76]	13/32 [10.32]	A1	R1	101, 204, 301
HLW-20	20	120K	2 [50.80]	7/16 [11.11]	5/16 [7.94]	9/16 [14.29]	A1	R1	101, 203, 301

*Minimum resistance is .1 ohm for all models. Consult factory for higher values.

For complete information, write or phone
DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

DALE® COMMERCIAL POWER WIREWOUND RESISTORS

DALE TYPE CP, AXIAL LEAD

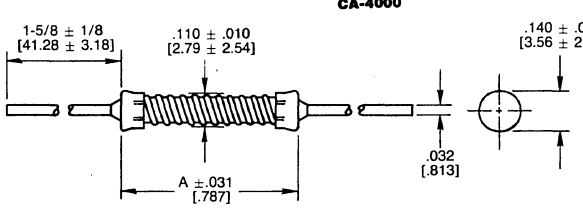


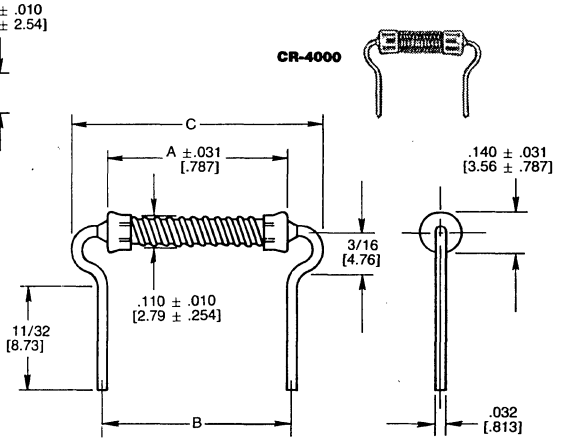
*1-3/8 ± 1/8 [34.92 ± 3.18] for CP-20, CP-20-3, CP-22, CP-22-3.

CP SERIES AXIAL LEAD TYPE

DALE TYPE	WATTAGE RATING	EIA STANDARD RS-344 TYPE	RESISTANCE	MAX. WORKING VOLTAGE	DIMENSIONS				
					A ± 1/32 [.79]	B ± 1/32 [.79]	C ± 1/32 [.79]	D ± 1/32 [.79]	E ± .001 [.02]
CP-2	2	CRU2A	.1 to 2.4K	65	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	–	.032 [.81]
CP-2-3	2	–	.1 to 2.4K	65	11/16 [17.46]	1/4 [6.35]	1/4 [6.35]	5/16 [7.94]	.032 [.81]
CP-3	3	CRU3	.1 to 7.5K	150	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	–	.036 [.91]
CP-3-3	3	–	.1 to 7.5K	150	7/8 [22.22]	5/16 [7.94]	5/16 [7.94]	3/8 [9.52]	.036 [.91]
CP-5	5	CRU5	.1 to 8.5K	200	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	–	.036 [.91]
CP-5-3	5	–	.1 to 8.5K	200	7/8 [22.22]	3/8 [9.52]	11/32 [8.73]	13/32 [10.32]	.036 [.91]
CP-7	7	CRU7	.12 to 18K	350	1-25/64 [35.32]	3/8 [9.52]	11/32 [8.73]	–	.036 [.91]
CP-7-3	7	–	.12 to 18K	350	1-25/64 [35.32]	3.8 [9.52]	11/32 [8.73]	15/32 [11.91]	.036 [.91]
CP-10	10	CRU10	.18 to 30K	540	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	–	.036 [.91]
CP-10-3	10	–	.18 to 30K	540	1-7/8 [47.62]	3/8 [9.52]	11/32 [8.73]	15/32 [11.91]	.036 [.91]
CP-15	15	CRU15	.18 to 30K	670	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	–	.036 [.91]
CP-15-3	15	–	.18 to 30K	670	1-7/8 [47.62]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.91]
CP-20	20	–	.29 to 30K	770	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	–	.036 [.91]
CP-20-3	20	–	.29 to 30K	770	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.91]
CP-22	22	–	.52 to 30K	815	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	–	.036 [.91]
CP-22-3	22	–	.52 to 30K	815	2-1/2 [63.50]	1/2 [12.70]	1/2 [12.70]	5/8 [15.88]	.036 [.91]

DALE TYPE CA & CR





DIMENSIONAL AND POWER SPECIFICATIONS

DALE TYPE	DIM. A		DIM. B ±1/32 [.79]	DIM. C ±1/32 [.79]
	MIN.	MAX.		
CA-4000	.6 [15.24]	2.0 [50.8]	N/A	N/A
CR-4000	.6 [15.24]	2.0 [50.8]	A + 3/32 [2.38]	A + 7/32 [5.56]

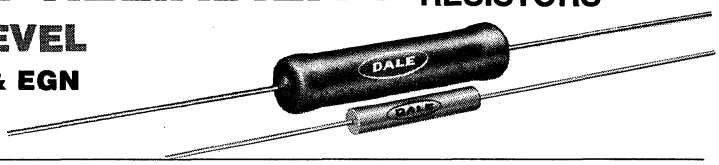
Resistance Range: .1Ω minimum to 7K, dependent on resistor core length. **Tolerance:** ±10% standard, ±5% also available.

For complete information, write or phone

DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

DALE® ESTABLISHED RELIABILITY WIREWOUND RESISTORS

MIL-R-39007, TYPE RWR, R LEVEL



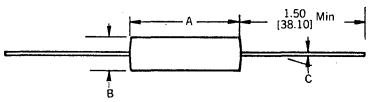
DALE TYPE ESS, ESW, EGS, EGW, ESN & EGN
Silicone Coated and Molded

STANDARD ELECTRICAL SPECIFICATIONS

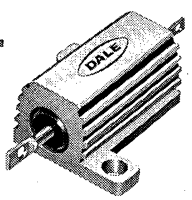
DALE TYPE	MIL-R-39007 TYPE	POWER RATING (Watts)	MILITARY RANGE .1%	MILITARY RANGE .5% & 1%	DIMENSIONS DIM. A	DIM. B	DIM. C
EGS-1-80*	RWR-81S	1	.499-1000	.1-1000	.250 ± .015 [6.35 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGW-1*	RWR-81W	1	.499-1000	.1-1000	.250 ± .015 [6.35 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGN-1-80*	RWR-81N	1	10-499	10-499	.250 ± .015 [6.35 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGN-1-10*	RWR-81Z	1	10-499	10-499	.250 ± .015 [6.35 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGS-2*	RWR-82S	1.5	.499-1300	.1-1300	.312 ± .015 [7.92 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGW-2*	RWR-82W	1.5	.499-1300	.1-1300	.312 ± .015 [7.92 ± .381]	.078 ± .015 [1.98 ± .381]	.020 ± .0015 [.508 ± .038]
EGS-3-80*	RWR-80S	2	.499-3160	.1-3160	.422 ± .015 [10.72 ± .381]	.110 ± .015 [2.79 ± .381]	.020 ± .0015 [.508 ± .038]
EGW-3*	RWR-80W	2	.499-3160	.1-3160	.422 ± .015 [10.72 ± .381]	.110 ± .015 [2.79 ± .381]	.020 ± .0015 [.508 ± .038]
EGN-3-80*	RWR-80N	2	10-1580	10-1580	.422 ± .015 [10.72 ± .381]	.110 ± .015 [2.79 ± .381]	.020 ± .0015 [.508 ± .038]
EGN-3-10*	RWR-80Z	2	10-1580	10-1580	.422 ± .015 [10.72 ± .381]	.110 ± .015 [.279 ± .381]	.020 ± .0015 [.508 ± .038]
ESS-2A	RWR-71S	2	.499-12.1K	.1-12.1K	.812 ± .062 [20.62 ± 1.57]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESW-2A	RWR-71W	2	.499-12.1K	.1-12.1K	.812 ± .062 [20.62 ± 1.57]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESN-2A	RWR-71N	2	10-6.04K	10-6.04K	.812 ± .062 [20.62 ± 1.57]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESN-2A-10	RWR-71Z	2	10-6.04K	10-6.04K	.812 ± .062 [20.62 ± 1.57]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESS-2B	RWR-89S	3	.499-4120	.1-4120	.560 ± .062 [14.22 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESW-2B	RWR-89W	3	.499-4120	.1-4120	.560 ± .062 [14.22 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESN-2B	RWR-89N	3	10-2050	10-2050	.560 ± .062 [14.22 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESN-2B-10	RWR-89Z	3	10-2050	10-2050	.560 ± .062 [14.22 ± 1.58]	.187 ± .031 [4.75 ± .787]	.032 ± .002 [.813 ± .051]
ESS-5	RWR-74S	5	.499-12,100	.1-12,100	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
ESW-5	RWR-74W	5	.499-12,100	.1-12,100	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
ESN-5	RWR-74N	5	10-6040	10-6040	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
ESN-5-10	RWR-74Z	5	10-6040	10-6040	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
EGS-10-80	RWR-84S	7	.499-12,400	.1-12,400	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
EGW-10	RWR-84W	7	.499-12,400	.1-12,400	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
EGN-10-80	RWR-84N	7	10-6190	10-6190	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
EGN-10-10	RWR-84Z	7	10-6190	10-6190	.875 ± .062 [22.23 ± 1.58]	.312 ± .031 [7.92 ± .787]	.040 ± .002 [1.02 ± .051]
ESS-10	RWR-78S	10	.499-39,200	.1-39,200	1.780 ± .062 [45.21 ± 1.58]	.375 ± .031 [9.52 ± .787]	.040 ± .002 [1.02 ± .051]
ESW-10	RWR-78W	10	.499-39,200	.1-39,200	1.780 ± .062 [45.21 ± 1.58]	.375 ± .031 [9.52 ± .787]	.040 ± .002 [1.02 ± .051]
ESN-10	RWR-78N	10	10-19,600	10-19,600	1.780 ± .062 [45.21 ± 1.58]	.375 ± .031 [9.52 ± .787]	.040 ± .002 [1.02 ± .051]
ESN-10-10	RWR-78Z	10	10-19,600	10-19,600	1.780 ± .062 [45.21 ± 1.58]	.375 ± .031 [9.52 ± .787]	.040 ± .002 [1.02 ± .051]

*Molded models. All others have conformal coating.

All styles available in non-Mil models with extended resistance ranges. Consult factory.



DALE® MIL-R-39009B, TYPE RER, R LEVEL



DALE TYPE ERH & ENH
Aluminum Housed Established Reliability

STANDARD ELECTRICAL SPECIFICATIONS

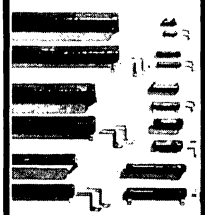
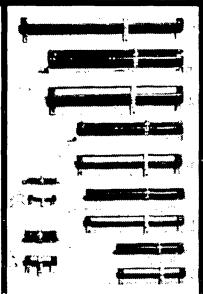
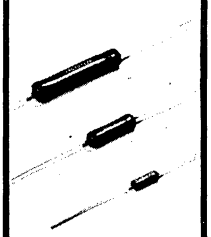
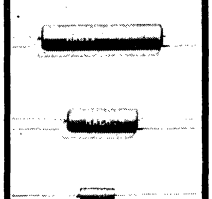
DALE TYPE	MIL-R-39009 TYPE	POWER RATING (Watts) MOUNTED	POWER RATING (Watts) FREE AIR	MILITARY RESISTANCE RANGE (Ohms) 1%	MAX. WORKING VOLTAGE	MAX. WEIGHT (Grams)	MIL-R-39009 STANDARD TEMPERATURE COEFFICIENT VALUE RANGES (Ohms) ±100 PPM	±50 PPM	±30 PPM
ENH-5	RER-40	5	3	1 to 1.65K	128.9	3.3	—	1 to 19.9	20 to 1.65K
ENH-10	RER-45	10	6	1 to 2.8K	190	8.8	—	1 to 19.9	20 to 2.8K
ENH-25	RER-50	20	8	1 to 6.04K	390	16.5	—	1 to 19.9	20 to 6.04K
ENH-50	RER-55	30	10	1 to 19.6K	890	35.0	—	1 to 19.9	20 to 19.6K
ERH-5	RER-60	5	3	0.10 to 3.32K	160	3	.1 to .99	1 to 19.9	20 to 3.32K
ERH-10	RER-65	10	6	0.10 to 5.62K	265	6	.1 to .99	1 to 19.9	20 to 5.62K
ERH-25	RER-70	20	8	0.10 to 12.1K	550	13	.1 to .99	1 to 19.9	20 to 12.1K
ERH-50	RER-75	30	10	0.10 to 39.2K	1250	28	.1 to .99	1 to 19.9	20 to 39.2K

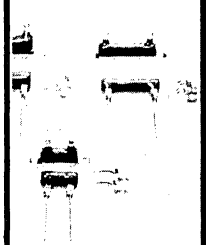
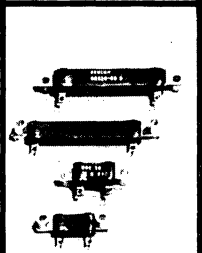
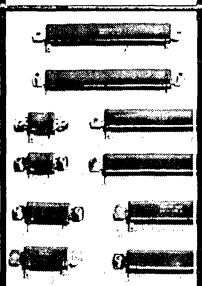
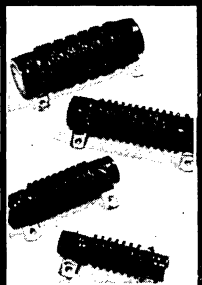
Standard Terminals: Tinned copperweld for all models. **Standard Tolerance:** ±1% **Dimensions:** Identical to Dale RH Resistors shown in this section.

For complete information, write or phone
DALE ELECTRONICS, INC., 2064 12th Avenue, Columbus, Nebraska 68601 • Phone 402-564-3131

E-SYSTEMS INC.
Memcor Division

WIRE WOUND RESISTORS

TYPE		Power Rating (Watts)	Max. Res. (Ohms)	Core Size (Inch.)
FR VITREOUS ENAMEL FIXED TUBULAR WITH TABS		5	25K	1 x 5/16
		10	50K	1¾ x 5/16
		20	100K	2 x 7/16
		25	100K	2 x 9/16
		50	250K	4 x 9/16
		100	100K	6½ x ¾
		160	100K	8½ x 1⅛
		200	100K	10½ x 1⅛
AR VITREOUS ENAMEL ADJUSTABLE TUBULAR WITH TABS		10	10K	1¾ x 5/16
		25	25K	2 x 9/16
		50	50K	4 x 9/16
		75	50K	6 x 9/16
		100	100K	6½ x ¾
		160	100K	8½ x 1⅛
		200	100K	10½ x 1⅛
VL VITREOUS ENAMEL AXIAL LEADS		3	10K	7/32 x 17/32
		5	25K	5/16 x 1 1/64
		10	50K	3/8 x 1 25/32
ML MOLDED SILICONE AXIAL LEADS		1	2500	.125 x .437
		2	3500	.205 x .590
		3	10K	.242 x .525
		6.5	80.6K	.375 x .917
		11	200K	.375 x 1.828

TYPE		Power Rating (Watts)	Max. Res. (Ohms)	Core Size (Inch.)
FR w/LEADS VITREOUS ENAMEL FIXED TUBULAR		5-8	25K	1 x 5/16
		10-12	50K	1¾ x 5/16
		20	100K	2 x 7/16
MZ VITREOUS ENAMEL MIDGET OVALS WITH TABS		10	5000	⅜ x 5/32
		20	25K	⅜ x 5/32
ZR VITREOUS ENAMEL OVALS TAB TERMINAL		30	10K	5/16 x 1
		40	15K	5/16 x 1
		55	25K	5/16 x 1
RR VITREOUS ENAMEL EDGEWOUND WITH TABS		40	1.8	2 x 9/16
		90	3	4 x 9/16
		100	2.5	3½ x ¾
		160	5.5	6 x ¾
		150	6.0	5 x 1
		300	13	8½ x 1⅛
		500	36	10½ x 1⅝
		750	40	12 x 2½
		1500	100	20 x 2½

MEMCOR Components represent the cumulative design and production knowledge gained during 30 years experience in the industry.

Let MEMCOR sales engineers aid you with your special design and application requirements.

For price, quality, and delivery look to MEMCOR Components. Immediate delivery on stock value resistors. Typical 3-5 week delivery on other standard values and special requirements. These products are available from MEMCOR's Nationwide Authorized Distributor Network.

Write for FREE Catalog.

E-SYSTEMS
Memcor Division

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RC-RCR	"	CARBON COMP
RE-RER	"	EXTRUDED HEAT SINK
RJ-RT-RJR-RTR-RV	"	POTENTIOMETERS
RL-RLR	"	METAL OXIDE
RN-RNC-RNR	"	METAL FILM
RW-RWR	"	WIRE WOUND POWER

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RJ-RT-RJR-RTR-RV	"	POTENTIOMETERS
RL-RLR	"	METAL OXIDE
RN-RNC-RNR	"	METAL FILM
RW-RWR	"	WIRE WOUND POWER

RNR-RNC, 55, 60, 65, 70, 75 C&E Type

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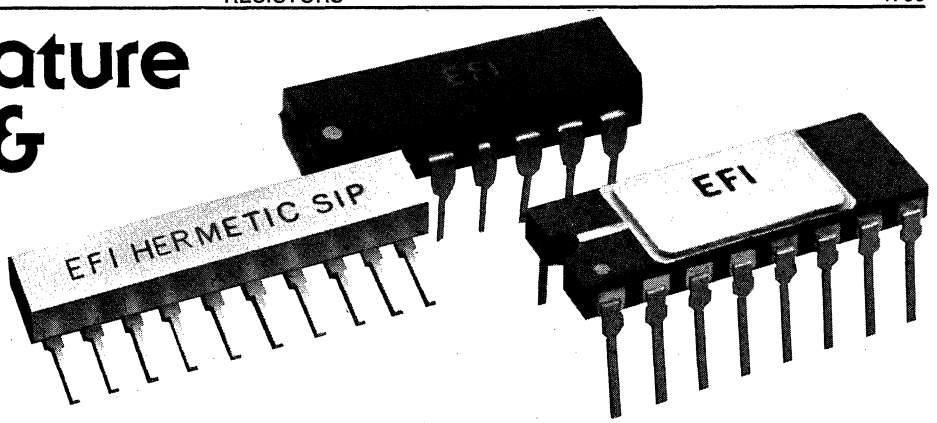


RESISTOR NETWORKS

PACKAGE TYPE	PINS/LEADS/ TERMINALS	RESISTANCE RANGES	DISSIPATION	TOLERANCES	NETWORK TYPES/CONFIGURATION
SIP	2—10	20Ω—1MΩ	125mW/Res.	Absolute: ±1% to ±0.05% Ratio: ±0.1% to ±0.005%	Common connection to all resistors (S1) Series connection (S2)
Hermetically sealed SIP	10	20Ω—1MΩ	100mW/Res. 1.0W/Pkg.		Common connection (S1) Series connection (S2)
Molded DIP (P) Epoxy-coated DIP (E) Hermetic DIP (C)	8, 14, 16 4—24 even # 8, 14, 16, 18, 24	20Ω—1MΩ 20Ω—1MΩ	125mW/Res. 1.2W/Pkg.		Common connection (D1) Series connection (D2) Single resistor connection (D4)
TRIM-PAK® * Laser-Trimmable DIP	8, 14, 16, 18, 24	20Ω—1MΩ	125mW/Res. 1.2W/Pkg.	Absolute: ±1% to ±0.01% Ratio: ±0.1% to ±0.005%	Common connection (D1) Series connection (D2) Single resistor connection (D4)
Hermetically sealed Chip-carrier	16, 18, 20, 28 32, 42, 64	20Ω—1MΩ	100mW/Res. 1.0W/Pkg.	Same as TRIM-PAK	Single-layer (epoxy sealed) Multi-layer (epoxy or alloy sealed)
Flip-chip	14, 16, 24 (other on request)	20Ω—1MΩ	125mW/Res. 1.0W/Pkg.	Same as SIP & DIP, above	Common connection (D1) Series connection (D2) Single resistor connection (D4)

*Patent Pending

LADDER NETWORKS

PACKAGE TYPE	MODEL NO.	CONFIGURATION	RESOLUTION	ACCURACY	OPERATING TEMPERATURE RANGE	MAXIMUM CUMULATIVE ERROR
16-pin ceramic DIP	D355	R-2R	10-bit or 12-bit	± ½LSB	0 to 70°C or −55°C to +125°C	12 Bits: ±0.012% 10 Bits: ±0.05%
24-pin hermetically sealed DIP	D350 D351	BCD	8, 10, or 12-bit	± ½LSB	0 to 70°C or −55°C to +125°C	12 Bits: ±0.012% (±0.03%)** 10 Bits: ±0.05% (±0.12%)**
14-pin hermetically sealed DIP	D352 D353	BCD				
14-lead hermetically sealed flatpack	F352 F353	Binary				8 Bits: ±0.2%
16-pin hermetic chip carrier	C355	R-2R	10-bit or 12-bit	± ½LSB	0 to 70°C or −55°C to +125°C	12 Bits: ±0.012% 10 Bits: ±.05%
24-pin hermetic chip carrier	C350	BCD	8, 10 or 12-bit	± ½LSB	0 to 70°C or −55°C to +125°C	12 Bits: ±0.012% 10 Bits: ±0.05% 8 Bits: ±0.2%

**D351 only.

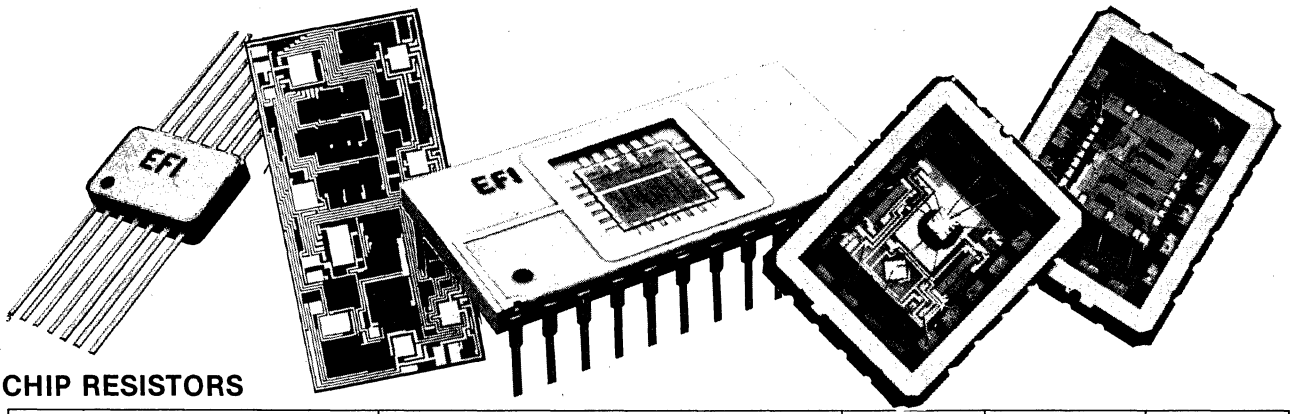
METALLIZED CERAMIC SUBSTRATES (Conductor-only and Resistor-conductor)

SUBSTRATE	METALLIZATION	RESISTORS*
Composition: 99.5% Al_2O_3 Surface Finish: 3—4 μin. typ. 1—2 μin. (polished) Size: .1″ × .1″ thru 4.5″ × 3.75″ Thickness: .010″ — .025″ Dimensional Tolerances: T — ±.002%, ±.001″ L — ±.003″ W — ±.003″ Camber: .004″/in. Dielectric Constant: 9.8 typ. @ 25°C—1MHz Loss Factor: .0004 typ @ 25°C—10GHz	**SPUTTERED** Ni/Cr, Ni, Au; Cr, Ni, Au; Cr, Au; Ta; Mo, Ni, Au; Cr, Cu, Au; Cr, Cu; Ti-W; Ti Other combinations of above metals. **ELECTROPLATED** Au: 100 μin. (Std.) — 300 μin. 24K: High ductility Cu: 100 μin.—300 μin. Resistivity: 10 ohms/square-200 ohms/square or 400 ohms/square	Range: to 1M Absolute Tolerance: to 0.01% Ratio Tolerance: to 0.01% Absolute TCR: ±50 ppm, ±25 ppm Ratio Tracking 100R/R**: 1 ppm/°C 1000R/R: 3 ppm/°C Time Stability Absolute: 0.05%/1000 hrs. @ 125°C Ratio: 0.005%/1000 hrs. @ 125°C Frequency: to >18 GHz

*For resistor-conductor pattern. **R >1000 ohms

ELECTRO-FILMS INCORPORATED

111 GILBANE STREET, WARWICK CENTRAL INDUSTRIAL PARK, WARWICK, RI 02886



CHIP RESISTORS

CHIP SIZE (±.003″)				TERMINATIONS				TOLERANCE	STABILITY	TCR
Type	Length	Width	Thickness	Width	Length	Resistance	Power*			
1.	.040″	.020″	.010″	.007″	.015″	20Ω— 24KΩ	15— 30mW	Standard: 5% and 1%	0.05%/1000 hrs. @ 125°C (Dependent on range)	Standard: ±50 PPM/°C
2.	.030″	.030″	.010″	.004″	.006″	250Ω— 40KΩ	18— 35mW	Special: .5% — .1% & tighter		Special: ±25 PPM/°C ±10 PPM/°C
3.	.050″	.050″	.010″	.0075″	.045″	20Ω— 125KΩ	50—100mW			
4.	.100″	.050″	.010″	.015″	.045″	40Ω— 400KΩ	85—175mW			
5.	.100″	.100″	.010″	.015″	.095″	20Ω—1000KΩ	200—400mW			
6.	.045″	.030″	.010″	.010″	.025″	40Ω— 59KΩ	30— 60mW			
7.**	.030″	.030″	.010″	.007″	.025″	20Ω— 30KΩ	18— 35mW			

SUBSTRATES	METALLIZATION
Composition — 99.5% Al_2O_3 Surface — 3—4 microinches (Standard) Thickness — .010″ ±.002″ (Standard) ±.001″ (Special)	Resistive Material: Cr/Ni/X, 100—200Å (R.F. Sputtered) Conductor Base: Nickel — 5—8 μin. (R.F. Sputtered) Terminations: A. Gold — 100 μin. (Electroplated) B. Nickel & Solder (62/32/2) Microwave versions available.
Passivation: Optional, thermo-plastic recommended for solder applications.	

*When bonded to substrate, value dependent. **Center-tapped.

New Surface Mounted Resistor Networks

RATIO TOLERANCES TO 0.01%
ANY COMBINATION OF RESISTOR VALUES FROM 20Ω TO 250 KΩ

HERMETIC CHIP CARRIERS — standard JEDEC hermetic chip carries to full MIL STD 883B specifications. Available with from 16 to 64 terminals.

ECONO-CHIP* — Low-cost replacements, in non-military applications, for hermetic chip-carrier networks. Bonding pad locations are equivalent to configurations of standard JEDEC cariers.

* Patent Pending.

FLIP CHIPS — solder bumped; coated, multi-resistor substrates for face down attachment. Suitable for reflow soldering assembly. Low cost and fast production in custom networks.

VERSA-CHIP — New low-cost, surface-mounted packaging design for precision resistor networks. Provides pin-for-pin equivalency with chip carriers, and versatility for many alternate configurations. Laser-trimmable by customer after mounting.

Microwave Components

METALIZED PLATES — metalized on 1, 2 or 6 sides; as fired or polished substrates, in house laser hole drilling and contouring, through hole metalization. Metalizations — see metalized ceramic substrates.

MICROWAVE ATTENUATOR CHIPS — (3rd Quarter) attenuation of 1, 2, 3, 4, 5, 6, 8, 10, 16, and 20 dB; frequency to 18 GHz.

Other New Products

R.C. NETWORKS — Precision RC Networks are now available in standard SIP and DIP packages.

SILICON CHIP RESISTORS — (3rd Quarter) Standard and center-tapped chip resistors to compliment EFI's alumina-substrate chip resistors, Ta or NiCr, passivated.

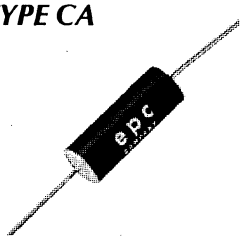
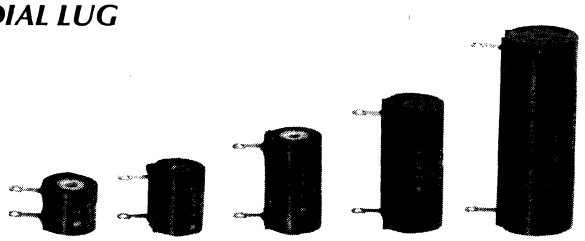
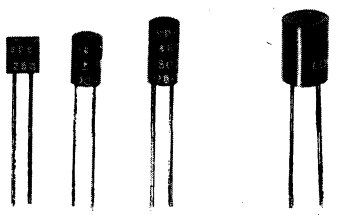
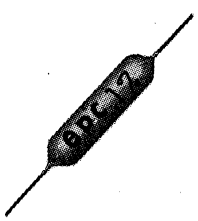
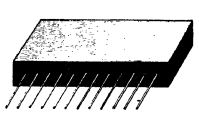
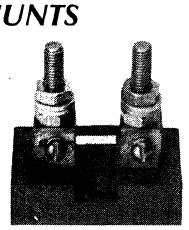
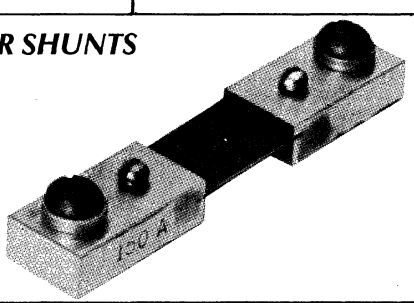
ELECTRO-FILMS INCORPORATED

111 GILBANE ST., WARWICK CENTRAL INDUSTRIAL PARK, WARWICK, RI 02886

epc CORPORATION

MANUFACTURERS OF PRECISION WIRE-WOUND RESISTORS • RESISTOR NETWORKS

CURRENT SHUNTS AND HIGH VOLTAGE DIVIDERS • NO ORDER TOO SMALL OR LARGE

EPC DEVICES	DESCRIPTION	Mil Equiv. MIL	Mil Equiv. EPC	CONDENSED SPECIFICATIONS
TYPE CA 	Encapsulated precision wire-wound resistors offering exceptional resistance stability, T.C. 5 ppm std. and low thermal EMF's. Designed to meet MIL-R-93/MIL-R-39005. Group encapsulization, Radial-lug four terminal and special physical configurations available. ***Request CA Brochure***	RBR-08 RBR-16 RBR-17 RBR-18 RBR-19 RBR-56 RBR-55 RBR-54 RBR-53 RBR-52 RBR-71 RBR-70	610 630 640 650 660 680 690 710 750 760 460 465	Power: .02 to 2.5W Range: 1Ω to 20MΩ depending on size Tolerance: .005%, .01%, .025%, .05%, .1% and 1% Temp. Coef.: 5 PPM/°C std. on values over 100Ω Stability: ±35ppm/YR
RADIAL LUG 				**PRINTED CIRCUIT** 
TYPE SP 	Silicone coated precision wire-wound power resistors, offering exceptional stability and performance under severe environmental conditions of MIL-R-26/MIL-R-39007. Also available utilizing Beryllium oxide cores. For greater power-size ratio and stability. ***Request SP Bulletin***	RWR-70 RWR-69 RWR-70 RWR-74 RWR-55 RWR-78 RWR-68 RWR-56	SP-1 SP-2A SP-5 SP-6 SP-7A SP-10A SP-10B SP-12	Power: .25W to 12.5W Range: .1Ω to 275KΩ depending on size Tolerance: 1% is std. Available to .01% Temp. Coef.: 20 PPM/°C. Slightly higher for lower values. Special T.C.'s available
NETWORKS 	*RC NETWORKS OUR SPECIALITY* Resistor networks to customer specification utilizing ultra precision wire-wound, metal film, carbon film, or wire-wound power resistors. All networks assembled on printed circuit boards. ***FAST DELIVERY ON PROTOTYPE AND LARGE ORDERS***			Power: .1W to 10W Range: .1Ω to 5MΩ Nominal Resistance Tolerance: To ±.005% D.C. W-W Resistance Ratio Tolerance: To .001% D.C. W-W Long Term Stability: .001% Response Time: 100MS
LIGHTWEIGHT SHUNTS 	Standard D.C. current shunts from .001Ω to 1Ω. Accuracy ±.25%, available to .01%. Also external portable and switchboard shunts for use with D.C. Ammeters. 1 to 200 amp. with a 50MV or 100MV drop. Accuracy ±1%. ***SPECIAL OEM CURRENT SHUNT RANGING FOR PANEL METERS***			**METER SHUNTS** 

ELECTRONIC PRECISION COMPONENTS CORPORATION

11 SANDFORD BLVD. • MOUNT VERNON, N.Y. 10550 • TELEPHONE: (914) 664-2333

GENERAL RESISTANCE

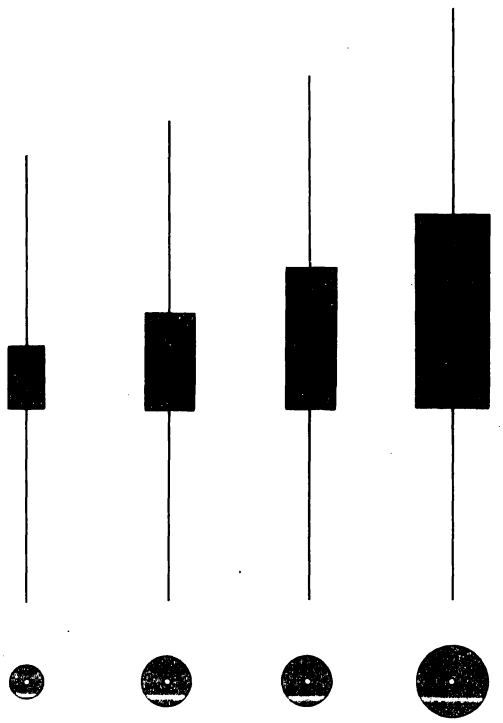
COMPONENTS WITH BUILT-IN PRECISION

PRECISION WIREWOUND RESISTORS

For thirty years we have been deeply involved in the refinement and manufacture of precision wirewound resistors meeting the exacting requirements of military specifications such as MIL-R-93/MIL-R-39005 (RB & RBR styles).

Many form factors are available, including axial and PC mounting types, in resistance values and accuracies to fill most requirements. "Standard" values and accuracies in our more popular types are usually available from stock. Orders for extremely large quantities and non-standard values are put on-line for prompt delivery.

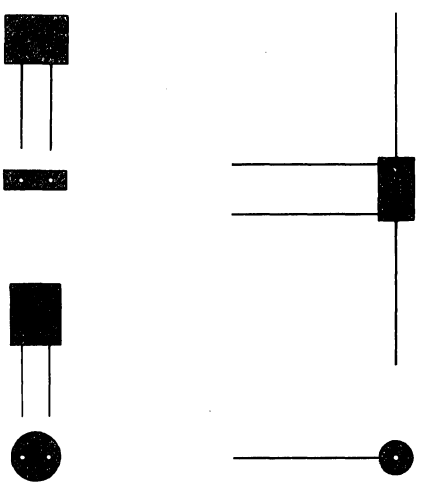
Standard accuracies are ±0.01%, ±0.025%, and ±0.1%. Stability on most styles is ±35ppm/year; maximum temperature coefficient is ±5ppm/°C, with lower values available.



CUSTOM COMPONENTS

We supply a number of unusual needs, such as 4-terminal current-sensing resistors, non-flammable fuse resistors, and sets critically matched for value, accuracy, temperature coefficient, and other pertinent parameters.

We design and manufacture custom active and passive networks to meet your requirements, simple or complex. A few examples are thermocouple reference junction simulators, voltage/current reference modules, ladder networks/voltage dividers.



BE PRECISE.

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Twin Lakes Road / P.O. Box 185

North Branford CT 06471

(203) 481-5721

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TWX 710-452-3092

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75 Union Avenue, Sudbury, MA 01776-0377
Tel: (617) 443-4631 • TWX: 710-347-0385

STANDARD & CUSTOM PRECISION, THIN-FILM, RESISTOR NETWORKS

CUSTOM RESISTOR NETWORKS A SPECIALTY...

During 13 years as a major supplier of precision resistor networks, HyComp has amassed a library of more than 200 different custom designs. Like our standard products, these are available free of any non-recurring engineering charge.

HyComp's custom-designed Nichrome thin-film resistor networks bring convenient and cost-effective solutions to the space-limited circuit designer requiring special resistor configuration, high precision, close tolerances and/or excellent stability over temperature and time. Fast turnaround and sensible pricing, recommend this approach for appropriate applications.

You should consider a custom thin-film network if your application includes any of the following requirements:

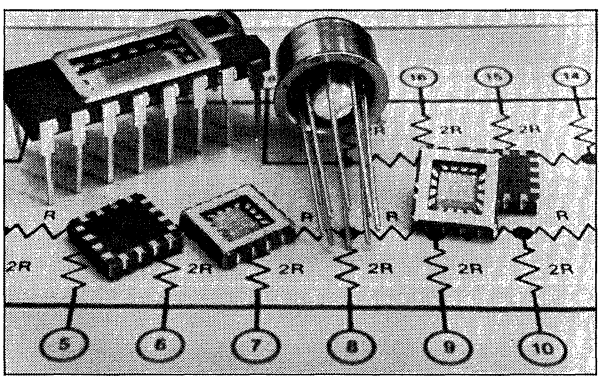
- Down to 0.006% ratio tolerance between specified resistors
- Down to ±0.5ppm/°C ratio tracking (TCRT)
- Down to ±0.5% absolute tolerance
- Down to ±10ppm/°C absolute temperature coefficient (TCR)
- Excellent long term stability and reliability over the −55°C to +125°C MIL temperature range.

For further information or assistance please contact HyComp directly.

STANDARD PRECISION THIN-FILM RESISTOR NETWORKS

Let Hycomp's broad selection of standard thin-film precision resistor networks reduce the cost and size of your product. Encased in your choice of hermetic or non-hermetic Flatpack, SIP, DIP, TO-9 and LCC packages, our standard networks support a wide variety of demanding applications requiring precision attenuation, gain-setting, and impedance matching or weighting.

Reliability? You bet! MIL-STD-883B processing is routine at HyComp. And to keep your costs down, we also build dependable non-MIL networks to our own exacting reliability standards. HyComp designs and builds reliable products. It's the only way we know.



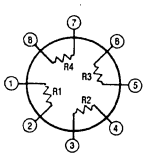


Figure 1
HC-143

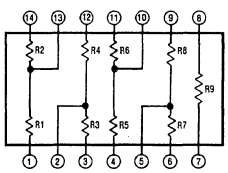


Figure 2
HC-149

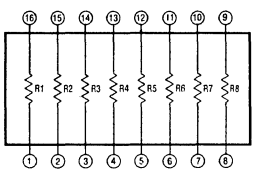


Figure 3
HC-150

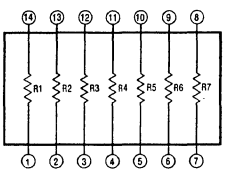


Figure 4
HC-160

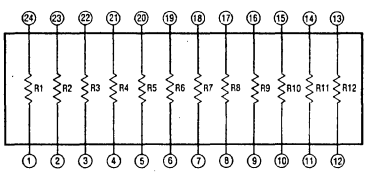


Figure 5
HC-170

SERIES / Parameters	HC-143 4 Equal Independent Resistors	HC-149 Quad Divider Feedback Network (All resistors equal)	HC-150 8 Equal Independent Resistors	HC-160 7 Equal Independent Resistors	HC-170 12 Equal Independent Resistors
Resistance Range of R Values	5K-50KΩ	10K-100KΩ	2K-100KΩ	2K-100KΩ	5K-100KΩ
Tolerance Absolute Ratio	Standard: 5% 0.01%		Custom: To 0.05%; All Models To 0.005%; All Models		
Thermal Stability Absolute (TCR) Tracking (TCRT)	Standard: ±25ppm/°C ±5ppm/°C		Custom: To ±10ppm/°C; All Models To ±0.5ppm/°C; All Models		
Power Dissipation Per Resistor, Max. Per Package, Max.	100mW 400mW	100mW 500mW	100mW 500mW	100mW 500mW	80mW 1 Watt
Package Style(s)	TO-99	14-Lead DIP, Flatpack or Chip	16-Lead DIP, Flatpack or Chip	14-Lead DIP, Flatpack or Chip	24-Lead DIP, Flaptack or Chip
Connections (Fig.)	**1**	**2**	**3**	**4**	**5**

NOTES: 1. All ladder networks include required application and/or feedback resistor(s).

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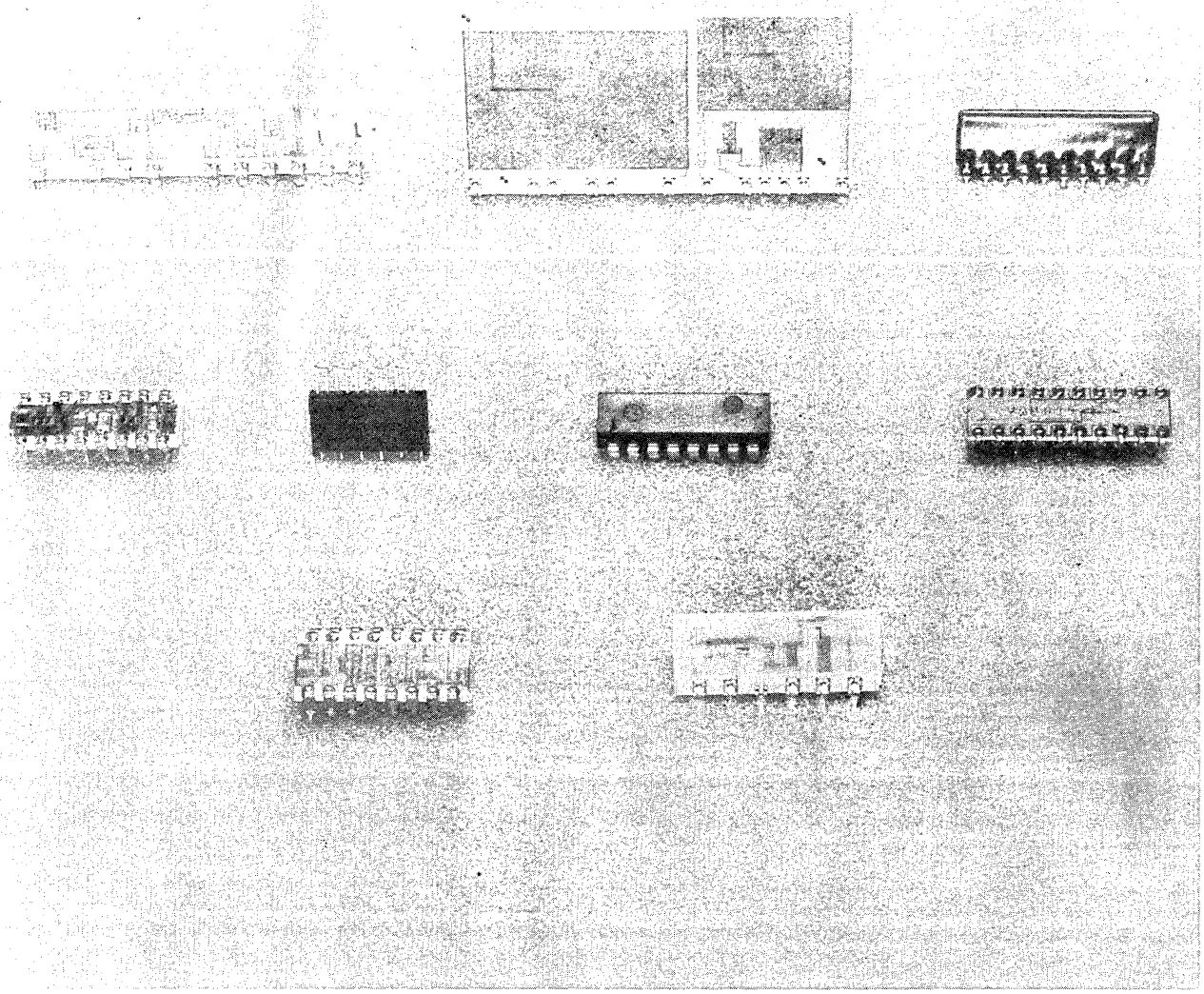
- Digital Delay Lines
- Crystal Clock Oscillators
- Custom Hybrid Circuits
- Thick Film Substrates
- Custom Resistor Networks

RESISTOR AND RESISTOR/CAPACITOR NETWORKS

- 4 to 6 weeks delivery for custom networks
- BeO our specialty
- High volume capacity
- ±1% standard tolerance
- High power capability



hytek microsystems incorporated

16780 LARK AVENUE, LOS GATOS, CALIFORNIA 95030
PHONE (408) 358-1991

INTEROHM RESISTORS by International

RESISTOR	Type	Power Rating @ 70°C	Resistance Tolerance	Resistance Range	Voltage Rating	Temperature Coefficient
Carbon Film	CF 25	0.25W	±2%, ±5%	1.0 ohm — 10 megohms	250V	From 200 PPM/°C
	CF 50	0.50W	±2%, ±5%	1.0 ohm — 10 megohms	350V	From 200 PPM/°C
Metal Film	MF 25	0.25W	±1%, ±2%, ±5%	1 ohm — 1.0 megohm	250V	100 PPM/°C
	MF 50	0.50W	±1%, ±2%, ±5%	1 ohm — 1.0 megohm	350V	100 PPM/°C
Metal Oxide (Flame Proof)	MO-1	1.0W	±2%, ±5%, ±10%	0.5 ohm — 100K ohms	350V	350 PPM/°C
	MO-2	2.0W	±2%, ±5%, ±10%,	0.5 ohm — 100K ohms	350V	350 PPM/°C

RESISTOR NETWORKS — SIP

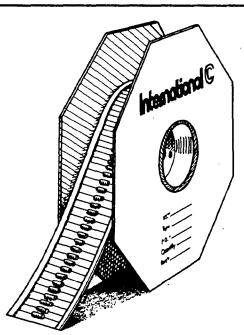
Pins	5-14
Resistance Range	22 ohms—2.2 megohms
Resistance Tolerance	±2%, ±5%, ±10%, ±20%
Element Power Rating	0.125W @70°C
Package Power Rating	0.35W — 1W @70°C
Temperature Coefficient	±150 PPM/°C, ±300 PPM/°C
Maximum Voltage	200V
Operating Temperature	−55°C to +130°C

ZERO OHM JUMPERS

1/4W Size Insulated Construction

PACKAGING

- Tape & Reel
- Magazine Pack
- Cut & Form (to specification)
- Bulk (100 Bag)



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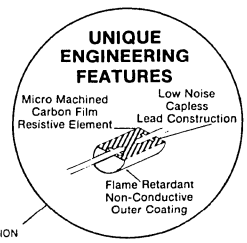
5%, 2% AND 1% CARBON FILM RESISTORS

FUSE ACTION — NON-FLAMMABLE



CAPLESS CONSTRUCTION ideally suited to HI DENSITY board population. Permits close to the shoulder bends.

- △ High Stability
- △ Lowest Noise
- △ Smallest Dimensions
- △ Capless Design
- △ Meets MIL Specifications
- △ Extremely Long Life
- △ Produced And Checked By Automatic Equipment
- △ Failure Rate Less Than 10^8/Hour (MTTF More Than 10^8)
- △ Solderability as per MIL-STD-202
- △ Insulation Resistance Higher Than 10^9 Ohms
- △ Terminal Strength > 8 Lbs.
- △ Equivalents: MIL R-10509, MIL R-39, MIL R-11
- △ Color Code: MIL-STD-129
- △ Available With Weldable Leads
- △ Available in Bulk Pack or Taped and Reeled

TYPE	A	b	a	L_1	L_4	d	D	L
UPM ¼ W (INCHES)	3.35-0.039	0.236	0.197 ± 0.08	0.236 + 0.039	1.457 ± 0.039	0.024	0.091 ± 0.08	$3.15 \begin{smallmatrix}+0.118\\-0.079\end{smallmatrix}$
UPM ¼ W (MM)	85-1	6	5 ± 0.2	6 + 1	37 ± 1	0.6	2.3 ± 0.2	$80 \begin{smallmatrix}+3\\-2\end{smallmatrix}$
UPM ½ W (INCHES)	3.35-0.039	0.236	0.197 ± 0.08	0.315 + 0.039	1.457 ± 0.039	0.027	0.111 ± 0.08	$3.15 \begin{smallmatrix}+0.118\\-0.079\end{smallmatrix}$
UPM ½ W (MM)	85-1	6	5 ± 0.2	8 + 1	36 ± 1	0.7	2.8 ± 0.2	$80 \begin{smallmatrix}+3\\-2\end{smallmatrix}$

INCLUDE RESISTANCE RANGES

Wattage	Tolerance	Range
¼	5%	4.7Ω — 1 MegΩ
	2%	10Ω — 300KΩ
½	5%	4.7Ω — 4.7 MegΩ
	2%	10Ω — 1 MegΩ

MIL R-11 EQUIVALENT	MIL R-10509 EQUIVALENT
RC 07 and RC 12	RN 65 cat. b,d
RC 20 and RC 22	RN 70 cat. b,d

	MAX. Δ RES.
Humidity (Steady State)	± 1.00%
Life	± 1.00
Short Time Overload	± 0.50
After Soldering	± 0.25
Thermal Shock	± 0.25
Twist	± 0.25
Vibration	± 0.25

Also Available 1% Metal Film Resistors
¼ Watt 50 PPM & 100 PPM

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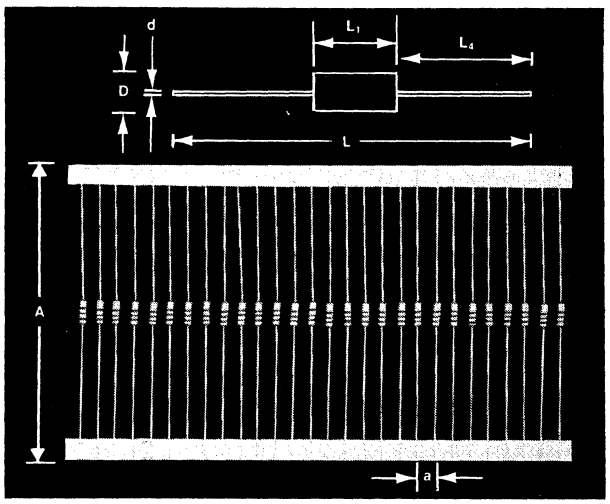
5, 2 & 1% CARBON & METAL FILM RESISTORS / FUSE ACTION — NON FLAMMABLE



FEATURES

- △ High Stability
- △ Lowest Noise
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- △ Capless Design
- △ Meets MIL Specifications
- △ Extremely Long Life
- △ Produced And Checked By Automatic Equipment
- △ Failure Rate Less Than 10^8/Hour (MTTF More Than 10^8)
- △ Solderability as per MIL-STD-202
- △ Insulation Resistance Higher Than 10^9 Ohms
- △ Terminal Strength >8 Lbs.
- △ Equivalents: MIL-R-10509, MIL-R-39, MIL-R-11
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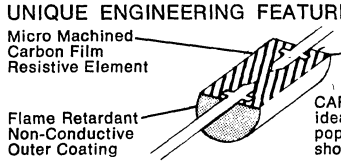
- △ Available With Weldable Leads
- △ Available in Bulk Pack or Taped and Reeled

UNIQUE ENGINEERING FEATURES



CAPLESS CONSTRUCTION ideally suited to HI DENSITY board population. Permits close to the shoulder bends.

SPECIFICATIONS

TYPE	A	b	a	L_1	L_4	d	D	L
UPM ¼ W (INCHES)	3.35/2.55	0.236	0.197 ±0.08	0.236 +0.039	1.457 ±0.039	0.024	0.091 ±0.08	3.15 $^{+0.118}_{-0.079}$
UPM ¼ W (MM)	85/65	6	5 ±0.2	6 +1	37 ±1	0.6	2.3 ±0.2	80 $^{+3}_{-2}$
UPM ½ W (INCHES)	3.35/2.55	0.236	0.197 ±0.08	0.315 +0.039	1.457 ±0.039	0.027	0.111 ±0.08	3.15 $^{+0.118}_{-0.079}$
UPM ½ W (MM)	85/65	6	5 ±0.2	8 +1	36 ±1	0.7	2.8 ±0.2	80 $^{+3}_{-2}$

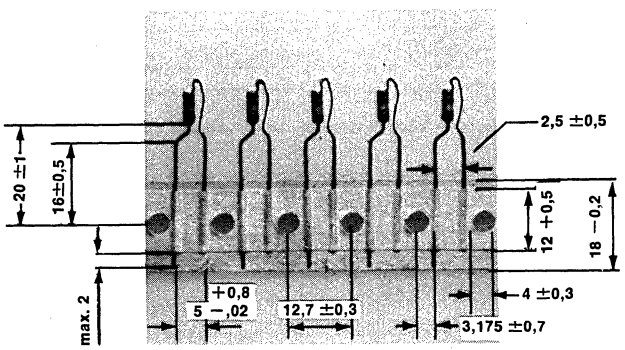
INCLUDE RESISTANCE RANGES

Wattage	Tolerance	Range	Reel Qtys.
¼	5% 2%	4.7Ω — 1 MegΩ 10Ω — 300KΩ	4000/RL
½	5% 2%	4.7Ω — 4.7 MegΩ 10Ω — 1 MegΩ	3000/RL

OTHERS ON SPECIAL REQUEST

MIL-R-11 EQUIVALENT	MIL-R-10509 EQUIVALENT
RC 07 and RC 12	RN 65 cat. b,d
RC 20 and RC 22	RN 70 cat. b,d

	MAX. △ RES.
Humidity (Steady State)	±1.00%
Life	±1.00
Short Time Overload	±0.50
After Soldering	±0.25
Thermal Shock	±0.25
Twist	±0.25
Vibration	±0.25



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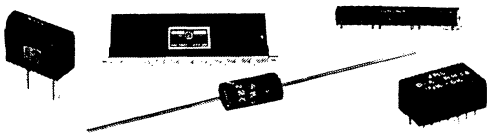
Available as individual, ratio or network assemblies, these expertly manufactured and trimmed resistors assist you in eliminating countless hours of Production Test time from your design. In addition, the use of these very stable resistors contribute to reliable design and reduced component count. Specify a Julie Resistor. Better yet, call us and we will assist in helping you get the best price-performance unit your application and budget will allow.

JUST A FEW OF THE PROVEN APPLICATIONS FOR THESE LOW REACTANCE HIGH PERFORMANCE RESISTORS ARE:

- Transducer Calibrating Networks
- Current Metering
- Gyro Torquing
- AC and DC Precision Bridge Elements
- Amplifier Summing Elements
- D/A Converters
- Reference Divider
- Precision Multiplier
- Resistive Divider Networks
- Shunting
- AC or DC Ratio
- High Performance MIL Spec
- Zener Trimming Networks

RESISTOR STYLES



SPECIFICATIONS

The DIP resistor is available with up to 7 resistance values in a 14 pin DIP or 8 resistance values in a 16 pin DIP.
Range: 100Ω to 100 KΩ per resistor.
Ratio Accuracy: To .001% for ratio 1:1.
Stability: Network .002% for standard ranges.
Temperature Coefficient: 1 ppm/°C to 20 ppm/°C.
Delivery: 3-4 weeks.
Custom designs available — contact factory with your specific applications.

HIGH LOAD-LIFE STABILITY, PRECISION NETWORKS

Type	Construction Dual In-Line	Resistor Configuration	Dimensions (Inches) L x W x H	Max Res Per Resistor	Max Volt. Per Resistor	Max Power Per Resistor
RNX-14	14 pin	7 max.	.740 x .39 x .27	100K	125V	1/10W
RNX-14	14 pin	13 max.	.740 x .39 x .51	100K	125V	1/10W
RNX-16	16 pin	8 max.	.840 x .39 x .27	100K	125V	1/10W
RNX-16	16 pin	15 max.	.840 x .39 x .51	100K	125V	1/10W

SPECIFICATIONS

Range: Individual Resistors, 0.1 ohm to 5 megohms. Ratio Sets, 1:1 to 10^6:1 depending on total resistance required.
Accuracy: Standard accuracy of resistors, 0.005% for values from 1000 ohms to 5 megohm. Standard accuracy of ratio sets, 0.0025% for ratios near 1:1. Accuracies from 0.002% to 0.1% are available (at corresponding prices) on special order.
Stability: Resistors, 0.002% per year for standard ranges.
Accuracy Over Military Temperature Range: ±0.02% from −45°C to +85°C.
Matching Over Military Temperature Range: ±0.005% from −45°C to +85°C.
Retrace Over Military Environmental Conditions: 0.002%.
Temperature Coefficient: Resistors, 5 ppm/°C standard. (Available as low as 1.0 ppm/°C). Ratio sets, 2.5 ppm/°C standard. (Available as low as 0.7 ppm/°C).
Note: Temperature Coefficient can be altered, in manufacture, over wide ranges.
Thermal Transients: All thermal-induced transient effects, e.g.: self-heating, Seebeck and Peltier effects, are less than 0.0015% at rated power dissipation. Self-heating and time constants of thermal transients are reduced to 10% of normal values in air.
Current Capability: To 2 amperes.
Voltage: Between Terminals, 300 volts maximum, Terminals to Case, 500 volts maximum.

LOWEST, LOW REACTANCE OIL FILLED AND ENCAPSULATED THA-H, CH, HCH, RESISTORS AXIAL WIRE LEAD CONSTRUCTION

Style	Size Inches	Size MM	AWG Leads	Max. Res.	Volt	Power	MIL R-93
H-32	3/8 x 1/2	9.5 x 12.7	20	250 K	250	1/2 W	—
H-33	3/8 x 3/4	9.5 x 19.1	20	350 K	450	1/2 W	RB 53
H-34	3/8 x 1	9.5 x 25.4	20	500 K	500	1/2 W	RB 52
H-42	1/2 x 1/2	12.7 x 12.7	18	750 K	250	1/2 W	—
H-44	1/2 x 1	12.7 x 25.4	18	2 Meg	500	1 W	RB 57
H-46	1/2 x 1/2	12.7 x 38.1	18	3 Meg	750	1 1/2	RB 58
H-48	1/2 x 2	12.7 x 50.8	18	5 Meg	1000	2 W	RB 59
HCH-32	3/8 x 1/2	9.5 x 12.7	20	150 K	—	3/4 W*	—
HCH-33	3/8 x 3/4	9.5 x 19.1	20	250 K	—	1 W*	—
HCH-34	3/8 x 1	9.5 x 25.4	20	350 K	—	1.5 W*	—
HCH-35	3/8 x 1 1/4	9.5 x 31.8	20	500 K	—	1.8 W*	—
HCH-42	1/2 x 1/2	12.7 x 12.7	18	375 K	—	1.5 W*	—
HCH-44	1/2 x 1	12.7 x 25.4	18	750 K	—	3 W*	—
HCH-46	1/2 x 1 1/2	12.7 x 38.1	18	1 M	—	4.5 W*	—
HCH-48	1/2 x 2	12.7 x 50.8	18	1.5 M	—	6 W*	—
CH-32	3/8 x 1/2	9.5 x 12.7	20	300 K	—	3/4*	—
CH-33	3/8 x 3/4	9.5 x 19.1	20	500 K	—	1 W*	—
CH-34	3/8 x 1	9.5 x 25.4	20	700 K	—	1.5*	—
CH-35	3/8 x 1 1/4	9.5 x 31.8	20	1 Meg	—	1.8*	—
CH-42	1/2 x 1/2	12.7 x 12.7	18	750 K	—	1.5*	—
CH-44	1/2 x 1	12.7 x 25.4	18	1.5 M	—	3.0*	—
CH-46	1/2 x 1 1/2	12.7 x 38.1	18	2 M	—	4.5*	—
CH-48	1/2 x 2	12.7 x 50.8	18	5 M	—	6 W*	—
THA-36	3/8 x 1/2	9.5 x 12.7	18	1 M	100	—	RB 53
THA-38	3/8 x 3/4	9.5 x 19.1	18	1 M	100	—	RB 53

* When mounted on heat sink.

SPECIFICATIONS

Range: Individual Resistors, 1 ohm to 10 megohms. Ratios, 1:1 to 10^6:1, depending on total resistance required.
Accuracy: Standard accuracy of resistors, 0.01%, for values from 100 ohms to 5 megohm. Standard accuracy of ratios, 0.005%, for ratios near 1:1. Intermediate accuracies of 0.05% and up and higher accuracies to .0025% are available on special order.
Stability: Resistors 0.003% per year for standard ranges.
Accuracy Over Military Temperature Range: 0.02% from −30°C to +85°C.
Retrace Over Military Environmental Conditions: 0.003%.
Temperature Coefficient: Resistors, 5 ppm/°C standard, (available as low as 1.0 ppm/°C). Ratios, 2.5 ppm/°C standard, (available as low as 0.7 ppm/°C).
Note: Temperature Coefficient can be altered, in manufacture, over over wide ranges.

SUPER ACCURATE, SUPER STABLE ENCAPSULATED, MINIATURE PRECISION R, XG, RS, L, GL RESISTORS

TYPE R AND C — AXIAL WIRE LEAD-CONSTRUCTION

C-21X	3/16 x 3/8		24	100 K	125	1/10 W	
R-22	1/4 x 9/16	6.4 x 14.3	22	500 K	125	1/8 W	—
R-23	1/4 x 3/4	6.4 x 19.1	22	750 K	125	1/4 W	RB 54
R-24	1/4 x 1	7.9 x 25.4	22	1 Meg	350	1/4 W	—
R-32	3/8 x 1/2	9.5 x 12.7	22	750 K	125	1/4 W	—
R-33	3/8 x 3/4	9.5 x 19.1	20	1 Meg	125	1/2 W	RB 53
R-34	3/8 x 1	9.5 x 25.4	20	1.5 Meg	250	1/2 W	RB 52
R-35	3/8 x 1 1/4	9.5 x 31.8	20	2 Meg	250	5/8 W	—
R-42	1/2 x 1/2	12.7 x 12.7	18	1.5 Meg	125	1/2 W	—
R-44	1/2 x 1	12.7 x 25.4	18	4 Meg	250	1 W	RB 57
R-46	1/2 x 1 1/2	12.7 x 38.1	18	7.5 Meg	250	1 1/2 W	RB 58
R-48	1/2 x 2	12.7 x 50.8	18	10 Meg	250	2 W	RB 59

TYPE L AND RB — RADIAL LUG CONSTRUCTION

L-10A	5/8 x 9/16	15.9 x 14.3	Solder Lug	1.5 Meg	125	1/2 W	RB 16
L-HB	5/8 x 1 1/4	15.9 x 31.8	Solder Lug	4 Meg	250	1 W	RB 18
RB-19	1 x 2 1/32	25.4 x 51.6	Solder Lug	10 Meg	300	2 W	RB 19
RB-17	1/2 x 1	12.7 x 25.4	Solder Lug	1.5 Meg	125	3/4 W	RB 17

TYPE XG — RADIAL WIRE LEAD CONSTRUCTION

R-32XG	3/8 x 9/16	9.5 x 14.3	22	500 K	125	1/4 W	—
R-42XG	1/2 x 9/16	12.7 x 14.3	20	1 Meg	125	1/2 W	—
R-44XG	1/2 x 1 5/32	12.7 x 29.3	20	3.5 Meg	250	1 W	—
R-46XG	1/2 x 1 3/8	12.7 x 34.9	20	5 Meg	250	1 1/2 W	—
R-48XG	1/2 x 2 1/16	12.7 x 52.4	20	10 Meg	250	2 W	—
R-52XG	5/8 x 1 5/32	15.9 x 15.1	20	1 Meg	125	3/4 W	—

TYPE RS — TOP HAT CONSTRUCTION

RS-36	11/32 x 1/2	10.3 x 12.7	22	750 K	125	1/4 W	—
RS-26	9/32 x 1/2	7.1 x 12.7	22	250 K	125	1/8 W	—

SPECIFICATIONS

Range: Individual Resistors, 1 ohm to 100 ohms.
Accuracy: Standard accuracy of resistors, 0.01%, for values from 1.0 ohm to 100 ohms. (R_1xG) .005% (CH).
Stability: Resistors 0.003% per year for standard ranges.
Accuracy Over Military Temperature Range: 0.02% fom −30°C to +85°C.
Retrace Over Military Environmental Conditions: 0.003%.
Temperature Coefficient: Resistors, 5 ppm/°C standard, (available as low as 2.5 ppm/°C).
Note: Temperature Coefficient can be altered, in manufacture, over wide ranges.
Voltage and Power Ratings: See chart.
Construction: See charts.
Group Encapsulation: Special techniquies permit group encapsulation of high-accuracy units on a high-yield basis, enabling better accuracies at competitive costs. (See JRL Bulletin B-11.)

LOW OHM, LONG TERM STABILITY, OIL FILLED AND ENCAPSULATED 4-TERMINAL CH46-T4, R-46-T4, R46xG-T4 AXIAL AND RADIAL CONSTRUCTION

Style	Size	MM	AWG Leads	Max. Res.	Current	Power
R-46T4	1/2 x 1 1/2	12.7 x 38.1	18	100 Ohms	2 Amps	1 1/2 W
R-46XG-T4	1/2 x 1 1/2	12.7 x 38.1	20	100 Ohms	2 Amps	1 1/2 W
CH-46T4	1/2 x 1 1/2	12.7 x 38.1	18	100 Ohms	2 Amps	3 W*

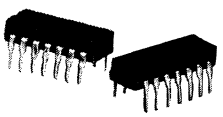
* When mounted on heat sink.

JULIE RESEARCH LABORATORIES, INC. • 211 W. 61 ST., NEW YORK, N.Y. 10023 • (212) 245-2727 • TWX: 710-581-5138

RESISTOR PRODUCTS

THICK AND THIN FILM

DIP RESISTOR NETWORKS



Thick film epoxy molded DIP resistor networks are available in both Commercial and M-83401 Mil-approved configurations. 14 and 16 Pin, A and B Schematics in standard resistance values are available from stock. Custom designed circuits for your unique requirements are a specialty.

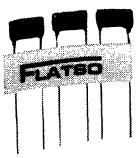
WRITE FOR BULLETIN MD 2/80
WRITE FOR BULLETIN PD 1/80

THICK FILM CAPACITOR ARRAYS

Thick Film Capacitor Arrays offer considerable cost advantages and reliability improvements for multiple capacitor circuits. The standard capacitance range is 10 pf to 200 pf. These circuits are available in virtually any customer required configurations. The capacitor elements exhibit NPO - type characteristics. Tolerances to 5% and voltage rating to 200 volts are available. Capacitors on a substrate may be matched to 2.5% on request. Dissipation factor is typically 1% and insulation resistance is greater than 10^{11} ohms.

WRITE FOR BULLETIN CA 3/82

FLATSO



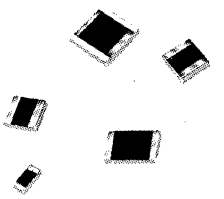
KDI Pyrofilm offers seven "FLATSO" resistors with voltage ratings to 20 KV and power ratings from .25 watts to 5 watts. Resistance values from 50Ω to 5,000 Meg and temperature coefficients to ±100 PPM/°C are available depending on value. Custom Flatso Networks and non-standard values will be quoted upon request.

WRITE FOR BULLETIN FL1-80

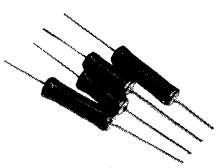
THICK FILM CHIP RESISTORS

A complete line of Thick Film Chip Resistors are available in eight sizes. These chips feature both single-sided and wrap-around terminations. They are available with platinum gold, gold, and solder coated terminations. The resistance range is from 5.1 ohms to 4 megohms. Tolerances from 1% to 20% are standard as are temperature coefficients from 100 PPM/°C to 250 PPM/°C. Power capabilities range from 50 mW to 0.5 Watts. These chip resistors offer high rel design and construction and environmental testing is available.

WRITE FOR BULLETIN PC 10/81



HIGH VOLTAGE



Axial lead thick film resistors for both high voltage and high resistance can be supplied in voltage ratings to 40 KV and resistance values to 1,000 Meg. Fired at over 900°C, these resistors are unmatched in performance with proven load life stability.

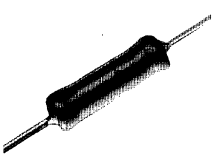
WRITE FOR BULLETIN PVC 2/80

HIGH VOLTAGE THICK FILM NETWORKS

Voltage dividers and other networks are available with ratings up to 60 KV. Divider Networks have tolerances to 1% with TC tracking to 25 PPM/°C. They can be manufactured with a resistance range from 10 ohm to 1,000 megohm. These networks are available in leaded and unleaded styles, in both standard and custom configurations.

WRITE FOR BULLETIN #FN 3/80

METAL FILM



Conformal coated high precision metal film resistors offer superior stability and reliability at a reasonable cost. Features include: small size, impervious to moisture, low noise, low T.C. and resistance range of 10 ohms to 70 Megohms. Surpasses MIL-R-10509 and MIL-R-55182. In-plant testing facilities as well as matched networks are available. Standard T.C.: ±10, ±25, ±50, and ±100 ppm/°C.

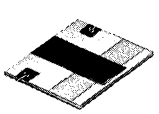
WRITE FOR BULLETIN #PME 2-80

THICK FILM RESISTOR CAPACITOR NETWORKS

Custom Resistor and Resistor Capacitor Networks can be supplied to virtually any customer requirement. The resistance range is from 10 ohms to 10 megohms with absolute tolerances to 0.5%, and ratios to 0.1%. Temperature coefficient of 100 PPM/°C is available. The capacitance range is determined by the type of dielectric material chosen. RC Time Constant Calibration is available to 0.5%. Complete environmental testing can be performed.

WRITE FOR BULLETIN RC 2/82

CHIP ATTENUATORS



Measuring only .125 × .150 inches, the Pyrofilm micro-thin deposited chip attenuators offer the engineer complete flexibility in his circuit design. They are laser trimmed to values from 2 thru 20 db assuring correlation from chip to chip. The thin metal film is evaporated on alumina substrate and is available with either single surface or wrap-around terminals that are silver-plated over nickel. Operating from DC to 12.4 GHz, they exhibit a maximum VSWR of 1.5:1 at the extreme band edge.

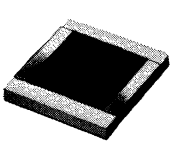
WRITE FOR BULLETIN PCA-981

THIN FILM CHIP RESISTORS

PMC's - Low powers up to 150 mW
PPC's - High powers up to 1,000 Watts
Resistance Values - 10-500 ohms

Chip resistors are available in various sizes and may be used directly in a microstrip transmission line circuit or as a building block for other requirements, such as terminations and power dividers. The smaller chips may be used at a higher frequency due to their lower shunt capacitance. Large chips, which are higher power, are frequency limited due to their higher capacitance.

WRITE FOR BULLETINS PPA-9/81 and PMC-2/81



KDI PYROFILM

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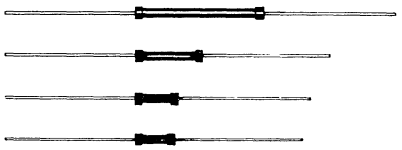
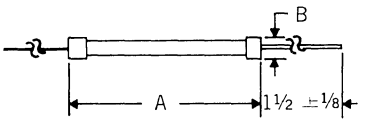
K&M electronics·inc

HIGH VOLTAGE
- PRECISION RESISTORS
- DIODE ARRAY

SERIES I RESISTORS
PRECISION HIGH OHMAGE HIGH VOLTAGE RESISTORS



FEATURES
- Tinned copper leads .020″ or .032″ standard. Other lead materials available
- Conformal epoxy coated
- Glass overglaze for vacuum applications



NOTES
- Voltage coefficient is dependent on resistance value. Typically less than 5 PPM/V in mid resistance values
- Burn in and other preconditioning options available
- Tolerance to ½% on request

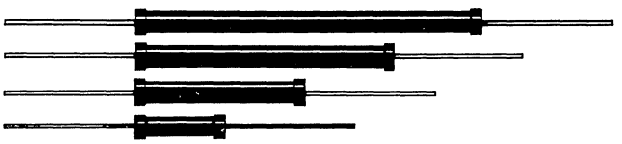
TYPES

Type	Resistance Megohms Min	Resistance Megohms Max	Power at 70°C Watts	Maximum Operating Voltage	Tolerance	Max Surface Temp.	Dimensions Max Inches A	Dimensions Max Inches B
K01040	1	5K	.4	2000V	1, 2 & 5%	220°C	.460	.145
K01243	1	10K	.5	2500V	1, 2 & 5%	220°C	.500	.170
K01268	1	20K	.75	5000V	1, 2 & 5%	220°C	.750	.170
K01213	1	100K	1.5	10,000V	1, 2 & 5%	220°C	1.500	.170

TEMPERATURE COEFFICIENT

Temperature Coefficient +25°C to +125°C	K01040 Megohms	K01243 Megohms	K01268 Megohms	K01213 Megohms
± 50 PPM/°C	1-100	1-100	1-200	1-400
± 100 PPM/°C	1-100	1-100	1-200	1-400
± 200 PPM/°C	100-3K	100-3K	200-6K	400-15K
±1000 PPM/°C	3K-5K	3K-10K	6K-20K	15K-100K

SERIES II RESISTORS
PRECISION HIGH OHMAGE HIGH VOLTAGE POWER RESISTORS



FEATURES
- Tinned copper leads .020″ or .032″ standard. Other lead materials available
- Conformal epoxy coated

NOTES
- Voltage coefficient is dependent on resistance value. Typically less than 5 PPM/V in mid resistance values
- Burn in and other preconditioning options available
- Tolerance to ½% on request

TYPES

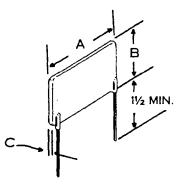
Type	Resistance Megohms Min	Resistance Megohms Max	Power at 70°C Watts	Maximum Operating Voltage	Tolerance	Max Surface Temp.	Dimensions Max Inches A	Dimensions Max Inches B
K02510	1	5K	4	8,000	1, 2 & 5%	220°C	1.125	.325
K02520	1	10K	8	16,000	1, 2 & 5%	220°C	2.125	.325
K02530	1	15K	12	24,000	1, 2 & 5%	220°C	3.125	.325
K02540	1	20K	16	32,000	1, 2 & 5%	220°C	4.125	.325

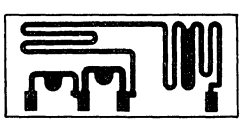
TEMPERATURE COEFFICIENT

Temperature Coefficient +25°C to +125°C	K02510 Megohms	K02520 Megohms	K02530 Megohms	K02540 Megohms
± 50 PPM/°C	1- 50	1- 100	1- 200	1- 400
±100 PPM/°C	1-500	1-1000	1-1500	1-2000
±200 PPM/°C	500-5K	1000-10K	1500-15K	2000-20K

SERIES III RESISTORS
PRECISION HIGH OHMAGE HIGH VOLTAGE FLAT RESISTORS, VOLTAGE DIVIDERS AND NETWORKS

SINGLE RESISTOR





TYPICAL VOLTAGE DIVIDER NETWORK

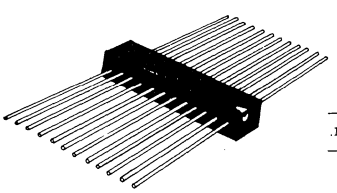
Type	Resistance Megohms Min	Resistance Megohms Max	Power @ 70°C Watts	Max Operating Voltage	Max Surface Temp	Dimensions Max Inches A	Dimensions Max Inches B	Dimensions Max Inches C
KF315	1	5,000	2	12,000	150°C	1.550	.350	.110
KF510	1	5,000	2	10,000	150°C	1.050	.550	.110
KF520	1	5,000	4	20,000	150°C	2.050	.550	.110
KF1020	1	10,000	8	30,000	150°C	2.050	1.050	.110

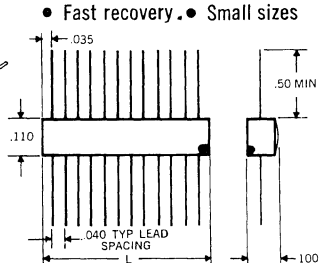
FEATURES
- Tolerances: 1%, 2%, 5%, 10%, 15%
- Conformal epoxy coated
- .032 tinned copper leads or nickel ribbon leads for welding
- Available without leads with solderable termination pads
- VCR less than 5 PPM/V
- Voltage dividers and networks designed to your specifications resistor ratios to 10,000:1 (size dependent).
- TCR tracking 25 PPM/°C
- Ratios to 1%

Temperature Coefficient +25°C to +125°C	KF315 Megohms	KF510 Megohms	KF520 Megohms	KF1020 Megohms
±100 PPM/°C	1-500	1-500	1-500	1-1000
±250 PPM/°C	500-5,000	500-5,000	500-5,000	1,000-10,000

MINIATURE HIGH VOLTAGE DIODE ARRAY

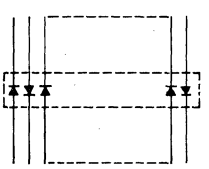
FEATURES
- Low reverse leakage current
- Fast recovery
- Small sizes





MECHANICAL
- Lead Diameter .015 max
- Lead Material—Silver
- Encapsulant—Epoxy

APPLICATIONS
- Typical applications are power supplies which generate the high voltage required for image intensifiers photomultipliers and CRTS.



K&M Part No.	No. of Diodes	Dim L
107-031-12	12	.510
107-031-10	10	.430
107-031- 8	8	.350
107-031- 6	6	.270
107-031- 4	4	.190
107-031- 2	2	.110

ELECTRICAL
- PIV = 1200 VDC
- IR @ 23°C 500 VDC 10 nano amps Max
- Junction Capacitance @ 23° Max 0.35 pf Max @ 500 VDC
- Recovery Time @ 23°C 1.5 micro Sec. @ If = 10 ma
- Recovery Time @ 23°C 0.5 micro Sec. .040 Max
- Operating Temp +55°C to −54°C
- Storage Temp +85°C to −70°C

K&M electronics·inc MINIATURE HIGH VOLTAGE POWER SUPPLIES & COMPONENTS
123 Interstate Drive • West Springfield • Mass • 01089 • (413) 781-1350 • TWX 710-350-6463

KELVIN

Precision Wire-wound Resistors, Power Resistors & Resistor Networks

Kelvin is a pioneer in the field of very high stability, close tolerance, precision wire-wound resistors. Resistors shown represent only part of the broad Kelvin line. Complete catalog data is available on request.

HIGH RELIABILITY "HRL" SERIES

Kelvin's "HRL" Series was generated after years of experience on the Polaris, Gemini, Apollo and other important high reliability missile and space programs. Kelvin has combined the many and varied parameters of these programs into a single resistor series, designed to meet the stringent high reliability requirements of many of today's military and commercial systems.

Kelvin's reliability goal, through the design and controls of the "HRL" Series resistor and the use of acceptance inspection procedures, was to produce precision wire-wound resistors having failure rates better than .0005%/1000 hours at a 90% confidence level. Present level is .00064%/1000 hours at a 60% confidence level.

All "HRL" resistors have a documented history. This includes traceability from the spool analysis of the resistance wire, through each phase of the production operation to the finished product. Each resistor is screened to eliminate INFANT MORTALITY. This consists of a 100 hour burn in at full rated power at 125°C and a short time overload at twice the rated power. Other tests are conducted as outlined in Bulletin HR 02449, which presents the complete procedure and methods approach for production of "HRL" resistors.

KELVIN TYPE	WATTAGE*	RESISTANCE MAXIMUM**	DIA. ± .015	LENGTH ± .032	MAXIMUM VOLTS	LEAD DIA.	MIL-R-39005
HRL-20	.08	25K	.187	.375	150 V	#22	
HRL-991	.125	150K	.250	.312	150 V	#22	RBR-71
HRL-1009	.125	316K	.250	.295	150 V	#22	RBR-75
HRL-1097	.125	90K	.193†	.500	150 V	#22	RBR-74
HRL-417	.125	220K	.250	.343	150 V	#20	RBR-56
HRL-467	.150	332K	.250	.500	200 V	#20	RBR-55
HRL-334	.200	500K	.375	.500	300 V	#20	
HRL-812	.250	562K	.250	.750	300 V	#20	RBR-54
HRL-815	.333	1.1 meg	.375	.750	300 V	#20	RBR-53
HRL-1100	.500	600K	.312	.812	300 V	#20	RBR-76
HRL-254	.500	1.21 meg	.375	1.000	600 V	#20	RBR-52
HRL-27	.750	6.42 meg	.500	1.000	600 V	#20	RBR-57

† ± .010 Tolerance

SUB-MINIATURE TYPES

TOLERANCES: 1% through .005% available on most types and resistance values.

TEMPERATURE COEFFICIENT: ±20 ppm/°C standard.

T.C.s available to 1 ppm depending on size, value and temperature range.

WINDINGS: Non-inductive.

*WATTAGE RATINGS: Based on a maximum ambient temperature of 125°C, derated to zero watts at +145°C.

**RESISTANCE MAX.: Contact factory for availability of values above maximum shown.

COMBINATION AXIAL-RADIAL LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ±1/64	LENGTH ±1/32	MAX. VOLTS	LEAD DIA.
315-PAR	.05	100K	.080	.375	100	#24
303-PAR	.05	100K	.125	.250	100	#24
162-PAR	.10	200K	.125	.375	100	#22
158-PAR	.15	700K	.187	.375	100	#22

AXIAL LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ±1/64	LENGTH ±1/32	MAX. VOLTS	LEAD DIA.
EP-00	.05	100K	.080	.375	100	#24
1788-P	.04	50K	.100	.225	75	#24
460-P	.06	100K	.100	.281	100	#24
301-P	.05	175K	.125	.250	100	#24
EP-01	.10	200K	.125	.375	100	#22
470-P	.10	500K	.160	.500	100	#24
EP-20	.15	700K	.187	.375	200	#22
304-P	.15	500K	.250	.250	100	#22
430-P	.15	600K	.250	.312	100	#20
417-P	.20	700K	.250	.343	100	#20

PRINTED CIRCUIT TYPES

TOLERANCES: 1% through .005% available on most types and resistance values.

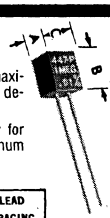
TEMPERATURE COEFFICIENT: ±20 ppm/°C standard.

T.C.s available to 1 ppm depending on size, value and temperature range.

WINDINGS: Non-inductive.

*WATTAGE RATINGS: Based on a maximum ambient temperature of 125°C, derated to zero watts at +145°C.

**RESISTANCE MAX.: Contact factory for availability of values above maximum shown.



HIGH DENSITY PACKAGING

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	SIZE ±.020 A	SIZE ±.020 B	SIZE ±.020 C	MAX. VOLTS	LEAD DIA.	LEAD SPACING
446-P	.250	2 Meg.	.140"	.270"	.500"	100	#20	.250
447-P	.125	1 Meg.	.140"	.270"	.250"	100	#20	.125

STANDARD PRINTED CIRCUIT

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ±1/64	LENGTH ±1/32	MAX. VOLTS	LEAD DIA.	LEAD SPACING
252-P	.15	375K	.250	.250	100	#22	.150
176-P	.15	450K	.250	.312	100	#22	.150
178-P	.20	650K	.250	.400	200	#22	.150
277-P	.20	700K	.250	.437	200	#22	.150
471-P	.25	750K	.250	.500	300	#22	.150
177-P	.30	850K	.312	.500	400	#22	.200
179-P	.30	1.1M	.375	.500	400	#22	.200
155-P	.50	3.0M	.500	.625	400	#20	.250

HIGH STABILITY SERIES

LONG TERM STABILITY: .003% resistance change per year maximum under conditions involving normal equipment and room temperature variations.

TOLERANCES: 1% through .005% available on most types and resistance values.

TEMPERATURE COEFFICIENT: ±10 ppm/°C standard.

T.C.s available to 1 ppm depending on size, value and temperature range.

WINDINGS: Non-inductive.

*WATTAGE RATINGS: Based on a maximum ambient temperature of 125°C, derated to zero watts at +145°C.

**RESISTANCE MAX.: Contact factory for availability of values above maximum shown.

AXIAL LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX**	DIA. ±1/64	LENGTH ±1/32	MAX. VOLTS	LEAD DIA.
OA	.15	560K	.187	.375	300	#22
OB	.25	1.2 Meg.	.250	.500	300	#22
OC	.33	2.2 Meg.	.250	.750	400	#22
OD	.33	2.4 Meg.	.375	.500	300	#20
OE	.50	3.6 Meg.	.375	.828	400	#20
OF	.60	5.2 Meg.	.375	1.000	400	#20
OG	.50	4.0 Meg.	.500	.500	400	#20
OH	.60	6.4 Meg.	.500	.625	400	#20
OJ	1.00	8.0 Meg.	.500	1.000	800	#20
OK	1.50	10.0 Meg.	.500	1.500	900	#20
OL	1.75	10.5 Meg.	.500	1.750	900	#20
OM	2.00	13.0 Meg.	.500	2.000	1200	#20

STANDARD TYPES

TOLERANCES: 1% through .005% available on most types and resistance values.

TEMPERATURE COEFFICIENT: ±20 ppm/°C standard.

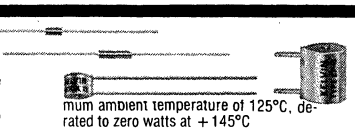
T.C.s available to 1 ppm depending on size, value and temperature range.

WINDINGS: Non-inductive.

*WATTAGE RATINGS: Based on a maximum ambient temperature of 125°C, derated to zero watts at +145°C

**RESISTANCE MAX.: Contact factory for availability of values above maximum shown.

*All Lug Types available with #20 gauge radial leads (except EP-22) by specifying letter "R" after type number.



LUG and RADIAL LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ±1/32	LENGTH ±1/32	MAX. VOLTS	TERMINAL TYPE*	MOUNTING HOLE
EP-22	.10	350K	.312	250	100	#24 x 2" (Wire Lead)	#2
346-P	.25	1.0M	.375	.440	150	Lug	#4
264-P	.33	1.5M	.375	.500	300	Lug	#4
EP-09	.50	4.0M	.500	.500	400	Lug	#6
263-P	.50	4.0M	.625	.500	400	Lug	#6
EP-15	.60	5.0M	.500	.625	400	Lug	#6
EP-16	1.00	6.5M	.500	1.000	800	Lug	#6
EP-30	1.50	10.0M	.500	1.500	900	Lug	#6

AXIAL-WIRE LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ±1/64	LENGTH ±1/32	MAX. VOLTS	LEAD DIA.
EP-21	.25	1.5 Meg.	.250	.500	400	#22
467-P	.25	1.5 Meg.	.250	.500	400	#20
EP-23	.33	2.75 Meg.	.250	.750	400	#22
812-P	.33	2.75 Meg.	.250	.750	400	#20
363-P	.40	3.0 Meg.	.250	1.000	400	#22
334-P	.33	3.0 Meg.	.375	.500	300	#20
815-P	.50	4.5 Meg.	.375	.750	600	#20
EP-24	.50	4.5 Meg.	.375	.828	600	#20
EP-25	.50	5.0 Meg.	.500	.500	400	#20
254-P	.60	6.5 Meg.	.375	1.000	800	#20
EP-26	.60	8.0 Meg.	.500	.625	400	#20
EP-27	1.00	10.0 Meg.	.500	1.000	800	#20
EP-28	1.50	12.0 Meg.	.500	1.500	900	#20
366-P	1.75	13.0 Meg.	.500	1.750	900	#20
EP-29	2.00	15.0 Meg.	.500	2.000	1200	#20

CATALOG #763 COVERS ALL PRODUCTS SHOWN ON THIS PAGE

KELVIN 5919 NOBLE AVENUE, VAN NUYS, CALIFORNIA 91411 TELEPHONE (213) 782-6662

FAST RISE TIME APPLICATIONS

"RT" style resistors provide exceptionally high frequency performance, in addition to the other recognized advantages of wire-wound resistors. "RT" resistors can be supplied with rise times as low as 25 nanoseconds (from 10% to 90% of peak pulse amplitude at 100 KC), depending on resistance values and physical configurations. See Catalog #763

TOLERANCES: 1% through .005% available on most types and resistance values.

TEMPERATURE COEFFICIENT: ±20 ppm/°C standard.

T.C.s available to 1 ppm depending on size, value and temperature range.

WINDINGS: Non-inductive.

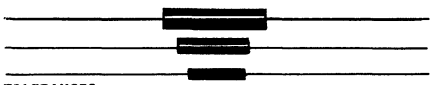
*WATTAGE RATINGS: Based on a maximum ambient temperature of 125°C, derated to zero watts at +145°C.

**RESISTANCE MAX.: Contact factory for availability of values above maximum shown.

AXIAL LEAD

KELVIN TYPE	COMMERCIAL WATTAGE*	RESISTANCE MAX.**	DIA. ·1/64	LENGTH ·1/32	MAX. VOLTS	LEAD DIA.
RTA	.15	560 K	.187	.375	300	#22
RTB	.25	1.2 Meg.	.250	.500	400	#22
RTC	.33	2.2 Meg.	.250	.750	400	#22
RTD	.33	2.4 Meg.	.375	.500	300	#20
RTE	.50	3.6 Meg.	.375	.828	400	#20
RTF	.60	5.2 Meg.	.375	1.000	400	#20
RTG	.50	4.0 Meg.	.500	.500	400	#20
RTH	.60	6.4 Meg.	.500	.625	400	#20
RTJ	1.00	8.0 Meg.	.500	1.000	800	#20
RTK	1.50	10.0 Meg.	.500	1.500	900	#20
RTL	1.75	10.5 Meg.	.500	1.750	900	#20
RTM	2.00	13.0 Meg.	.500	2.000	1200	#20

SERIES KM MOLDED, POWER RESISTORS



Series KM are general purpose, reliable power resistors designed to be used where heat sinks are not available or not desired. These resistors are extremely stable for their size as compared to film types. Series KM are considered to have the lowest dollar per watt cost of precision resistors. Send for Bulletin K-1.

TOLERANCES:

KM025, KM050, KM100—.1% thru 5%
KM200 thru KM1000—.05% thru 5%

TEMPERATURE COEFFICIENT:
(Per Degree Centigrade)

±20 PPM (170 ohms and above)
±30 PPM (10 to 170 ohms)
±50 PPM (1 to 9.99 ohms)
Below one ohm—contact factory

T.C.s to 5 PPM/°C available depending on size and value.

NON-INDUCTIVE STYLES: Reduce resistance values by approximately 50%; derate maximum working voltage by 30%. Add "N" to part number. Example: KMN025.

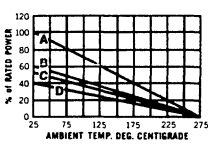
KELVIN PART NUMBER	WATTAGE @ 25° C	DC Working Voltage	Maximum Resistance	SIZE and TOLERANCES Length	Diameter	Lead Length (±0.125)	Lead Diameter (AWG)	Equivalent Military Styles MIL-R-26E
KM025	0.40	35	3.5K	0.250±.015	0.078±.015	1.5 in.	24	
KM050	0.75	50	7.0K	0.312±.015	0.078±.015	1.5 in.	24	
KM100	1.0	75	10.0K	0.422±.015	0.093±.015	1.5 in.	24	RW70
KM200	2.0	200	15.0K	0.490±.015	0.150±.015	1.5 in.	22	
KM250	2.5	200	30.0K	0.500±.031	0.218±.015	1.5 in.	20	
KM300	3.0	150	25.0K	0.560±.031	0.187±.015	1.5 in.	20	RW79
KM301	3.3	200	42.0K	0.812±.031	0.187±.015	1.5 in.	20	
KM350	4.0	200	47.0K	0.625±.031	0.250±.015	2.0 in.	18	
KM500	5.0	400	95.0K	0.875±.031	0.312±.031	2.0 in.	18	RW74
KM700	7.0	600	150K	1.218±.031	0.312±.031	2.0 in.	18	
KM1000	10.0	1000	275K	1.780±.031	0.375±.031	2.0 in.	18	RW78

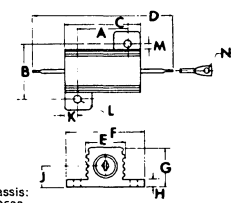
SERIES KC CHASSIS MOUNT POWER RESISTORS

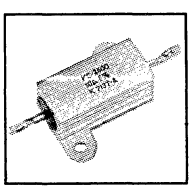
DERATING CURVES

Derating is required for reduced chassis mounting area and high ambient temperatures.

Curves:







A — When mounted on proper aluminum chassis:
48 sq. inches 0.040 aluminum for KC500 and KC1000
70 sq. inches 0.040 aluminum for KC2500
144 sq. inches 0.040 aluminum for KC5000

B — Unmounted KC500 and KC1000
C — Unmounted KC2500
D — Unmounted KC5000

Designed to provide maximum heat dissipation through heat sink and finned case configuration. Ideally suited where large amounts of power must be dissipated and small size is important. Capable of maintaining their precision tolerance in wattage ratings up to 50 watts. Send for Bulletin K-3.

TOLERANCES: 0.05% through 5.0%.

TEMPERATURE COEFFICIENT:
(Per Degree Centigrade)

TC	KC500	KC1000	KC2500	KC5000
±50PPM	1 Ω to 9.9 Ω	1 Ω to 9.9 Ω	1 Ω to 9.9 Ω	1 Ω to 9.9 Ω
±30PPM	10 Ω to 25 Ω	10 Ω to 99 Ω	10 Ω to 170 Ω	10 Ω to 500 Ω
±20PPM	26 Ω to 20K	100 Ω to 30K	171 Ω to 75K	501 Ω to 200K

Below one ohm—contact factory.

T.C.s to 5 PPM/°C available depending on size and value.

NON-INDUCTIVE STYLES: Reduce resistance values by approximately 50%; derate maximum working voltage by 30%. Add "N" to part number. Example: KCN500.

KELVIN PART NUMBER	Watts	DC Working Voltage	Max. Res.	SIZE and TOLERANCES A ±.005	B ±.005	C ±.031	D ±.062	E ±.015	F ±.015	G ±.015	H ±.010	J ±.010	K ±0.10	L ±.005	M ±.015	N ±.005	Mtg. Screw Size	MIL-R-18546
KC500	7.0	165	20K	0.344	0.490	0.600	1.125	0.334	0.646	0.320	0.065	0.133	0.078	0.093	0.078	0.050	#2	RE60
KC1000	12	275	30K	0.562	0.625	0.750	1.375	0.425	0.812	0.400	0.075	0.190	0.093	0.093	0.093	0.086	#2	RE65
KC2500	25	560	75K	0.719	0.781	1.062	1.938	0.525	1.080	0.550	0.088	0.280	0.171	0.125	0.115	0.086	#4	RE70
KC5000	50	1300	200K	1.563	0.844	1.968	2.781	0.615	1.150	0.615	0.085	0.307	0.203	0.125	0.115	0.086	#4	RE75

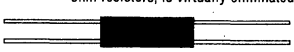
SERIES KM-4T & KC-4T POWER RESISTORS

GENERAL FEATURES

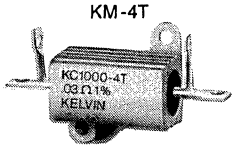
TOLERANCES:	1% through 10%
RESISTANCE RANGE:	.001 ohms and up
TEMPERATURE COEFFICIENT:	.1Ω to 1Ω ±90 PPM/°C .05Ω to <.1Ω ± 150 PPM/°C Below .05 ohm—Check Factory
TEMPERATURE RANGE:	−55°C to +275°C
DIELECTRIC STRENGTH:	1000 VRMS all styles except KC5000-4T at 2500 VRMS
LEADS:	Tinned copperweld

See KM & KC Series this page for additional specifications.

KELVIN FOUR TERMINAL POWER RESISTORS provide low resistance and close tolerance capabilities to users who require accurate measurements in tightly designed circuits. The two voltage (sense) leads will yield a very precise measurement at the points where they join the current leads. Lead resistance, which plays a predominant role in low ohm resistors, is virtually eliminated.



KM-4T



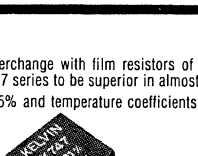
KELVIN PART NUMBER	WATTAGE RATING	DC WORKING VOLTAGE	MINIMUM RESISTANCE IN OHMS 10%	5%	3%	1%
KM300-4T	3W	150	.003	.005	.01	.02
KM500-4T	5W	400	.002	.003	.0075	.015
KC1000-4T	12W	275	.003	.005	.01	.02
KC2500-4T	25W	560	.002	.003	.0075	.015
KC5000-4T	50W	1300	.001	.002	.005	.01

K747 WIREWOUND RESISTOR

Lead Size:	#22 (.025) solder-coated brass
Lead Spacing ℄ to ℄:	.150" (±.010)
Wattage:	.3 watts
Voltage:	200 volts
Resistance Range:	.5Ω to 375K
Resistance Tolerance:	1% thru .01%
Temperature Coefficient:	±5 PPM standard (0–85°C)
TC Tracking:	±3PPM/°C Typical—Available to ±1PPM/°C (Value dependent)
Stability:	25PPM/year
Rise Time:	25 nanoseconds (value dependent)
Noise:	Not measureable on commercially available equipment
Environmental:	Exceeds all requirements of MIL-R-39005

Designed specifically to interchange with film resistors of same physical configuration. Performance characteristics show the K747 series to be superior in almost all instances. Send for Bulletin K747.

For closer tolerances to .005% and temperature coefficients to 1 PPM (0 to 60°C referenced to 25°C), request Bulletin K746.



SIZE: .320±.020 H,
.295±.010 L,
.100±.015 W.
Or .100±.010W (specify K746)

Kelvin pioneered the close tolerance, close temperature coefficient and excellent long term stability wire-wound resistor. State-of-the-art manufacturing techniques and superior testing capabilities yield the ultimate in quality at a competitive price. Please contact your nearest Kelvin representative or the factory direct for further details.

KELVIN 5919 NOBLE AVENUE, VAN NUYS, CALIFORNIA 91411 (213) 782-6662, TELEX: 651417

KELVIN

Precision Wire-wound Resistors, Power Resistors & Resistor Networks

Kelvin is a pioneer in the field of very high stability, close tolerance, precision wire-wound resistors. Resistors shown represent only part of the broad Kelvin line. Complete catalog data is available on request.

Series G HERMETICALLY SEALED RESISTORS

DESCRIPTION

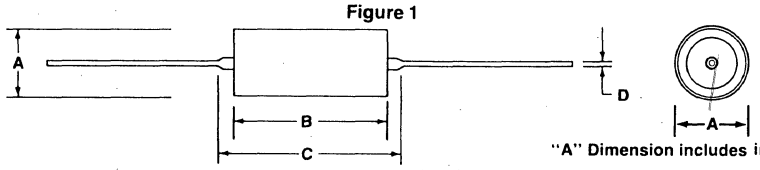
- The Kelvin "G" Series are true hermetically sealed resistors where the resistive element is contained in its own stable environment within an insulated, non-magnetic metal shell with Kovar glass-to-metal end seals.
- By providing a true hermetic seal, plus closely controlled production techniques, guaranteed shelf life stabilities of less than 5 PPM per year are now made commercially available. Stability plots conducted over an extended period show deviations of less than 5PPM after the first year and 10PPM over a three year period.
- In order to achieve these high accuracies of stability, special handling in a controlled environment and attention to finite Engineering, Production and Quality details is a prerequisite.
- Kelvin has developed special winding techniques wherein repeatability of winding tension from lot to lot is controllable within a finite degree. This repeatability of tension results in consistency of stability and temperature coefficient. For example: TC's of 1PPM are available (value dependent) from 0°C to 85°C referenced to 25°C.

ELECTRICAL SPECIFICATIONS: "G" SERIES

1. Resistance Range: See Table 1
2. Standard Resistance Tolerances: 0.1% to .0025%*
3. Resistance Ratios: To .001%*
4. Temperature Coefficient: ±5PPM/°C from −55°C to +125°C Available to ±1PPM* 0 to 85°C TC's referenced to 25°C
5. Stability: (Storage Life) 5PPM/Year 10PPM/3 Years
6. Environmental: Conforms to MIL-R-39005
7. Wattage: See Table 1
8. Maximum Voltage: See Table 1
9. Mechanical Dimensions: See Table 1
10. Leads: Solderable, 1½ inch minimum length. See Table 1

*Value Dependent

Figure 1



"A" Dimension includes insulating sleeve.

TABLE 1

KELVIN PART NUMBER	WATTAGE @ 85°C (1)	MAXIMUM VOLTAGE	RESISTANCE MAX. (2)	A ± .015	B ±.031	C MAX.	D AWG
G-19	.1	100	200K	.261	.500	.650	#22
G-20	.1	100	200K	.194	.600	.750	#22
G-21	.2	100	500K	.261	.700	.850	#22
G-23	.3	200	800K	.261	.970	1.120	#22
G-24	.4	300	1.8 MEG	.375	1.000	1.200	#20
G-27	.5	500	3.0 MEG	.520	1.000	1.200	#20
G-28	1.0	600	5.0 MEG	.520	1.500	1.700	#20
G-29	1.5	600	8.0 MEG	.520	2.000	2.200	#20

(1) Derated to Zero Watts See Figure 3
(2) Check Factory for minimum value vs electrical tolerance and physical size.

ELECTRICAL SPECIFICATIONS: SERIES G-747

1. Resistance Max: 375K
2. Tolerance: .1% to .005%*
3. Resistance Ratios: To .001%*
4. Temperature Coefficient: ±5PPM/°C from −55°C to +125°C Available to ±1PPM* 0 to 85°C TC's referenced to 25°C
5. Stability (Storage Life): 5PPM/year 10PPM/3 year
6. Environmental: Conforms to MIL R 39005
7. Wattage: 0.1W at 85°C(1)
8. Maximum voltage: 200 volts

*Value dependent

Figure 2

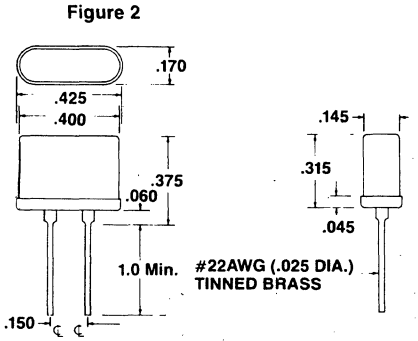
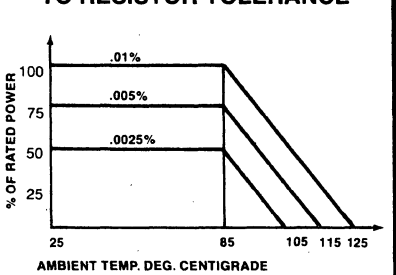


Figure 3

DERATING CURVES RELATED TO RESISTOR TOLERANCE



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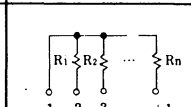
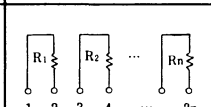
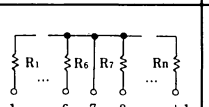
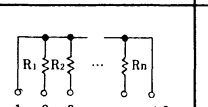
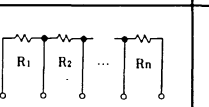
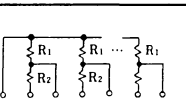
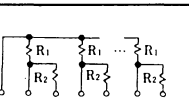
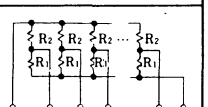
CIRCUIT SYMBOL	O	S	C	D	A	T	E	R
CIRCUIT CONSTRUCTION								

PARAMETER		RESISTOR NETWORK SIP THICK FILM (TYPE RKC)
OPERATING TEMP. RANGE		−40°C ~ 150°C
TEMP. COEFFICIENT		±250ppm/°C
SHORT TIME OVERLOAD		±0.5%
INSULATION RESISTANCE		over 10^4 MΩ
DIELECTRIC WITHSTANDING V.		±0.5%
TERMINAL STRENGTH	PULL TEST	±0.5%
	BEND TEST	cycles and over
RESISTANCE TO SOLDERING HEAT		±0.5%
SOLDERABILITY		over ¾
LIFE (AT ELEVATED AMBIENT TEMP.)		±3%
TEMPERATURE CYCLING		±0.5%
ENDURANCE (MOISTURE LOAD)		± 1% ≧ 100K Ω < ± 2%
ENDURANCE (RATED LOAD)		± 1% ≧ 100K Ω < ± 2%
MAX. WORKING VOLTAGE		200V
MAX. OVERLOAD VOLTAGE		280V
RATING AMBIENT TEMP.		70° C
RESISTANCE RANGE		10 Ω ~ 2.2M Ω
RESISTANCE TOLERANCE		J (± 5%), G (± 2%)

NO. OF PINS		5	6	7	8	9	10	11	12	13	14
$L_{MAX.}$	MM	13.2	15.8	18.3	20.9	23.4	25.9	28.5	31.0	33.6	36.1
	IN.	0.520	0.622	0.720	0.823	0.921	1.020	1.122	1.220	1.323	1.421

PARAMETER	METAL FILM				METAL OXIDE	CARBON FILM
	PRECISION	SEMI-PRECISION	ULTRA PRECISION	MIL		
TYPE DESIGNATION	MF	ML	H	RN	MO	CF
WATTAGE	1/8-1	1/8-1/2	1/10-1/2	1/8-1/4	1-3	1/8-1
TEMP. COEFFICIENT	25-100°C	200°C	5-25°C	50 & 100°C	200°C	—
RESIST. TOLER. (%)	0.5 & 1.0	2.0 & 5.0	0.05-1.0	0.5 & 1.0	2.0 & 5.0	2.0 & 5.0
OPER. TEMP. RANGE	−55/+155°C	−55+155°C	−55/+155°C	−55/+165°C	−55/+225°C	−55/+155°C
SHORT TIME OVRLD. (%)	0.3	0.5	0.06	0.05(C) 0.1(D)	0.5	0.4
TEMP. CYCLING	0.3	0.5	0.04	0.1	0.5	0.5
LOAD LIFE (%)	1.0	1.5	0.3	0.5(C) 1.0(D)	2.0	2.0
MOISTURE RESISTANCE	1.0	1.5	0.4	0.3(C) 1.0(D)	2.0	2.0
VOLTAGE COEFFICIENT	5ppm/V	10ppm/V	5ppm/V	5ppm/V	10ppm/V	15ppm/V
FAILURE RATE/1000 HRS.	$<10^{-5}$	$<10^{-5}$	$<10^{-5}$	$<10^{-5}$	$<10^{-3}$	$<10^{-4}$
MARKING	CLR. BAND (5)	CLR. BAND (4)	Alpha	Alpha	CLR. BAND (4)	CLR. BAND (4)

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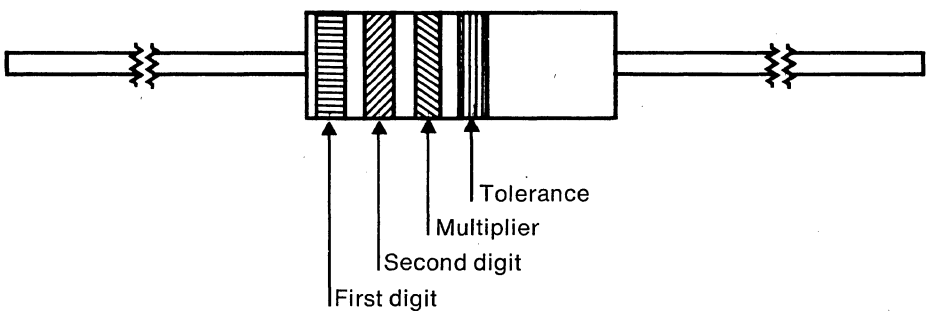
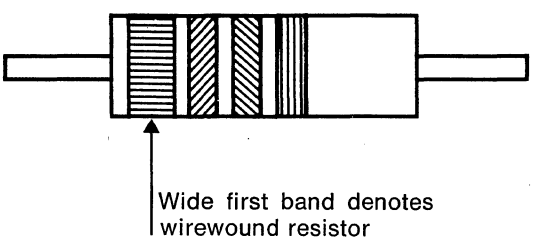
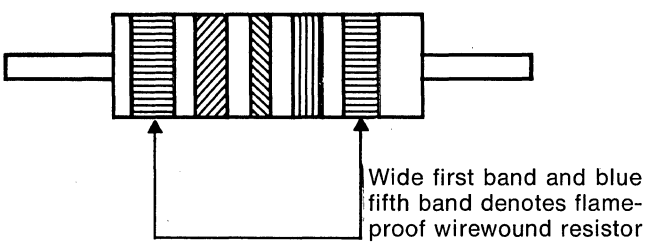
MINIGLOSSARY
RESISTOR COLOR CODES

EIA/MIL Resistor Color Codes



Color code for general-purpose industrial resistors

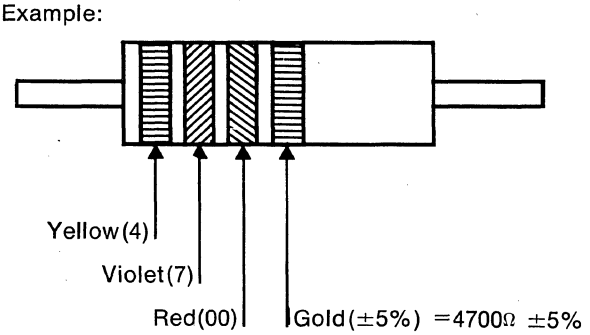




Color code for general-purpose wirewound resistors

Color	Significant digit	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1000	± 3%
Yellow	4	10,000	± 4%
Green	5	100,000	—
Blue	6	1,000,000	—
Violet	7	10,000,000	—
Gray	8	—	—
White	9	—	—
Gold	—	0.1	± 5%
Silver	—	0.01	±10%
No color	—	—	±20%

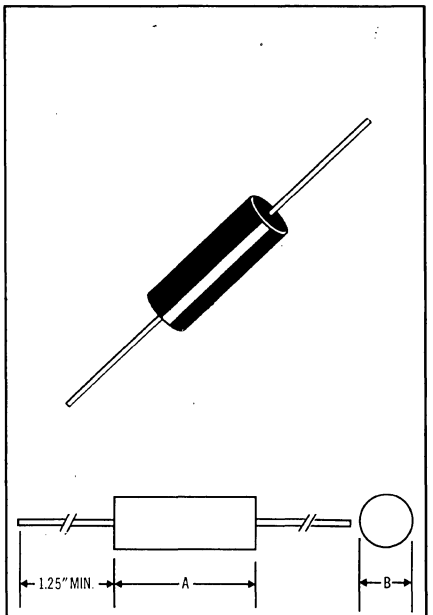
Example:



ULTRA PRECISION / FASTEST DELIVERY MEISSNER

ULTRA PRECISION WIREWOUND RESISTORS

STYLE	MIL R 93 STYLE	WATTAGE	NOMINAL DIMENSIONS A ± .062	NOMINAL DIMENSIONS B ± .062	MAX OHMS
AX-01		.1	.188	.093	75 K
AX-1		.1	.250	.125	150 K
AX-1A		.1	.312	.150	175 K
AX-2		.2	.375	.150	200 K
AX-2F		.2	.375	.187	250 K
AX-4	RB 56	.25	.312	.250	400 K
AX-5	RB 55	.33	.500	.250	500 K
AX-6		.33	.625	.250	650 K
AX-7	RB 54	.5	.750	.250	1 MEG
AX-8	RB 53	.75	.750	.375	2 MEG
AX-9	RB 52	1.0	1.000	.375	3 MEG
AX-10	RB 57	1.25	1.000	.500	5 MEG
AX-11	RB 58	1.5	1.500	.500	7.5 MEG
AX-12	RB 59	2.0	2.000	.500	10 MEG

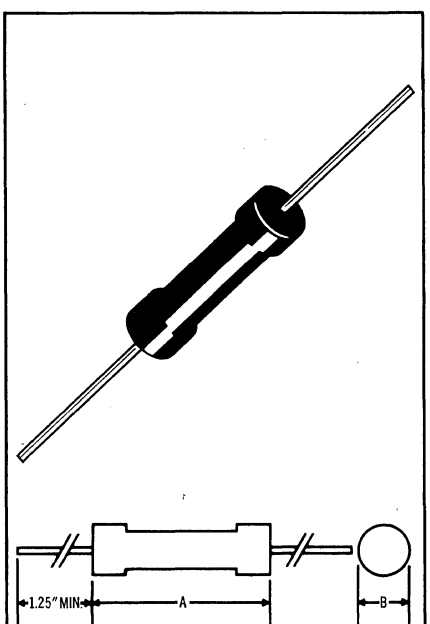


SPECIFICATIONS

TOLERANCE: .1% to .001%
WATTAGE: .1 Watt to 2.0 Watts
STABILITY: .0005% per year
TEMPERATURE COEFFICIENT: ±2 ppm/°C above 10 Ω
±15 ppm/°C below 10 Ω
WINDINGS: Non inductive
CONSTRUCTION: Encapsulated Epoxy
ADDITIONAL FEATURES: Tracking T.C. ±.5 ppm/°C. Shunts as low as .001 Ω. Special T.C. 0 to +6000 ppm/°C. Low capacitance ±1 pF Hermetic sealing available

SILICONE COATED POWER WIREWOUND RESISTORS

STYLE	MIL R 26 TYPE	WATTAGE RATING U 275°C	WATTAGE RATING V 350°C	NOMINAL DIMENSIONS A ± .062	NOMINAL DIMENSIONS B ± .031	MAX OHMS
MI-1A	RW 70	1.0	1.25	.406	.094	10 K
MI-1B		1.1	1.3	.531	.094	15 K
MI-2		4.0	5.5	.625	.250	47 K
MI-2A		3.0	3.75	.812	.188	42 K
MI-2B	RW 79	3.0	3.75	.560	.188	24 K
MI-2C	RW 69	3.0	3.75	.500	.218	32 K
MI-5	RW 74	5.0	6.5	.875	.312	95 K
MI-7		7.0	9.0	1.185	.312	154 K
MI-10	RW 78	10.0	13.0	1.780	.375	273 K



SPECIFICATIONS

TOLERANCE: 5%, 1% closer tolerances available to .05%
WATTAGE: 1 Watt to 13 Watts
STANDARD RESISTANCE VALUES: From .1 Ω to maximum values as stated in table. Values as low as .001 Ω and 4 terminal construction available
COATING: Special silicone coating withstands moisture, salt water immersion and cleaning solvents. It will withstand operation from −65°C up to 400°C
LEADS: Tinned copperweld. Length 1.25″ minimum
TEMPERATURE COEFFICIENT: ±20 ppm/°C 500 Ω up
CONSTRUCTION: Welded Terminations
ADDITIONAL FEATURES: Non inductive windings. Other sizes and wattages. Special Temperature Coefficients up to +6000 ppm/°C

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Established reliability metal film, Mil-R-55182 style RNR
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INDUSTRIAL/CONSUMER GROUP

Mepco/ Electra Series	Category	Body Type	Resistance Range (ohms)	Tolerance Range (±%)	Temperature Coefficient Range (PPM/°C)	Power Range @ 70°C (watts)	Max. Voltage Range (watts)
SPACE MISER	GENERAL PURPOSE	METAL FILM Conformal-Coated	.22Ω-5.1 Meg	5% 1%	±100	⅓	200
CR	GENERAL PURPOSE	CARBON FILM Conformal-Coated	1Ω-1 Meg	5%-10%	−200 to +500, ±300	⅛-¼ ½	150-250-350
SFR	GENERAL PURPOSE	METAL FILM Conformal-Coated	1Ω-10 Meg	1%-2% 5%	±200 and ±100	⅛-¼ ½	150-250-350
SPR	STANDARD PRECISION	METAL FILM Conformal-Coated	1Ω-25.5 Meg	0.5%-1.0%	+50 to +150	¼-1	350-500
UPR & MATCHED SETS	ULTRA PRECISION	METAL FILM Conformal-Coated	51.1Ω-499K	.025%-1%	+2 to +25	@ 85°C 1/20 ⅛-¼ ⅓	200-300
MIL Style	**MIL Specs**	**INDUSTRIAL/STANDARD MILITARY**					
RL	MIL-R-22684	METAL FILM Conformal-Coated	4.3Ω-470K	2% 5%	±100	¼-½	250-350
RN	MIL-R-10509	METAL FILM Conformal-Coated	10Ω-4M	0.1%-1%	±25 to ±100	1/20-½	200-350
		ESTABLISHED RELIABILITY (MIL)					
RLR	MIL-R-39017	METAL FILM Conformal-Coated	4.2Ω-1M	1%-2%	±100	⅛-½	250-350
RNC	MIL-R-55182	METAL FILM Conformal-Coated	10Ω-3.01M	0.1%-1%	±25 to ±100	@ +125°C 1/20-¼	200-300
RNR Hermetic	MIL-R-55182	METAL FILM Hermetic Seal	10Ω-1M	0.1%-1%	±25 to ±50	@ +125°C 1/10-½	200-350

CHIP RESISTORS

Columbia Road, Morristown, NJ 07960 (201) 539-2000 TWX: 710-986-7437

SERIES 9C COMMERCIAL CHIP RESISTORS

Mepco/ Electra Series	Resistance Range	Tolerance	Temperature Coefficient (ppm/°C)	Power Rating (70°C)	Maximum Voltage	Dimensions (mm)		
						Length	Width	Thickness
9C1206	10Ω-100MΩ	±1% ±5%	±100 ±200	⅛ Watt	200V (R.M.S.)	3.2 ±0.15	1.6 ±0.15	0.6 ±10

SERIES RM ESTABLISHED RELIABILITY CHIP RESISTORS (MIL-R-55342)

Mil-Part Part Number Style	Resistance Range	Tolerance	Temperature Coefficient (ppm/°C)	Power Rating (70°C)	Maximum Voltage	Dimensions (Inches)		
						Length	Width	Thickness
M55342/2 RM0505	100Ω-300KΩ 100Ω-500KΩ 100Ω-500KΩ	±1% ±5% ±10%	±100 ±300 ±300	50mw	40VDC	.050 +.025 −.005	.050 +.010 −.005	.010 Min. .040 Max.
M55342/6 RM0705	100Ω-500Ω 100Ω-1MΩ 100Ω-1MΩ	±1% ±5% ±10%	±100 ±300 ±300	100mw	50VDC	.075 +.025 −.005	.050 +.010 −.005	.010 Min. .040 Max.
M55342/3 RM1005	100Ω-500KΩ 100Ω-1MΩ 100Ω-1MΩ	±1% ±5% ±10%	±100 ±300 ±300	100mw	40VDC	.100 +.025 −.005	.050 +.010 −.005	.010 Min. .040 Max.
M55342/4 RM1505	100Ω-1MΩ 100Ω-1MΩ 100Ω-1MΩ	±1% ±5% ±10%	±100 ±300 ±300	150mw	40VDC	.150 +.025 −.005	.050 +.010 −.005	.010 Min. .040 Max.

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NETWORKS

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SERIES 9S FIXED RESISTOR NETWORKS SINGLE IN LINE PACKAGE

Mepco/Electra Series	Resistance Range	Tolerance	Temperature Coefficient (ppm/°C)	Circuits Available	Pin Styles Available
9S06, 08, 10	22Ω-1MΩ	±2% ±1%*	±200 ±100*	Terminator Pull Up/Pull Down	6, 8, and 10 Single in Line
9S06, 08, 10	22Ω-1MΩ	±2% ±1%* ±5%*	±200	Dual Terminator Circuit	6, 8, and 10 Single in Line

SERIES RZ040, RZ050, RZ030 MILITARY STYLE (MIL-R-83401) RESISTOR NETWORKS

Military Part Number	Resistance Range	Tolerance	Temperature Coefficient (ppm/°C)	Circuits Available	Pin Styles Available
M8340104 RZ040	47.5Ω-1MΩ	±1% ±2% ±5%	±100 ±300	Terminator Pull Up	6 Pin Single in Line
M8340105 RZ050	47.5Ω-1MΩ	±1% ±2% ±5%	±100 ±300	Terminator Pull Up	8 Pin Single in Line
M8340103 RZ030	100Ω-100KΩ	±1% ±2% ±5%	±100 ±300	Terminator Pull Up	14 Pin Flat Pack

10K AND 100K ECL TERMINATORS

Mepco/Electra Series	Standard Resistance Values	Tolerance	Temperature Coefficient (ppm/°C)	Circuits Available	Capacitors	Pin Styles Available
9N08	68Ω, 100Ω,** 150Ω	±5%	±200	For 10K	.01μf Z5U 25VDC	8 Pin Single in Line
9N10	50Ω, 68Ω,** 100Ω	±5%	±200	For 100K	.01μf Z5U 25VDC	10 Pin Single in Line

* These characteristics available upon request. ** Others available upon request.

NON-LINEAR RESISTORS

Columbia Road, Morristown, NJ 07960 (201) 539-2000 TWX: 710-986-7437

PTC/NTC THERMISTORS

Mepco/ Electra Series	Category	Body Type	Resistance Range	Tolerance	Temperature Coefficient Range (ppm/°C)	Power Range @ 70°C (watts)	Ma. Voltage Range (volts)
NTC	Non Linear	Conformal Coated Disc	15Ω-330KΩ	±5% ±10%	8%-98%/°C	¼-1	N.A.
PTC			30Ω-250Ω	±20%	5%-75%/°C	N.A.	15-265V

VOLTAGE DEPENDENT RESISTORS (ZnO VARISTORS)

Mepco/ Electra Series	Style & Size Range Inches (mm)	R.M.S. Working Voltage	Temperature Coefficient @ 1mA. +25°C to +85°C	Max. Avg. Dissipation (Including Transients)	Max. Non-Repetitive Transient Current
VZ, VW, VY, VV	.276 — .630 O.D. (7 — 16) O.D.	60 — 460 All types	−0.065%/K All Types	100mW — 600mW	400A — 4500A

For information on Mepco/Electra's CAPACITORS/POTENTIOMETERS/MILITARY COMPONENTS, see pages 1•1142, 1•2141 and 1•1674.

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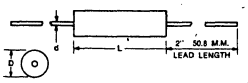
4900 SANTA ANITA DRIVE, EL MONTE, CA 91731
PHONE (213) 442-3310 • (213) 686-0535 • TWX: 910-587-3425

QUALITY PRECISION RESISTORS

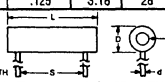
AXIAL LEAD
Series 100



Tolerances: .001% to 1%
T.Cs: 1 PPM to 6000 PPM
Windings: Non-inductive

MO Style	Mil R-83 Equiv.	Length (L) Inch ±.032	Length (L) mm ±.81	Diameter (D) Inch ±.015	Diameter (D) mm ±.30	Lead (d) AWG	Lead (d) mm	Com'l Wattage	Max. Voltage DC	Max. Resistance (.0004 Wire)
133		.500	12.70	.200	5.08	22	.64	.30	300	600K
139		.700	17.78	.200	5.08	22	.64	.40	300	1.2M
144		.250	6.35	.250	6.35	22	.64	.25	150	400K
115		.312	7.92	.250	6.35	22	.64	.25	200	1M
156	RB56	.375	9.52	.250	6.35	20	.81	.25	200	700K
143	RB55	.500	12.70	.250	6.35	20	.81	.30	300	900K
137	RB54	.750	19.05	.250	6.35	20	.81	.50	300	1.2M
136		.610	15.49	.375	9.52	20	.81	.50	400	3M
132	RB53	.750	19.05	.375	9.52	20	.81	.66	500	3M
138	RB52	1.00	25.40	.375	9.52	20	.81	1.0	750	5M
134		.500	12.70	.500	12.70	20	.81	.66	300	3M
170		.625	15.88	.500	12.70	20	.81	.75	400	3M
146	RB57	1.00	25.40	.500	12.70	20	.81	1.5	750	7M
180	RB58	1.50	38.10	.500	12.70	20	.81	2.0	1000	15M
190	RB59	2.00	50.80	.500	12.70	20	.81	2.5	1200	20M
SUBMINIATURES										
140		.250	6.35	.125	3.18	24	.51	.10	100	150K
112		.375	9.52	.125	3.18	24	.51	.125	200	125K
113		.312	7.92	.160	4.06	22	.64	.15	150	300K
150		.500	12.70	.160	4.06	22	.64	.20	200	400K
114		.312	7.92	.187	4.75	22	.64	.20	200	300K
135		.375	9.52	.187	4.75	22	.64	.25	300	300K
160		.625	15.88	.187	4.75	20	.81	.30	300	600K
MICRO-MINIATURES										
XP101		.375	9.52	.050	1.27	30	.25	.02	50	10K
100		.110	2.79	.070	1.78	30	.25	.03	50	11K
105		.155	3.94	.075	1.91	30	.25	.04	50	11K
110		.200	5.08	.093	2.36	28	.32	.05	75	30K
130		.312	7.92	.093	2.36	28	.32	.06	100	60K
142		.185	4.70	.120	3.05	28	.32	.06	100	30K
141		.180	4.06	.125	3.18	28	.32	.06	100	30K

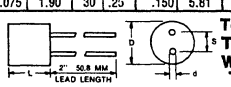
RADIAL LEAD
Series 200 & 600



Tolerances: .001% to 1%
T.Cs: 1 PPM to 6000 PPM
Windings: Non-inductive

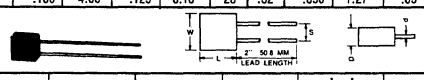
MO Style	Mil R-93 Equiv.	Length (L) Inch ±.032	Length (L) mm ±.81	Diameter (D) Inch ±0.15	Diameter (D) mm ±.38	Lead (d) AWG	Lead (d) mm	Lead Spacing (S) Inch ±.032	Lead Spacing (S) mm ±.81	Mounting Hole (H) Inch ±.010	Mounting Hole (H) mm ±.35	Comm'l Wattage	Max. Voltage DC	Max. Resistance (.0006 Wire)
*221		.490	12.45	.365	9.27	24	.51	.390	9.91	.140	3.56	.50	300	2.5M
*211		.325	8.26	.375	9.52	24	.51	.245	6.22	.120	3.05	.50	300	1.5M
*226		1.000	25.40	.375	9.52	20	.81	.855	21.72	.089	2.26	1.00	600	5M
222		.668	17.48	.420	10.69	20	.81	.555	14.10	None		1.00	600	3M
236		1.125	28.59	.435	11.05	20	.81	.960	24.38	None		1.25	600	5M
*220	RB17	1.000	25.40	.500	12.70	20	.81	.845	21.46	.140	3.56	1.00	600	10M
*228	RB73	2.000	50.80	.500	12.70	20	.81	1.750	44.45	.140	3.56	2.00	1200	20M
*227	RB08	.500	12.70	.550	13.97	20	.81	.235	5.97	.140	3.56	.50	300	1M
*224	RB16	.612	15.54	.550	13.97	20	.81	.475	12.06	.140	3.56	.50	300	12M
*230	RB18	1.250	31.75	.750	19.05	20	.81	1.125	28.59	.140	3.56	2.00	600	20M
SUBMINIATURES														
225		.500	12.70	.160	4.06	24	.51	.385	9.78	None		.20	200	500K
*202		.250	6.35	.312	7.92	24	.51	.180	4.57	.089	2.26	.25	200	500K
243		.500	12.70	.250	6.35	22	.64	.290	7.37	None		.25	300	300K
MICRO-MINIATURES														
**206		.200	5.08	.105	2.67	30	.25	.100	2.54	None		.30	100	30K
210		.250	6.35	.100	2.54	28	.32	.200	5.08	None		.05	100	30K
205		.165	4.19	.075	1.90	30	.25	.150	5.81	None		.04	50	11K

PRINTED CIRCUIT LEAD
Series 400



Tolerances: .001% to 1%
T.Cs: 1 PPM to 6000 PPM
Windings: Non-inductive

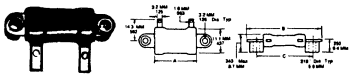
MO Style	Mil R-93 Equiv.	Length (L) Inch ±.032	Length (L) mm ±.81	Diameter (D) Inch ±.032	Diameter (D) mm ±.81	Lead (d) AWG	Lead (d) mm	Lead Spacing (S) Inch ±.010	Lead Spacing (S) mm ±.25	Com'l Wattage	Max. Voltage DC	Max. Resistance (.0006 Wire)
440		.250	6.35	.125	3.18	24	.51	.050	1.27	.10	100	120K
412		.375	9.52	.125	3.18	24	.51	.050	1.27	.125	200	55K
413		.312	7.92	.160	4.06	24	.51	.080	2.03	.15	150	300K
414		.312	7.92	.187	4.75	22	.64	.100	2.54	.20	200	300K
435		.375	9.52	.187	4.75	22	.64	.100	2.54	.25	300	300K
415	RB71	.312	7.92	.250	6.35	22	.64	.200	5.08	.25	300	500K
416		.375	9.52	.250	6.35	22	.64	.200	5.08	.25	300	800K
443		.500	12.70	.250	6.35	22	.64	.125	3.18	.30	300	1M
437		.750	19.05	.250	6.35	22	.64	.125	3.18	.50	300	1M
417	RB70	.500	12.70	.375	9.52	20	.81	.200	5.08	.50	300	1.5M
436		.610	15.49	.375	9.52	20	.81	.250	6.35	.50	450	3M
438		1.00	2.54	.375	9.52	20	.81	.250	6.35	1.00	750	5M
434		.500	12.70	.500	12.70	20	.81	.300	7.62	.50	300	3M
MICRO-MINIATURES												
405		.155	3.94	.075	1.91	30	.25	.030	.76	.04	50	11K
430		.312	7.92	.093	2.36	28	.32	.040	1.02	.05	100	50K
401		.175	4.44	.105	2.67	28	.32	.040	1.02	.05	75	30K
442		.185	4.70	.120	3.05	28	.32	.050	1.27	.05	100	30K
441		.160	4.06	.125	3.18	28	.32	.050	1.27	.05	100	30K



RECTANGULAR

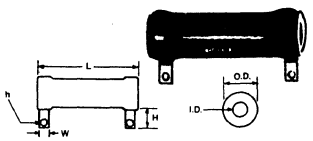
MO Style	Length (L) Inch ±.032	Length (L) mm ±.81	Width (W) Inch ±.015	Width (W) mm ±.38	Depth (D) Inch ±.015	Depth (D) mm ±.38	Lead (d) AWG	Lead (d) mm	Lead Spacing (S) Inch ±.010	Lead Spacing (S) mm ±.25	Com'l Wattage	Max. Voltage DC	Max. Resistance (.0006 Wire)
450	.250	6.35	.250	6.35	.125	3.18	20	.81	.125	3.18	.125	100	1M
460	.250	6.35	.500	12.70	.125	3.18	20	.81	.250	6.35	.250	100	2M

POWER RESISTORS
Series FP



MO Style	Core Length (A) Inch ±.032	Core Length (A) mm ±.01	Length Inch Hdwe. (D) Inch ±.015	Length Inch Hdwe. (D) mm ±.38	Mounting Hole Spacing (C) Inch ±.015	Mounting Hole Spacing (C) mm ±.38	Wattage Rating	Maximum Working Voltage	Resistance Range (Ohms)
FP-10	.750	19.05	1.218	30.94	1.00	25.4	10	300	.1-15K
FP-20	2.062	52.37	2.625	66.68	2.313	58.75	20	1000	.1-15K

Series TL



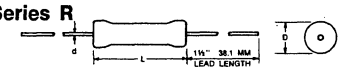
Tolerances: .05% to 10%
T.Cs: 90 PPM to 20 PPM depending on value

TERMINAL DIMENSIONS

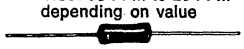
M.O. Series	TL-5 Inch	TL-5 mm	TL-10 25 & 30 Inch	TL-10 25 & 30 mm	TL-60 & 100 Inch	TL-60 & 100 mm
Width (W)	.125	3.2	.187	4.8	.250	6.4
Height (H)	.250	6.4	.406	10.3	.750	19.1
Hole Dia. (h)	.062	1.57	.093	2.4	.154	3.9

No. Style	Length (L) Inch ±.062	Length (L) mm ±1.57	Diameter O.D. Inch ±.032	Diameter O.D. mm ±.81	Diameter I.D. Inch ±.032	Diameter I.D. mm ±.81	Wattage Rating	Maximum Working Voltage	Resistance Range (Ohms)
TL-6	1.00	25.40	.250	6.35	.156	3.96	5	230	.1-12K
TL-10	1.00	25.40	.438	11.12	.312	7.92	10	400	.1-22K
TL-25	2.00	50.80	.563	14.30	.312	7.92	25	1300	.1-100K
TL-50	4.00	101.60	.563	14.30	.312	7.92	50	1900	.1-250K
TL-60	4.00	101.60	.750	19.05	.500	12.70	60	2100	.1-350K
TL-100	6.50	165.10	.750	19.05	.500	12.70	100	2500	.1-550K

Series R

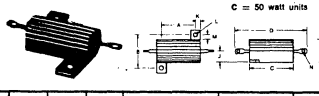


Tolerances: .05% to 10%
T.Cs: 90 PPM to 20 PPM depending on value



MO Style	Mil R-26 Equiv.	Length (L) Inch ±.032	Length (L) mm ±.81	Diameter (D) Inch ±.032	Diameter (D) mm ±.81	Lead (d) AWG	Lead (d) mm	Wattage U	Wattage V	Max. Working Voltage U	Max. Working Voltage V	Resistance Ranges (ohms) .05% .1% .25%	Resistance Ranges (ohms) .5% 1% 3% 5%
R-¼		.250	6.35	.078	1.98	24	.51	.40		20		10-950	.1-3.4K
R-½		.312	7.92	.078	1.98	24	.51	.75		29		10-1.3K	.1-4.9K
R-1A	RW70	.406	10.31	.093	2.36	22	.64	1.00		52		1-2.7K	.1-10.4K
R-1		.531	13.49	.093	2.36	22	.64	1.10		62		1-4.0K	.1-15K
R-2½	RW69	.500	12.70	.210	5.33	20	.81	2.50	3.25	138	157	1-8.6K	.01-32.2K
R-3A	RW79	.562	14.27	.210	5.33	20	.81	3.00	3.75	135	148	1-6.5K	.01-34.5K
R-3		.812	20.62	.210	5.33	20	1.02	3.25	4.75	185	220	1-11.4K	.01-42.1K
R-4		.625	15.88	.300	7.62	18	1.02	4.00	5.50	210	250	1-12.7K	.01-47-1K
R-5	RW67 RW74	.875	22.22	.300	7.62	18	1.02	5.00	6.50	330	376	.5-24.5K	.01-91.0K
R-7		1.218	30.94	.375	9.52	18	1.02	7.00	9.00	504	576	.5-41.4K	.01-154K
R-10	RW68 RW78	1.780	45.21	.375	9.52	18	1.02	10.00	13.00	799	911	.5-71.3K	.01-265K

SERIES HS
(Heat Sink)

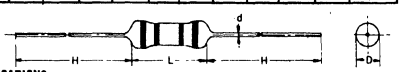


Tolerances: .05% to 10%
T.Cs: PPM/°C — Resistance
20 — 10Ω & over
30 — 1Ω — 10Ω
90 — under 1Ω

MO Style	Mil-R 18546	Com'l Watt	Max. Work. Volt.	Max. Res.	A Inch ±.005	A mm ±.013	B Inch ±.005	B mm ±.013	C Inch ±.032	C mm ±.81	D Inch ±.062	D mm ±1.57	E Inch ±.015	E mm ±.38
HS-5	RE60	5	160	20K	.444	11.28	.490	12.45	.600	15.24	1.125	28.58	.334	8.48
HS-10	RE65	10	265	30K	.562	14.27	.625	15.88	.750	19.05	1.375	34.93	.438	11.13
HS-25	RE70	25	550	75K	.719	18.26	.781	19.84	1.062	26.97	1.938	49.23	.500	12.70
HS-50	RE75	50	1234	200K	1.563	39.70	.844	21.44	1.968	49.99	2.781	70.64	.625	15.88

F Inch ±.015	F mm ±.38	G Inch ±.015	G mm ±.38	H Inch ±.010	H mm ±.25	J Inch ±.010	J mm ±.25	K Inch ±.010	K mm ±.25	L Inch ±.005	L mm ±.013	M Inch ±.015	M mm ±.38	N Inch ±.005	N mm ±.013	Mtg. Hole Size
.646	16.41	.317	8.05	.075	1.91	.145	3.68	.078	1.98	.093	2.36	.078	1.98	.050	1.27	#2
.812	20.62	.406	10.31	.100	2.54	.203	5.16	.093	2.36	.093	2.36	.094	2.39	.086	2.18	#2
1.094	27.79	.563	14.30	.094	2.39	.250	6.35	.171	4.34	.125	3.18	.125	3.18	.086	2.18	#2
1.156	29.36	.625	15.88	.094	2.39	.281	7.14	.196	4.98	.125	3.18	.125	3.18	.086	2.18	#4

DEPOSIT CARBON FILM
Fixed Resistors Type
M 50, 25, 12



SPECIFICATIONS

Type	M-50	M-25	M-12
Wattage Rating at 70°C	0.5W	0.25W	0.125W
Max. Working Voltage	350V	250V	150V
Max. Over Load Voltage	700V	500V	300V
Resistance Tolerance	±2% (G), ±5% (J)	±2% (G), ±5% (J)	±5% (J)
Resistance Range 5%	1Ω to 10MΩ	1Ω to 13MΩ	1Ω to 5MΩ
Resistance Range 2%	10Ω to 910K	10Ω to 910K	51Ω to 220K
Temperature Range	−55°C to +155°C	−55°C to +155°C	−55°C to +155°C

Type	Body Length (L) Inch	Body Length (L) mm	Body Diameter (D) Inch	Body Diameter (D) mm	Leadwire Length (H) Inch	Leadwire Length (H) mm	Leadwire Diameter (d) Inch	Leadwire Diameter (d) mm	Net Weight
M-50	.350±.020	8.9±0.5	.146±.008	3.7±0.2	1.125±.1	30±3	.031±.001	0.8±0.03	500 grms (1.1 lb.)
M-25	.245+.020 −.010	6.7 max.	.098 max.	2.5 max.	1.125±.1	30±3	.024±.005	0.6±0.05	200 grms (.44 lb.)
M-12	.160+.020 −.010	4.6 max.	.068 max.	1.7 max.	1.125±.1	30±3	.020±.005	0.5±0.05	135 grms (.30 lb.)

SEND FOR CATALOG

Tolerances: .05% to 10%
T.Cs: PPM/°C — Resistance
20 — 10Ω & over
30 — 1Ω — 10Ω
90 — under 1Ω

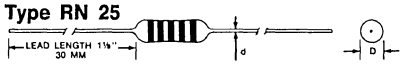
For manufacturers' sales offices refer to Manufacturers & Sales Offices Directory

MICRO-OHM CORPORATION
4900 SANTA ANITA DRIVE, EL MONTE, CA 91731
PHONE (213) 442-3310 • (213) 686-0535 • TWX: 910-587-3425

QUALITY PRECISION RESISTORS

METAL FILM RESISTORS

Type RN 25

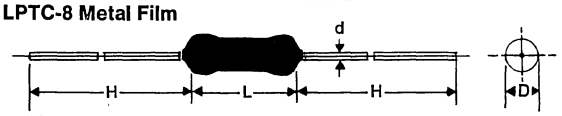


T.Cs: 25, 50 & 100 PPM
Tolerances: 0.5% to 1%
RN55 Size: ¼w rating

MO Style	Length (L) Inch ±0.39	Length (L) mm ±1.0	Diameter (D) Inch ±.02	Diameter (D) mm ±0.5	Lead (d) Tin Cu. AWG	Lead (d) Tin Cu. mm	Wattage @ 70°C	Max. Working Voltage	Max. Overload Voltage	Resistance Range (Ω)
RN25	.25	6.4	.09	2.3	22	0.5	¼	250	500	1-1.1Meg

HIGH STABILITY LINEAR POSITIVE T.C. RESISTORS

Type LPTC-8 Metal Film



Rating & Dimensions: (in inches)

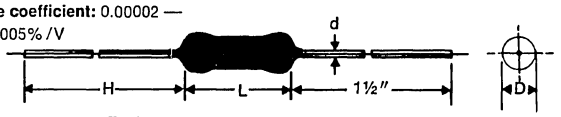
Max. Power Rating @ 70°C	L ±.020	D ±.020	1	d
⅛ W	.250	.090	1.0	22 ga.

Resistance Range: 10 ohm — 20K ohm (T1 and T2)
10 ohm — 1K ohm (T3 and T4)
Resistance Tolerance: ±2% (G) and ±5% (J)
Resistance Temperature Coefficient: T1 (±2500 PPM)
T2 (±3000 PPM)
T3 (±3500 PPM)
T4 (±4000 PPM)
Features: a) Linear resistance change vs. temperature, which cannot be obtained in a semiconductor or thermister.
b) Positive temperature coefficient
Application: Temperature compensation, temperature indication, temperature control, temperature protection and liquid level detection.
Markings: First two bands are significant digits, third band the multiplier, and the fourth and fifth bands are first two digits of T.C.R.

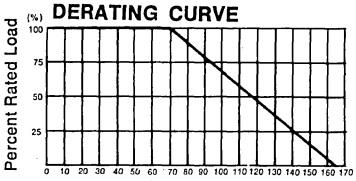
SPECIFICATIONS FOR MG SERIES METAL GLAZE RESISTORS

This high resistance component has been developed to be used as a precision or power resistor for X-ray equipment, measuring equipment and statistic electric equipment. It has high reliability in its shelf life, T.C.R. and other characteristics.

CHARACTERISTICS:
T.C.R.: 100 PPM
Load life: 3000 Hrs. ±1%
Anti moisture load life: ±1% after 250 Hrs. at 40°C 90-95% RH
Voltage coefficient: 0.00002 — 0.0005% /V
Shelf life: ±1% after 10,000 Hrs. at room temp.
Max. Temperature: 220°C
Temperature range: −55°C — +165°C



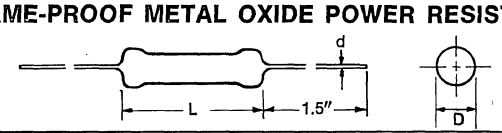
DERATING CURVE



Style	Rated Wattage (W)	Max. Working Voltage (KV)	Pulse Voltage (KV)	Resistance Range	Dimensions (Inches) D ±.04	L ±.06	d ±.004
MG-25	0.25	0.10	0.30	1Meg- 100Meg	.09	.256	.025
MG-50	0.50	0.35	0.70	1Meg- 200Meg	.126	.393	.028
MG-1	1.0	1.00	1.00	1Meg-1000Meg	.165	.472	.032
MG-2	2.0	5.00	7.50	1Meg-2000Meg	.217	.630	.032

Resistance Tolerance: F = ±1% G = ±2% J = ±5% Markings: EIA color coding system or Digital marking.

FLAME-PROOF METAL OXIDE POWER RESISTORS



Style	Dimension (inches) L ±.02	D ±.02	d (nominal)
RSF-½B	.35	.12	.028
RSF-1B	.46	.16	.028
RSF-2B	.61	.23	.032
RSF-3B	.98	.33	.032
RSF-5B	1.60	.33	.032

Style	Power Rating @ 70°C	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Resistance Tolerance
RSF-½B	0.5W	250V	400V	500V	0.2 -100KΩ	
RSF-1B	1W	500V	1,000V	700V	0.2 -100KΩ	
RSF-2B	2W	500V	1,000V	700V	0.2 -120KΩ	G*
RSF-3B	3W	750V	1,000V	1,000V	0.2 -150KΩ	J
RSF-5B	5W	750V	1,000V	1,500V	0.47-240KΩ	

* G 5.1Ω and over

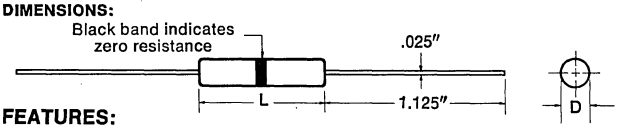
CHARACTERISTICS

Requirements		Characteristics	Test Method JIS C 5202	Test Method Mil-R-22684B
Operating Temperature Range		−55°C to +275°C		
Temperature Coefficient (ppm C)		±200	5.2	4 6 11
Max. Resistance Change	Short Time Overload	±(0.5% +0.05Ω)	5.5	4 6 5
	Effect of Soldering	±(0.5% +0.05Ω)	6.4 350°C 3 sec	4 6 9
	Temperature Cycling	±(0.5% +0.05Ω)	7.4 −55°C/85°C	4 6 3
	Moisture Resistance	±5%	7.9 1,000 hr	4 6 10
	Load LIfe	±5%	7.10 1,000 hr	4 6 12
Dielectric Withstanding Voltage		±(0.5% +0.05Ω)	5.7	4 6 7
Insulation Resistance		over 10^4 MΩ	5.6	4 6 8
Non-Combustibility		The resistor shall withstand Overload test in accordance with Article UL492, 213 without producing a fire hazard.		
Resistance to Solvents		The resistor shall withstand Solvents test in accordance with Article MIL-STD-202 E 215 without producing any mechanical or electrical damage.		

JUMPER WIRE ZERO OHM RESISTORS

Type 104, 106, 108

DIMENSIONS:



FEATURES:

- Sizes equal to ⅛, ¼ and ½W carbon film
- Economical
- Straight-through zero ohm continuity
- Conformal multilayer epoxy coating
- Welded cap and lead construction
- Packing: Tape & reeled or bulk

Type	Equivalent Wattage	Body Inch Length (L) ±.010	Body Inch Diameter (D) ±.005
104	⅛	.150	.080
106	¼	.245	.085
108	½	.500	.095

SPECIFICATIONS:

Maximum Resistance: 0.0025 ohm
Lead Material: Leads are copperclad steel with 30/70 solder coatings to allow both welding and soldering operations.
Body material: Epoxy coated metal body
Minimum Insulation Resistance: Dry, 10,000 megohm; Wet, 100 megohm
Minimum Dielectric Withstanding Voltage: Atmospheric, 500V RMS; Reduced, 325V RMS
Insulation Flammability: Resistor insulation is self extinguishing within 10 seconds after externally applied flame is removed.
Current Rating: 25 amps at 25°C, derating to 0 amps at 150°C
Reel Capacity: 5000 pcs

APPLICATIONS

Jumper wires or crossovers, as they are sometimes called, are basically interconnection devices between points on a PC board.
Generally they are used for the following reasons:

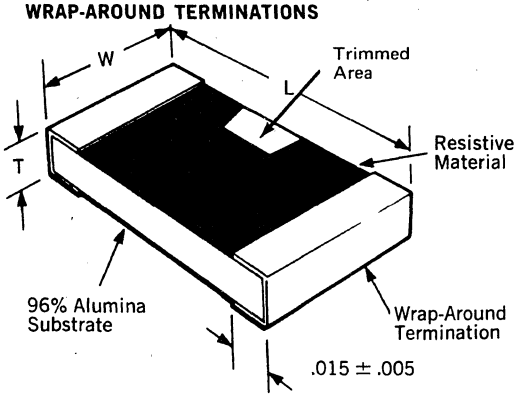
- Inability to connect two points on a PC board due to other circuit paths which must be crossed over.
- An after-the-fact design change that requires new point connections.
- Circuit tuning by changing point connections.

CHIP RESISTORS (THICK FILM)

FEATURES

- Eliminates expensive multiple screenings
- Provides very low to very hgh resistance values (trimmed to your specific order)
- Wrap-around terminations provide assembly ease and reliability
- Allows high density packaging
- Offers uniform tolerances — to 1%
- Can be wave-soldered directly to the back of a P.C. board
- Can be color-coded for identification
- High reliability-manufactured to meet MIL-R-55342C standards (see chart)
- High purity alumina substrate
- Precision performance-resulting from tight TCR, close tracking and excellent environmental performance
- Backside metalization available on request.

WRAP-AROUND TERMINATIONS



- Technical information and samples available without obligation.

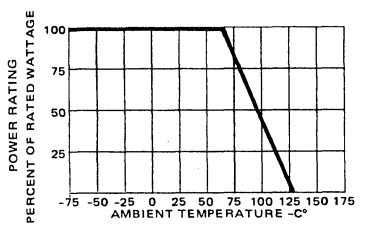
SIZES

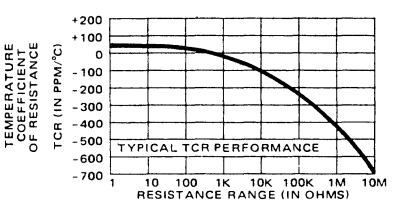
Style*	Resistance Range	Power Rating at 25°C	Length (L) ± .005" (.13)	Width (W) ± .005" (.13)	Thickness (T) ± .005" (.13)
Ec	5 Ω - 50 meg	75 mw	.050" (1.27)	.030" (.76)	.020" (.5)
A	1 Ω - 50 meg	125 mw	.050" (1.27)	.050" (1.27)	.020" (.5)
B	1 Ω - 50 meg	200 mw	.075" (1.91)	.050" (1.27)	.020" (.5)
C	5 Ω - 100 meg	250 mw	.100" (2.54)	.050" (1.27)	.020" (.5)
D	5 Ω - 100 meg	700 mw	.150" (3.81)	.050" (1.27)	.020" (.5)
E	5 Ω - 100 meg	1 w	.100" (2.54)	.100" (2.54)	.020" (.5)
F	5 Ω - 100 meg	2 w	.200" (5.08)	.100" (2.54)	.020" (.5)
G	5 Ω - 100 meg	500 mw	.225" (5.7)	.075" (1.9)	.020" (.5)
H	5 Ω - 100 meg	300 mw	.125" (3.2)	.060" (1.6)	.020" (.6)

*Other values and sizes available on special orders.

PERFORMANCE CHARACTERISTICS

CHARACTERISTIC	TEST METHOD	REQUIREMENT
Temperature Coefficient	MIL-STD-202F, Method 304 — 55°C to + 125°C	± 200 PPM/°C (± 50 PPM/°C available)
Thermal Shock	MIL-STD-202F, Method 107 5 cycles, — 55°C to + 125°C	± 0.5% max.
Low Temperature Operation	MIL-R-55342C, Para. 4.7.4 One hour at — 55°C followed by 45 minutes RCWV	± 0.5% max.
Short Time Overload	MIL-R-55342C, Para. 4.7.5 2.5 times RCWV for 5 sec at 25°C not exceeding 80 volts	± 0.5% max.
High Temperature Exposure	MIL-R-55342C, Para. 4.7.6 125°C for 100 hours	± 1.0% max.
Resistance to Bonding Exposure	MIL-R-55342C, Para. 4.7.7 Soldered to test board at 260°C for 10 seconds	± 0.25% max.
Moisture Resistance	MIL-STD-202F, Method 106 10 cycles, total 240 hours	± 0.5% max.
Life	MIL-STD-202F, Method 108A 2000 hours at 70°C, RCWV intermittent	± 2.0% max.
Solderability	MIL-STD-202F, Method 208 230°C for 5 seconds	95% min. coverage
Termination Adhesion	MIL-R-55342C, Para. 4.7.12 15 gram pull for 30 seconds	15 gram minimum
Maximum Operating Voltage		100 WVDC (Not to exceed maximum power)
TCR Tracking		± 5 PPM/°C (From same lot)

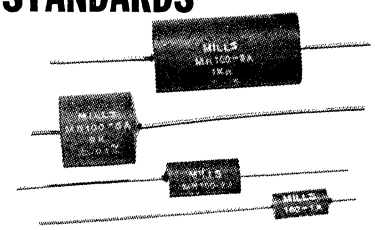




MICROPLEX, INC.
2126 So. Lyon St., Santa Ana, CA 92705 (714) 979-8833

PRECISION WIREWOUND RESISTORS

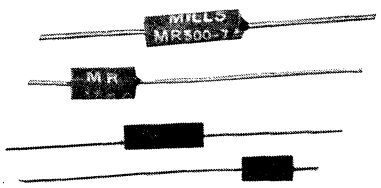
STANDARDS



Part No.	Watt	Max. R	Dia.	Length	Lead
MR100-1	.15	100K	.187	.375	#22
MR100-2	.25	1.5M	.250	.500	#22
MR100-3	.30	2.75M	.250	.750	#22
MR100-4	.35	3.0M	.375	.625	#20
MR100-5	.50	4.0M	.375	.828	#20
MR100-6	.50	5.0M	.50	.50	#20

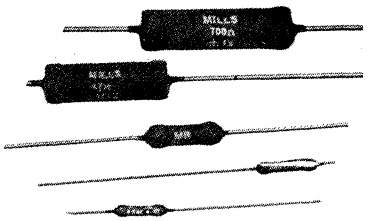
- Lead Configuration:
  "A" after Part No. 1 Axial Leads
  "R" for Radial Leads
  "L" for Lugs
- For high speed applications (minimum distributed L and C) specify MR200 Series.
- For high stability applications specify MR300 Series.
- Tolerance: .005% and up; to .002% in some cases.
- Metric sizes available, ask for our Metric Flyer.

MINIATURE PARTS



Part No.	Watt	Max. R	Dia.	Length	Lead
MR500-1	.04	100K	.080	.210	#20
MR500-2	.05	125K	.080	.375	#24
MR500-3	.04	100K	.125	.125	#24
MR500-4	.05	125K	.100	.210	#24
MR500-5	.10	125K	.125	.187	#24
MR500-6	.10	125K	.125	.250	

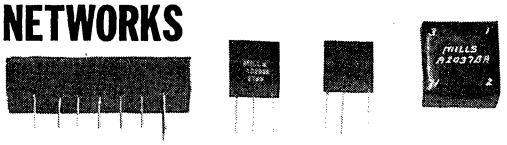
PRECISION POWER WIREWOUND RESISTORS



Part No.	Watt	Max. R	Dia.	Length	Lead
MRP-½-A	½	4.9K	.093	.343	#24
MRP-1-A	1	10.4K	.093	.406	#24
MRP-3-A	3	18K	.187	.562	#20
MRP-5-A	5	90K	.312	1.032	#18
MRP-10-A	10	370K	.344	1.719	#18

- To 10 watts.
- Silicone covered for maximum heat transfer.
- Tolerance: 5%, 1% standard, available to .05%.
- Ask for our Precision Power Flyer.

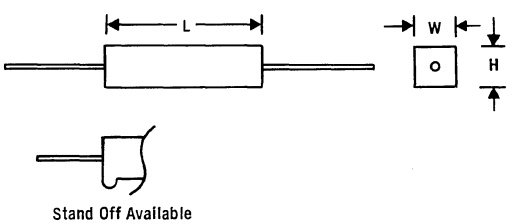
NETWORKS



- Any configuration you desire.
- Matched 2, 3 or 4 Network configurations available in standard sizes.
- Standard R, 2R, 4R types, etc. available.
- Tolerances: To .005%, closer in some cases;
  Temperature Coefficient tracking to 1 PPM; Ratio matches to .001%.
- Ask for our Network Flyer.

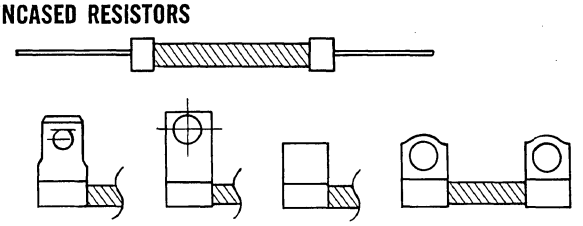
FIBERGLASS CORE WIREWOUND RESISTORS

CERAMIC-CEMENT ENCASED RESISTORS



Stand Off Available

UNCASED RESISTORS



Part No.	Watt	Dimensions W	H	L	Leads
MRW-5	5	⅜	⅜	⅞	#20
MRW-7	7	⅜	⅜	1⅜	#20
MRW-10	10	⅜	⅜	1⅞	#20
MRW-15	15	½	½	1⅞	#18
MRW-20	20	½	½	2½	#18
MRW-25	25	⅝	⅝	2½	#18

ELECTRICAL SPECIFICATIONS

Tolerance ±10%, ±5″ available
Wattage to 20 watts
Positive temperature coefficient parts are available

MECHANICAL INFORMATION

Variety of terminals available
Tin plated steel or brass lug terminal material
Axial leads — tinned copper or copperweld
Core is silicone impregnated fiberglass
Most dimensions per your requirements

MILLS RESISTOR COMPANY, INC.

3840 CATALINA STREET
LOS ALAMITOS, CA 90720
(213) 598-2454

7000 FRANKLIN BLVD.
SUITE 1070
SACRAMENTO, CA 95823
(916) 422-5461

CUSTOM BUILT OR STANDARD.....
..... MRC MEETS YOUR EXACT SPECS

MRC MILWAUKEE RESISTOR CORPORATION
704 W. VIRGINIA ST. • MILWAUKEE, WI 53204 • (414) 271-9900

Custom Roundwire Power Resistors

ALTHOUGH MILWAUKEE RESISTOR ALSO MANUFACTURES INDUSTRY **STANDARD** VITREOUS ENAMEL RESISTORS, OUR SPECIALTY IS SOLVING DESIGN PROBLEMS THROUGH CUSTOM INNOVATION. SOME OF THE CUSTOM POSSIBILITIES ARE SHOWN ON THIS PAGE.

AVAILABLE WATTAGE RATINGS by core size.
Ratings based on 325°C above 25°C ambient.

Watts	Core Size O.D.xI.D.xL.	Ohmic Range Fixed † Min Ω	Fixed † Max Ω	Adjustable † Min Ω	Adjustable † Max Ω	Part No.*
8 (5) †	5/16X3/16X1	.70	13.5K	N.A.	N.A.	5-16-Ω
12 (10)†	5/16X3/16X1 3/4	.12	66K	0.27	15.2K	5-28-Ω
11 (8)	7/16X5/16X1	6.15	3.1K	N.A.	N.A.	7-16-Ω
15 (10)	7/16X5/16X1 1/2	.19	21K	N.A.	N.A.	7-24-Ω
20 (15)†	7/16X5/16X2	.11	63K	N.A.	N.A.	7-32-Ω
26	7/16X5/16X3	.11	110K	N.A.	N.A.	7-48-Ω
25 (20)†	9/16X5/16X2	.22	35K	0.47	28K	9-32-Ω
31 (25)	9/16X5/16X2 1/2	.11	55K	0.68	40K	9-40-Ω
50 (35)†	9/16X5/16X4	.21	119K	1.31	78K	9-64-Ω
75	9/16X5/16X6	.33	207K	2.15	128K	9-96-Ω
24	3/4X1/2X1 1/2	.33	13K	N.A.	N.A.	12-24-Ω
30 (25)	3/4X1/2X2	.28	29K	0.62	26K	12-32-Ω
45 (35)	3/4X1/2X3	.18	63K	1.17	59K	12-48-Ω
51 (40)	3/4X1/2X3 1/2	.22	83K	1.44	79K	12-56-Ω
61 (45)	3/4X1/2X4	.27	97K	1.72	93K	12-64-Ω
65 (50)	3/4X1/2X4 1/2	.31	122K	2.0	117K	12-72-Ω
75 (60)	3/4X1/2X5	.35	134K	2.27	129K	12-80-Ω
90	3/4X1/2X6	.43	172K	2.82	167K	12-96-Ω
100†	3/4X1/2X6 1/2	.47	186K	3.1	181K	12-104-Ω
52	1X3/4X3	.15	43K	0.49	38K	16-48-Ω
70	1X3/4X4	.12	72K	0.75	66K	16-64-Ω
85	1X3/4X5	.16	106K	1.02	99K	16-80-Ω
105	1X3/4X6	.20	134K	1.29	127K	16-96-Ω
40 (33)	1 1/8X3/4X2	.48	7.9K	N.A.	N.A.	18-32-Ω
80	1 1/8X3/4X4	.12	53K	0.77	48K	18-64-Ω
95	1 1/8X3/4X5	.17	83K	1.07	79K	18-80-Ω
120	1 1/8X3/4X6	.21	106K	1.37	100K	18-96-Ω
130 (115)	1 1/8X3/4X6 1/2	.23	119K	1.51	114K	18-104-Ω
160	1 1/8X3/4X8	.31	160K	1.96	154K	18-128-Ω
175 (160) †	1 1/8X3/4X8 1/2	.32	169K	2.11	163K	18-136-Ω
225†	1 1/8X3/4X10 1/2	.41	214K	2.71	208K	18-168-Ω
235	1 1/8X3/4X11 1/4	.45	239K	2.94	230K	18-180-Ω
251	1 1/8X3/4X12	.48	259K	3.16	250K	18-192-Ω
220	1 5/8X1 1/8X8 1/2	.41	100K	2.69	98K	26-136-Ω
275	1 5/8X1 1/8X10 1/2	.55	131K	3.54	129K	26-168-Ω
300	1 5/8X1 1/8X11 3/4	.62	151K	4.10	149K	26-188-Ω
500‡	2 1/2X1 3/4X12	.98	58K	6.4	58K	40-192-Ω C
750‡	2 1/2X1 3/4X15	1.30	75K	8.4	75K	40-240-Ω C
1000‡	2 1/2X1 3/4X20	1.80	105K	11.6	104K	40-320-Ω C
850‡	3 1/4X1 3/4X15	1.65	50K	10.8	50K	52-240-Ω C
1150‡	3 1/4X1 3/4X20	2.30	69K	15.0	69K	52-320-Ω C

• Wattages shown in parenthesis are Navy ratings per Mil-R-15109.
† Resistors shown are standard wattages
*Add "A" after part number for adjustable types.
†For resistance values outside the limits shown, consult M.R.C.
‡ Cement coating standard — Silicone available.
• Unable to find what you need above? The same cores can be wound with ribbon wire for higher wattage capability

M.R.C. can build a resistor to your specifications on any of the basic cores shown here. (If these do not suit your need, contact M.R.C. for engineering assistance, as 32 additional cores are also available.)

When contemplating a custom resistor, consider the following options to meet your exact requirement(s):

- **SPECIAL APPLICATIONS**
- **SIZE LIMITATIONS**
- **MIL–R–15109**

SPECIAL TOLERANCE–
- Resistance tolerance to ±1% can be manufactured in many cases.

SPECIAL COATINGS–
- Silicone
- Cement
- Sand & Cement

SPECIAL TAPS–
- Taps can be provided to your specifications.

SPECIAL T.C.–
- Temperature coefficient to 20 ppm/°C.

SPECIAL WINDINGS–
- Ayrton-Perry (Non-inductive, round wire only)
- Bilfilar (Non-inductive)

SPECIAL TERMINALS–
- Single and double ¼" quick-connect
- Metal sleeve ferrule
- Live-bracket

HARDWARE–
- Terminal hardware
- L–Bracket mounting
- Spring clip mounting
- Vertical mounting hardware

LOAD BANKS–
- M.R.C. will custom design and build load banks to your requirements.

CUSTOM BUILT or STANDARD.....
.....MRC MEETS YOUR EXACT SPECS

MRC MILWAUKEE RESISTOR CORPORATION
DEPT. EM, 704 W. VIRGINIA ST. MILWAUKEE, WI 53204 414-271-9900

UNIQUE HI-OHM RIBWOUNDS .....
.....SAVE SPACE

MRC MILWAUKEE RESISTOR CORPORATION
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Vitreous Enamel Ribwound Resistors

APPLICATIONS

Particularly useful where high energy is to be dissipated in the lower ohmic ranges. Due to its ability to operate at higher temperatures and dissipate greater heat, the ribwound resistor is almost one-half the physical size of the equivalently rated round-wire style resistor. Ribwound wattage ratings are based on a temperature rise of 375°C above an ambient of 40°C. They may be mounted with spring clips (thru 1 1/8" dia.); thrubolt mounting hardware, individual or multiple-stacked bracket assemblies or live-bracket mountings.

BASIC CONSTRUCTION

Crimped ribbon resistance wire is edge-wound and then locked to the ceramic core with vitreous enamel. Resistance wire is spot-welded to the terminal bands. Ribwound resistors can be furnished in fixed, adjustable, or tapped styles and are also available with cement coating.

OHMS	OHMS	OHMS
0.1	1.0	6.0
0.15	1.25	8.0
0.2	1.5	10.0
0.25	2.0	12.0
0.4	2.5	15.0
0.5	3.0	20.0
0.6	4.0	25.0
0.75	5.0	33.0

Many 300 watt units are stocked in both fixed and adjustable styles. Listed are the more popular 300 watt ohmic values. All other wattage ratings and styles are made to order.

HI–OHM RIBS
Exclusively from M.R.C.

You may note on the adjacent chart that maximum ohmic values shown for each wattage are three or more times that normally available.

This development is the result of the installation of precision rib winding machines designed and manufactured by M.R.C.

Unique in the industry, these precision machines produce a winding with extreme uniformity, as close inspection of M.R.C. ribwound resistors will reveal. The uniform winding allows turns to be applied much closer to each other and consequently significantly higher resistances are achieved.

This means that lower ohmic value round wire power resistors may feasibly be replaced by HI–OHM RIBS with a significant saving in size. (For a given wattage rating, ribwounds are considerably smaller physically.)

WATTS	CORE SIZE	OHMIC RANGE#		PART NUMBER	
	O.D. X I.D. X L.	FIXED	ADJ.	FIXED	ADJ.
40	$^{9}/_{16}$X$^{5}/_{16}$X2	.010-9.4	N.A.	9-32-Ω R	USE SAME PART NUMBER BUT SUBSTITUTE "AR" FOR "R".
50	$^{3}/_{4}$X$^{1}/_{2}$X2	.010-6.1	N.A.	12-32-Ω R	
60	$^{3}/_{4}$X$^{1}/_{2}$X2$^{1}/_{2}$	.010-12.2	N.A.	12-40-Ω R	
75	$^{3}/_{4}$X$^{1}/_{2}$X3	.010-18.3	N.A.	12-48-Ω R	
90	$^{9}/_{16}$X$^{5}/_{16}$X4	.016-28.0	.014-25.0	9-64-Ω R	
100	$^{3}/_{4}$X$^{1}/_{2}$X3$^{1}/_{2}$	.013-24.0	.011-20.0	12-56-Ω R	
110	$^{3}/_{4}$X$^{1}/_{2}$X4	.016-30.0	.014-26.0	12-64-Ω R	
120 (110)	$^{3}/_{4}$X$^{1}/_{2}$X4$^{1}/_{2}$	.020-36.0	.018-32.0	12-72-Ω R	
135	$^{3}/_{4}$X$^{1}/_{2}$X5	.022-42.0	.020-39.0	12-80-Ω R	
150	1$^{1}/_{8}$X$^{3}/_{4}$X4	.023-44.0	.020-39.0	18-64-Ω R	
160	$^{3}/_{4}$X$^{1}/_{2}$X6	.029-55.0	.027-51.0	12-96-Ω R	
160 (155)	1$^{1}/_{8}$X$^{3}/_{4}$X4$^{1}/_{4}$	.025-49.0	.022-43.0	18-68-Ω R	
175	1$^{1}/_{8}$X$^{3}/_{4}$X4$^{1}/_{2}$	.027-53.0	.024-48.0	18-72-Ω R	
180	$^{3}/_{4}$X$^{1}/_{2}$X6$^{1}/_{2}$	.032-61.0	.030-57.0	12-104-ΩR	
220	1$^{1}/_{8}$X$^{3}/_{4}$X6	.041-80.0	.038-74.0	18-96-Ω R	
225 (220)	1$^{1}/_{8}$X$^{3}/_{4}$X6$^{1}/_{8}$	.040-82.0	.035-77.0	18-98-Ω R	
240 (240)	1$^{1}/_{8}$X$^{3}/_{4}$X6$^{1}/_{2}$	.041-89.0	.038-83.0	18-104-Ω R	
300 (300)†	1$^{1}/_{8}$X$^{3}/_{4}$X8$^{1}/_{2}$	.057-125	.055-119	18-136-Ω R	
375	1$^{1}/_{8}$X$^{3}/_{4}$X10$^{1}/_{2}$	.074-161	.071-155	18-168-Ω R	
400	1$^{1}/_{8}$X$^{3}/_{4}$X11$^{1}/_{4}$	.080-174	.077-168	18-180-Ω R	
400 (400)	1$^{5}/_{8}$X1$^{1}/_{8}$X8$^{1}/_{2}$	.066-159	.062-149	26-136-Ω R	
420	1$^{1}/_{8}$X$^{3}/_{4}$X11$^{3}/_{4}$	.084-183	.081-177	18-188-Ω R	
500 (500)	1$^{5}/_{8}$X1$^{1}/_{8}$X10$^{1}/_{2}$	.087-200	.083-200	26-168-Ω R	
550 (550)	1$^{5}/_{8}$X1$^{1}/_{8}$X11$^{3}/_{4}$	.100-240	.096-230	26-188-Ω R	
750‡	2$^{1}/_{2}$X1$^{3}/_{4}$X12	.140-166	.130-157	40-192-Ω RC	
1000‡	2$^{1}/_{2}$X1$^{3}/_{4}$X15	.183-210	.176-200	40-240-Ω RC	
1500‡	2$^{1}/_{2}$X1$^{3}/_{4}$X20	.250-300	.240-290	40-320-Ω RC	
2000‡	3$^{1}/_{4}$X1$^{3}/_{4}$X20	.300-390	.290-380	52-320-Ω RC	

 # Standard resistance tolerance is ±10% - closer on request.
† Stock wattage - see stock list this page.
‡ Cement coating is standard rather than vitreous enamel.
Wattages in parenthesis are Navy ratings per Mil-R-15109, Form EW.

UNIQUE HI-OHM RIBWOUNDS .....
.....SAVE SPACE

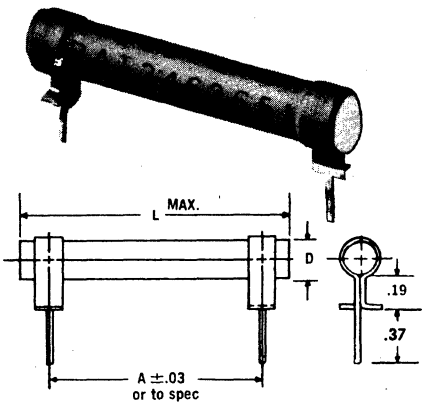
MRC MILWAUKEE RESISTOR CORPORATION

DEPT. EM, 704 W. VIRGINIA ST. MILWAUKEE, WI 53204 414-271-9900

MILWAUKEE RESISTOR CORPORATION
704 W. VIRGINIA ST. MILWAUKEE, WI. 53204 414-271-9900

ON TIME DELIVERIES.....
.....DATE GUARANTEED when required

PCB Printed Circuit Board Resistors*



FIXED PCB'S

WATTS	L	A	D	MAX. OHMS
3	1	0.6	13/64	20,000
5	1 1/4	0.9	13/64	38,000
7	1 5/8	1.3	13/64	69,000
10	2.1	1.7	13/64	86,000
15	2.1	1.7	5/16	85,000
20	2 1/2	2.2	5/16	113,000

ADJUSTABLE PCB'S

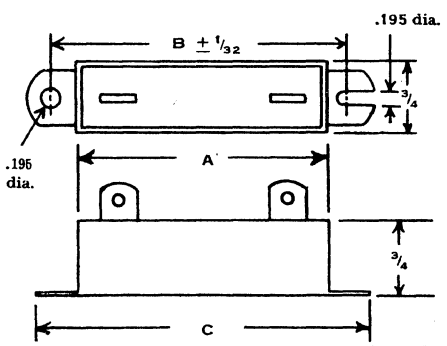
WATTS	L	A	D	MAX. OHMS
15	2.1	1.7	5/16	2,000 ‡
20	2 1/2	2.2	5/16	3,000 ‡

‡=FOR HIGHER OHMS, CONSULT FACTORY

FEATURES

- Built-in standoff keeps board cool.
- Mounting feet prevent rocking.
- Power ratings 3 to 20 watts.
- Complete OHM range.
- One-piece, welded terminals
- Rectangular leads .020 x .040 in.
- Silicon base coating. Vitreous enamel coating available.
- Standard tolerance ±5%.
- 20 PPM upon request.

* Patent #3,462,651

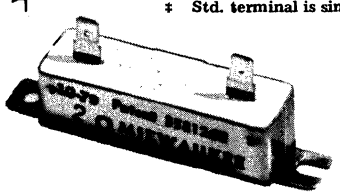


TERMINALS TO CUSTOMER SPECIFICATIONS—Screw Lug, Quick-Connect.

WATTS Ratings at 275°C rise showing benefit of mounting flush for full heat sink.††		DIMENSIONS			PART NUMBER
Without Heat Sink	With Heat Sink	A	B	C	(Specify Terminal)
20	45	1	1 7/16	1 7/8	12M16-Ω †
40	70	2 1/2	3	3 3/8	12M40-Ω ‡
50	100	3 11/16	4 1/8	4 9/16	12M59-Ω ‡

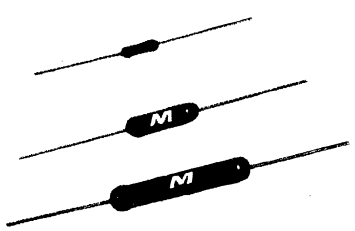
†† Ratings based on mounting on steel panel 10" x 10" x .040"; (heat transfer to heat sink is improved by the use of thermal conductive grease or epoxy).
† Std. terminal is 3/16" wide with hole, Type AB.
‡ Std. terminal is single quick connect, Type H.

Metal Case



High Heat Sink—flush mounting dissipates heat.
20 to 100 Watts — higher on Specials
Quick Connect or Screw Terminals
Save: Space -First Cost- Assembly Cost
Patent #3,581,266
WRITE FOR ADDITIONAL INFORMATION

Axials



APPLICATIONS
- Electronic Circuitry
- Printed Circuits
- Radio, Television and Sound Reproduction
- Miniature Controls

FEATURES
- Rugged yet small.
- Highly stable.
- Matched expansion in core caps and coating for temperature stability.
- Standard 5% tolerance over 1 ohm, available in close tolerances on request.
- Wattage ratings based on 325°C rise at 25°C ambient.
- Standard Sizes—3, 6.5, 11 watts.
- Leads Hot Tin Dipped.

Ovals

OVAL RESISTORS are for use where space saving is desired and where the use of the 'Heat Sink' function of the metal chassis, rack or panel may be employed. Resistance tolerance of ±5% is standard except on low resistance and multi-tapped units. COATINGS of vitreous enamel or silicone base are offered.

OVALS are available in regular or miniature sizes; an original development of MILWAUKEE Resistor.

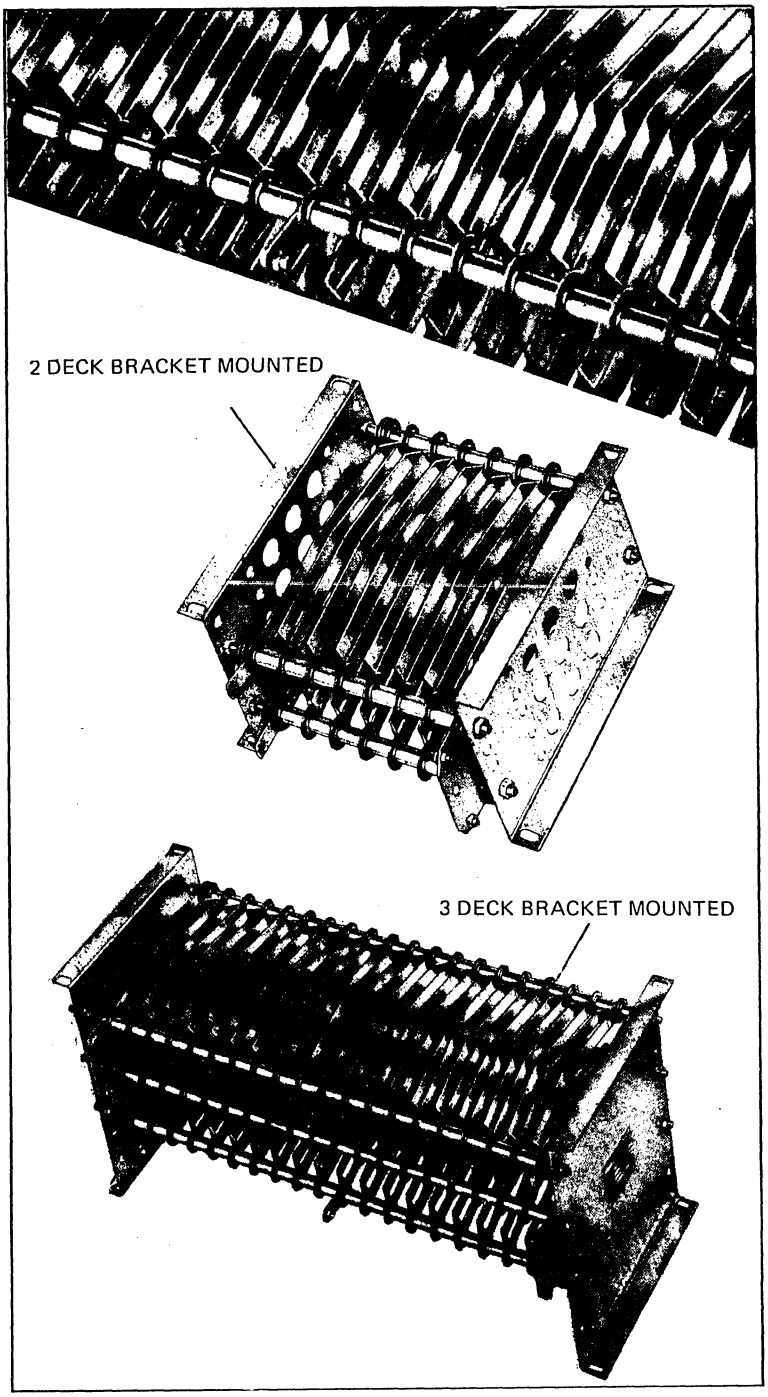
MILWAUKEE RESISTOR CORPORATION
704 W. VIRGINIA ST. • MILWAUKEE, WI 53204 • (414) 271-9900

EXCLUSIVE PATENTED*, PRE-FORMED.....
.....GRID ELIMINATES WARPING PROBLEMS

Grid Resistors *

For High Current and High Power Circuits

COMPUTER AIDED DESIGN – All Milwaukee Grids are designed for the specific application involved at no extra cost. Without the constraints of standard resistance and current ratings, Milwaukee can offer a grid for your exact need, often at a considerable saving in cost.



APPLICATIONS WHERE RUGGED MILWAUKEE GRIDS ARE IN USE.....

- Motor Starting
- Speed Control
- Braking
- Power Systems
- Heaters
- Crane Controls
- Dummy Loads
- Grounding Resistors
- Feedback Resistors

* Patent 3,212,045

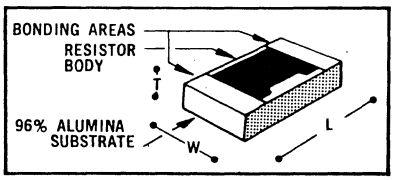
MILWAUKEE RESISTOR CORPORATION

EXCLUSIVE, PATENTED*, PRE-FORMED .....
.....GRID ELIMINATES WARPING PROBLEMS

DEPT. EM, 704 W. VIRGINIA ST. MILWAUKEE, WI 53204 414-271-9900

PRECISION THICK/THIN FILM CHIP RESISTORS

MINI-SYSTEMS, INC
20 David Road, P.O. Box 69, North Attleboro, MA 02761
TELEPHONE: (617) 695-0203 • TWX NO. 710-348-0564



MINI-SYSTEMS, INC., thick/thin film chip resistor components are ideally suited for the fabrication of microelectronic circuits where tight resistance tolerance, wide range of resistance values, or short production runs make the conventional screening and firing of thick/thin film resistance networks too costly. MINI-SYSTEMS, INC., chip resistors are made from a carefully engineered selection of materials. Geometries are mechanically precise and uniform. Careful testing and inspection result in the highest quality resistors.

STANDARD "MSR" SERIES

- Sizes Available: .035″ x .035″ up to .661″ x .494″.
- PDIS Rating (25°C free air): 35 mW to 12,000 mW.
- Resistors manufactured with palladium silver or platinum gold.
- Tolerances available: ±.25%, 1%, 2%, 5%, 10%, and 20% for most resistance values.
- All types available in untinned versions for conductive epoxy attachment.
- Hi-Rel screening available on all resistor types.
- Backside metalization available upon request.
- "Flip-Chip" resistors are solder tinned (SN-62).
- Wire bond resistors have gold metalization optimized for wire bonding.
- Sandwich metalization standard on all wrap-around resistors.

Wrap-Around Terminations

WA-	Size (L x W)	PDIS Rating 25°C Free Air (Milliwatts)	Ohmic Range
10	.040 x .037	35	1Ω to 75MΩ
4	.057 x .052	125	1Ω to 100MΩ
13	.083 x .052	200	1Ω to 100MΩ
9	.110 x .052	250	1Ω to 100MΩ
7	.110 x .102	500	1Ω to 100MΩ
24	.160 x .052	300	1Ω to 100MΩ

Write for free literature with detailed resistor chart.

ESTABLISHED RELIABILITY QPL MIL-R-55342 CHIP RESISTORS FOR ALL CRITICAL APPLICATIONS

- Sizes 55342/1 through /6
- Terminations Available: S, R, W, T, U
- Tolerances Available: F, G, J, K
- Meet or exceed Characteristic M
- Delivery: Typically 4 to 6 weeks ARO

NEW LOW COST "JR" SERIES COMPUTER/INDUSTRIAL GRADE WRAP AROUND CHIP RESISTOR

TYPE #JR13 — .075(L) x .050(W) x .017(T)

- Resistance Range: 10Ω to 10MΩ to standard EIA/MIL/IEC resistance decade values.
- PDIS Rating (25°C free air): 200 milliwatts.
- Untinned for either epoxy or solder attachment.
- Immediate delivery from stock.

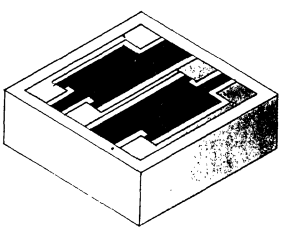
THIN FILM

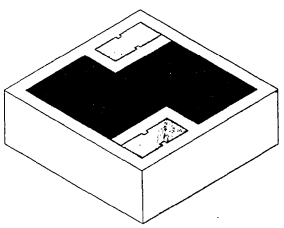
MSTF-2 SERIES (.020″ x .020″)

MSTF-3 SERIES (.030″ x .030″)

MSTF-4 SERIES (.040″ x .040″)

CUSTOM NETWORKS





MSTF-3 FORMAT A **MSTF-3 FORMAT B**

- Nichrome or Tantalum Nitride
- Choice of Substrates:
  a) Oxidized Silicon −.010″ ±.003″
  Oxide Thickness −12,000 Å ±2,000 Å
  b) Ceramic, 99.6% −.010″ ±.001″
- Values range through the RETMA Series from 1Ω up to 10 megohm, depending on chip size.
- Tolerances: ±20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% for most values.
- Backside gold available (3,000 Å typ.) on request.
- MSTF-3 series includes standard center tap dual resistor pattern.
- Visual requirements designed to meet MIL-STD-883 Method 2010.6 with full lot traceability of material and processing.
- Bond pad size: .005″ x .005″ minimum. Bond pad conductor material: Gold (10,000 Å typ.) standard. Bondable with normal wire bonding methods, such as thermocompression, thermosonic, or ultrasonic.
- Nichrome resistors passivated with silicon dioxide (5,000 Å typ.) for moisture protection and reliability. TCR (absolute) can be provided from 0-25 ppm. Special TCR's available on request.
- Noise: −30 to −35 dB typical for most values.
- Stability: 0.05% max. 0.02% typical. ± .003% typical Ratio. (After 1000 hours @ + 125°C.)
- Trimmable: Designed for later active trimming with Xenon or YAG Laser.
- Chip or Packaged

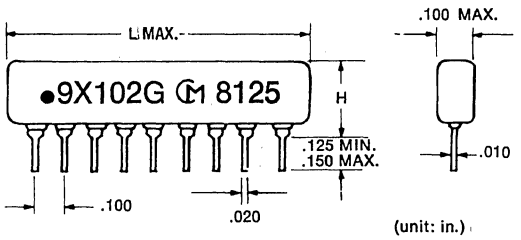
FOR ANY CUSTOM REQUIREMENTS, CONTACT FACTORY

THICK/THIN MULTILAYER SUBSTRATES/ HYBRID MICROCIRCUITS

MINI-SYSTEMS, INC. has the latest materials technology processing capabilities for thick film multilayer substrates/monolithic thick film substrates, and custom resistor networks coupled with complete facilities for hybrid assembly, packaging, and testing. Fully automatic wire bonders and fully automatic laser trim systems give substantial production quantity capabilities.

sip resistor networks

MURATA ERIE NORTH AMERICA, INC.



⅛ Watt H = .200
⅛ Watt H = .250
¼ Watt H = .336 (Except RSC___Y—.250)

X-CIRCUIT

No. Pins	No. of Elements	L
4	3	0.395
5	4	0.495
6	5	0.595
7	6	0.695
8	7	0.795
9	8	0.895
10	9	1.024
11	10	1.100
12	11	1.200
13	12	1.300

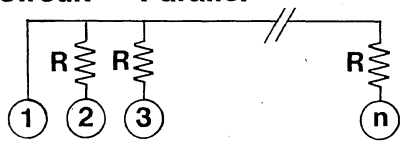
Y-CIRCUIT

No. Pins	No. of Elements	L
6	3	0.595
8	4	0.795
10	5	1.024
12	6	1.200

Z-CIRCUIT

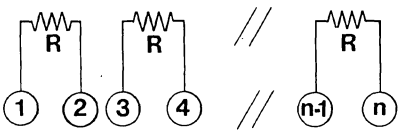
No. Pins	No. of Elements	L
6	8	0.595
8	12	0.795
9	14	0.895
10	16	1.024

X-Circuit — Parallel



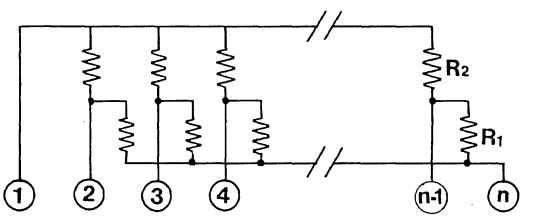
12 Elements Max. N = Pins 4 through 13

Y-Circuit — Discrete



6 Elements Max. N = 6, 8, 10 and 12 Pins

Z-Circuit — Double Termination



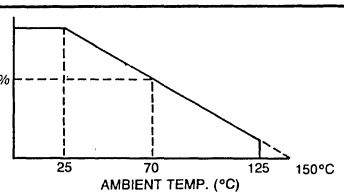
16 Elements Max. N = 6, 8, 9 and 10 Pins

SPECIFICATIONS

Electrical

Temp. Range:	−55°C to +125°C
Resistance Range:	47Ω to 750KΩ (22Ω to 1MΩ available on special request)
Resistance Tolerance:	±2% (G), ±5% (J), ±10% (K), ±20% (M)
Temp. Coefficient:	±200 ppm/°C max. (±100 ppm/°C max. on special order)
Power:	RSC-125 mW max./resistor or 1.5W max./package (whichever is smaller) RSH-250 mW max/resistor or 2.5W max./package (whichever is smaller)

Power Derating Characteristics:



Mechanical

Substrate Material:	Alumina
Resistor Material:	Cermet, thick film
Lead Pull Strength:	2 lbs.
Lead Material:	Tinned Copper Alloy

STANDARD RESISTANCES

Res. (ohms)	Code	Res. (ohms)	Code	Res. (ohms)	Code	Res. (ohms)	Code
100	101	1K	102	10K	103	100K	104
150	151	1.5K	152	15K	153	150K	154
220	221	2.2K	222	22K	223	220K	224
330	331	3.3K	332	33K	333	330K	334
470	471	4.7K	472	47K	473	470K	474
680	681	6.8K	682	68K	683	680K	684

TYPICAL RESISTANCE COMBINATIONS*

R_1/R_2	R_1/R_2	R_1/R_2
160/240	330/390	330/390
180/390	330/470	1.5K/3.3K
220/330	330/680	3K/6.2K

*** Note 1:** In addition to $R_1 = R_2$ resistance combinations, the typical resistor combinations shown in the chart are available on special order.
2: RC networks also available. Contact Murata Erie for technical details.

MARKING: Pin 1 Location, No. of Pins, Circuit Type, Res. Value, Tolerance, 4 = RSH ¼W only

PART NUMBERING SYSTEM

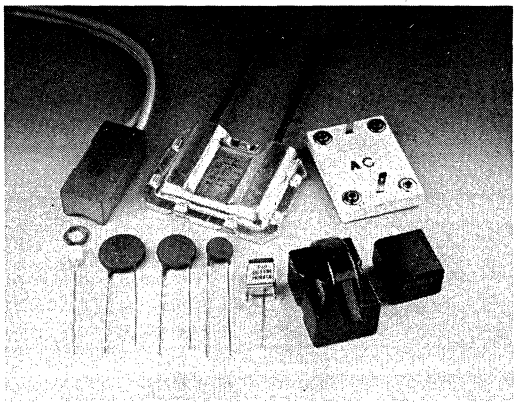
RSC 6 X 102 G

- **RSC** — SINGLE IN-LINE RESISTOR NETWORK: RSC = ⅛W, RSH = ¼W
- **6** — NO. OF PINS
- **X** — CIRCUIT TYPE: X = Parallel, Y = Discrete, Z = Double Termination
- **102** — RESISTANCE CODE: First two digits are significant. Last indicates number of zeros.
- **G** — RESISTANCE TOLERANCE: G = ±2%, J = ±5%, K = ±10%, M = ±20%

MURATA ERIE NORTH AMERICA, INC. 1148 Franklin Rd., S.E., Marietta, Georgia 30067 Tel: (404) 952-9777 Telex: 54-2329 TWX: 810-766-1531

posistor® positive temperature coefficient resistors

MURATA ERIE NORTH AMERICA, INC.

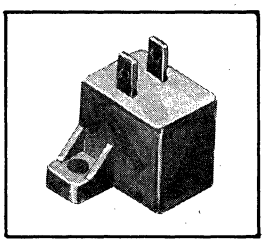


Murata Erie Posistors are basically positive temperature coefficient resistors with a very well defined resistance-temperature "knee" and the unique ability to "switch" relatively large amounts of power. They may also be used as self-regulating heating devices at useful power levels and as control devices for high power heaters. Applications include temperature sensing, over temperature and over current protection and motor starting to name a few.

Products utilizing Positors are extremely safe and reliable and offer all of the design, manufacturing, repair and sales advantages of solid state technology.

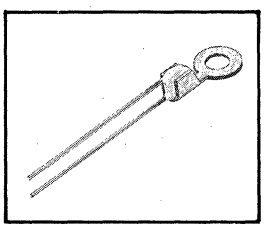
- Compact
- Reduced component count
- Extremely reliable
- "Stepless" temperature control
- Simple repair or replacement
- Long term reliability
- Shock and vibration immunity
- Nonflammable case and insulation available
- No electrical or acoustical noise
- No electrical contacts

FOR MOTOR STARTING



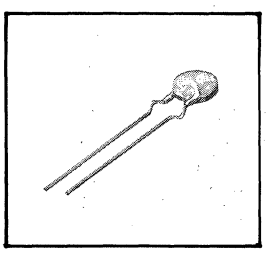
Provides a smooth, solid state electronic starting device for single phase motors utilizing a split-phase starting winding or for PSC motors as a direct replacement for starting capacitors and switches.

FOR SEMICONDUCTOR OVERLOAD PROTECTION



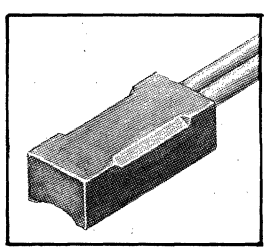
Senses the case temperature of high power semiconductors and appropriately reduces the power dissipation when dangerous power or current levels are reached by switching to a high resistance state and reducing base bias current.

FOR CIRCUIT PROTECTION



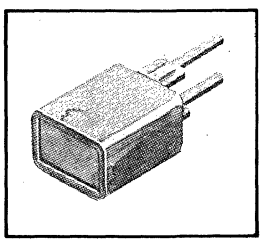
Provides overcurrent protection in a variety of applications. When connected in series with the protected device, Posistors limit the circuit current to a predetermined value — above that value they switch to a high resistance state and limit the current to a safe level.

FOR FREEZE PROTECTION



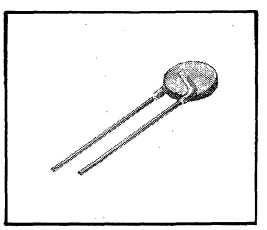
Designed for water filled pipe freeze-protection. Self-temperature regulating. As temperature decreases the Posistor power dissipation increases creating more heat that is conducted to the pipe (approximately 25 watts @ −20°C).

FOR DEGAUSING



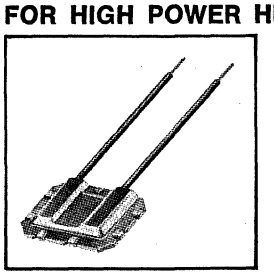
Used in series with CRT degausing coils, the Posistor functions as an automatic switch that goes to a high resistance state in a fixed time period after power is applied, effectively eliminating the current that flows through the degausing coil.

FOR TRANSFORMER PROTECTION



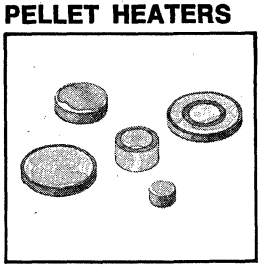
These devices are connected mechanically to the transformer core and electrically in series with the transformer primary. If core temperature exceeds temperature specs, the Posistor switches to a high resistance state and limits input current. It resets automatically when temperature returns to normal.

FOR HIGH POWER HEATING



Posistors for heating are self-temperature regulating with fast thermal response and power ratings to 170 watts.

PELLET HEATERS



Basic Posistor elements are available in a variety of shapes and electrical characteristics to meet custom application requirements.

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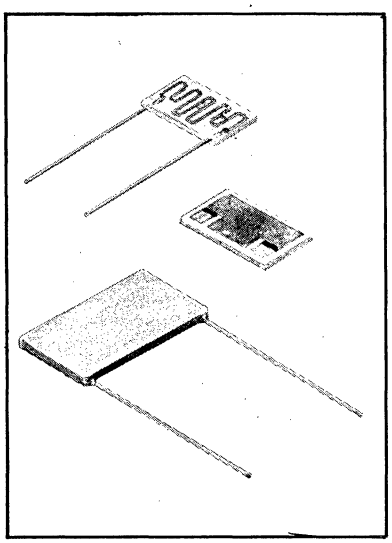
high voltage resistors

MURATA ERIE NORTH AMERICA, INC.



HV resistors

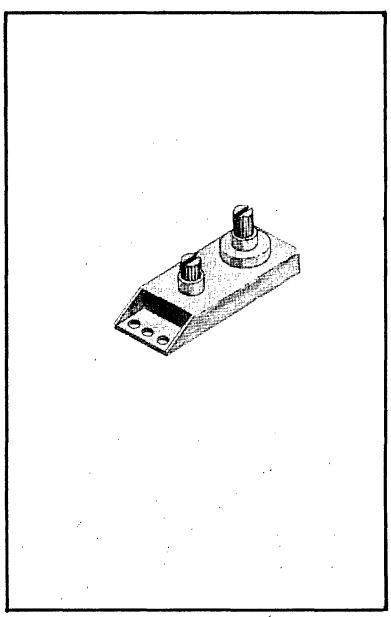
Murata Erie's line of high voltage resistors are designed to replace high voltage carbon film resistors and feature an extremely rigid alumina substrate with a deposited *thick film* resistance element for maximum electrical and mechanical stability.

Three models are offered — the *P Series* is for subassemblies that will be encapsulated in epoxy resin after assembly, the *D Series* which is supplied completely encapsulated and the *F Series* which is supplied encapsulated but without leads.

Murata Erie's application engineers are available to aid in the selection of exactly the right high voltage resistor to meet specific application requirements.

SPECIFICATIONS

Voltage Range	10 to 35 KV
Resistance Range	1 to 5000 Megohms
Power Rating	3 to 5 Watts at −70°C
Operating Temperature Range	−25°C to +130°C
Temperature Coefficient	±150 ppm/°C
Tolerance	±2% to ±20%



focus adjusting resistors

Murata Erie's focus adjusting resistors are designed to meet the stringent demands of high voltage CRT power supply applications. They are offered in a variety of configurations including those with integral capacitors and multiple taps such that most application requirements can be easily met.

TYPICAL CHARACTERISTICS

Item	Condition	Performance
Rated Power	Ambient Temperature: −20°C to +70°C	3W Max.
Temperature Coefficient	Ambient Temperature: −20°C to +120°C	±300 ppm/°C
Voltage Coefficient	Impressed Voltage: 1/10 Rated Voltage (to rated Voltage)	±3 ppm/Volt
Load Life	Ambient Temperature: 70°C; Impressed Voltage: Rated Voltage; Impressed Time: 1000 hours (90 minutes ON, 30 minutes OFF)	$\triangle R \leqq \pm 5\%$ $\triangle N \leqq \pm 3\%$
Humidity Characteristics	Ambient Temperature: 40°C; Relative Humidity: 95%; Shelf Time: 1000 hours	$\triangle R \leqq \pm 5\%$ $\triangle N \leqq \pm 3\%$
Thermal Shock Characteristics	1 cycle is −30°C (1 hour) to +130°C (1 hour) — Repeat 10 cycles	$\triangle R \leqq \pm 3\%$ $\triangle N \leqq \pm 2\%$
Withstanding Voltage	Impressed Voltage: 1½ Rated Voltage; Impressed Time: 1 minute	$\triangle R \leqq \pm 3\%$ No failure

△R denotes variation of resistance value. △N denotes variation of tapped resistance ratio.

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ORANGE STREET, DARLINGTON, S. C. 29532
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RESISTORS

TYPE S RESISTOR ITEM DESCRIPTION

Sage Part Number identification consists of a combination of numerals and letters according to the following guide. This is the nomenclature ordinarily marked on resistors and it fully serves the purpose of purchased item description except for limited cases of special testing. Note that grouping of characters is not constant, but varies to fit descriptive need of a given part.

STYLE DESIGNATION

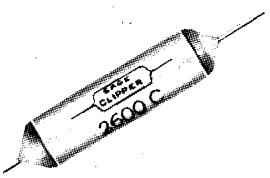
1500 — Body type, size, lead details per catalog chart

S / **NS** — **S** = single layer wound; **NS** = non-inductively wound

B — If applicable. Core Material and Process Classification:
Blank entry indicates regular steatite core, commercial processing
A = alumina core, commercial processing **P** = alumina core, High Rel processing
B = beryllia core, commercial processing **M** = beryllia core, High Rel processing

2740 — Nominal Value, Ohms (decimal symbol, as required, is used in both nominal value and tolerance)

1 — ±% tolerance



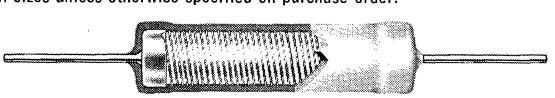
TYPE C

TYPE S

TYPE S CONSTRUCTION

Showing ceramic core, spaced single layer winding, welded to stainless steel cap, and multiple layer coating.

Copperweld leads 60/40 Hot Solder Dip. Lead Length 2" ±1/16* is supplied on all sizes unless otherwise specified on purchase order.



*Except 250S and 500S Styles, which are 1½" minimum.

TYPE C METAL SHEATHED RESISTORS

Similar in all respects to Type S, fully insulated plus addition of metal sleeve for heat sink mounting in spring clip holders.
Full heat sink rating.

STYLE	Rating Watts
	Full heat sink rating
2200C	6
2250C	6
2400C	7
2550C	11
2600C	14

SAGE BODY STYLE NO.	WATTAGE DATA (25°C AMBIENT) IND. STD.	SAGE CAPABILITY CHAR. G OR U 275°C	SAGE CAPABILITY CHAR. V 350°C	PHYSICAL DATA LEAD WIRE AWG NO.	PHYSICAL DATA BODY LENGTH INCHES	PHYSICAL DATA BODY DIAMETER INCHES	BODY DIELECTRIC STRENGTH VOLT rms	STD. RESISTANCE RANGE REGULAR WINDING MIN.	REGULAR WINDING MAX.	NON-INDUCTIVE MIN.	NON-INDUCTIVE MAX.
100S	1	1.2	1.7	24-.020	.400 Nom.*	.094±.031	500	0.1	8400	10	3000
200S	2	2.1	3	24-.020	.400 Nom.*	.125±.031	500	0.1	11,000	10	3900
250S	.25	.6	1	24-.020	.250±.031	.078±.016	500	0.1	3800	10	1350
300S	3	3	3.6	24-.020	.400 Nom.*	.187±.031	500	0.1	15,000	10	5300
500S	.5	.9	1.2	24-.020	.312±.031	.078±.016	500	0.1	5000	10	1750
1000S	1	1.2	1.7	24-.020	.406±.031	.094±.031	750	0.1	8400	10	3000
1100S	2	2.3	3.4	20-.032	.500±.062	.125±.031	1000	0.1	15,000	10	5500
1200S	2, 3	3	4	20-.032	.500±.062	.187±.031	1000	0.1	20,000	10	7000
1240S	3	3.2	4.2	20-.032	.562±.062	.187±.031	1000	0.1	24,000	10	8400
1250S	2, 3	3.5	5	20-.032	.812±.062	.187±.031	1000	0.1	40,000	10	14,000
1300S	3	4.2	5.5	18-.040	.625±.062	.250±.031	1000	0.1	30,000	10	10,500
1400S	3, 4	4.3	5.6	18-.040	.750±.062	.250±.031	1000	0.1	42,000	10	15,000
1500S	5	5.3	7.5	18-.040	.875±.062	.312±.031	1000	0.1	71,000	10	25,000
1550S	5	6	8	18-.040	1.000±.062	.312±.031	1000	0.1	88,000	10	31,000
1600S	7	7	9	18-.040	1.219±.062	.312±.031	1000	0.1	114,000	10	40,000
1700S	10	10	12	18-.040	1.781±.062	.375±.031	1000	0.1	230,000	10	80,000
1900S	7	10	12	18-.040	1.375±.062	.431±.031	1000	0.1	210,000	10	73,000
1950S	10	11	15	18-.040	1.937±.062	.431±.031	1000	0.1	314,000	10	110,000

Body dia. may exceed that of 1100NS and smaller sizes, also values less than 0.1Ω.

* Clean lead to clean lead = .450 Max.

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RESISTORS

INDUSTRY'S FINEST RESISTORS

MIL-R-39007
ESTABLISHED RELIABILITY
FAILURE RATES M, P, AND R .01%/1000 HRS.
RESISTANCE TOLERANCE ±1%
TEMPERATURE COEFFICIENT
±20 PPM/°C MAX. 10Ω AND HIGHER
±50 PPM/°C MAX. 1Ω TO 10Ω
±90 PPM/°C MAX. .1Ω TO 1Ω

ALL STYLES AVAILABLE WITH SOLDERABLE (S) OR WELDABLE (W) TERMINALS
ALSO: NON-INDUCTIVELY WOUND (N)

TYPE DESIGNATIONS

MIL STYLE	DETAIL SPEC. NO.	SAGE STYLE	MIL WATTS @ 25°C	AVAILABLE RESISTANCE RANGE
RWR80S RWR80W	/8E /8E	1009SM 1007SM	2	.10Ω to 2.67K
RWR81S RWR81W	/9C /9C	259SM 257SM	1	.10Ω to 1.0K
RWR89S RWR89W	/11C /11C	1249SM 1247SM	3	.10Ω to 4.12K
RWR84S RWR84W	/10C /10C	1509SM 1507SM	7	.10Ω to 12.4K
RWR71S RWR71W	/5D /5D	1259SP 1257SP	2	.10Ω to 16.2K
RWR74S RWR74W	/6C /6C	1509SP 1507SP	5	.10Ω to 12.1K
RWR78S RWR78W	/7C /7C	1709SP 1707SP	10	.10Ω to 39.2K

EXAMPLE PART DESIGNATION:

RWR-74 — Body style

S — Terminals
S — Solderable
W — Weldable
N — Non-inductive

49R9 — Nominal res., Ω. Three significant digits plus fourth indicating number of zeroes. Below 100Ω, R-decimal and following digits are significant.

F — Tolerance ±1%

R — Life failure rate

MIL-R-26E TYPE DESIGNATIONS

MIL STYLE	SAGE STYLE	MIL WATTS	DEFINED OHMIC RANGE	
			Single layer wound .00175 min. wire dia.	.001 min. wire dia.
RW55V	1900S	7	.1—5100	
RW56V	1950S	14	.1—9100	
RW67V	1550S	6.5	.1—3600	.1—8200
RW68V	1700S	11	.1—8200	.1—20K
RW69V	1200S	3	.1—910	.1—2K

EXAMPLE: RW69 (Body Style) V (Characteristic, V only (350° C max.)) 471 (Nominal resistance, Ω. Two significant digits plus third indicating number of zeros. Below 10ΩR = decimal and last digit is significant.)

TOLERANCE: ±5% for values 1Ω and up; ±10% below 1Ω. TC: ±260 ppm/°C 20Ω and up; 400 ppm/° below 20Ω.

MIL STYLE	SAGE STYLE	MIL WATTS	VOLTAGE Max.	DEFINED OHMIC RANGE		
				Min.	Max. for .001" wire (Navy)	Max. for .0008" wire(all other)
RW70U	1000S	1	—	.1	1210	3160
RW74U	1500S	5	300	.1	12100	38300
RW78U	1700S	10	720	.1	40200	90900
RW79U	1240S	3	135	.1	3570	10500
RW80U	1000SB	2	—	.1	1240	3160
RW81U	250SB	1	25	.1	649	—

EXAMPLE: RW70 (Body Style) U (Characteristic, U only (275°C max.)) 49R9 (Nominal resistance, Ω. Three significant digits plus fourth indicating number of zeros. Below 10ΩR decimal and following digits are significant.) F (Tolerance ± % F = 1.0% B = .1% D = .5%)

TC: ±30 ppm/°C 10Ω and above/±50 ppm/°C 1Ω to 10Ω/±90 ppm/°C below 1Ω.

SAGE SILICONE COATED fixed wire-wound units are not ordinary power resistors. They provide remarkable miniaturization vs. required wattage performance. Sage has pioneered the area of power handling capacity combined with precision and stability features ordinarily associated with Mil-R-93 resistors.

TYPE SB & NSB HIGH WATTAGE COMMERCIAL BERYLLIA CORE RESISTORS

Standard Solderable Leads	Rated Watts		Approx. Grams Weight
	G	V	
250SB	1	1.5	.18
500SB	1.5	2	.28
1000SB	2.25	2.75	.32
1200SB	3.5	4.5	1.0
1240SB	4	5	1.1
1250SB	4.5	6	1.2
1300SB	6	8	1.8
1500SB	7	9	3.6
1600SB	9	12	4.2
1700SB	14	18	7.3

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RESISTORS

SAGE TYPE M item identification is as follows:

3225 M B 360 — 1

- **1** — ±% tolerance
- **360** — Nominal value, Ohms. Decimal symbol, as required, is used in both nominal value and tolerance.
- **B** — If applicable. Core Material & Process Classification. Blank entry indicates regular alumina core and commercial processing.
  - **B** = beryllia core, commercial processing
  - **P** = alumina core, High Rel processing
  - **M** = beryllia core, High Rel processing
- **M** — **M** for regular single layer winding; **NM** for non-inductive winding
- **3225** — Body style

STYLE		RATED WATTS 25°C AMBIENT					DIELECTRIC TEST VOLTS rms	WORK-VOLTS MAX. DC or rms	STD. RESISTANCE RANGE, OHMS		MIL-R-18546, OHMS	
		SAGE			MIL-R-18546							
		ON CHASSIS		FREE AIR	ON CHASSIS	FREE AIR						
SAGE	MIL-R 18546	STD	HI REL						MIN.	MAX.	MIN.	MAX.
3105M	RE60G	8	6	4	5	3	1000	440	.1	24,000	.1	3320
3105NM	RE60N	8	6	4	5	3	1000	260	1.0	8400	1.0	1650
3010M	RE65G	14	10	6	10	6	1000	650	.1	30,000	.1	5620
3010NM	RE65N	14	10	6	10	6	1000	380	1.0	10,500	1.0	2800
3225M	RE70G	25	20	12	20	8	1500	1000	.1	71,000	.1	12,000
3225NM	RE70N	25	20	12	20	8	1500	790	1.0	25,000	1.0	6040
3550M	RE75G	50	40	16	30	10	2000	1500	.1	230,000	.1	39,200
3550NM	RE75N	50	40	16	30	10	2000	1500	1.0	80,000	1.0	19,600

OUTLINE DIMENSIONS

STYLE Dimensions: inches	3105 M NM	3010 M NM	3225 M NM	3550 M NM
A ± .062	1.125	1.375	1.937	2.781
B ± .005	.490	.625	.781	.844
C ± .010	.078	.094	.172	.172
D ± .005	.444	.562	.719	1.562
E ± .016	.600	.750	1.062	1.906
F ± .062	.250	.312	.437	.437
G ± .015	.334	.406	.500	.562
H ± .015	.245	.312	.390	.422
J ± .015	.646	.812	1.094	1.156
K ± .005	.093	.093	.125	.125
L ± .015	.317	.422	.562	.625
M ± .015	.145	.219	.312	.344
N ± .010	.075	.078	.078	.094
P ± .015	.156	.187	.344	.344
R ± .015	.078	.094	.172	.172
Mount Screw	#2	#2	#4	#4
Terminal ± .005 Punched Holes	.050	.085	.085	.085

TYPE MB HIGH WATTAGE

BERYLLIUM OXIDE CORES

STYLE	RATED WATTS 25°C ambient	
	chassis mounted	free air
3105 MB NMB	15	6
3010 MB NMB	20	8
3225 MB NMB	35	14
3550 MB NMB	50	20

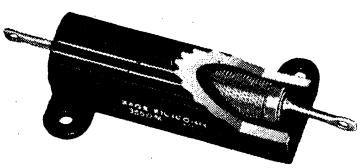
MB suffic designates regular single layer wind, NMB non-inductive wind.

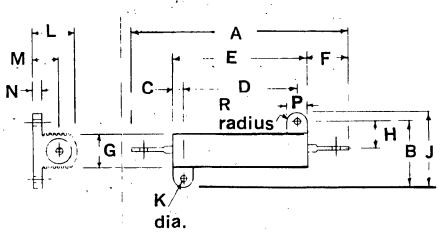
RE65 G 1001

- **RE65** — Style
- **G** — Characteristic, 275°C Max. G for regular inductive winding. N for non-inductive winding.
- **1001** — Nominal resistance, Ω. ±1% only. Three significant digits plus fourth indicating number of zeros. Below 100Ω R = decimal and following digits are significant.

T.C. ±30 ppm/°C 2000Ω and above
±50 ppm/°C under 2000Ω

TYPE M — METAL CLAD CHASSIS MOUNT RESISTORS

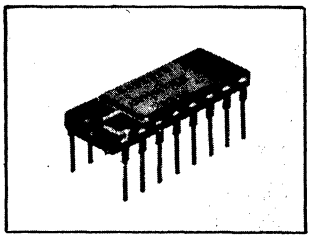




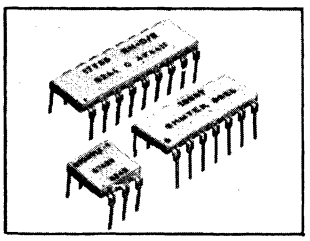
Leads: Copperweld, 60-40 Solder Coated
Body: Black Anodized Aluminum

OHMTEK Precision Resistor Networks

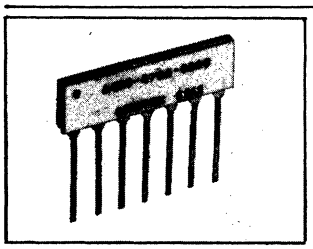
Wirewound Performance in Contemporary Packages



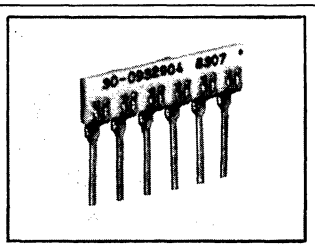
DUAL-IN-LINE HERMETIC
Meets Mil-R-83401 Characteristic "C" for military and other environmental extremes. Available 8, 14, 16 and 18 leads.



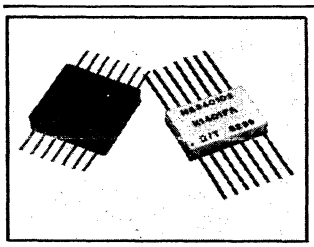
DUAL-IN-LINE CERAMIC SANDWICH
Meets Mil-R-83401 Characteristic "V". Packages of 4-22 leads in rugged monolithic inexpensive construction with highest precision in the industry.



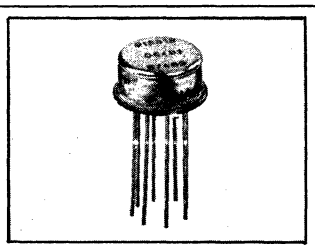
SINGLE-IN-LINE MIL-GRADE
Meets Mil-R-83401 Characteristic "V". 3-13 lead ceramic sandwich construction in high and low profile versions.



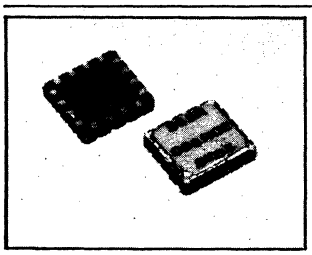
SINGLE-IN-LINE CONFORMAL
3-13 lead packages available. Designed for a wide range of tolerances and values at minimum cost.



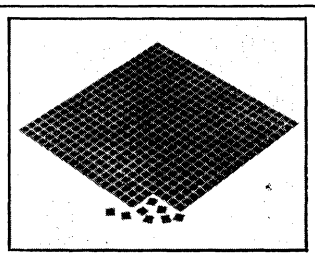
FLATPACKS
Hermetic or non-hermetic meet Mil-R-83401 Characteristic "C", "V" or "K". Available in 14 through 28 lead packages.



TO-STYLE HERMETIC
Available for custom precision applications requiring very low TCR and tight tracking.



LEADLESS CHIP CARRIERS
Hermetic or ceramic sandwich JEDEC packages. Standard and custom schematics available.



CHIP RESISTORS AND ARRAYS
Exceptional stability and reliability. Available in general purpose, 30-Mil square Mil-R-55342 characteristics and custom circuit arrays on ceramic or silicon.

Features:

- Standard circuits for military and commercial applications.
- Custom circuits as required for demanding applications.
- Nichrome or Tantalum based films optional.
- Wide packaging styles - standard hermetic or versatile custom pin counts with ceramic sandwich and conformal coated styles.
- Full Mil-spec screening available in-house.
- Rugged construction provides dependable performance at minimum cost.
- Network reliability greater than discrete resistor arrays.

Performance/Design Characteristics:

- Tolerances: .005% - 1%
- Resistance values: 10 ohms to 10 Megohm.
- Low TCR: 25 ppm/°C Std.
- Ultra low TCR: 10 and 5 ppm/°C available.
- Tracking less than 1 ppm.
- Operating temperature range: -55°C to +125°C
- Low noise: -35 db
- Stability: Δ R less than 200 ppm/70°C/ 10,000 hrs.

ohmtek INC. 2160 LIBERTY DRIVE, NIAGARA FALLS, NY 14304
PHONE: 716/283-4025 TWX: 710-524-1653

OHMITE® type 200 *brown devil*© fixed resistors

BROWN DEVIL® (Type 200) resistors, are vitreous enameled, wirewound units long famous for ruggedness and durability in small power resistors. With the emphasis towards miniaturization and the current industry trend towards higher operating temperatures, Ohmite has been able to increase the ratings on two Brown Devil sizes. The 5 watt size is now rated **8 watts** and the 10 watt size is now rated **12 watts**. The 20 watt unit retains the same rating. The higher ratings may be confidently applied to any 5 or 10 watt unit now in the possession of users or distributors.

Standard resistance tolerance is ±5% for values 1 ohm or higher; ±10% for values below 1 ohm. Tinned leads 1½" long: 3 and 5¼ watt, 20 AWG; 8, 12 and 20 watt, 18 AWG.

DIMENSIONS & WEIGHTS

Rating	5¼W	8W	12W	20W
Core Dimen.	⅜ø x ¼D	1x⅜D	1¾x⅜D	2x⅞D
Weight (lbs.)	.005	.01	.015	.03

Ohms	5¼ WATT Old Cat. No.	5¼ WATT New Cat. No.	8 WATT Old Cat. No.	8 WATT New Cat. No.	12 WATT Old Cat. No.	12 WATT New Cat. No.	20 WATT Old Cat. No.	20 WATT New Cat. No.
0.5					**1700A**	B12JR50	**1800A**	B20JR50
1.0	**2822**	B5J1R0	**1500**	B8J1R0	**1701**	B12J1R0	**1802A**	B20J1R0
1.1	(2823)	B5J1R1						
1.2	(2824)	B5J1R2						
1.3	(2825)	B5J1R3						
1.5	2826	B5J1R5	**1500B**	B8J1R5	1704	B12J1R5		
1.6	(2827)	B5J1R6						
1.8	2828	B5J1R8						
2.0	2829	B5J2R0	**1501**	B8J2R0	**1705**	B12J2R0	**1802B**	B20J2R0
2.2	2830	B5J2R2						
2.4	2831	B5J2R4						
2.7	(2832)	B5J2R7						
3.0	2833	B5J3R0	1502	B8J3R0	**1706**	B12J3R0	**1802C**	B20J3R0
3.3	2834	B5J3R3						
3.6	(2835)	B5J3R6						
3.9	2836	B5J3R9						
4.0			**1503**	B8J4R0	1707	B12J4R0	**1802D**	B20J4R0
4.3	2837	B5J4R3						
4.7	2838	B5J4R7						
5.0			**1504**	B8J5R0	**1708**	B12J5R0	**1803**	B20J5R0
5.1	**2839**	B5J5R1						
5.6	(2840)	B5J5R6						
6.2	2841	B5J6R2						
6.8	(2842)	B5J6R8						
7.5	2843	B5J7R5	1505	B8J7R5	1709	B12J7R5		
8.2	2844	B5J8R2						
9.1	(2845)	B5J9R1						
10	**2846**	B5J10R	**1506**	B8J10R	**1710**	B12J10R	**1804**	B20J10R
11	(2847)	B5J11R						
12	2848	B5J12R	1507	B8J12R	**1711**	B12J12R		
13	(2849)	B5J13R						
15	2850	B5J15R	1508	B8J15R	**1712**	B12J15R		
16	(2851)	B5J16R						
18	2852	B5J18R						
20	2853	B5J20R	**1509**	B8J20R	**1713**	B12J20R		
22	2854	B5J22R						
24	2855	B5J24R						
25			**1510**	B8J25R	**1714**	B12J25R	**1805**	B20J25R
27	2856	B5J27R						
30	2857	B5J30R	1511	B8J30R	**1715**	B12J30R		
33	**2858**	B5J33R						
35			1512	B8J35R	1716	B12J35R		
36	2859	B5J36R						
39	2860	B5J39R						
40			1513	B8J40R	**1717**	B12J40R		B20J40R
43	2861	B5J43R						
47	2862	B5J47R						
50			**1514**	B8J50R	**1718**	B12J50R	**1806**	B20J50R
51	2863	B5J51R						
56	2864	B5J56R						
62	2865	B5J62R						
68	2866	B5J68R						
75	2867	B5J75R	1515	B8J75R	**1719**	B12J75R	1807	B20J75R
82	2868	B5J82R						
91	2869	B5J91R						
100	**2870**	B5J100	**1516**	B8J100	**1720**	B12J100	**1808**	B20J100
110	(2871)	B5J110						
120	2872	B5J120						
125			**1517**	B8J125	**1721**	B12J125		B20J125
130	2873	B5J130						
150	**2874**	B5J150	1518	B8J150	**1722**	B12F150	**1809**	B20J150
160	2875	B5J160						
180	2876	B5J180						
200	**2877**	B5J200	**1519**	B8J200	**1723**	B12J200	**1810**	B20J200
220	2878	B5J220						
225			1520	B8J225	1724	B12J225		
240	**2879**	B5J240						
250			**1521**	B8J250	**1725**	B12J250	**1811**	B20J250
270	2880	B5J270						
300	2881	B5J300	**1522**	B8J300	**1726**	B12J300	**1812**	B20J300
330	2882	B5J330						
350			1523	B8J350	1727	B12J350	1813	B20J350
360	2883	B5J360						
390	2884	B5J390						
400			**1524**	B8J400	1728	B12J400	**1814**	B20J400
430	2885	B5J430						
450			1525	B8J450	1729	B12J450		
470	2886	B5J470						

Ohms	5¼ WATT Old Cat. No.	5¼ WATT New Cat. No.	8 WATT Old Cat. No.	8 WATT New Cat. No.	12 WATT Old Cat. No.	12 WATT New Cat. No.	20 WATT Old Cat. No.	20 WATT New Cat. No.
500			**1526**	B8J500	**1730**	B12J500	**1815**	B20J500
510	**2887**	B5J510						
560	2888	B5J560						
600			1527	B8J600	1731	B12J600		
620	2889	B5J620						
650							**1816**	B20J650
680	2890	B5J680						
700			1528	B8J700	1732	B12J700	1817	B20J700
750	2891	B5J750	(1529)	B8J750	1733	B12J750	1818	B20J750
800			1530	B8J800	1734	B12J800	1819	B20J800
820	2892	B5J820						
900			1531	B8J900	1735	B12J900	(1820A)	B20J900
910	2893	B5J910						
1000	2894	B5J1K0	1532	B8J1K0	1736	B12J1K0	**1821**	B20J1K0
1100	(2895)	B5J1K1	(1533)	B8J1K1	(1737)	B12J1K1		
1200	2896	B5J1K2	**1534**	B8J1K2	**1738**	B12J1K2	**1822**	B20J1K2
1250			1535	B8J1K25	1739	B12J1K25	1823	B20J1K25
1300	2897	B5J1K3						
1500	2898	B5J1K5	**1536**	B8J1K5	**1740**	B12J1K5	**1824**	B20J1K5
1600	(2899)	B5J1K6						
1750			1537	B8J1K75	1741	B12J1K75	1825	B20J1K75
1800	2900	B5J1K8						
2000	2901	B5J2K0	**1538**	B8J2K0	**1742**	B12J1K0	**1827**	B20J1K0
2200	2902	B5J2K2						
2250			1539	B8J2K25	1743	B12J2K25	(1828)	B20J2K25
2400	2903	B5J2K4						
2500			**1540**	B8J2K5	**1744**	B12J2K5	1830	B20J2K5
2700	2904	B5J2K7						
2750							1831	B20J2K75
3000	2905	B5J3K0	**1541**	B8J3K0	**1745**	B12J3K0	**1832**	B20J3K0
3300	2906	B5J3K3						
3500			1542	B8J3K5	**1746**	B12J3K5	1833	B20J3K5
3600	2907	B5J3K6						
3900	2908	B5J3K9						
4000			1543	B8J4K0	**1747**	B12J4K0	1834	B20J4K0
4300	(2909)	B5J4K3						
4500			1544	B8J4K5	1748	B12J4K5	1835	B20J4K5
4700	2910	B5J4K7						
5000			**1545**	B8J5K0	**1749**	B12J5K0	**1836**	B20J5K0
5100	2911	B5J5K1						
5600	2912	B5J5K6						
6000			**1546**	B8J6K0	**1750**	B12J6K0	1837	B20J6K0
6200	2913	B5J6K2						
6800	2914	B5J6K8						
7000			1547	B8J7K0	1751	B12J7K0	1838	B20J7K0
7500	2915	B5J7K5	1548	B8J7K5	**1752**	B12J7K5	1839	B20J7K5
8000			1549	B8J8K0	**1753**	B12J8K0	1840	B20J8K0
8200	**2916**	B5J8K2						
8500					(1754)	B12J8K5		
9000			1550	B8J9K0	(1754A)	B12J9K0	(1840A)	B20J9K0
9100	(2917)	B5J9K1						
10K	**2918**	B5J10K	**1551**	B8J10K	**1755**	B12J10K	**1841**	B20J10K
11K	(2919)	B5J11K			(1756)	B12J11K		
12K	2920	B5J12K			1757	B12J12K		
12.5K			1552	B8J12K5	1758	B12J12K5	1842	B20J12K5
13K	2921	B5J13K						
13.5K					(1759)	B12J13K5		
15K	**2922**	B5J15K	1553	B8J15K	**1761**	B12J15K	**1843**	B20J15K
16K	2923	B5J16K			(1762)	B12J16K		
17.5K			(1554)	B8J17K5	(1763)	B12J17K5		
18K	2924	B5J18K			1764	B12J18K		
20K	**2925**	B5J20K	**1555**	B8J20K	**1765**	B12J20K	**1844**	B20J20K
22.5K			(1556)	B8J22K5	1766	B12J22K5		
25K			**1557**	B8J25K	**1767**	B12J25K	1845	B20J25K
30K					**1768**	B12J30K	1846	B20J30K
35K					1769	B12J35K	(1847)	B20J35K
40K					1770	B12J40K	1848	B20J40K
45K					1771	B12J45K	(1849)	B20J45K
50K					**1772**	B12J50K	1850	B20J50K
55K							(1851)	B20J55K
60K							(1852)	B20J60K
65K							(1853)	B20J65K
70K							(1854)	B20J70K
75K							(1855)	B20J75K
80K							1856	B20J80K
85K							(1857)	B20J85K
90K							(1858)	B20J90K
95K							(1859)	B20J95K
100K							**1860**	B20J100K

[1] Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items appearing in LIGHT FACE print are available from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® type 270 vitreous enameled fixed resistors

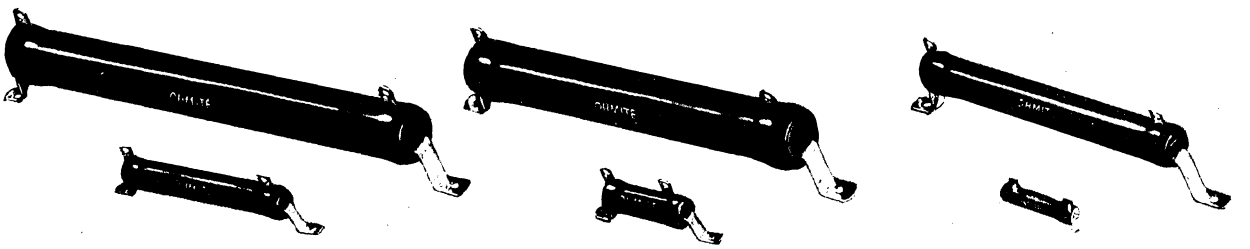
These lug type resistors are wire-wound on high quality ceramic cores, protected and insulated by Ohmite vitreous enamel — the time-proved standard covering that is the best conductor of heat for a material which must also be a good electrical insulator.

Resistance tolerance is ±5% for values 1 ohm or higher; ±10% below 1 ohm.

Wattage ratings are for use in free air. When resistors are mounted in closed spaces or where the circulation of air is restricted, they should not be used at more than one-half rating. Currents and voltages for reduced ratings can be obtained by multiplying full rating by the following factors: 75% load = .86, 66% = .81, 50% = .71, 33% = .57, 25% = .50.

Higher wattage resistors are available on a custom manufactured basis, for information, request copy of catalog 101.

These items are also available on special order, with non-inductive windings, (Aryton Perry).



12 WATT Free air rating to 5600 Ohms Core: 1-3/4" x 5/16" Mtg. Ctr: 2 3/16" — Av. Wt. .02 lb. Std. Mtg. Brkt.: Cat. No. 5		
Resist. Ohms	Catalog Numbers Old	New
.51	3723	L12JR51
1.0	3730	L12J1R0
1.5	3734	L12J1R5
2.2	3738	L12J2R2
3.3	3742	L12J3R3
4.7	3746	L12J4R7
6.8	3750	L12J6R8
10	3754	L12J10R
12	**3756**	L12J12R
15	3758	L12J15R
18	3760	L12J18R
22	3762	L12J22R
27	3764	L12J27R
33	3766	L12J33R
39	3768	L12J39R
47	3770	L12J47R
56	3772	L12J56R
68	3774	L12J68R
82	3776	L12J82R
100	3778	L12J100
120	3780	L12J120
150	3782	L12J150
180	3784	L12J180
220	3786	L12J220
270	3788	L12J270
330	3790	L12J330
390	3792	L12J390
470	3794	L12J470
560	3796	L12J560
680	3798	L12J680
820	3800	L12J820
1,000	3802	L12J1K0
1,200	3804	L12J1K2
1,500	3806	L12J1K5
1,800	3808	L12J1K8
2,200	3810	L12J2K2
2,700	3812	L12J2K7
3,300	3814	L12J3K3
3,900	3816	L12J3K9
4,700	3818	L12J4K7
5,600	3820	L12J5K6
6,800	3822	L12J6K8
8,200	3824	L12J8K2
10,000	3826	L12J10K
12,000	3828	L12J12K
15,000	3830	L12J15K
18,000	3832	L12J18K
22,000	3834	L12J22K
27,000	3836	L12J27K
33,000	3838	L12J33K
39,000	3840	L12J39K
47,000	3842	L12J47K
51,000	3843	L12J51K

	25 WATT Free air rating to 12,000 Ohms. Core: 2" x 9/16" Mtg. Ctr: 2 3/4" — Av. Wt. .05 lb. Std. Mtg. Brkt.: No. 9		50 WATT Free air rating to 25,000 Ohms. Core: 4" x 9/16" Mtg. Ctr: 4 3/4" — Av. Wt. .09 lb. Std. Mtg. Brkt.: No. 9		100 WATT Free air rating to 60,000 Ohms. Core: 6 1/2" x 3/4" Mtg. Ctr: 7 3/8" — Av. Wt. .20 lb. Std. Mtg. Brkt.: No. 12		175 WATT Free air rating for All Values Core: 8 1/2" x 1 1/8" Mtg. Ctr: 9 3/8" — Av. Wt. .50 lb. Std. Mtg. Brkt.: No. 18		225 WATT Free air rating for All Values Core: 10 1/2" x 1 1/8" Mtg. Ctr: 11 3/8" — Av. Wt. .62 lb. Std. Mtg. Brkt.: No. 18	
Ohms Res.	Catalog Numbers Old	New	Catalog Numbers Old	New	Catalog Numbers Old	New	Catalog Numbers Old	New	Catalog Numbers Old	New
1	**0200J**	L25J1R0	**0400J**	L50J1R0	**0600C**	L100J1R0	**0700C**	L175J1R0	**0900C**	L225J1R0
2	**0200K**	L25J2R0	**0400K**	L50J2R0	**0600D**	L100J2R0	0700D	L175J2R0	**0900D**	L225J2R0
3	0200	L25J3R0	0400L	L50J3R0	0600E	L100J3R0	0700E	L175J3R0	0900E	L225J3R0
4	0200N	L25J4R0	0400N	L50J4R0	0600F	L100J4R0	0700F	L175J4R0	0900F	L225J4R0
5	**0200A**	L25J5R0	**0400A**	L50J5R0	**0600A**	L100J5R0	**0700A**	L175J5R0	**0900A**	L225J5R0
10	**0200B**	L25J10R	**0400B**	L50J10R	**0600B**	L100J10R	**0700B**	L175J10R	**0900B**	L225J10R
15	**0200R**	L25J15R								
25	**0200C**	L25J25R	**0400C**	L50J25R	**0601**	L100J25R	0701	L175J25R	**0901**	L225J25R
50	**0200D**	L25J50R	**0400D**	L50J50R	**0602**	L100J50R	0702	L175J50R	**0902**	L225J50R
75	**0200E**	L25J75R	0400E	L50J75R	**0603**	L100J75R	0703	L175J75R	**0903**	L225J75R
100	**0200F**	L25J100	**0400F**	L50J100	**0604**	L100J100	0704	L175J100	**0904**	L225J100
125					0604B	L100J125	0704B	L175J125		
150	0200G	L25J150	**0400G**	L50J150	**0605**	L100J150	0705	L175J150	**0905**	L225J150
200	**0200H**	L25J200	0400H	L50J200						
250	**0201**	L25J250	**0401**	L50J250	**0606**	L100J250	0706	L175J250	**0906**	L225J250
500	0202	L25J500	**0402**	L50J500	**0607**	L100J500	0707	L175J500	**0907**	L225J500
750	0203	L25J750	0403	L50J750	0608	L100J750	(0708)	L175J750	0908	L225J750
800	0204	L25J800	0404	L50J800						
1,000	**0205**	L25J1K0	**0405**	L50J1K0	**0609**	L100J1K0	0709	L175J1K0	**0909**	L225J1K0
1,500	**0206**	L25J1K5	0406	L50J1K5	0610	L100J1K5	0710	L175J1K5	**0910**	L225J1K5
2,000	**0207**	L25J2K0	0407	L50J2K0	0611	L100J2K0	0711	L175J2K0	**0911**	L225J2K0
2,500	0208	L25J2K5	0408	L50J2K5	0612	L100J2K5	0712	L175J2K5	0912	L225J2K5
3,000	0209	L25J3K0	0409	L50J3K0	0613	L100J3K0	0713	L175J3K0	0913	L225J3K0
3,500	0210	L25J3K5								
4,000	0211	L25J4K0	0410	L50J4K0						
5,000	**0212**	L25J5K0	**0411**	L50J5K0	0614	L100J5K0	0714	L175J5K0	**0914**	L225J5K0
6,000	0213	L25J6K0								
7,500	0214	L25J7K5	0412	L50J7K5	0615	L100J7K5	0715	L175J7K5	0915	L225J7K5
8,000			0413	L50J8K0						
10,000	**0215**	L25J10K	**0414**	L50J10K	0616	L100J10K	0716	L175J10K	**0916**	L225J10K
12,000	0216	L25J12K	0415	L50J12K						
15,000	0217	L25J15K	0416	L50J15K	0617	L100J15K	0717	L175J15K	0917	L225J15K
20,000	0218	L25J20K	0417	L50J20K	0618	L100J20K	0718	L175J20K	0918	L225J20K
25,000	0219	L25J25K	0418	L50J25K	0619	L100J25K	0719	L175J25K	0919	L225J25K
30,000	0220	L25J30K			0620	L100J30K	0720	L175J30K	0920	L225J30K
35,000	0221	L25J35K	0419	L50J35K						
40,000	0222	L25J40K			(0621)	L100J40K	0721	L175J40K	0921	L225J40K
50,000	0224	L25J50K	**0420**	L50J50K	**0622**	L100J50K	0722	L175J50K	0922	L225J50K
60,000	0225	L25J60K			0623	L100J60K	0723	L175J60K	0923	L225J60K
70,000	0226	L25J70K								
75,000			0421	L50J75K	0624	L100J75K	0724	L175J75K	0924	L225J75K
80,000	0227	L25J80K								
100,000	0229	L25J100K	**0422**	L50J100K	0625	L100J100K	0725	L175J100K	**0925**	L225J100K
125,000			0423	L50J125K						
150,000			0424	L50J150K						
175,000			0425	L50J175K						
200,000			0426	L50J200K						
250,000			0428	L50J250K						

[1]Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items appearing in LIGHT FACE print are available from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.

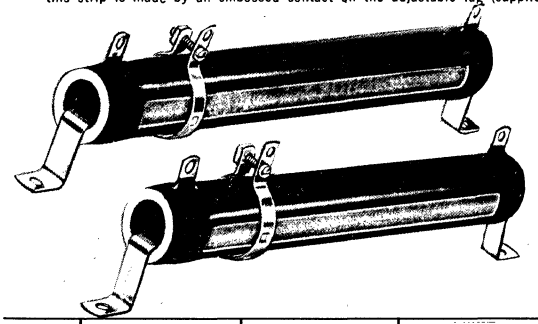
OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

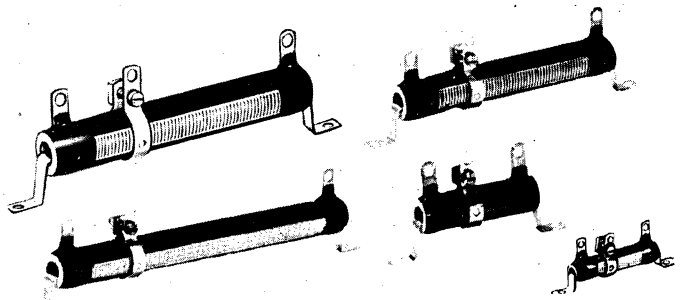
OHMITE® dividohm® type 210 adjustable vitreous enameled resistors

"Dividohm" resistors make ideal voltage dividers for original equipment and replacement in transmitters, rectifiers and other apparatus. Such tapped "bleeders" are made by using one or more adjustable lugs, as required. "Dividohms" are also handy for obtaining odd resistance values, for adjusting circuits, and for use on equipment which must be set to meet various line voltages.

"Dividohm" resistors are vitreous enameled resistors on which a narrow strip has been left uncovered to expose a portion of each turn. Contact to any wire in this strip is made by an embossed contact on the adjustable lug (supplied).

WATT RATING: **The stated wattage rating applies only when the entire resistance is in the circuit.** When the adjustable lug is set at an intermediate point, the wattage rating is reduced in approximately the same proportion, i.e., if the lug is set at half the resistance, the wattage is reduced by one-half. A safe rule to follow is to make sure that the maximum rated current is not exceeded. This should be carefully checked particularly if the resistor will be used as a voltage divider with several adjustable lugs. Resistance tolerance is ±10% for the total resistance value.





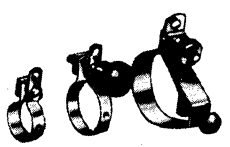
	12 WATT Core: 1¾″ x ⅝″ D. Mtg. Ctr.: 2⅜″ — Av. Wt. .02 lb. Std. Mtg. Brkt.* No. 5		25 WATT Core: 2″ x ¾″ D. Mtg. Ctr.: 2¾″ — Av. Wt. .05 lb. Std. Mtg. Brkt.* No. 9		50 WATT Core: 4″ x ¾″ D. Mtg. Ctr.: 4¾″ — Av. Wt. .09 lb. Std. Mtg. Brkt.* No. 9		75 WATT Core: 6″ x ⅞″ D. Mtg. Ctr.: 7⅝″ — Av. Wt. .15 lb. Std. Mtg. Brkt.* No. 9		100 WATT Core: 6½″ x ¾″ D. Mtg. Ctr.: 7⅜″ — Av. Wt. .20 lb. Std. Mtg. Brkt.* No. 12		175 WATT Core: 8½″ x 1⅛″ D. Mtg. Ctr.: 9⅜″ Av. Wt. .50 lb. Std. Mtg. Brkt.* No. 18		225 WATT Core: 10½″ x 1⅛″ D. Mtg. Ctr.: 11⅜″ Av. Wt. .62 lb. Std. Mtg. Brkt.* No. 18	
Resist. Ohms	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.
1	1001	D12K1R0	**0360**	D25K1R0	**0560A**	D50K1R0	0769A	D75K1R0	**0956A**	D100K1R0	**1156A**	D175K1R0	**1356A**	D225K1R0
2	1002	D12K2R0	0360B	D25K2R0	**0560B**	D50K2R0	0769B	D75K2R0	**0956B**	D100K2R0	1156B	D175K2R0	**1356B**	D225K2R0
3	1003	D12K3R0	0361	D25K3R0	0560C	D50K3R0	0769C	D75K3R0	0956C	D100K3R0	1156C	D175K3R0	1356C	D225K3R0
4					0560D	D50K4R0	(0769D)	D75K4R0	0956D	D100K4R0	1156D	D175K4R0	1356D	D225K4R0
5	**1004**	D12K5R0	**0362**	D25K5R0	**0560**	D50K5R0	**0769**	D75K5R0	0956	D100K5R0	1156	D175K5R0	**1356**	D225K5R0
7.5	1005	D12K7R5	0362B	D25K7R5										
10	**1006**	D12K10R	**0363**	D25K10R	**0561**	D50K10R	**0770**	D75K10R	**0957**	D100K10R	**1157**	D175K10R	**1357**	D225K10R
15	1007	D12K15R	**0364**	D25K15R			**0771**	D75K15R						
20	1008	D12K20R	0364B	D25K20R										
25	**1009**	D12K25R	**0365**	D25K25R	**0562**	D50K25R	**0772**	D75K25R	**0958**	D100K25R	**1158**	D175K25R	**1358**	D225K25R
50	**1010**	D12K50R	**0366**	D25K50R	**0563**	D50K50R	**0773**	D75K50R	**0959**	D100K50R	**1159**	D175K50R	**1359**	D225K50R
75	**1011**	D12K75R	0367	D25K75R	**0564**	D50K75R								
100	**1012**	D12K100	**0368**	D25K100	**0565**	D50K100	0774	D75K100	**0960**	D100K100	**1160**	D175K100	**1360**	D225K100
150	1013	D12K150	0369	D25K150	**0566**	D50K150								
200	**1014**	D12K200	0370	D25K200	**0567**	D50K200	0774B	D75K200						
250	**1015**	D12K250	0371	D25K250	**0568**	D50K250	0775	D75K250	**0960B**	D100K250	**1160B**	D175K250	**1360B**	D225K250
300	**1016**	D12K300	0371B	D25K300	**0568B**	D50K300	0775B	D75K300						
350	(1017)	D12K350												
400	1018	D12K400	0371C	D25K400	0568C	D50K400	**0775C**	D75K400						
500	1019	D12K500	**0372**	D25K500	**0569**	D50K500	0776	D75K500	0961	D100K500	**1161**	D175K500	**1361**	D225K500
600	(1020)	D12K600												
750	1021	D12K750	0373	D25K750	**0570**	D50K750	0777	D75K750						
800	(1022)	D12K800	0374	D25K800	0571	D50K800	(0777B)	D75K800						
1000	1023	D12K1K0	**0375**	D25K1K0	**0572**	D50K1K0	0778	D75K1K0	0962	D100K1K0	1162	D175K1K0	**1362**	D225K1K0
1250	1024	D12K1K25	0375B	D25K1K25	0572B	D50K1K25	0778B)	D75K1K25						
1500	1025	D12K1K5	0376	D25K1K5	0573	D50K1K5	(0779)	D75K1K5	0962B	D100K1K5	1162B	D175K1K5	1362B	D225K1K5
2000	1026	D12K2K0	0377	D25K2K0	0574	D50K2K0	(0780)	D75K2K0						
2250	(1027)	D12K2K25	0377B	D25K2K25	(0574B)	D50K2K25	(0780B)	D75K2K25						
2500	1028	D12K2K5	0378	D25K2K5	0575	D50K2K5	(0781)	D75K2K5	0963	D100K2K5	**1163**	D175K2K5	1363	D225K2K5
3000	1029	D12K3K0	0379	D25K3K0	0576	D50K3K0	(0781B)	D75K3K0						
3500	(1030)	D12K3K5	0380	D25K3K5	0576B	D50K3K5	(0782)	D75K3K5						
4000	1031	D12K4K0	(0381)	D25K4K0	0577	D50K4K0	(0782B)	D75K4K0						
4500	(1032)	D12K4K5	0381B	D25K4K5	(0577B)	D50K4K5	(0782C)	D75K4K5						
5000	**1033**	D12K5K0	0382	D25K5K0	**0578**	D50K5K0	(0783)	D75K5K0	0964	D100K5K0	1164	D175K5K0	1364	D225K5K0
6000	1034	D12K6K0	0383	D25K6K0	(0578B)	D50K6K0	(0783B)	D75K6K0						
7000	1035	D12K7K0	0383B	D25K7K0	0578C	D50K7K0	(0783C)	D75K7K0						
7500	1036	D12K7K5	**0384**	D25K7K5	0579	D50K7K5	(0784)	D75K7K5						
8000	(1037)	D12K8K0	(0384B)	D25K8K0	(0580)	D50K8K0	(0784B)	D75K8K0						
8500	(1038)	D12K8K5												
9000	(1039)	D12K9K0	(0384C)	D25K9K0	0580B	D50K9K0	(0784C)	D75K9K0						
10000	1040	D12K10K	0385	D25K10K	0581	D50K10K	(0785)	D75K10K	0965	D100K10K	1165	D175K10K	1365	D225K10K
12000			(0386)	D25K12K	(0582)	D50K12K	0785B	D75K12K						
15000			0387	D25K15K	0583	D50K15K	(0786)	D75K15K	(0966)	D100K15K	(1166)	D175K15K	1366	D225K15K
20000			0388	D25K20K	0584	D50K20K	0787	D75K20K	(0967)	D100K20K	(1167)	D175K20K	1367	D225K20K
25000			0389	D25K25K	0585	D50K25K	(0788)	D75K25K	(0968)	D100K25K	(1168)	D175K25K	1368	D225K25K
30000					0586	D50K30K	(0789)	D75K30K	(0969)	D100K30K	(1169)	D175K30K	(1369)	D225K30K
35000							0790	D75K35K						
40000					0587	D50K40K	(0791)	D75K40K	(0970)	D100K40K	(1170)	D175K40K	(1370)	D225K40K
45000							(0792)	D75K45K						
50000					0588	D50K50K	(0793)	D75K50K	0971	D100K50K	(1171)	D175K50K	1371	D225K50K
60000					(0589)	D50K60K	(0794)	D75K60K						
75000									(0972)	D100K75K	(1172)	D175K75K	1372	D225K75K
80000					(0590)	D50K80K	(0795)	D75K80K						
100000					0591	D50K100K	(0796)	D75K100K	0973	D100K100K	(1173)	D175K100K	1373	D225K100K

[1]**Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items appearing in LIGHT FACE print are available from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.**

adjustable lugs

One "Screw Driver Type Adjustable Lug" is supplied with each unit. Lugs with a silver contact button can be ordered from the table shown below.

MOVING THE LUGS: Lugs always should be loosened completely before moving and not moved except while the current is off, in order to protect the exposed wire from mechanical or electrical injury and to protect the operator from dangerous voltages.



STANDARD

Core Diam. Inches	Screw Driver Type New Cat. No.	Screw Driver Type Old Cat. No.	Bakelite Knob Type New Cat. No.	Bakelite Knob Type Old Cat. No.
5/16	2115	1058	—	—
9/16	2121	0358	2122	0359
¾	2125	1958	2126	1959
1⅛	2133	2158	2134	2159

With SILVER CONTACT BUTTONS

Core Diam. Inches	Screw Driver Type New Cat. No.	Screw Driver Type Old Cat. No.	Bakelite Knob Type New Cat. No.	Bakelite Knob Type Old Cat. No.
5/16	2116	2161	—	—
9/16	2123	2164	2124	2165
¾	2127	2166	2128	2167
1⅛	2135	2170	2136	2171

DOUBLE THUMB SCREW ADJUSTABLE LUG

This adjustable lug, which is illustrated at left, features two advantages — ease of adjustment and less chance of damaging the resistance wire while moving lugs. Available for 1⅛″ cores. Catalog No. **2160**

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® LO-MITE and other low resisitance wire-wound resistors

SERIES 99L LO-MITE

SPECIFICATIONS

Tolerance: ±5% std. Other tolerances available.

Temperature Coefficient:

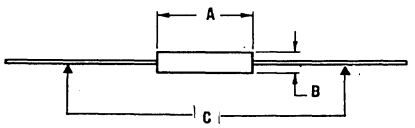
	Max. Temperature Coefficient
.005 — .009 ohms	0 ±600 ppm/°C
.01 — .019 ohms	0 ±300 ppm/°C
.02 — .029 ohms	0 ±175 ppm/°C
.03 — .039 ohms	0 ±125 ppm/°C
.04 — .09 ohms	0 ±100 ppm/°C
.1 — 1.0 ohm	0 ± 60 ppm/°C

Dielectric Withstanding Voltage: 1000 VAC.

Overload: 10X rated wattage for 5 sec. for 5 watt size and larger. 5X rated wattage for 5 sec. for 3 watt size.

Inductance: Typical values, 0.1 μhy for .01 to .09 ohms.

Coating: Molded vitreous enamel.



Watts	Type	Resistance Range	Body Dimensions				Leads 1.5" (38.1 mm)	
			Max. Lgth.—A		Max. Dia.—B			
		Min.-Max.	In.	MM	In.	MM	In.	MM
3	993L	.005—1.0	.562	14.3	.234	5.9	.032	.81
5	995L	.005—1.0	.937	23.8	.343	8.7	.032	.81
10	990L	.008—1.0	1.796	45.6	.343	8.7	.032	.81

The points at which the resistance is measured are critical. All resistance values and tolerances are based upon measurements at dimension "C".

Watts	Type	Dim. C	
		In.	MM
3	993L	1.313	33.35
5	995L	1.688	42.87
10	990L	2.531	64.39

SERIES 44 OHMICONE®

SPECIFICATIONS

Tolerance: ±1% and ±5% std. ±.05% to ±10% available.

Temperature Coefficient:
0 ±20 ppm/°C 10 ohms and above.
0 ±50 ppm/°C 1 to 10 ohms.
0 ±90 ppm/°C below 1 ohm.

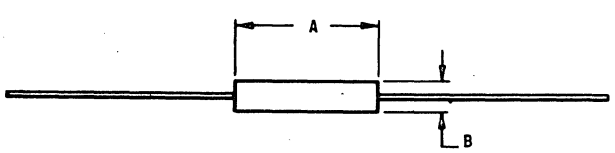
Dielectric Withstanding Voltage: 500V. (250V for 1 watt size.) 1000V available.

Overload: 10X rated wattage for 5 sec. for 5 watt size and larger. 5X rated wattage for 5 sec. under 5 watt size.

Inductance: Standard units have single layer inductive winding. Non-inductive (Aryton Perry or limited inductance) windings available.

Core: Steatite ceramic.

Coating: Conformal silicone ceramic.



Watts	Type	Resistance Range	Body Dimensions				Leads 1.5" (38.1 mm)	
			Max. Lgth.—A		Max. Dia.—B			
		Min.-Max.	In.	MM	In.	MM	In.	MM
1	441	.5—6.7K	.437	9.4	.125	3.2	.025	.64
2	442	.1—8.7K	.406	10.3	.219	5.6	.032	.81
3	443	.1—22.1K	.563	14.3	.250	6.4	.032	.81
5	445	.1—81.4K	.937	23.8	.343	8.7	.040	1.02
7	447	.1—119K	1.250	31.8	.343	8.7	.040	1.02
10	440	.1—223K	1.843	46.8	.406	10.3	.040	1.02

SERIES 99

SPECIFICATIONS

Tolerance: ±5% std. ±.25% to ±10% available. 2 ohm minimum for tolerances closer than ±1%.

Temperature Coefficient:
0 ± 30 ppm/°C 10 ohms and above.
0 ±100 ppm/°C 1 to 10 ohms.
0 ±200 ppm/°C below 1 ohm.

Dielectric Withstanding Voltage: 1000 VAC. 500 VAC for 1 watt size.

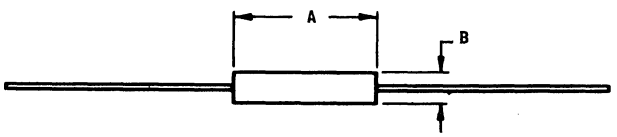
Overload: 10X rated wattage for 5 sec. for 5 watt size and larger. 5X rated wattage for 5 sec. under 5 watt size.

Wattage Rating: May be increased by using metal mounting clips as a heat sink.

Inductance: Standard units have single layer inductive winding. Non-inductive (Aryton Perry or limited inductance) windings available.

Core: Steatite ceramic.

Coating: Molded vitreous enamel.



Watts	Type	Resistance Range	Body Dimensions				Leads 1.5" (38.1 mm)	
			Max. Lgth.—A		Max. Dia.—B			
		Min.-Max.	In.	MM	In.	MM	In.	MM
1.5	995-1A	.1—6.65K	.437	11.1	.140	3.6	.020	.51
2.25	995-2A	.1—6.49K	.390	9.9	.219	5.6	.032	.81
3.25	995-3A	.1—22.1K	.562	14.3	.234	5.9	.032	.81
5	995-5B	.1—53.6K	.953	24.2	.234	5.9	.032	.81
6.5	995-5A	.1—80.6K	.937	23.8	.343	8.7	.032	.81
9	995-7A	.1—118K	1.233	31.3	.343	8.7	.032	.81
11	995-10A	.1—187K	1.796	45.6	.343	8.7	.032	.81
15	995-15A	.1—243K	2.015	51.2	.425	10.8	.032	.81

SERIES 22

SPECIFICATIONS

Tolerance: ±5% std. ±1% to ±10% available.

Temperature Coefficient:
0 ±30 ppm/°C 10 ohms and above.
0 ±50 ppm/°C 1 to 9.99 ohms.
0 ±90 ppm/°C below 1 ohm.

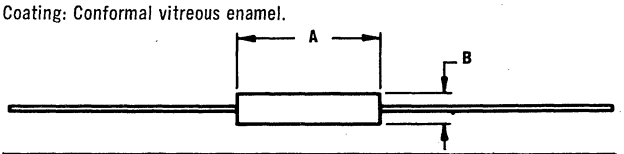
Dielectric Withstanding Voltage: 1000 VAC. (500 VAC for 1 watt type).

Overload: 10X rated wattage for 5 sec. for 5 watt size and larger. 5X rated wattage for 5 sec. under 5 watt size.

Inductance: Standard units have single layer inductive winding. Low inductance windings available.

Core: Steatite ceramic.

Coating: Conformal vitreous enamel.



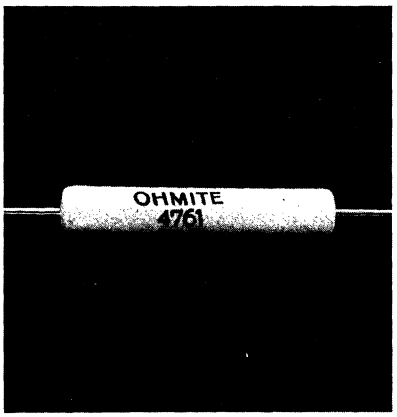
Watts	Type	Resistance Range	Body Dimensions				Leads 1.5" (38.1 mm)	
			Max. Lgth.—A		Max. Dia.—B			
		Min.-Max.	In.	MM	In.	MM	In.	MM
1	221	.1—6.1K	.406	10.3	.156	4.0	.025	.64
2	222	.1—8.7K	.406	10.3	.219	5.6	.032	.81
3	223	.1—22K	.562	14.3	.250	6.4	.032	.81
5	225	.1—54K	1.000	25.4	.250	6.4	.032	.81
6	226	.1—89K	1.031	26.2	.343	8.7	.032	.81
7	227	.1—118K	1.250	31.8	.343	8.7	.032	.81
10	220	.1—190K	1.797	45.6	.343	8.7	.032	.81
12.5	220P	.1—21K	1.812	46.0	.406	10.3	.040	1.02

ORDERING DATA

To order any of the above, specify series wanted, wattage, resistance, and tolerance.

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, IL 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® type 995 MOLDED axial lead vitreous enameled resistors



- FIRST MOLDED WIREWOUND,
- VITREOUS ENAMEL RESISTOR
- INSULATED! MEETS 1000 VAC TEST
- WITHSTANDS 1500°F TEMPERATURES WITHOUT DISTORTION
- RESISTS CHIPPING, BREAKING
- UNIFORM SIZE PERMITS CLIP-MOUNTING
- WITH SIGNIFICANT HEAT SINK BENEFITS
- HIGH OVERLOAD CAPABILITY

An exclusive technique (U. S. Patent No.'s 3,229,237 and 3,489,828) permits application of the vitreous enamel coating by **molding** instead of the conventional "dip" process. The dimensionally consistent and thicker coating that results, guarantees a 1000 VAC insulation rating plus unparalleled capability for withstanding very high temperatures, high humidity and immersion in salt solution.

These resistors are normally mounted by their axial leads. However, their consistent form also permits mounting in clips with heat sink benefits up to 100%. Resistance tolerance is ±5%. Series 99 resistors meet the requirements of MIL-R-26 for "insulated" resistors.

	1½ WATT .422" x .125" Dia. Style 995-1A Avg. Wt., .0009 lb.		2¼ WATT .375" x .188" Dia. Style 995-2A Avg. Wt., .0018 lb.		3¼ WATT .547" x .203" Dia. Style 995-3A Avg. Wt., .003 lb.		5 WATT .938" x .203" Dia. Style 995-5B Avg. Wt., .004 lb.		11 WATT 1.781" x .312" Dia. Style 995-10A Avg. Wt., .015 lb.			1½ WATT .422" x .125" Dia. Style 995-1A Avg. Wt., .0009 lb.		2¼ WATT .375" x .188" Dia. Style 995-2A Avg. Wt., .0018 lb.		3¼ WATT .547" x .203" Dia. Style 995-3A Avg. Wt., .003 lb.		5 WATT .938" x .203" Dia. Style 995-5B Avg. Wt., .004 lb.		11 WATT 1.781" x .312" Dia. Style 995-10A Avg. Wt., .015 lb.	
Ohms	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Ohms	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.	Old Cat. No.	New Cat. No.
1.0	**4030**	91J1R0	**3860**	92J1R0	**4330**	93J1R0	**4530**	95J1R0	**4730**	90J1R0	450	4109A	91J450	(3942)	92J450	4409A	93J450	4609A	95J450	(4809A)	90J450
1.1	4031	91J1R1	(3861)	92J1R1	(4331)	93J1R1	(4531)	95J1R1	(4731)	90J1R1	470	**4110**	91J470	3943	92J470	4410	93J470	4610	95J470	4810	90J470
1.2	4032	91J1R2	3862	92J1R2	4332	93J1R2	(4532)	95J1R2	4732	90J1R2	500	4111	91J500	3944	92J500	**4411**	93J500	**4611**	95J500	**4811**	90J500
1.3	4033	91J1R3	3863	92J1R3	(4333)	93J1R3	(4533)	95J1R3	(4733)	90J1R3	510	**4112**	91J510	3945	92J510	4412	93J510	4612	95J510	(4812)	90J510
1.5	**4034**	91J1R5	3864	92J1R5	**4334**	93J1R5	4534	94J1R5	4734	90J1R5	560	4113	91J560	3946	92J560	**4413**	93J560	4613	95J560	4813	90J560
1.6	**4035**	91J1R6	(3865)	92J1R6	(4335)	93J1R6	(4535)	95J1R6	(4735)	90J1R6	600	4114	91J600	3947	92J600	4414	93J600	4614	95J600	4814	90J600
1.8	4036	91J1R8	(3866)	92J1R8	4336	93J1R8	(4536)	95J1R8	4736	90J1R8	620	4115	91J620	3948	92J620	4415	93J620	(4615)	95J620	(4815)	90J620
2.0	4037	91J2R0	3867	92J2R0	**4337**	93J2R0	**4537**	95J2R0	**4737**	90J2R0	680	(4116)	91J680	3949	92J680	**4416**	93J680	4616	95J680	4816	90J680
2.2	4038	91J2R2	3868	92J2R2	4338	93J2R2	4538	95J2R2	4738	90J2R2	700	4117	91J700	(3950)	92J700	4417	93J700	4617	95J700	(4817)	90J700
2.4	4039	91J2R4	3869	92J2R4	4339	93J2R4	4539	95J2R4	4739	90J2R4	750	4118	91J750	3951	92J750	4418	93J750	4618	95J750	4818	90J750
2.7	4041	91J2R7	(3871)	92J2R7	4341	93J2R7	4541	95J2R7	(4741)	90J2R7	800	4119	91J800	(3952)	92J800	4419	93J800	4619	95J800	4819	90J800
3.0	**4042**	91J3R0	3872	92J3R0	4342	93J3R0	4542	95J3R0	**4742**	90J3R0	820	**4120**	91J820	3953	92J820	**4420**	93J820	4620	95J820	4820	90J820
3.3	4043	91J3R3	3873	92J3R3	4343	93J3R3	4543	95J3R3	4743	90J3R3	900	(4121)	91J900	(3954)	92J900	4421	93J900	(4621)	95J900	(4821)	90J900
3.6	4044	91J3R6	(3874)	92J3R6	(4344)	93J3R6	(4544)	95J3R6	(4744)	90J3R6	910	4122	91J910	(3955)	92J910	4422	93J910	(4622)	95J910	(4822)	90J910
3.9	4045	91J3R9	(3875)	92J3R9	4345	93J3R9	4545	95J3R9	(4745)	90J3R9	1000	**4123**	91J1K0	3956	92J1K0	**4423**	93J1K0	**4623**	95J1K0	**4823**	90J1K0
4.0	4046	91J4R0	3876	92J4R0	4346	93J4R0	4546	95J4R0	4746	90J4R0	1100	(4124)	91J1K1	3957	92J1K1	(4424)	93J1K1	(4624)	95J1K1	4824	90J1K1
4.3	4047	91J4R3	(3877)	92J4R3	(4347)	93J4R3	(4547)	95J4R3	(4747)	90J4R3	1200	4125	91J1K2	3958	92J1K2	**4425**	93J1K2	**4625**	95J1K2	4825	90J1K2
4.7	4048	91J4R7	3878	92J4R7	4348	93J4R7	4548	95J4R7	4748	90J4R7	1300	4126	91J1K3	(3959)	92J1K3	4426	93J1K3	(4626)	95J1K3	4826	90J1K3
5.0	4049	91J5R0	3879	92J5R0	**4349**	93J5R0	**4549**	95J5R0	**4749**	90J5R0	1400	4126A	91J1K4	(3960)	92J1K4	(4426A)	93J1K4	(4626A)	95J1K4	4826A	90J1K4
5.1	(4050)	91J5R1	(3880)	92J5R1	4350	93J5R1	(4550)	95J5R1	(4750)	90J5R1	1500	**4127**	91J1K5	3961	92J1K5	**4427**	93J1K5	**4627**	95J1K5	**4827**	90J1K5
5.6	4051	91J5R6	3881	92J5R6	4351	93J5R6	4551	95J5R6	4751	90J5R6	1600	(4128)	91J1K6	(3962)	92J1K6	4428	93J1K6	4628	95J1K6	4828	90J1K6
6.2	4053	91J6R2	3883	92J6R2	4353	93J6R2	4553	95J6R2	4753	90J6R2	1800	4129	91J1K8	(3963)	92J1K8	4429	93J1K8	4629	95J1K8	4829	90J1K8
6.8	4054	91J6R8	3884	92J6R8	4354	93J6R8	**4554**	95J6R8	4754	90J6R8	2000	**4130**	91J2K0	3964	92J2K0	**4430**	93J2K0	**4630**	95J2K0	**4830**	90J2K0
7.5	4056	91J7R5	3886	92J7R5	4356	93J7R5	**4556**	95J7R5	**4756**	90J7R5	2200	4131	91J2K2	3965	92J2K2	4431	93J2K2	**4631**	95J2K2	4831	90J2K2
8.2	(4058)	91J8R2	3888	92J8R2	4358	93J8R2	4558	95J8R2	4758	90J8R2	2400	4132	91J2K4	(3966)	92J2K4	4432	93J2K4	4632	95J2K4	(4832)	90J2K4
9.1	(4060)	91J9R1	(3890)	92J9R1	(4360)	93J9R1	4560	95J9R1	(4760)	90J9R1	2500	4133	91J2K5	3967	92J2K5	4433	93J2K5	**4633**	95J2K5	**4833**	90J2K5
10	**4061**	91J10R	3891	92J10R	**4361**	93J10R	**4561**	95J10R	**4761**	90J10R	2700	(4134)	91J2K7	(3968)	92J2K7	4434	93J2K7	**4634**	95J2K7	4834	90J2K7
11	(4062)	91J11R	(3892)	92J11R	(4362)	93J11R	(4562)	95J11R	4762	90J11R	3000	4135	91J3K0	3969	92J3K0	4435	93J3K0	**4635**	95J3K0	**4835**	90J3K0
12	4063	91J12R	3893	92J12R	4363	93J12R	4563	95J12R	4763	90J12R	3300					**4436**	93J3K3	**4636**	95J3K3	4836	90J3K3
13	(4064)	91J13R	(3894)	92J13R	(4364)	93J13R	(4564)	95J13R	(4764)	90J13R	3500					4436A	93J3K5	4636A	95J3K5	4836A	90J3K5
15	(4065)	91J15R	3895	92J15R	**4365**	93J15R	**4565**	95J15R	**4765**	90J15R	3600					4437	93J3K6	4637	95J3K6	4837	90J3K6
16	4066	91J16R	(3896)	92J16R	(4366)	93J16R	4566	95J16R	4766	90J16R	3900					4438	93J3K9	4638	95J3K9	4838	90J3K9
18	4067	91J18R	3897	92J18R	4367	93J18R	4567	95J18R	4767	90J18R	4000					4439	93J4K0	**4639**	95J4K0	4839	90J4K0
20	4068	91J20R	3898	92J20R	4568	93J20R	**4568**	95J20R	**4768**	90J20R	4300					(4440)	93J4K3	(4640)	95J4K3	4840	90J4K3
22	4069	91J22R	3899	92J22R	4369	93J22R	**4569**	95J22R	4769	90J22R	4500					4440A	93J4K5	4640A	95J4K5	4840A	90J4K5
24	(4070)	91J24R	(3900)	92J24R	(4370)	93J24R	4570	95J24R	4770	90J24R	4700					**4441**	93J4K7	4641	95J4K7	4841	90J4K7
25	4071	91J25R	(3901)	92J25R	4371	93J25R	**4571**	95J25R	**4771**	90J25R	5000					**4442**	93J5K0	**4642**	95J5K0	**4842**	90J5K0
27	4072	91J27R	3902	92J27R	4372	93J27R	4572	95J27R	4772	90J27R	5100					4443	93J5K1	4643	95J5K1	4843	90J5K1
30	4073	91J30R	3903	92J30R	4373	93J30R	**4573**	95J30R	4773	90J30R	5600					**4444**	93J5K6	**4644**	95J5K6	4844	90J5K6
33	4074	91J33R	(3904)	92J33R	4374	93J33R	**4574**	95J33R	4774	90J33R	6000					4445	93J6K0	4645	95J6K0	4845	90J6K0
35	(4074A)	91J35R	(3905)	92J35R	4374A	93J35R	4574A	95J35R	4774A	90J35R	6200					4446	93J6K2	4646	95J6K2	4846	90J6K2
36	4075	91J36R	(3906)	92J36R	(4375)	93J36R	4575	95J36R	4775	90J36R	6800					4447	93J6K8	**4647**	95J6K8	4847	90J6K8
39	4076	91J39R	3907	92J39R	4376	93J39R	4576	95J39R	4776	90J39R	7000					4448	93J7K0	**4648**	95J7K0	(4848)	90J7K0
40	(4077)	91J40R	(3908)	92J40R	(4377)	93J40R	4577	95J40R	4777	90J40R	7500					4449	93J7K5	**4649**	95J7K5	4849	90J7K5
43	(4078)	91J43R	(3909)	92J43R	4378	93J43R	4578	95J43R	(4778)	90J43R	8000					4450	93J8K0	4650	95J8K0	4850	90J8K0
47	4079	91J47R	3910	92J47R	4378	93J47R	4579	95J47R	4779	90J47R	8200					4451	93J8K2	4651	95J8K2	4851	90J8K2
50	4080	91J50R	3911	92J50R	4380	93J50R	**4580**	95J50R	4780	90J50R	9000					(4452)	93J9K0	4652	95J9K0	4852	90J9K0
51	4081	91J51R	3912	92J51R	4381	93J51R	4581	95J51R	(4781)	90J51R	9100					(4453)	93J9K1	(4653)	95J9K1	4853	90J9K1
56	4082	91J56R	(3913)	92J56R	4382	93J56R	4582	95J56R	4782	90J56R	10000					**4454**	93J10K	**4654**	95J10K	**4854**	90J10K
62	4084	91J62R	(3915)	92J62R	4384	93J62R	4584	95J62R	4784	90J62R	11000							4655	95J11K	(4855)	90J11K
68	4085	91J68R	3916	92J68R	4385	93J68R	**4585**	95J68R	**4785**	90J68R	12000							**4656**	95J12K	**4856**	90J12K
75	4087	91J75R	3918	92J75R	4387	93J75R	4587	95J75R	4787	90J75R	13000							(4657)	95J13K	4857	90J13K
82	4089	91J82R	(3920)	92J82R	4389	93J82R	4589	95J82R	4789	90J82R	14000							(4657A)	95J14K	(4857B)	90J14K
91	4091	91J91R	3922	92J91R	4391	93J91R	4591	95J91R	4791	90J91R	15000							**4658**	95J15K	4858	90J15K
100	**4092**	91J100	3923	92J100	**4392**	93J100	**4592**	95J100	**4792**	90J100	16000							4659	95J16K	(4859A)	90J16K
110	(4093)	91J110	(3924)	92J110	4393	93J110	4593	95J110	(4793)	90J110	17000							4659B	95J17K	(4859C)	90J17K
120	4094	91J120	3925	92J120	4394	93J120	4594	95J120	4794	90J120	18000							4660	95J18K	4860	90J18K
130	(4095)	91J130	3926	92J130	4395	93J130	4595	95J130	4795	90J130	20000							**4661**	95J20K	4861	90J20K
150	**4096**	91J150	3927	92J150	**4396**	93J150	**4596**	95J150	4796	90J150	22000							4662	95J22K	(4862)	90J22K
160	(4097)	91J160	3928	92J160	4397	93J160	4597	95J160	4797	90J160	24000							4663	95J24K	(4863)	90J24K
180	**4098**	91J180	3929	92J180	4398	93J180	4598	95J180	4798	90J180	25000							**4664**	95J25K	**4864**	90J25K
200	4099	91J200	3930	92J200	**4399**	93J200	**4599**	95J200	4799	90J200	27000									4865	90J27K
220	4100	91J220	**3931**	92J220	4400	93J220	4600	95J200	**4800**	90J220	30000									**4866**	90J32K
240	4101	91J240	(3932)	92J240	4401	93J240	4601	95J240	4801	90J240	33000									4867	90J33K
250	4102	91J250	3933	92J250	4402	93J250	4602	95J250	4802	90J250	35000									4867A	90J35K
270	**4103**	91J270	3934	92J270	4403	93J270	4603	95J270	4803	90J270	36000									(4868)	90J36K
300	4104	91J300	3935	92J300	4404	93J300	4604	95J300	4804	90J300	39000									4869	90J39K
330	**4105**	91J330	3936	92J330	**4405**	93J330	4605	95J330	4805	90J330	40000									4870	90J40K
350	(4105A)	91J350	3937	92J350	4405A	93J350	4605A	95J350	4805A	90J350	43000									4871	90J43K
360	4106	91J360	3938	92J360	4406	93J360	4606	95J360	(4806)	90J360	45000									(4871A)	90J45K
390	4107	91J390	3939	92J390	4407	93J390	4607	95J390	4807	90J390	47000									4872	90J47K
400	4108	91J400	3940	92J400	4408	93J400	4608	95J400	4808	90J400	50000									**4873**	90J50K
											51000									4874	90J51K

[1]Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items appearing in LIGHT FACE print are avilable from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® Series 22 5% tolerance

conformal vitreous enamel axial lead wirewound resistors

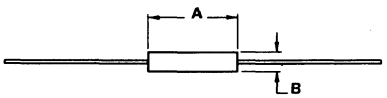
- **Rugged Vitreous Enamel Coating Withstands Severe Humidity and Temperature Cycling**
- **Economical**
- **All Welded Construction**
- **Ideal for Machine Insertion**

Advanced conformal vitreous enamel coating protects resistors, even in environments of high heat.

These rugged, economical wirewound resistors are recommended for industrial applications where quality construction and reliable operation are prime specifying parameters.

5% tolerance is standard for all wattage sizes. Dielectric breakdown is 1KV (500V for 1 Watt size). Typical T.C. of ± 30 ppm/°C. for 10 ohm values and above.

Watts	Body Dimensions Max L (A) ("/mm)	Body Dimensions Max Dia. (B) ("/mm)	Leads 1.5"/38.1 mm GA
1	.406/10.3	.156/4	22
3	.562/14.3	.250/6.4	20
5	1.000/25.4	.250/6.4	20
7	1.250/31.8	.343/8.7	20
10	1.797/49.2	.343/8.7	20



MECHANICAL

Terminal Strength: Meets MIL-R-26 requirements.

ELECTRICAL

Tolerance: ±5% std.;

Temperature Coefficient: 0±30 ppm/°C typical for 10Ω and above.

Dielectric Withstanding Voltage: 1 KV (500 V for 1 W types).

Overload, Short Time: 10X rated wattage for 5 sec. (5 W size & larger); 5X rated wattage for 5 sec. (under 5 W).

Inductance: Varies with no. of turns and wire size. Std. units have single layer winding.

MATERIALS

Core: Ceramic, resistant to thermal shock and wide variations in temperature.

Resistance Element: High grade resistance alloy wire, single layer winding. Leads and resistance element welded to metal end caps.

Coating: High performance conformal vitreous enamel.

Leads: Solder coated.

Resistance Ohms	Catalog Numbers 1 Watt	3 Watt	5 Watt	7 Watt	10 Watt
1.0	**21J1R0**	**23J1R0**	25J1R0	**27J1R0**	**20J1R0**
1.5	21J1R5	23J1R5	25J1R5	(27J1R5)	20J1R5
2.0	21J2R0	**23J2R0**	**25J2R0**	(27J2R0)	20J2R0
2.2	21J2R2	23J2R2	25J2R2	(27J2R2)	20J2R2
3.0	21J3R0	23J3R0	**25J3R0**	**27J3R0**	20J3R0
4.0	21J4R0	23J4R0	25J4R0	(27J4R0)	20J4R0
5.0	21J5R0	**23J5R0**	**25J5R0**	**27J5R0**	**20J5R0**
7.5	21J7R5	23J7R5	25J7R5	(27J7R5)	**20J7R5**
10.0	21J10R	**23J10R**	**25J10R**	**27J10R**	**20J10R**
12.0	21J12R	**23J12R**	25J12R	(27J12R)	20J12R
15.0	21J15R	23J15R	**25J15R**	**27J15R**	20J15R
18.0	21J18R	23J18R	25J18R	(27J18R)	20J18R
20.0	21J20R	23J20R	25J20R	(27J20R)	**20J20R**
22.0	21J22R	23J22R	25J22R	**27J22R**	20J22R
25.0	21J25R	**23J25R**	25J25R	(27J25R)	20J25R
27.0	21J27R	23J27R	25J27R	(27J27R)	20J27R
30.0	21J30R	23J30R	25J30R	(27J30R)	20J30R
33.0	21J33R	23J33R	25J33R	(27J33R)	20J33R
35.0	21J35R	23J35R	25J35R	(27J35R)	20J35R
39.0	21J39R	23J39R	25J39R	(27J39R)	(20J39R)
40.0	21J40R	23J40R	25J40R	**27J40R**	20J40R
47.0	21J47R	23J47R	25J47R	(27J47R)	20J47R
50.0	21J50R	23J50R	**25J50R**	**27J50R**	20J50R
56.0	21J56R	23J56R	25J56R	(27J56R)	20J56R
62.0	21J62R	23J62R	25J62R	(27J62R)	(20J62R)
68.0	21J68R	23J68R	25J68R	(27J68R)	
75.0	21J75R	23J75R	25J75R	**27J75R**	20J75R
82.0	21J82R	23J82R	25J82R	(27J82R)	20J82R
100	**21J100**	**23J100**	**25J100**	**27J100**	20J100
120	21J120	23J120	5J120	(27J120)	(20J120)
125	(21J125)	23J125	25J125	(27J125)	20J125
150	21J150	**23J150**	25J150	(27J150)	20J150
180	21J180	23J180	25J180	**27J180**	20J180
200	(21J200)	23J200	**25J200**	27J200	**20J200**
220	(21J220)	23J220	25J220	(27J220)	20J220
225	21J225	23J225	25J225	(27J225)	(20J225)
250	21J250	23J250	25J250	(27J250)	20J250
270	**21J270**	**23J270**	25J270	(27J270)	(20J270)
300	21J300	**23J300**	25J300	(27J300)	20J300
330	21J330	**23J330**	25J330	(27J330)	20J330
350	21J350	(23J350)	25J350	(27J350)	20J350
390	21J390	23J390	25J390	(27J390)	(20J390)
400	21J400	23J400	25J400	(27J400)	20J400
450	21J450	23J450	25J450	(27J450)	20J450
470	**21J470**	23J470	25J470	(27J470)	**20J470**
500	21J500	**23J500**	25J500	**27J500**	20J500
560	21J560	**23J560**	25J560	(27J560)	20J560
600	21J600	23J600	25J600	**27J600**	20J600
680	21J680	23J680	25J680	(27J680)	20J680
750	21J750	23J750	25J750	(27J750)	20J750
800	21J800	23J800	25J800	(27J800)	20J800
820	21J820	23J820	(25J820	(27J820)	20J820
900	21J900	23J900	25J900	(27J900)	20J900
1000	(21J1K0)	**23J1K0**	**25J1K0**	(27J1K0)	20J1K0
1100	(21J1K1)	23J1K1	25J1K1	(27J1K1)	(20J1K1)
1200	(21J1K2)	**23J1K2**	**25J1K2**	**27J1K2**	20J1K2
1500	(21J1K5)	23J1K5	25J1K5	(27J1K5)	(20J1K5)
1800	(21J1K8)	(23J1K8)	(25J1K8)	(27J1K8)	(20J1K8)
2000	(21J2K0)	23J2K0	**25J2K0**	(27J2K0)	20J2K0
2200	(21J2K2)	**23J2K2**	25J2K2	(27J2K2)	20J2K2
2500	(21J2K5)	23J2K5	25J2K5	(27J2K5)	**20J2K5**
2700	(21J2K7)	**23J2K7**	(25J2K7)	(27J2K7)	20J2K7
3000	(21J3K0)	**23J3K0**	25J3K0	(27J3K0)	20J3K0
3300		23J3K3	25J3K3	(27J3K3)	20J3K3
3500		23J3K5	25J3K5	(27J3K5)	20J3K5
3900		23J3K9	25J3K9	(27J3K9)	20J3K9
4000		**23J4K0**	25J4K0	(27J4K0)	20J4K0
4500		23J4K5	25J4K5	(27J4K5)	20J4K5
4700		**23J4K7**	25J4K7	(27J4K7)	20J4K7
5000		23J5K0	**25J5K0**	(27J5K0)	**20J5K0**
6000		23J6K0	25J6K0	(27J6K0)	20J6K0
6800		**23J6K8**	**25J6K8**	(27J6K8)	(20J6K8)
7000		23J7K0	25J7K0	(27J7K0)	20J7K0
7500		23J7K5	25J7K5	(27J7K5)	20J7K5
8000		23J8K0	25J8K0	(27J8K0)	(20J8K0)
9000		23J9K0	(25J9K0)	(27J9K0)	(20J9K0)
10,000		**23J10K**	**25J10K**	**27J10K**	**20J10K**
12,000			25J12K	(27J12K)	20J12K
13,000				(27J13K)	20J13K
15,000			**25J15K**	(27J15K)	20J15K
17,000				(27J17K)	(20J17K)
20,000			**25J20K**	**27J20K**	**20J20K**
22,000			25J22K	(27J22K)	20J22K
25,000			**25J25K**	(27J25K)	20J25K
30,000					20J30K
33,000					(20J33K)
35,000					20J35K
40,000					20J40K
50,000					**20J50K**

Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items appearing in LIGHT FACE print are available from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® Series 44 OHMICONE®

1% tolerance 5% tolerance

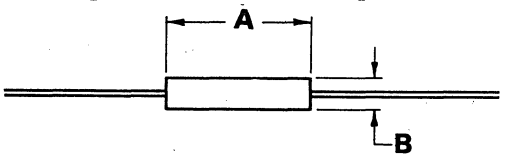
conformal silicone ceramic axial lead wirewound resistors

Series 44 Ohmicone® conformal silicone ceramic power resistors are designed for a wide range of commercial, industrial and communications equipment and systems. Resistors feature low, stable T.C.; all welded construction; and operation under high temperature conditions.

SERIES 44 OHMICONE*

Watts	Body Dimensions		Leads (1.5"/38.1 mm) Ga.
	Max. Lgth. A ("/mm)	Max. Dia. B ("/mm)	
1	.437/9.4	.125/3.2	22
2	.406/10.3	.219/5.6	20
3	.563/14.3	.250/6.4	20
5	.937/23.8	.343/8.7	18
10	1.843/46.8	.406/10.3	18

*OHMICONE is a registered trade name of Ohmite Mfg. Co.



ELECTRICAL

Tolerance: ±1% and ±5% closer tolerance available.

Temperature Coefficient: <1Ω—0±90 ppm/°C; 1 to 10Ω—0±50 ppm/°C; 10Ω & greater—0±20 ppm/°C.

Dielectric Withstanding Voltage: 500 V (250 V for 1 W size).

Overload, Short Time: 10X rated wattage for 5 seconds (5 W and larger); 5X rated wattage for 5 seconds (3 W and smaller).

Wattage: 1, 2, 3, 5, and 10 Watt Sizes.

Inductance: Varies with no. of turns and wire size. Standard units have single layer winding.

Non-inductive (ARYTON-PERRY) windings available.

MATERIALS

Core: Ceramic, resistant to thermal shock and wide variations in temperature.

Resistance Element: High grade resistance alloy wire, single layer winding. Leads and resistance element welded to metal end caps.

Coating: High performance conformal silicone ceramic.

Leads: Solder coated.

DERATING

Wattage is based on 25°C **Free Air Rating.** For higher temperature operation, derate linearly from 100% @ +25°C to 0% @ +275°C.

OHMS	1 WATT	
	1%+	5%+
	41Fxxx	41Jxxx

STOCK NUMBER CODE

F—±1% Tolerance
J—±5% Tolerance
R—Decimal point
K—Decimal point and X1000

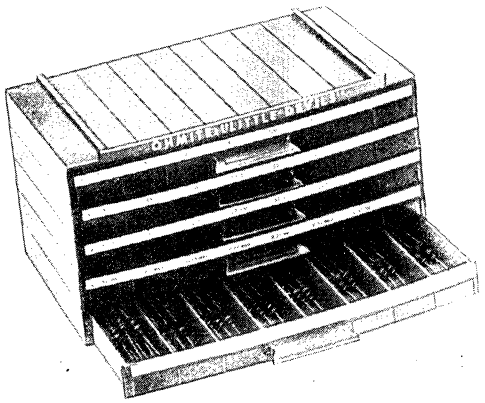
OHMS	CATALOG NUMBERS				
	1 Watt	2 Watts	3 Watts	5 Watts	10 Watts
.1	— 41JR10	— 42JR10	43FR10 43JR10	45FR10 45JR10	40FR10 40JR10
.15	— 41JR15	— 42JR15	43FR15 43JR15	45FR15 45JR15	40FR15 40JR15
.2	— 41JR20	— 42JR20	43FR20 43JR20	45FR20 45JR20	40FR20 40JR20
.3	— 41JR30	— 42JR30	43FR30 43JR30	45FR30 45JR30	40FR30 40JR30
.4	— 41JR40	— 42JR40	43FR40 43JR40	45FR40 45JR40	40FR40 40JR40
.5	— 41JR50	— 42JR50	43FR50 43JR50	45FR50 45JR50	40FR50 40JR50
.75	— 41JR75	— 42JR75	43FR75 43JR75	45FR75 45JR75	40FR75 40JR75
1.0	41F1R0 41J1R0	— 42J1R0	43F1R0 43J1R0	45F1R0 45J1R0	40F1R0 40J1R0
1.5	41F1R5 41J1R5	— 42J1R5	43F1R5 43J1R5	45F1R5 45J1R5	40F1R5 40J1R5
2.0	41F2R0 41J2R0	— 42J2R0	43F2R0 43J2R0	45F2R0 45J2R0	40F2R0 40J2R0
2.2	41F2R2 41J2R2	— 42J2R2	43F2R2 43J2R2	45F2R2 45J2R2	40F2R2 40J2R2
3.0	41F3R0 41J3R0	— 42J3R0	43F3R0 43J3R0	45F3R0 45J3R0	40F3R0 40J3R0
4.0	41F4R0 41J4R0	— 42J4R0	43F4R0 43J4R0	45F4R0 45J4R0	40F4R0 40J4R0
5.0	41F5R0 41J5R0	— 42J5R0	43F5R0 43J5R0	45F5R0 45J5R0	40F5R0 40J5R0
7.5	41F7R5 41J7R5	— 42J7R5	43F7R5 43J7R5	45F7R5 45J7R5	40F7R5 40J7R5
10.0	41F10R 41J10R	— 42J10R	43F10R 43J10R	45F10R 45J10R	40F10R 40J10R
12.0	41F12R 41J12R	— 42J12R	43F12R 43J12R	45F12R 45J12R	40F12R 40J12R
15.0	41F15R 41J15R	— 42J15R	43F15R 43J15R	45F15R 45J15R	40F15R 40J15R
18.0	41F18R 41J18R	— 42J18R	43F18R 43J18R	45F18R 45J18R	40F18R 40J18R
20.0	41F20R 41J20R	— 42J20R	43F20R 43J20R	45F20R 45J20R	40F20R 40J20R
22.0	41F22R 41J22R	— 42J22R	43F22R 43J22R	45F22R 45J22R	40F22R 40J22R
25.0	41F25R 41J25R	— 42J25R	43F25R 43J25R	45F25R 45J25R	40F25R 40J25R
27.0	41F27R 41J27R	— 42J27R	43F27R 43J27R	45F27R 45J27R	40F27R 40J27R
30.0	41F30R 41J30R	— 42J30R	43F30R 43J30R	45F30R 45J30R	40F30R 40J30R
33.0	41F33R 41J33R	— 42J33R	43F33R 43J33R	45F33R 45J33R	40F33R 40J33R
35.0	41F35R 41J35R	— 42J35R	43F35R 43J35R	45F35R 45J35R	40F35R 40J35R
39.0	41F39R 41J39R	— 42J39R	43F39R 43J39R	45F39R 45J39R	40F39R 40J39R
40.0	41F40R 41J40R	— 42J40R	43F40R 43J40R	45F40R 45J40R	40F40R 40J40R
47.0	41F47R 41J47R	— 42J47R	43F47R 43J47R	45F47R 45J47R	40F47R 40J47R
50.0	41F50R 41J50R	— 42J50R	43F50R 43J50R	45F50R 45J50R	40F50R 40J50R

OHMS	CATALOG NUMBERS				
	1 Watt	2 Watts	3 Watts	5 Watts	10 Watts
56.0	41F56R 41J56R	— 42J56R	43F56R 43J56R	45F56R 45J56R	40F56R 40J56R
62.0	41F62R 41J62R	— 42J62R	43F62R 43J62R	45F62R 45J62R	40F62R 40J62R
68.0	41F68R 41F68R	— 42J68R	43F68R 43J68R	45F68R 45J68R	40F68R 40J68R
75.0	41F75R 41J75R	— 42J75R	43F75R 43J75R	45F75R 45J75R	40F75R 40J75R
82.0	41F82R 41J82R	— 42J82R	43F82R 43J82R	45F82R 45J82R	40F82R 40J82R
100.0	41F100 41J100	— 42J100	43F100 43J100	45F100 45J100	40F100 40J100
120.0	41F120 41J120	— 42J120	43F120 43J120	45F120 45J120	40F120 40J120
125	41F125 41J125	— 42J125	43F125 43J125	45F125 45J125	40F125 40J125
150	41F150 41J150	— 42J150	43F150 43J150	45F150 45J150	40F150 40J150
180	41F180 41J180	— 42J180	43F180 43J180	45F180 45J180	40F180 40J180
200	41F200 41J200	— 42J200	43F200 43J200	45F200 45J200	40F200 40J200
220	41F220 41J220	— 42J220	43F220 43J220	45F220 45J220	40F220 40J220
225	41F225 41J225	— 42J225	43F225 43J225	45F225 45J225	40F225 40J225
250	41F250 41J250	— 42J250	43F250 43J250	45F250 45J250	40F250 40J250
270	41F270 41J270	— 42J270	43F270 43J270	45F270 45J270	40F270 40J270
300	41F300 41J300	— 42J300	43F300 43J300	45F300 45J300	40F300 40J300
330	41F330 41J330	— 42J330	43F330 43J330	45F330 45J330	40F330 40J330
350	41F350 41J350	— 42J350	43F350 43J350	45F350 45J350	40F350 40J350
390	41F390 41J390	— 42J390	43F390 43J390	45F390 45J390	40F390 40J390
400	41F400 41J400	— 42J400	43F400 43J400	45F400 45J400	40F400 40J400
450	41F450 41J450	— 42J450	43F450 43J450	45F450 45J450	40F450 40J450
470	41F470 41J470	— 42J470	43F470 43J470	45F470 45J470	40F470 40J470
500	41F500 41J500	— 42J500	43F500 43J500	45F500 45J500	40F500 40J500
560	41F560 41J560	— 42J560	43F560 43J560	45F560 45J560	40F560 40J560
600	41F600 41J600	— 42J600	43F600 43J600	45F600 45J600	40F600 40J600
680	41F680 41J680	— 42J680	43F680 43J680	45F680 45J680	40F680 40J680
750	41F750 41J750	— 42J750	43F750 43J750	45F750 45J750	40F750 40J750
800	41F800 41J800	— 42J800	43F800 43J800	45F800 45J800	40F800 40J800
820	41F820 41J820	— 42J820	43F820 43J820	45F820 45J820	40F820 40J820
900	41F900 41J900	— 42J900	43F900 43J900	45F900 45J900	40F900 40J900

OHMS	CATALOG NUMBERS				
	1 Watt	2 Watts	3 Watts	5 Watts	10 Watts
1000	41F1K0 41J1K0	— 42J1K0	43F1K0 43J1K0	45F1K0 45J1K0	40F1K0 40J1K0
1100	41F1K1 41J1K1	— 42J1K1	43F1K1 43J1K1	45F1K1 45J1K1	40F1K1 40J1K1
1200	41F1K2 41J1K2	—	43F1K2 43J1K2	45F1K2 45J1K2	40F1K2 40J1K2
1500	41F1K5 41J1K5	— 42J1K5	43F1K5 43J1K5	45F1K5 45J1K5	40F1K5 40J1K5
1800	41F1K8 41J1K8	—	43F1K8 43J1K8	45F1K8 45J1K8	40F1K8 40J1K8
2000	41F2K0 41J2K0	—	43F2K0 43J2K0	45F2K0 45J2K0	40F2K0 40J2K0
2200	41F2K2 41J2K2	—	43F2K2 43J2K2	45F2K2 45J2K2	40F2K2 40J2K2
2500	41F2K5 41J2K5	—	43F2K5 43J2K5	45F2K5 45J2K5	40F2K5 40J2K5
2700	41F2K7 41J2K7	—	43F2K7 43J2K7	45F2K7 45J2K7	40F2K7 40J2K7
3000	41F3K0 41J3K0	— 42J3K0	43F3K0 43J3K0	45F3K0 45J3K0	40F3K0 40J3K0
3300	— —	— —	43F3K3 43J3K3	45F3K3 45J3K3	40F3K3 40J3K3
3500	— —	— —	43F3K5 43J3K5	45F3K5 45J3K5	40F3K5 40J3K5
3900	— —	— —	43F3K9 43J3K9	45F3K9 45J3K9	40F3K9 40J3K9
4000	— —	— —	43F4K0 43J4K0	45F4K0 45J4K0	40F4K0 40J4K0
4500	— —	— —	43F4K5 43J4K5	45F4K5 45J4K5	40F4K5 40J4K5
4700	— —	— —	43F4K7 43J4K7	45F4K7 45J4K7	40F4K7 40J4K7
5000	— —	— —	43F5K0 43J5K0	45F5K0 45J5K0	40F5K0 40J5K0
6000	— —	— —	43F6K0 43J6K0	45F6K0 45J6K0	40F6K0 40J6K0
6800	— —	— —	43F6K8 43J6K8	45F6K8 45J6K8	40F6K8 40J6K8
7000	— —	— —	43F7K0 43J7K0	45F7K0 45J7K0	40F7K0 40J7K0
7500	— —	— —	43F7K5 43J7K5	45F7K5 45J7K5	40F7K5 40J7K5
8000	— —	— —	43F8K0 43J8K0	45F8K0 45J8K0	40F8K0 40J8K0
9000	— —	— —	43F9K0 43J9K0	45F9K0 45J9K0	40F9K0 40J9K0
10,000	— —	— —	43F10K 43J10K	45F10K 45J10K	40F10K 40J10K
12,000	— —	— —	— —	45F12K 45J12K	40F12K 40J12K
13,000	— —	— —	— —	45F13K 45J13K	40F13K 40J13K
15,000	— —	— —	— —	45F15K 45J15K	40F15K 40J15K
17,000	— —	— —	— —	45F17K 45J17K	40F17K 40J17K
20,000	— —	— —	— —	45F20K 45J20K	40F20K 40J20K
22,000	— —	— —	— —	45F22K 45J22K	40F22K 40J22K
25,000	— —	— —	— —	45F25K 45J25K	40F25K 40J25K
30,000	— —	— —	— —	45F30K 45J30K	40F30K 40J30K
33,000	— —	— —	— —	— —	40F33K 40J33K
35,000	— —	— —	— —	— —	40F35K 40J35K
40,000	— —	— —	— —	— —	40F40K 40J40K
50,000	— —	— —	— —	— —	40F50K 40J50K

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St.. Skokie. Illinois 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OHMITE® cabinet resistor assortments



Perfect for R & D and prototype labs.
All popular values included.
8 wattage sizes to choose from.
Contents clearly marked on front of each drawer segment.

Always have the right style, wattage, and resistance value on hand. Thwart Murphey's Law which states; "The resistance value needed will not be available."

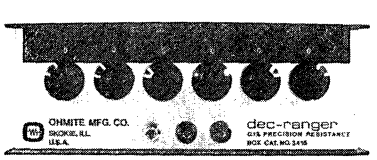
Ohmite cabinet assortments come in four different resistor styles and 8 different wattages. The resistors used to make up these assortments are the most popular resistance values as determined by national usage.

The handy compact plastic cabinets are packed in accordance with the tables below, which state the quantities, number of values, and the resistance range of each assortment. Each drawer segment is individually labeled. Dovetail tops and bottoms of each cabinet facilitate stacking. Individual cabinet dimensions are: 9″ long by 4¾″ high by 5¼″ deep.

For specific information regarding any of the cabinet assortments, ask your Ohmite Distributor for the latest cabinet brochure.

Style of Resistor	Watts	Cat. No.	Tolerance	Quantity	No. of Values	No. of Cab. in Assortment	Resistance Range
WIREWOUND SEE PAGES 5 AND 6 FOR DIMENSIONS AND CHARACTERISTICS							
Conformal Vitreous Enamel	1	CAB-221	5%	167	40	1	1Ω - 3KΩ
Conformal Vitreous Enamel	3	CAB-223	5%	325	71	2	1Ω - 10KΩ
Conformal Vitreous Enamel	5	CAB-225	5%	357	77	2	1Ω - 25KΩ
Conformal Vitreous Enamel	10	CAB-220	5%	185	40	1	1Ω - 50KΩ
Conformal Ohmicone®	1	CAB-441	5%	120	40	1	.1Ω - 3KΩ
Conformal Ohmicone®	3	CAB-443	5%	120	40	1	.1Ω - 5KΩ
Conformal Ohmicone®	5	CAB-445	5%	120	40	1	.1Ω - 10KΩ
Conformal Ohmicone®	10	CAB-440	5%	120	40	1	.1Ω - 15KΩ
LITTLE DEVIL®							
Carbon Composition	⅛	CAB-21	5%	500	80	2	2.7Ω - 22 MEGΩ
Carbon Composition	⅛	CAB-45	5%	1000	160	4	2.7Ω - 22 MEGΩ
Carbon Composition	¼	CAB-54	5%	124	37	1	47Ω - 10MΩ
Carbon Composition	¼	CAB-525	5%	800	80	2	2.7Ω - 22MΩ
Carbon Composition	¼	CAB-46	5%	1500	160	4	2.7Ω - 22MΩ
Carbon Composition	½	CAB-510	5%	120	40	1	10Ω - 10MΩ
Carbon Composition	½	CAB-596	5%	800	80	2	2.7Ω - 22MΩ
Carbon Composition	½	CAB-47	5%	1500	160	4	2.7Ω - 22MΩ
Carbon Composition	1	CAB-52	5%	100	40	1	10Ω - 10MΩ
Carbon Composition	1	CAB-527	5%	480	80	2	2.7Ω - 22MΩ
Carbon Composition	1	CAB-48	5%	900	160	4	2.7Ω - 22MΩ
Carbon Composition	2	CAB-53	5%	100	40	1	10Ω - 10MΩ
LITTLE REBEL®							
Carbon Film	⅛	CAB-5F	5%	150	31	1	10Ω to 22MΩ
Carbon Film	⅛	CAB-22F	5%	500	52	2	10Ω to 22MΩ
Carbon Film	⅛	CAB-34F	5%	1000	104	3	10Ω to 22MΩ
Carbon Film	¼	CAB-6F	5%	150	36	1	1Ω to 1MΩ
Carbon Film	¼	CAB-23F	5%	500	75	2	1Ω to 1MΩ
Carbon Film	¼	CAB-43F	5%	1500	137	4	1Ω to 1MΩ
Carbon Film	½	CAB-7F	5%	150	36	1	1Ω to 1MΩ
Carbon Film	½	CAB-24F	5%	500	75	2	1Ω to 1MΩ
Carbon Film	½	CAB-44F	5%	1500	137	4	1Ω to 1MΩ
METAL DEVIL®							
Metal Film	¼	CAB-8M	1%	250	40	1	10Ω to 301KΩ
Metal Film	¼	CAB-28M	1%	500	80	2	10Ω to 301KΩ
Metal Film	¼	CAB-31M	1%	1000	120	3	10Ω to 301KΩ
Metal Film	½	CAB-9M	1%	250	40	1	10Ω to 1MΩ
Metal Film	½	CAB-29M	1%	500	80	2	10Ω to 1MΩ
Metal Film	½	CAB-32M	1%	1000	120	3	10Ω to 1MΩ

DEC-RANGER™



0.1% ACCURACY PRECISION DECADE RESISTANCE BOX NO. 3416

SPECIFICATIONS:

ACCURACY: ±0.1% (PLUS 0.03Ω MAXIMUM CONTACT AND CIRCUIT RESISTANCE)

NUMBER OF DECADES: 6

SELECTION: ROTARY TAP SWITCHES, CONTINUOUS ROTATION IN EITHER DIRECTION

READ OUT: DIGITAL, IN LINE, THROUGH "WINDOWS" IN PANEL

SWITCH LIFE: IN EXCESS OF 50,000 OPERATIONS

DIMENSIONS: 10½″ LONG x 3¾″ HIGH x 4⅝″ DEEP

CAP-RANGER®

ECONOMICAL, PORTABLE CAPACITANCE SELECTOR

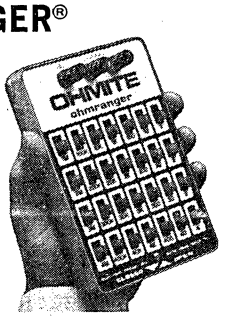
100 picofarads to 11.111 microfarads in 100 picofarad steps with ±2% accuracy. Three binding posts, one to ground the metal case. Compact size. Big performance. Simple operation. Solves your troubleshooting, breadboarding and circuit design problems using simple sliding switches. Dimensions 4″ x 6″ x 1″.

Catalog No. 3430

OHM-RANGER®

ECONOMICAL, PORTABLE RESISTANCE SELECTOR

- **Over 11 million ohms in one-ohm increments**
- **1% accuracy***
- **Easy slide switch operation**
- **Handy slimline size**
- **Rugged metal construction**



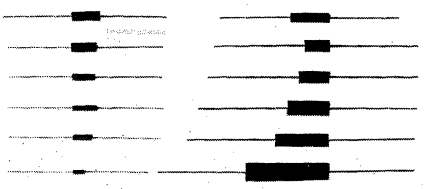
1 to 11,111,110 ohms, in one-ohm steps — with accuracy assured by half-watt 1% tolerance resistors! Has three binding posts, one to ground case. Small enough to take anywhere in your pocket, the handy easy-to-use OHM-RANGER is ideal for lab use, schools and service technicians. Dimensions 4″ x 6″ x 1″.

* 10 ohms and above

Catalog No. 3420

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, IL 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

PRECISION POWER RESISTORS
Sub-Miniature Wire Wound
V-Coated for 350° C

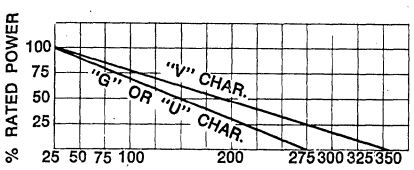


TYPE A MOLDED
.4 to 14 watts

TYPE B MOLDED
1 watt to 10 watts
Beryllium or Alumina Oxide Core

ELECTRICAL SPECIFICATIONS

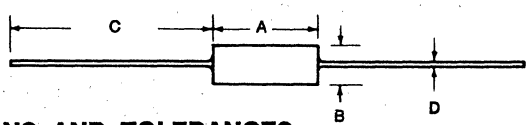
1. **Tolerances** — 5%, 3%, 1%, .5%, .25%, .1%, .05%, .02%.
2. **Dielectric Strength** — 500 VAC for 04A, 05A, 15A; B1, B3. Bal. 1000 VAC, circular foil wrap method or V-block.
3. Life — Maximum 0.5% resistance change after 1000 hour load life cycling 1½ hours on, ½ hour off, full load at 25°C).
4. Temperature Coefficient — Below 1 ohm = 90 PPM, Below 10 ohms = 50 PPM, Below 50 ohms = 30 PPM, All above = 20 PPM.



AMBIENT TEMP. DEG. CENTIGRADE

GENERAL SPECIFICATIONS

1. **Molded Type A** axial-lead resistors, molded for uniformity and minimum size for today's space age requirements.
2. Completely welded construction.
3. Meet or exceed requirements of Mil-R26, characteristic U.
4. Leads are tinned copperweld. Other materials available on request.
5. High temperature silicone molded coating.
6. **Molded Type B** beryllium oxide or alumina with power ratings 1.4 to 4 times higher than conventional ceramic resistors of the same size.

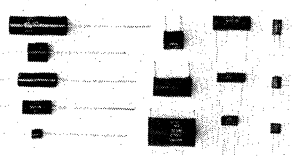


DIMENSIONS AND TOLERANCES

PRC Type	DIMENSIONS AND TOLERANCES A	B	C	D	Wattages G 275°	V 350°	Max. Res. Value	Working Voltage	MIL-R26 E Equiv.
04A	.250 ±.010	.090 ±.010	1.5	#24	.4	.75	3.4K	30	
05A	.330 ±.010	.110 ±.010	1.5	#24	.5	1.0	6K	50	
*15A	.412 ±.010	.115 ±.010	1.5	#24	1.25	2.0	7.5K	75	
20A	.550 ±.010	.115 ±.010	1.5	#24	1.25	2.0	10K	100	
S1A	.490 ±.010	.162 ±.010	1.5	#22	1.75	2.5	15K	150	
1A	.610 ±.010	.210 ±.010	1.5	#20	3.0	3.75	20K	200	
**N1A	.535 ±.010	.220 ±.010	1.5	#20	3.0	3.75	20K	200	
25A	.890 ±.010	.210 ±.010	1.5	#20	3.0	4.5	28K	200	
2A	.535 ±.010	.270 ±.010	2.0	#18	3.0	4.25	20K	200	
3A	.656 ±.010	.270 ±.010	2.0	#18	3.25	5.2	30K	200	
***5A	.900 ±.010	.312 ±.010	2.0	#18	5.5	7.5	75K	400	
7A	1.187 ±.010	.312 ±.010	2.0	#18	7.0	9.0	100K	600	
****10A	1.825 ±.010	.405 ±.010	2.0	#18	10.0	14.0	200K	1000	
B1	.250 ±.010	.090 ±.010	1.5	.020	1.0w	1.5w	3.4K	35	RW 81
B2	.325 ±.010	.090 ±.010	1.5	.020	1.5	2.0	4.9K	48	
B3	.412 ±.010	.115 ±.010	1.5	.020	2.25	3.0	10.4K	85	RW 80
B5	.610 ±.010	.210 ±.010	1.5	.032	4.0	5.0	24.5K	172	
B5C	.540 ±.010	.240 ±.010	2.0	.040	5.0	7.0	32.3K	260	
B6	.656 ±.010	.270 ±.010	2.0	.040	6.0	8.0	47.1K	300	
B10	.900 ±.010	.312 ±.010	2.0	.040	7.0	10.0	96 K	470	

* RW 70 ** RW 59/69/79 *** RW 57/67/74 **** RW 58/68/78
For Non-Inductive Winding add Suffix "N" to Callout.

MOLDED PRECISION WIRE WOUND RESISTORS



TYPE AP: AXIAL PRECISION
TYPE LP: LUG PRECISION
TYPE RP: RADIAL PRECISION
TYPE RPC: RECTANGULAR PRINTED CIRCUIT
TYPE PC: PRINTED CIRCUIT

All are non-inductively, reverse Pi wound at minimum wire tension for maximum long life stability. All production is aged before calibration for insurance of minimum long-term load-life drift. Due to advance winding techniques and design they have extremely low rise time characteristics approaching film type resistors. Through matching of materials, resistance changes from temperature expansion rates is eliminated. Zero voltage coefficient and low noise characteristics. Leads are solderable or weldable. TC of 15 PPM/°C standard. TC of 2 PPM/°C to 6000 PPM/°C available. All bridges and other instrumentation used in calibration are periodically checked against National Bureau Primary Standards. Designs exceed Mil-R-93 and Mil-R-9444. Distinct capabilities for: Special Networks; Matched Sets; Voltage Dividers; Molded and encapsulated Modules.

DIMENSIONS TABLE

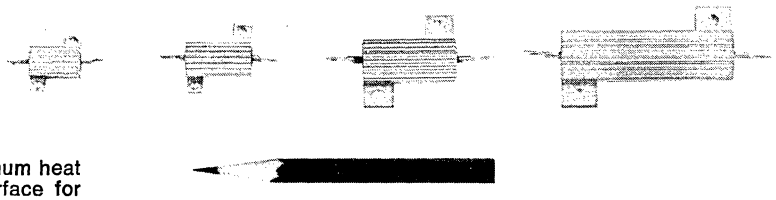
New Type		Comm. Watts	Max. Res.	Max. Dia.	Max. Length	Max. Volt.	Lead Spacing	Lead Gauge	Hole Size
118AP		.08	250K	.128	.263	100		#24	
122AP		.10	500K	.128	.380	100		#24	
130AP		.13	1.2M	.190	.300	100		#22	
134AP		.15	1.3M	.190	.380	100		#22	
142AP		.15	750K	.260	.260	150		#20	
152AP	RB56	.20	2.0M	.260	.385	100		#20	
156AP		.25	2.5M	.260	.510	150		#22	
160AP	RB55	.25	2.5M	.260	.510	150		#20	
164AP	RB54	.35	4.5M	.260	.760	300		#20	
168AP	RB53	.50	8.0M	.385	.760	400		#20	
172AP		.50	4.0M	.385	.510	300		#20	
176AP		.50	8.0M	.510	.510	400		#20	
180AP		.60	9.0M	.510	.635	400		#20	
184AP	RB52	.60	9.0M	.385	1.010	400		#20	
188AP	RB57	1.00	18.0M	.510	1.010	800		#20	
192AP	RB58	1.50	30.0M	.510	1.510	900		#20	
202RP		.25	500K	.260	.285	100	.200	#22	N.H.
214RP		.25	1.0M	.260	.447	150	.277	#22	#2
324LP	RB08	.50	4.0M	.510	.510	400	.325	Lug	#6
372LP	RB18	2.00	10.0M	.760	1.260	1000	1.000	Lug	#6
400RPC		.125	500K	.145 x .260 x .260		150	.125	#20	
500PC		.25	500K	.260	.320	150	.200	#22	
512PC		.20	700K	.260	.410	150	.150	#20	

PACIFIC RESISTOR CO.
18300 OXNARD STREET, TARZANA, CA 91356 • (213) 345-7811 - (213) 873-4575 • Inside CA: 800-835-3355 • Outside CA: 800-367-6677

PRECISION POWER RESISTORS
Aluminum-Finned Heat Sink

TYPE CH CHASSIS MOUNT
5 through 250 watts

TYPE BCH CHASSIS MOUNT
15 through 35 watts
Beryllium Oxide or Alumina Core

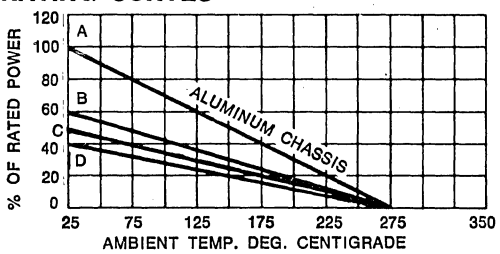


Chassis Mount, Type CH units are designed for maximum heat dissipation by mounting solidly to metal chassis surface for maximum heat transfer. They are outstanding for their high power dissipation with precision tolerances in minimum physical sizes.

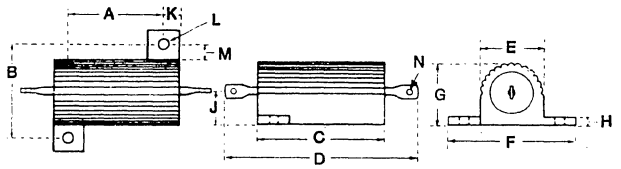
ELECTRICAL SPECIFICATIONS
1. Resistance Range — .05 ohms to 275K ohms.
2. Tolerance — 5%, 3%, 1%, .5%, .25%, .1%, .05%.
3. Temperature Coefficient — ±20 PPM to 90 PPM

GENERAL SPECIFICATIONS
1. Lower hot spot ratings due to exclusive complete encapsulation of element within anodized aluminum body.
2. Welded construction throughout assures long stable load life.
3. Heavy spade lug type leads on 5 through 70 watt sizes, threaded heavy stud terminals on 100 through 250 watts.
4. 1000 VAC minimum dielectric strength on 5CH, 10CH, B5CH and B10CH; 2500 VAC on 25CH, 50CH, 100CH, and B25CH; 5500 VAC on all others.
5. Temperature Range — −55°C to +275°C.
6. Eight standard sizes.

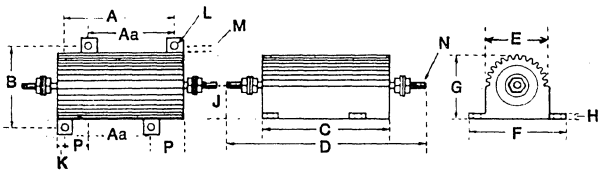
DERATING CURVES



Temp. of −55°C to +275°C. Derating is required for reduced chassis mounting area and high ambient temp.
Curves:
A — When mounted on proper alum.
Chassis:
4x6x2x.040 alum. chassis = 5CH & 10CH.
5x7x2x.040 alum. chassis = 25CH, B25CH, & B50CH.
12x12x.059 alum. panel = 50CH & 100CH.
12x12x.125 alum. panel = 110CH, 180CH, and 250CH.
B — Unmounted 5CH, 10CH, B5CH, B10CH.
C — Unmounted 25CH, 100CH, B25CH, and 110CH.
D — Unmounted 50CH, 180CH, and 250CH.



5CH, 10CH, 25CH, 50CH, 100CH, B5CH, B10CH, B25CH



110CH, 180CH, 250CH

Core Conductivity at 275°C — BTU-Ft / Ft²-Hr-°F

- BERYLLIUM OXIDE (BeO)-64
- ALUMINUM OXIDE — 8
- STEATITE — 1.5

DIMENSIONS TABLE

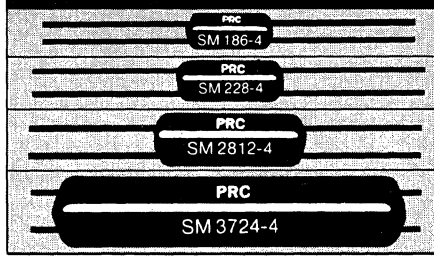
PRC Type	Mil-R 18546	Com. Watts	Max. Res.	A	Aa	B	C	D	E	F	G	H	J	K	L	M	N	P	No. Mtg. Screw Size
5CH	RE60	5	20K	.444	—	.490	.500	1.125	.334	.646	.317	.075	.145	.078	.093	.078	.050		2-#2
10CH	RE65	10	30K	.562	—	.625	.750	1.375	.438	.812	.406	.100	.203	.093	.093	.094	.086		2-#2
25CH	RE70	25	75K	.719	—	.781	1.062	1.938	.500	1.094	.563	.094	.250	.171	.125	.125	.086		2-#2
50CH	RE75	50	200K	1.563	—	.844	1.968	2.781	.625	1.156	.625	.094	.281	.196	.125	.125	.086		2-#4
100CH	—	70	275K	2.625	—	.844	2.968	3.781	.625	1.156	.625	.094	.281	.196	.125	.125	.086		2-#4
B5CH	RE60	15	20K	.444	—	.490	.600	1.125	.334	.646	.317	.075	.145	.078	.093	.078	.050		2-#2
B10CH	RE65	20	30K	.562	—	.625	.750	1.375	.438	.812	.406	.100	.203	.093	.093	.094	.086		2-#2
B25CH	RE70	35	75K	.719	—	.781	1.062	1.938	.500	1.094	.563	.094	.250	.171	.125	.125	.086		2-#2
TOL.	—	—	—	±.005	—	±.005	±.031	±.063	±.031	±.031	±.031	±.016	±.016	±.01	±.005	±.016	±.005 thd	—	—
110CH	RE77	100	50K	2.750	—	2.250	3.500	5.478	1.80	2.813	1.750	.188	.800	.375	.188	.250	12/24 thd		2-#8
180CH	—	180	50K	2.770	—	2.500	3.500	5.478	2.125	3.000	2.188	.250	.950	.375	.188	.200	12/24 thd		2-#8
250CH	RE80	250	45K	3.875	3.00	2.500	4.500	7.000	2.125	3.000	2.188	.250	1.00	.312	.188	.200	¼/20	.875	4-#8
TOL.	—	—	—	±.01	‡.01	±.01	±.094	±.094	REF.	±.031	±.031	±.016	REF.	±.031	±.010	REF.	—	±.01	—

‡ For Non-Inductive Winding add Suffix "N" to Callout.

PACIFIC RESISTOR CO.
18300 OXNARD STREET, TARZANA, CA 91356 • (213) 345-7811 - (213) 873-4575 • Inside CA: 800-835-3355 • Outside CA: 800-367-6677

PRECISION WIREWOUND RESISTORS

TYPE SM-(4)
FOUR (4) TERMINAL SHUNTS

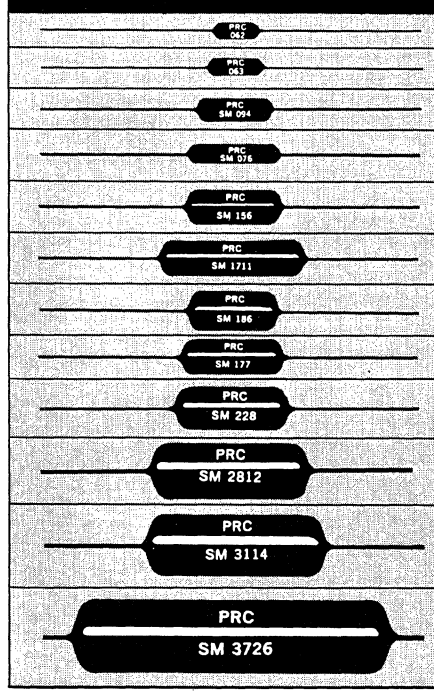


PRC Type	Max. Power Rating	Body Dimensions ±.787mm (.031") Length mm	Length (ins.)	Diameter mm	Diameter (ins.)	Std. Space	1.5"L. Std. Lead Diam. (±.001")	Min. Res. @ Max. Watts Ω	Min. Res. @ Max. Watts W	Min. Res. @ Derated Power Ω	Min. Res. @ Derated Power W
SM186-4	2½W	16.5	(.650")	6.35	(.250")	.110"	.0285"	.025	@ 2½W	.005	@ .5W
SM228-4	3W	19.69	(.775")	7.11	(.280")	.110"	.0285"	.03	@ 3W	.005	@ .5W
SM2812-4	5W	26.04	(1.025")	8.71	(.343")	.118"	.032"	.02	@ 5W	.005	@ 1.125W
SM3724-4	7½W	45.72	(1.800")	11.10	(.437")	.243"	.032"	.03	@ 7½W	.005	@ 1.125W

ALL DRAWINGS ILLUSTRATE ACTUAL SIZE

Precise low-value repeatability. Eliminates lead-out and contact resistance. "Single Joint" design makes lead identification academic.

TYPE SM
TWO (2) TERMINAL
PRECISION "POWER" AXIAL LEAD



For higher resistance values (at max. rated voltage) decrease max. power rating ($P = E^2/R$)
For lower resistance values (at max. rated power) decrease max. voltage rating ($E = \sqrt{PR}$)

PRC Type	RW Styles MIL-R-26	Max. Power Rating (Watts)	*Min. Allowable Resist. (Ohms)	Resist. Values Based Upon Max. Power & Max. Voltage ($R=E^2/P$)	*Max. Allowable Resist. (Ohms)	Max. Voltage Rating	Body Dimensions ±.787mm (.031") Length mm	Length (ins.)	Diameter mm	Diameter (ins.)	1.5"L. Lead Diam. Tinned Copper
SM062	—	¼W	1.0	17K	30K	65V	6.35	(.250")	2.03	(.080")	.020"
SM063	—	½W	0.1	24K	50K	110V	7.92	(.312")	2.03	(.080")	.020"
SM094	RW70	1W	0.1	40K	80K	200V	10.31	(.406")	2.92	(.115")	.025"
SM076	—	1⅛W	0.1	53K	180K	245V	12.7	(.500")	2.29	(.090")	.020"
SM156	—	1½W	0.1	90K	400K	375V	13.49	(.531")	4.47	(.176")	.028"
SM1711	—	2W	0.1	225K	900K	670V	20.62	(.812")	4.83	(.190")	.028"
SM186	RW69	3W	*0.025	80K	480K	500V	12.7	(.500")	5.26	(.207")	.028"
SM177	RW79	3W	0.1	80K	540K	500V	14.27	(.562")	4.83	(.190")	.028"
SM228	—	3W	*0.02	120K	720K	600V	15.88	(.625")	6.10	(.240")	.032"
SM2812	RW74	5W	*0.02	200K	1 MEG	1000V	22.23	(.875")	7.92	(.312")	.032"
SM3114	RW67	6½W	0.1	154K	1.5 MEG	1000V	25.4	(1.000")	7.92	(.312")	.032"
SM3726	RW78	10W	*0.07	156K	4 MEG	1250V	45.21	(1.780")	10.03	(.395")	.032"

* 0.02 ohm to 0.1 ohm and maximum resistance values available in non-standard physical sizes −0 +.062". All low value 2-terminal designs are calibrated and tested at mid-point on lead unless otherwise specified.

ENGINEERING DATA:

1 RESISTANCE RANGE "widest in the industry"
Any ohmic value or decimal part of an ohm within range listed. Shunt values to 0.005 ohm.

2 RESISTANCE TOLERANCE
Standard: ±1% (other tolerances available: ±½%, ±¼%, ±1/10% & ±1/20%).

3 TEMPERATURE COEFFICIENT OF RESISTANCE (TCR)
Standard: Zero ±5 ppm/°C to Zero ±20 ppm/°C.
Special: To ±2 ppm/°C.

4 INDUCTANCE
The basic TYPE SM resistors are inductively wound. Non-inductive resistors are available—add suffix letter "N" in part number.

5 VOLTAGE RATINGS (D.C. Voltage or Peak Voltage)
To calculate the safe operating voltage for any resistance value below the maximum listed, apply the Formula $E = \sqrt{PR}$. Our unique design allows twice normal operating standards.

6 POWER RATINGS
All standard 1% tolerance TYPE SM resistors are designed for continuous full load operation at 25°C. Derate to zero power at +275°C.

7 PROTECTIVE COATING
All TYPE SM resistors are sealed in a tough solvent resistant — high temperature silicone coating.

8 PRODUCTION CAPACITY
Small quantity lots delivered quickly, as well as competitive high volume general purpose resistor capabilities.

LONG LIFE • SOLVENT RESISTANT • LOWER TCR • HIGH TEMPERATURE • LOW COST

PRC PRECISION RESISTOR CO., INC.
109 U.S. HIGHWAY #22 • HILLSIDE, NJ 07205 U.S.A. • TEL: (201) 926-3036 • TELEX: 13-6479 (413)

PRECISION WIREWOUND RESISTORS

PRC Types	RB Styles Meets or Exceeds Environmental Conditions of: MIL- R-39005	RB Styles Meets or Exceeds Environmental Conditions of: MIL- R-93	Max. Watts 1% Res. Tol.	Max. Volts	Body Dimensions ±.787mm (.031") Length mm	Length (ins.)	Diameter mm	Diameter (ins.)	2"L. Leads Diam. Max.	Resistance (Ohms) Min. 0.1	Resistance (Ohms) Max.
HR175N	—	—	.2W	100V	7.92	(.312")	3.96	(.156")	.020"	100K	
HR186N	—	—	.2W	150V	9.53	(.375")	4.75	(.187")	.025"	150K	
HR188N	RBR74	—	.25W	150V	12.7	(.500")	4.9	(.193")	.025"	200K	
HR255N	RBR75	—	.25W	150V	7.49	(.295")	6.35	(.250")	.025"	316K	
HR256N	RBR56	RB56	.25W	200V	9.53	(.375")	6.35	(.250")	.032"	200K	
HR258N	RBR55	RB55	.33W	300V	12.7	(.500")	6.35	(.250")	.032"	500K	
HR2512N	RBR54	RB54	.5W	300V	19.05	(.750")	6.35	(.250")	.032"	1 MEG	
HR3114N	RBR76	—	.5W	300V	20.62	(.812")	7.92	(.312")	.032"	1.5 MEG	
HR3712N	RBR53	RB53	.66W	300V	19.05	(.750")	9.53	(.375")	.032"	2 MEG	
HR3716N	RBR52	RB52	1W	600V	25.4	(1.000")	9.53	(.375")	.032"	3 MEG	
HR5016N	RBR57	RB57	1.5W	600V	25.4	(1.000")	12.7	(.500")	.032"	5 MEG	
HR5024N	—	RB58	2W	900V	38.1	(1.500")	12.7	(.500")	.032"	7.5 MEG	
HR5032N	—	RB59	2.5W	1200V	50.8	(2.000")	12.7	(.500")	.032"	10 MEG	

TYPE HR
ULTRA HIGH PRECISION AXIAL LEAD

1 RESISTANCE RANGE AND TOLERANCE "MIL GUIDELINES"

Standard: Any ohmic value or decimal part of an ohm desired from 0.1 ohm to 10 megohms with tolerances to ±0.01%.

2 TEMPERATURE COEFFICIENT OF RESISTANCE "TEMPERATURE STABLE"

Standard: Zero ±5 ppm/°C (100 ohms and above).
Zero ±15 ppm/°C (values below 100 ohms).
Special: To ±1 ppm/°C.

3 STABILITY VS. TIME CHARACTERISTICS "ZERO DRIFT"

To ±0.001%/year at 25°C. of tol.
.01% tol. = .001% stability/yr (no load).

PRC Types	$P = \frac{E^2}{R}$ Max. Watts	$E = \sqrt{PR}$ Max. Volts	Body Dimensions ±.787mm (.031") Length mm	Length (ins.)	Diameter mm	Diameter (ins.)	1.5"L. Leads Max. Diam.	Resistance (Ohms) Min.	Max. Standard	Max. Special
SX062	.04W	35V	6.86	(.270")	2.03	(.080")	.020"	1.0	17K	30K
SX063	.05W	50V	8.43	(.332")	2.03	(.080")	.020"	0.1	20K	50K
SX072	.06W	45V	6.86	(.270")	2.29	(.090")	.020"	0.1	25K	35K
SX073	.07W	65V	8.43	(.332")	2.29	(.090")	.020"	0.1	30K	65K
SX093	.1W	85V	8.43	(.332")	2.92	(.115")	.025"	0.1	35K	75K
SX094	.1W	100V	10.03	(.395")	2.92	(.115")	.025"	0.1	50K	100K
SX095	.125W	125V	11.61	(.457")	2.92	(.115")	.025"	0.1	60K	180K
SX105	.166W	165V	11.61	(.457")	3.3	(.130")	.025"	0.1	75K	210K
SX123	.166W	165V	8.43	(.332")	3.68	(.145")	.025"	0.1	40K	120K
SX106	.2W	200V	13.21	(.520")	3.3	(.130")	.025"	0.1	100K	280K
SX124	.2W	200V	10.03	(.395")	3.68	(.145")	.025"	0.1	50K	160K
SX143	.2W	200V	8.43	(.332")	4.06	(.160")	.028"	0.1	50K	130K
SX154	.25W	250V	10.03	(.395")	4.47	(.176")	.028"	0.1	100K	200K
SX155	.25W	250V	11.61	(.457")	4.47	(.176")	.028"	0.1	100K	300K
SX156	.33W	330V	13.21	(.520")	4.47	(.176")	.028"	0.1	140K	400K
SX174	.33W	330V	10.03	(.395")	4.83	(.190")	.028"	0.1	130K	220K
SX175	.33W	330V	11.61	(.457")	4.83	(.190")	.028"	0.1	135K	350K
SX158	.5W	500V	16.38	(.645")	4.47	(.176")	.028"	0.1	450K	600K
SX177	.5W	500V	14.78	(.582")	4.83	(.190")	.028"	0.1	400K	540K
SX185	.5W	500V	11.61	(.457")	5.26	(.207")	.028"	*0.01	135K	360K
SX186	.5W	500V	13.21	(.520")	5.26	(.207")	.028"	*0.01	150K	480K
SX188	.6W	600V	16.38	(.645")	5.26	(.207")	.028"	*0.01	450K	720K
SX2210	.8W	800V	19.56	(.770")	6.10	(.240")	.032"	0.1	511K	1.1 MEG
SX3110	1W	1000V	19.56	(.770")	8.43	(.332")	.032"	0.1	750K	1.6 MEG
SX2812	1.25W	1000V	22.73	(.895")	7.62	(.300")	.032"	0.1	1 MEG	1.8 MEG
SX3114	1.33W	1000V	25.91	(1.020")	8.43	(.332")	.032"	0.1	1.25 MEG	2 MEG
SX3712	1.5W	1000V	22.73	(.895")	11.1	(.437")	.032"	0.25	1.5 MEG	2.5 MEG
SX3716	2W	1250V	29.08	(1.145")	11.1	(.437")	.032"	0.5	2 MEG	3.5 MEG
SX3724	3W	1250V	41.78	(1.645")	11.1	(.437")	.032"	0.5	3 MEG	5 MEG
SX3730	5W	1500V	51.31	(2.020")	11.1	(4.37")	.032"	0.5	4 MEG	6 MEG

TYPE SX
HIGH PRECISION AXIAL LEAD

1 RESISTANCE RANGE AND TOLERANCE "REPEATABLE (PART TO PART)"

Any ohmic value desired with tolerances of ±1% (standard), ±½%, ±¼%, ±1/10% and ±1/20%.

2 TEMPERATURE COEFFICIENT OF RESISTANCE (TCR)

Zero: ±10 ppm/°C (standard).

3 STABILITY VS. TIME CHARACTERISTICS "LOW ΔR"

To ±0.005%/year at 25°C (no load).

4 POWER RATINGS VS. AMBIENT TEMPERATURE AND RESISTANCE TOLERANCE

(Full power ratings to +125°C, are based upon standard ±1% resistance tolerance. Derating is required for higher temperatures and closer resistance tolerances.)

5 INDUCTANCE

The standard Type SX resistors are inductively wound. Non-inductive resistors are available — add suffix letter "N" in part number.

6 TERMINALS

Solderable hot-tinned (63% Sn — 37% Pb) copper wire leads. Low thermal EMF construction.

7 PROTECTIVE COATINGS

Type SX: New **solvent resistant** silicone-epoxy-seal.

8 PURCHASING INFORMATION

Please specify: Quantity, type, resistance value, resistance tolerance and special features which may apply. All orders are accurately checked 100% and delivered "on time" to meet critical schedules.

PRC Types	Power Rating	Body Dimensions ±.787mm (.031") Length mm	Length (ins.)	Diameter mm	Diameter (ins.)	1.5"L. Lead Diam. Tinned Copper	Maximum Resistance Values for Partial Listing of Popular +(TCR) Characteristics +400 ppm/°C	+1400 ppm/°C	+3930 ppm/°C	+4500 ppm/°C	+6000 ppm/°C
PT094	0—.1W	10.03	(.395")	3.18	(.125")	.025"	7K	6K	100	1500	500
PT156	0—.25W	13.21	(.520")	4.75	(.187")	.028"	27K	20K	500	5K	2K
PT158	0—.5W	16.38	(.645")	4.75	(.187")	.028"	45K	40K	800	10K	3500

TYPE PT
TEMPERATURE-SENSITIVE SPECIFICATIONS

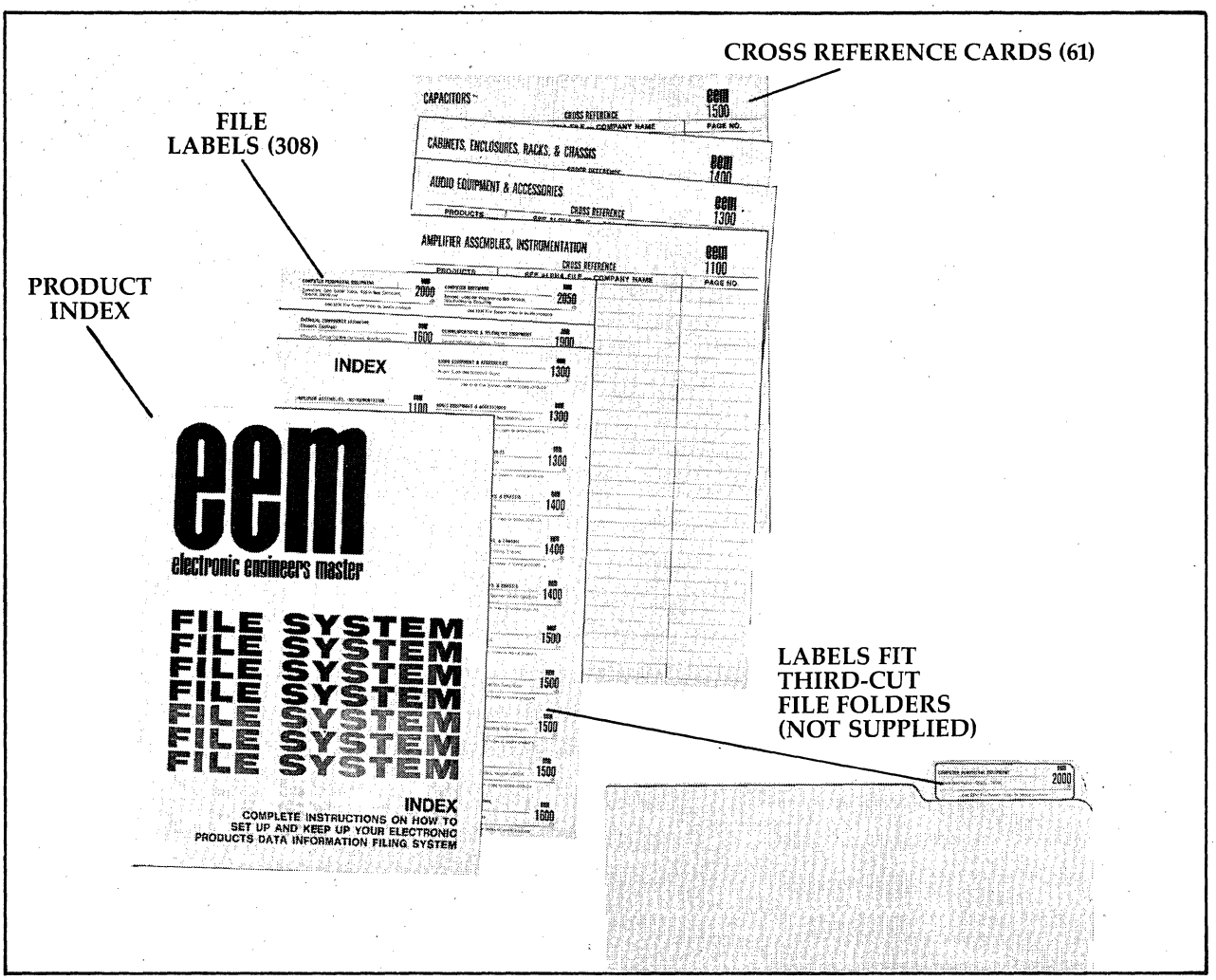
PRECISION'S linear (+) TCR thermal tracking resistors function as **economical temperature sensing** devices or used as **compensators** for voltage stabilization.

Maximum Resistance values based upon .001" wire size.
Hundreds of additional physical sizes and TCR combinations are available.

REQUEST FREE GENERAL CATALOG AND SPECIFIC ENGINEERING SAMPLES

EXCELLENT STABILITY • LINEARITY • REPEATABILITY • CUSTOM MATCHING

PRC PRECISION RESISTOR CO., INC.
109 U.S. HIGHWAY #22 • HILLSIDE, NJ 07205 U.S.A. • TEL: (201) 926-3036 • TELEX: 13-6479 (413)



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All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

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Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

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PRECISION RESISTIVE PRODUCTS, INC.
HIGHWAY 61 SOUTH, MEDIAPOLIS, IOWA 52637 (319) 394-9131

PR-SERIES ULTRA PRECISION METAL FILM RESISTORS

- Low Temperature Coefficients
- Tight Tolerances • High Stability • Low Noise

DIMENSIONS

Style	Max. L.	Max. Dia.	CL to CL	Dim. A
PR1/10	.280	.102	.300	AWG #22
PR1/8	.400	.150	.450	AWG #22
PR1/4	.600	.200	.685	AWG #22

SPECIFICATIONS

Style	Resistance Range (Ohms)	Wattage Rating @ 85°C	Voltage Rating
PR1/10	10-500K	1/10	300
PR1/8	10-1M	1/8	400
PR1/4	10-1M	1/4	500

TYPICAL PERFORMANCE

	%ΔR
1000 Hr. Load Life 85°C	0.02
Humidity	0.04
Temperature Cycling	<0.01
Short Time Overload	<0.01
Dielectric Withstanding	<0.01
Noise	<−30dB
Insulation Resistance	>10000 M. Ohm
Shelf Life	<50 PPM/YR.

TEMPERATURE COEFFICIENTS

TC25 = 0 ±25 PPM/°C −20 to +85°C
TC20 = 0 ±20 PPM/°C −20 to +85°C
TC15 = 0 ±15 PPM/°C −20 to +85°C
TC10 = 0 ±10 PPM/°C −20 to +85°C
TC5 = 0 ± 5 PPM/°C −20 to +85°C

RESISTANCE TOLERANCES

±1.0%, ±0.5%, ±.25% & ±0.1%, ±0.5%, ±.02%, ±.01%

LEAD MATERIAL

OFHC with 60/40 Tin/Lead Coating

RL-SERIES ULTRA PRECISION METAL FILM RESISTORS

- Radial Leads • Small Size
- Low TC • High Stability

DIMENSIONS (INCHES)

H	Height	.365
L	Length	.260
W	Width	.140
LS	Lead Spacing Lead Gage #22	.150

SPECIFICATIONS

Style	Temperature Coefficient	Resistance Range (Ohms)	Standard Tolerance	Wattage @ 85°C
RL 1	20 PPM/°C 15 10 5	20 thru 100K	1%, 5%, .25%, .10%, .05%, & .02% .01%	.1
RL 3	20 PPM/°C 15 10 5	20 thru 100K	1%, .5%, .25%, .1% .05% & .02% .01%	.3

TEMPERATURE COEFFICIENTS

TC20 = 0 ±20 PPM/°C −20 to +85°C
TC15 = 0 ±15 PPM/°C −20 to +85°C
TC10 = 0 ±10 PPM/°C −20 to +85°C
TC5 = 0 ± 5 PPM/°C −20 to +85°C

TYPICAL ENVIRONMENTAL PERFORMANCE

	%ΔR
1000 Hr. Load Life	±0.02%
Humidity	±0.04%
Temperature Cycling	±0.01%
Short Time Overload	±0.01%
Insulation Resistance	>1000 Megohms
Noise Index	<−30dB
Voltage Coefficient	<0.05 PPM/Volt
1 Year Shelf Life	±50 PPM

MATCHED SETS AND NETWORKS

Customized resistance and temperature coefficient matching is available.

Resistance matching to .01% and T. C. tracking of 1 PPM/°C are standard.

Please consult the factory for details on your requirements.

GP-SERIES GENERAL PURPOSE PRECISION METAL FILM RESISTORS

- Economical • High Performance
- Very Stable • Low Noise

DIMENSIONS

Style	Max. L.	Max. Dia.	CL to CL	Dim. A
GP¼	.280	.102	.325	AWG #22
GP½	.400	.150	.450	AWG #22
GP¾	.600	.200	.685	AWG #22
GP1	.600	.200	.685	AWG #20

SPECIFICATIONS

PRP Style	Mil. Style	Resist. Range (Ohms)	Wattage Rating @ 70°C	Wattage Rating @ 125°C	Voltage Rating
GP¼	RN55	2.5—500K	¼	1/10	300
GP½	RN60	2.5—1 M	½	⅛	500
GP¾	RN65	10—1.5M	¾	¼	500
GP1	RN70	10—1.5M	1	½	500

TYPICAL PERFORMANCE

	%ΔR
Temperature Cycling	0.05
Low Temperature Operation	0.03
Terminal Strength, 5 Lb. Load	0.02
Resistance To Soldering Heat	0.02
Dielectric Withstanding Voltage	0.02
Short Time Overload	0.05
Moisture Resistance	0.20
1000 Hour Load Life @ 125°C	0.15

TEMPERATURE COEFFICIENTS

TC25 = 0 ±25 PPM/°C −20 to +85°C
TC50 = 0 ±50 PPM/°C −20 to +85°C
T100 = 0 ±100 PPM/°C −20 to +85°C
T250 = 0 ±250 PPM/°C −20 to +85°C

RESISTANCE TOLERANCES

±5.0%, ±2.0%, ±1.0%, ±0.5%, ±.25%, & ±0.1%

LEAD MATERIAL

OFHC with 60/40 Tin/Lead Coating

NOTE: The GP-Series of resistors is conformally coated and fully protected against moisture by a multi-paint coat system and a hard epoxy outer coating.

Marking is alpha-numeric and meets the most demanding marking requirements. Special marking is available upon request.

Consult the factory concerning failsafe, flameproof, and fusing requirements.

LCR¼-SERIES GENERAL PURPOSE NON-PRECISION METAL FILM RESISTORS

- Low Cost • Taped and Reel Package
- Color Band Marking • Exceeds Mil-R-22684B & Mil-R-10509F Performance Requirements

DIMENSIONS

Max. L	Max. Dia.	Lead L.	Lead Dia.
.270″	.098″	1¼″	.025

GENERAL SPECIFICATIONS

Resist. Tolerance	Resist. Range	Temp. Coef. of Resist.	Power Rating	Max. Volt.
1% 2% 5%	10Ω through 1M	50 & 100 PPM/°C	¼W (70°C)	250 VRMS

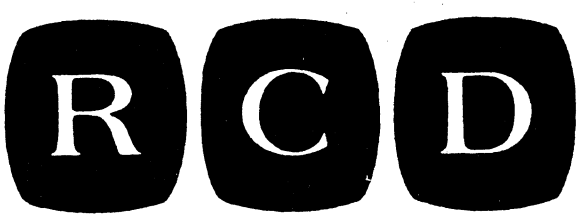
Performance Characteristics		PRP	Mil-R-22684B	Mil-R-10509F
Type No. (Style)		LCR¼	RL07	RN55D
Size: inch	Body Length	.270 Max.	.243 ±.038	.250 ±.031
	Body Diameter	.098 Max.	.090 ±.008	.109 ±.031
	Lead Diameter	.024 ±.002	0.23 ±.004	.025 ±.002
Power Rating		0.25W at 70°C 0.125W at 125°C	0.25W at 70°C 0.078W at 125°C	0.125W at 70°C 0.0625W at 25°C
Max. Rated Continuous Working Voltage		250V	250V	200V
Max. Ambient Temperature		165°C	150°C	165°C
TCR		±50 & ±100 PPM/°C	±200 PPM/°C	+200 −500 PPM/°C
Nominal Resistance Range		10Ω to 1MΩ	47Ω to 150kΩ	10Ω to 301kΩ
Standard Tolerances		1%, 2% & 5%	5% & 2%	1%
Dielectric Withstanding Voltage	ΔR	0.25%	0.5%	0.5%
Insulation Resistance		10,000 MΩ	1,000 MΩ	10,000 MΩ
Temperature Cycling	ΔR	0.25%	1.0%	0.5%
Short-Time Overload	ΔR	0.25%	0.5%	0.5%
Moisture Resistance	ΔR	0.5%	1.5%	1.5%
Load Life	ΔR	1.0%	2.0%	1.0%
Terminal Strength	ΔR	0.2%	0.5%	0.2%
Resistance to Soldering Heat	ΔR	0.5%	0.5%	0.5%
Shock	ΔR	0.2%	0.5%	0.5%
Vibration	ΔR	0.2%	0.5%	0.5%
Low Temperature Operation	ΔR	0.25%	0.5%	0.5%
Shelf Life	ΔR	0.2%	0.2%	N.A.

It's simple.

If we can't save you money on resistors, then we don't deserve your business.

RCD Components.

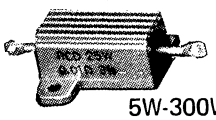
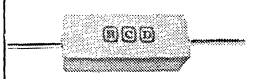
The fastest growing resistor manufacturer in the country.



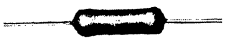
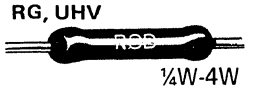
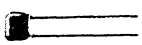
RCD Components Inc. • 330 Bedford Street, Manchester, NH 03101
(603) 669-0054 Tlx: 943512

RCD Quick Reference Guide

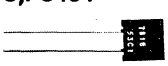
POWER WIREWOUND RESISTORS

STOCK	**100,100X,100R,100B** ¼W-20W	Silicone coated, all-welded, per MIL-R-26(RW), MIL-R-39007 (RWR). .001Ω to 300KΩ, tolerances to ±0.01%, TCR to 5PPM. **100X** — non-inductive **100BEO** — increased power **100R** — radial leads **100F** — flameproof coating
	600,600X,600B  5W-300W	Silicone molded in an aluminum housing. High wattage capability with chassis mounting, per MIL-R-18546(RE), MIL-R-39009(RER). .005Ω to 200KΩ, tolerances to ±0.01%, TCR to 5PPM. **600X** — non-inductive **600BEO** — increased power
STOCK	**PW,PWA,PWR,PWF**  2W-50W	Low cost general purpose wirewounds. Ceramic encased, completely flameproof. **PWX** — non-inductive **PWA** — standoffs **PWR** — radial leads **PWF** — failsafe fusible **PWS** — miniature sizes
	RW,RWF 	Low cost epoxy molded or conformal coated wirewounds offer savings over carbon comps. RW-1 (1-watt) is the size of a ½-W carbon comp. RW-2(2W) and RW-3(3W) are both the size of a 1W comp. **RWF** — Flameproof fusible
	ULV,LVF 	Series ULV utilizes a newly-developed manufacturing technique to obtain very low values (to 0.002Ω), with precision accuracy at lowest cost. **LVF** — four terminal construct.

THICK FILM RESISTORS

STOCK	**RSF,BW**  ¼W-9W	New development! Flameproof, thick complex-oxide construction results in performance and size of wirewounds, at significant price reductions. Non-inductive, high-surge capability. 0.1Ω to 240K stocked. BW Series is fusible.
	RG, UHV  ¼W-4W	Cermet glaze for high voltage and/or high resistance applications. Voltage capability to 50KV. Resistance to 10,000 Gig. Tolerances to 0.5%, TCR to 50PPM.
	MG ¼W-1W	Miniature resistors! ½-watt is ⅛W size, 1-watt is ¼-watt size. Improved dissipation due to thick cermet glaze. 6.2 ohm to 1 Meg, TCR to 50 PPM, tolerances to 1.0%.
	MC, MCR 1/16-1.0W	High-stability thick film chip resistors. 4.7Ω to 2000 Meg. Wrap-around termination available. Tolerances to 0.25%, TCR to 50PPM.
	MR  1/4W	Cermet micro-resistors offer highest performance in smallest possible size. Only 0.1" long! 4.7Ω to 8.2 Meg. ±5%, ±10%.
STOCK	**DIP,SIP** 	Thick film resistor networks offer premium performance per MIL-R-83401. SIP packages are 4 to 12 pin. DIP's are 14 or 16 pin. Variety of standard and custom configurations, hybrids available.

PRECISION WIREWOUND RESISTORS

	SA,MA .1W-2W	Epoxy encapsulated, non-inductive precision bobbin wirewounds per MIL-R-93(RB), MIL-R-39005 (RBR). 0.1Ω to 25 Meg, tolerances to ±0.005%, TCR from ±1PPM to +6700PPM
	PC,PC451  .1W-1W	Same as Series SA, MA but feature radial leads for easy PCB insertion and space savings per MIL-R-93, MIL-R-39005. PC451 (rectangular) is direct low-cost replacement for ultra-precision films.
	Q 	Wirewound substitutes for precision metal film's RN55, RN60, RN65, RN70, RN75. Better stability, lower price. TCR as low as ±2PPM. Tolerances to ±0.01%.

THIN FILM RESISTORS

	MF .1W-1W	Precision metal film per MIL-R-10509, RN55,60,65,70,75 and MIL-R-55182(RNR,RNC). 10Ω to 5.1 Meg, tolerances to ±0.05%. Outstanding TC's to 5PPM.
STOCK	**GP** .1W-1W	Commercial metal film with MIL-spec performance at half the price! Exceeds MIL-R-10509(RN),-22684 (RL),-39017(RLR). Values to 22.1 Meg, TC's to 25PPM, tolerances to ±0.5%.
STOCK	**CF,CFF** 1/8W-2W	General purpose carbon fim feature highest grade core for extended life stability and overload dissipation. 1ohm to 22 Meg, 7 standard sizes. Series CFF is flameproof.

TEMPERATURE SENSORS

	LP 1/4 +150°C	Low cost metal film with linear positive TCR. 33Ω to 30K, tolerances to ±1.0%. Available in any T.C. up to +5000PPM (.5%/°C). Only ¼" long.
	ATB,PTB,ATS,ATC +375°C	Precision wirewound, axial or radial. Interchangeable TCR, 1Ω to 1 Meg, tolerances to ±0.05%. Available in any T.C. up to +6720 PPM.
	PTC,PTS +600°C	Ceramic encased RTD elements or stainless steel RTD probles. Platinum, Nickel, Nife elements stocked. Tolerances to +0.1%.

SPECIALTY PRODUCTS

	FUSE RESIRTORS 1/8W-10W	Standard and Custom fusing curves to provide precisely controlled circuit protection. Fusing time to 5μS at 0.1A and up.
	SURGE RESISTORS 1W-50W	Withstand high energy dissipation and absorb surges up to 75 joules with minor resistance shift Standard and Custom designs.
STOCK	**ZERO OHM** ¼W	Insulated jumpers come in 1/4 W size and are suited for automatic insertion. Resistance is .02 ohm or less.

INDUCTORS

STOCK	**AL** 	Low cost color banded inductors per MIL-C-15305. Special core results in high Q and SRF, low DCR. .22μH to 56000μH. Axial or radial leads.

CUSTOM

RCD manufactures a series of custom coil products including toroids, transformers, and shielded chokes. RCD also offers custom Res/cap, Res/Diode hybrid networks and voltage dividers.

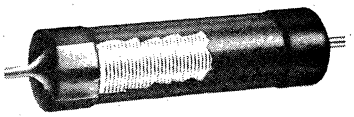
Don't forget our **'SWIFT'** service (**S**hip **W**ith **I**n **F**ifty **T**wo hours) when you require fast delivery of a non-stock item!

RCD Components Inc. • 330 Bedford Street, Manchester, NH 03101 • (603) 669-0054 Tlx: 943512

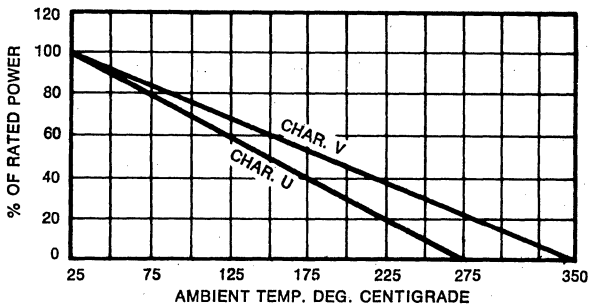
RCL·Shallcross POWER WIREWOUND RESISTORS

MIL-R-26, TYPE RW

T Series, Silicone Coated



DERATING CURVE



GENERAL SPECIFICATIONS

Wattage Range: 25 styles to choose from ranging from .4 to 14 watts.

Resistance Values: From 0.1 ohm to maximum values as stated in table. For values below 0.1 ohm, use RCL-Shallcross Low Ω Metal Element Resistors.

Power Rating: Two power ratings, depending on operating temperature and stability requirements:

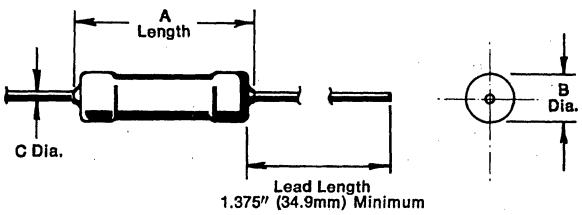
- Characteristic U: 275°C maximum hotspot temperature.
- Characteristic V: 350°C maximum hotspot temperature.

Derating: Wattage Ratings based on operation at 25°C. For higher ambient temperatures, derate per derating curve.

Tolerance: ±1.0% is standard. Closer tolerances are available.

Temperature Range: From −65°C to +275°C (Characteristic U) or +350°C (Characteristic V).

Temperature Coefficient of Resistance: Standard T.C.: ±20 PPM/°C = 500Ω and up, ±30 PPM/°C = 10Ω to 499Ω, ±50 PPM/°C = 1Ω to 9.99Ω, ±90 PPM/°C = 0.1Ω to 0.99Ω, ±400 PPM/°C = 0.025Ω to 0.099Ω, ±650 PPM/°C = 0.01Ω to 0.024Ω.



ELECTRICAL AND DIMENSIONAL SPECIFICATIONS

Metric Dimensions

RCL[1] Style	MIL-R-26[1] Style	Wattage Rating U	Wattage Rating V	Dimensions Clean lead to clean lead Length A	Dimensions Clean lead to clean lead Diameter B	Resistance[2] RCL Style	Resistance[2] MIL-R-26 Style	Lead[2] Diam. C AWG	Dimensions Clean lead to clean lead Length A mm	Dimensions Clean lead to clean lead Diameter B mm	Lead Diam. mm
T-½-A	—	0.4		.220 ±.062	.078 ±.031	2K	—	#24	5.6 ±1.6	2.0 ±0.8	0.5
T½	—	0.75	—	.330 ±.062	.078 ±.031	4K		#24	8.4 ±1.6	2.0 ±0.8	0.5
T-½-A81	RW81	1.0	—	.250 ±.032	.085 ±.020	2K	1K	#24	6.4 ±0.8	2.2 ±0.8	0.5
T-1-80	RW80	2.0		.406 ±.032	.094 ±.032	10K	3.16K	#24	10.3 ±0.8	2.4 ±0.5	0.5
T-1A	—	1.0	1.25	.406 ±.062	.093 ±.032	6.5K	—	#24	10.3 ±1.6	2.4 ±0.8	0.5
T-1A-70	RW70	1.0		.406 ±.031	.094 ±.031	6.5K	3.16K	#24	10.3 ±0.8	2.4 ±0.8	0.5
T-1B	—	1.1	1.30	.530 ±.062	.093 ±.031	8.2K	—	#24	13.5 ±1.6	2.4 ±0.8	0.5
T-1C	—	1.0	—	.280 ±.062	.093 ±.031	3.4K	—	#24	7.1 ±1.6	2.4 ±0.8	0.5
T-2	—	1.5	—	.343 ±.062	.156 ±.031	8K	—	#20	8.7 ±1.6	4.0 ±0.8	0.8
T-2A	—	3.0	3.75	.500 ±.062	.187 ±.031	12K	—	#20	12.7 ±1.6	4.8 ±0.8	0.8
T-2A-69	RW69	—	3.00	.500 ±.063	.188 ±.063	18K	2K	#20	12.7 ±1.6	4.8 ±1.6	0.8
T-2B	—	3.0	3.75	.812 ±.062	.188 ±.031	34K	—	#20	20.0 ±1.6	4.8 ±0.8	0.8
T-2B-79	RW79	3.0		.560 ±.062	.187 ±.031	22K	10.5K	#20	14.2 ±1.6	4.8 ±0.8	0.8
T-2C	—	3.0	3.25	.500 ±.062	.250 ±.031	18K	—	#18	12.7 ±1.6	6.3 ±0.8	1.0
T-3	—	4.0	5.5	.625 ±.062	.250 ±.031	25K	—	#18	15.8 ±1.6	6.3 ±0.8	1.0
T-5	—	5.0	6.5	.875 ±.062	.312 ±.031	45K	—	#18	22.2 ±1.6	8.0 ±0.8	1.0
T-5-74	RW74	5.0	—	.875 ±.062	.312 ±.031	45K	38.3K	#18	22.2 ±1.6	8.0 ±0.8	1.0
T-6	—	6.0	7.5	1.00 ±.062	.312 ±.031	65K	—	#18	25.4 ±1.6	8.0 ±0.8	1.0
T-6-67	RW67	—	6.5	1.00 ±.094	.313 ±.063	65K	8.2K	#20	25.4 ±2.4	8.0 ±1.6	0.8
T-7	—	7.0	9.0	1.185 ±.062	.312 ±.031	75K	—	#18	30.0 ±1.6	8.0 ±0.8	1.0
T-7A-55	RW55	—	7.0	1.375 ±.094	.469 ±.094	120K	5.1K	#20	35.0 ±2.4	12.0 ±2.4	0.8
T-10	—	10.0	13.0	1.812 ±.062	.375 ±.031	150K	—	#18	46.0 ±1.6	9.5 ±0.8	1.0
T-10-78	RW78	10.0	—	1.780 ±.062	.375 ±.031	150K	90.9K	#18	45.2 ±1.6	9.5 ±0.8	1.0
T-10-68	RW68	—	11.0	1.875 +.063 −.125	.344 ±.094	150K	20K	#20	22.2 +1.6 −3.2	8.7 ±2.4	0.8
T-10-A-56	RW56	—	14.0	2.00 ±.094	.469 ±.094	200K	9.1K	#20	50.8 ±2.4	12.0 ±2.4	0.8

[1] Aryton Perry Winding available for non-inductive requirements. (Divide Max. Resistance Value by 2).
[2] Contact factory for lead diameter, ohmic values or temperature coefficients not listed as standard.

NON-INDUCTIVE WINDINGS, RADIAL LEADS, EXTENDED HEAT DISSIPATION and other SPECIAL FEATURES are available.

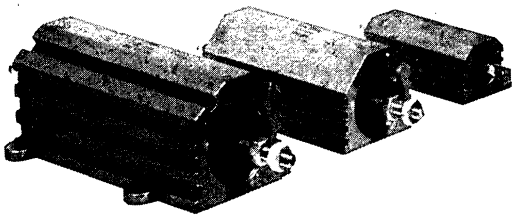
Call or write factory for complete information

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831
SHALLCROSS, INC., U.S. 70 East, Smithfield, NC 27577 • (919) 934-5181

RCL·Shallcross POWER WIREWOUND RESISTORS

MIL-R-18546, TYPE RE

AL Series, Aluminum Housed Chassis Mount



GENERAL SPECIFICATIONS

Wattage Range: 7 styles to choose from ranging from 5 to 250 watts.

Resistance Values: From 0.1 ohm to maximum values as stated in table.

Power Rating: 275°C maximum hotspot at 25°C ambient. 1% maximum ΔR in 1000 hour load life.

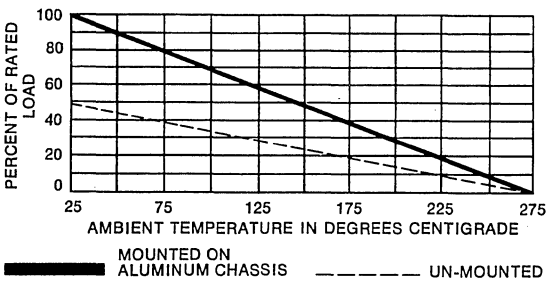
Derating: Wattage ratings based on operation at 25°C. For higher ambient temperatures, derate per derating curve.

Tolerance: ±1.0% is standard.

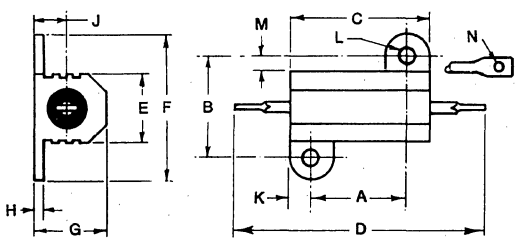
Temperature Range: From −55°C to +275°C.

Temperature Coefficient of Resistance: Standard T.C.: ±20 PPM/°C = 10Ω and up, ±50 PPM/°C = 1Ω to 9.99Ω, ±90 PPM/°C = below 1Ω.

WATTAGE VS. AMBIENT TEMP. DERATING

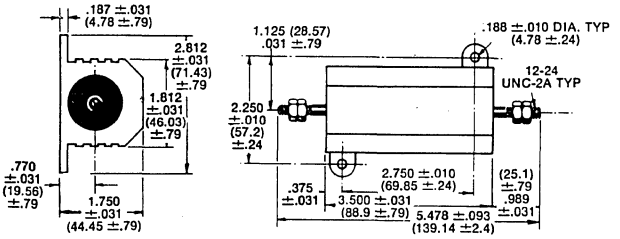


DIMENSIONS — 5 THRU 75 WATTS

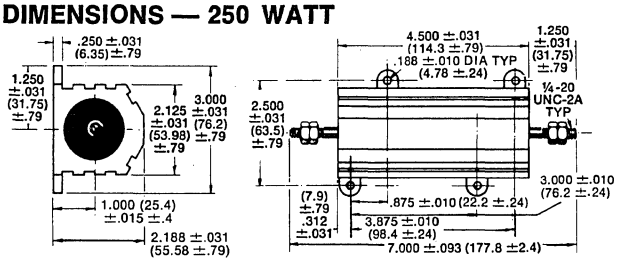


(METRIC DIMENSIONS ARE IN PARENTHESIS)

DIMENSIONS — 100 WATT



DIMENSIONS — 250 WATT



ELECTRICAL SPECIFICATIONS

RCL** Style	MIL Style	Power Rating (Watts)*		Resistance Range			Max. Weight
		RCL	MIL	Min.	Max.	Max. MIL	Grams
AL-5	RE-60G	5	5	.1	16K	3.32K	3
AL-10	RE-65G	10	10	.1	25K	5.62K	7
AL-25	RE-70G	25	20	.1	55K	12.1K	14
AL-50	RE-75G	50	30	.1	180K	39.2K	29
AL-75		75		.1	75K		120
AL-100	RE-77G †	100	75	.1	50K		400
AL-250	RE-80G †	250	120	.1	75K		800

* AL resistors have an operating temperature range of −55°C to +275°C. Derating is required for reduced chassis mounting area and or for high ambient temperatures.

** To order non-inductive styles add suffix N. (e.g.: ALN-5, RE-60N) (Divide Max. Res. Values by 2).

† For reference only

DIMENSIONAL SPECIFICATIONS

Style	A	B	C	D	E	F	G	H	J	K	L	M	N
Tol.	±.005	±.005	±.031	±.062	±.015	±.015	±.015	±.010	±.010	±.010	±.005	±.015	±.005
Tol. (metric)	±0.1	±0.1	±0.8	±1.6	±0.4	±0.4	±0.4	±0.25	±0.25	±0.25	±0.1	±0.1	±0.1
AL-5	.444 (11.28)	.490 (12.45)	.600 (15.24)	1.125 (28.58)	.334 (8.48)	.646 (16.41)	.320 (8.13)	.065 (1.65)	.140 (3.56)	.078 (1.98)	.093 (2.36)	.078 (1.98)	.050 (1.27)
AL-10	.562 (14.27)	.625 (15.88)	.750 (19.1)	1.375 (34.93)	.430 (10.92)	.800 (20.3)	.400 (10.2)	.075 (1.91)	.190 (4.83)	.093 (2.4)	.093 (2.4)	.102 (2.59)	.086 (2.18)
AL-25	.719 (18.26)	.781 (19.84)	1.062 (26.97)	1.938 (49.23)	.530 (13.46)	1.080 (27.43)	.560 (14.22)	.085 (2.16)	.260 (6.6)	.172 (4.37)	.125 (3.18)	.115 (2.92)	.086 (2.18)
AL-50	1.563 (39.7)	.844 (21.44)	1.968 (49.99)	2.781 (70.64)	.615 (15.62)	1.140 (28.96)	.615 (15.62)	.085 (2.16)	.300 (7.62)	.196 (4.97)	.125 (3.18)	.107 (2.71)	.086 (2.18)
Tol.	±.010	±.010	±.031	±.093	±.031	±.031	±.031	±.015	±.015	±.015	±.005	±.015	±.005
Tol. (metric)	±0.25	±0.25	±0.8	±2.4	±0.8	±0.8	±0.8	±0.4	±0.4	±0.4	±0.1	±0.4	±0.1
AL-75	2.125 (53.98)	1.500 (38.1)	2.500 (63.5)	3.750 (95.25)	1.125 (28.58)	1.875 (47.62)	1.125 (28.58)	.125 (3.18)	.625 (15.89)	.187 (4.75)	.172 (4.37)	.187 (4.75)	.095 (2.4)

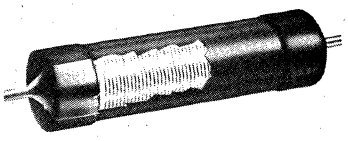
NON-INDUCTIVE WINDINGS, SPECIAL LEADS and EXTENDED HEAT DISSIPATION versions are available.

Call or write factory for complete information.

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831

RCL/Shallcross ESTABLISHED RELIABILITY POWER WIREWOUND RESISTORS

MIL-R-39007, TYPE RWR, S LEVEL PR Series, Silicone Coated



GENERAL SPECIFICATIONS

Wattage Range: 15 styles to choose from ranging from 1 to 15 watts.

Resistance Values: From 0.1 ohm to maximum values as stated in table.

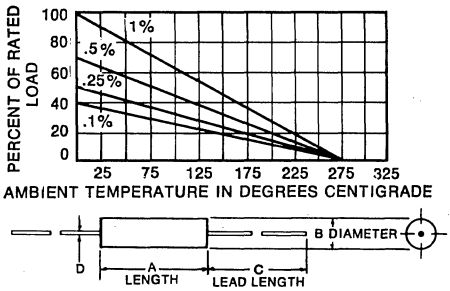
Power Rating: 275°C maximum hotspot at 25°C ambient.

Tolerance: ±1.0% is standard. ±0.1%, ±0.25%, ±0.5%, ±3%, ±5% and ±10% are available.

Temperature Range: −55°C to +275°C.

Temperature Coefficient of Resistance: Standard T.C.: ±20 PPM/°C = 10Ω and up, ±50 PPM/°C = 1Ω to 10Ω, ±400 PPM/°C = 0.499Ω to 1Ω, ±650 PPM/°C = 0.1Ω to 0.499Ω.

WATTAGE VS. AMBIENT TEMP. DERATING



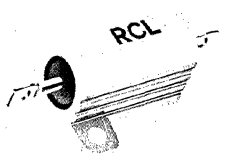
ELECTRICAL AND DIMENSIONAL SPECIFICATIONS

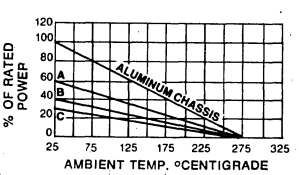
Shallcross Style	MIL-R-39007[1][2][3] Style	Power Rating (Watts) 275°	Resistance Value Min. Tol. 0.1%	Min. Tol. 1.0%	Max. All Tol.	Maximum Weight (Grams)	Dimensions A	B	C	D
PR13		6	10	0.1	10K	2.25	.625 ±.062	.250 ±.032	1.500	.040
PR17		5	10	0.1	7K	1.5	.500 ±.062	.218 ±.032	1.500	.040
PR33		15	10	0.1	80K	8.5	1.780 ±.062	.375 ±.032	1.500	.040
PR433	RWR78	10	0.499	0.1	80K	8.5	1.780 ±.062	.375 ±.032	1.500	.040
PR246	RWR84	7	0.499	0.1	25K	4.0	.875 ±.062	.312 ±.032	1.500	.040
PR446	RWR74	5	0.499	0.1	25K	4.0	.875 ±.062	.312 ±.032	1.500	.040
PR49	RWR80	2	0.499	0.1	3.16K	.35	.406 ±.032	.094 ±.032	1.500	.020
PR449		1	10	0.1	3.16K	.35	.406 ±.032	.094 ±.032	1.500	.020
PR60		10	10	0.1	45K	4.7	1.218 ±.062	.312 ±.032	1.500	.040
PR61	RWR89	4	0.499	0.1	4.12K	1.0	.560 ±.062	.187 ±.032	1.500	.032
PR261	RWR89	3	0.499	0.1	4.12K	1.0	.560 ±.062	.187 ±.032	1.500	.032
PR461		3	10	0.1	4.12K	1.0	.560 ±.062	.187 ±.032	1.500	.032
PR62		4.5	10	0.1	14K	1.25	.812 ±.062	.187 ±.032	1.500	.032
PR462	RWR71	3.25	0.499	0.1	16.2K	1.25	.812 ±.062	.187 ±.032	1.500	.032
PR66	RWR82	1.5	0.499	0.1	1.3K	.30	.312 ±.032	.085 ±.015	1.500	.020
PR68	RWR81	1	0.499	0.1	1K	.25	.250 ±.032	.085 ±.015	1.500	.020
PR268	RWR81	1	0.499	0.1	1K	.25	.250 ±.032	.085 ±.015	1.500	.020

[1] MIL-R-39007 Approved. To Life Failure Rate M, P, R, & S.
[2] Tolerances F (1%), D (.5%) and B (.1%) available at Life Failure Rate M, P, R, & S.
[3] Ayrton Perry Winding available for Non-Inductive requirements.

MIL-R-39009, TYPE RER, R LEVEL

AL-ER Series, Aluminum Housed Chassis Mount





GENERAL SPECIFICATIONS

Wattage Range: 4 styles to choose from ranging from 5 to 50 watts.

Power Rating: 275°C maximum hotspot at 25°C ambient. 1% maximum ΔR in 2000 hour load life.

Derating: AL-ER chassis mount resistors have an operating temperature range of −55°C to +275°C. For higher ambient temperatures, use derating curve which applies to operation of unmounted resistors (A = AL5ER and AL10ER, B = AL25ER and C = AL50ER).

Tolerance: ±1% is standard.

Temperature Coefficient of Resistance: Standard T.C.: ±20 PPM/°C = 20Ω and up, ±50 PPM/°C = 1Ω to 19.6Ω, ±100 PPM/°C = below 1Ω.

Dimensional Specifications: Identical to AL Series on previous page.

ELECTRICAL SPECIFICATIONS

RCL Style Refer to Note #1	MIL-R-39009 Style	Power Rating* (Watts) RCL	MIL	Minimum Resistance	Maximum Resistance	Maximum Working Voltage	Maximum Weight (Grams)
ALN5 ER	RER-40	7.5	5	1.0Ω	1.65K	90.8	3.3
AL5 ER	RER-60	7.5	5	0.1Ω	3.32K	128.9	3.0
ALN10 ER	RER-45	12.5	10	1.0Ω	2.80K	167.3	8.8
AL10 ER	RER-65	12.5	10	0.1Ω	5.62K	237.1	8.0
ALN25 ER	RER-50	25.0	20	1.0Ω	6.04K	347.6	16.5
AL25 ER	RER-70	25.0	20	0.1Ω	12.1K	550.0	15.0
ALN50 ER	RER-55	50.0	30	1.0Ω	19.6K	766.8	35.0
AL50 ER	RER-75	50.0	30	0.1Ω	39.2K	1085.0	32.0

* Rating based on chassis mounting at +25°C ambient.

Call or write factory for complete information

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831
SHALLCROSS, INC., U.S. 70 East, Smithfield, NC 27577 • (919) 934-5181

RCL·Shallcross LO-M® METAL ELEMENT RESISTORS

Low Ohmic Value At An Affordable Price

GENERAL SPECIFICATIONS

Wattage Range: 3 and 5 watts.

Resistance Values: 0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.04, 0.05, 0.07, 0.08, 0.1, 0.2 ohms.

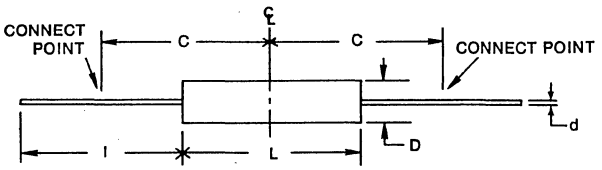
Derating: Lo Ω Metal Element Resistors are derated linearly from room temperature at full power to 0 power at 275°C.

Tolerance: 5% — All styles and values, 3% — All styles and values, 0.5% available above 0.005 ohms.

Construction: Tinned copper leads are welded directly to a low temperature coefficient of resistance element by a highly mechanized proprietary process. Resistors are encapsulated in a special formulated compound.

FEATURES

- Ultra Low Resistance Valves
- High Stability Over Life
- Low Temperature Coefficient of Resistance
- Inherently Non-Inductive



DIMENSION SPECIFICATIONS

Dimensions — Inches (Millimeters)

Style	L	D	C	l	d
LO-3	0.560 ±0.010 (14.224 ±0.254)	0.210 ±0.010 (5.334 ±0.254)	0.655 (16.64)	1.375 ±0.125 (34.925 ±3.175)	0.032 ±0.002 (0.813 ±0.051)
LO-5	0.920 ±0.010 (23.368 ±0.254)	0.330 ±0.010 (8.382 ±0.254)	0.835 (21.209)	1.250 ±0.125 (31.750 ±3.175)	0.040 ±0.002 (1.016 ±0.051)

DUAL FUNCTION FUSE RESISTORS

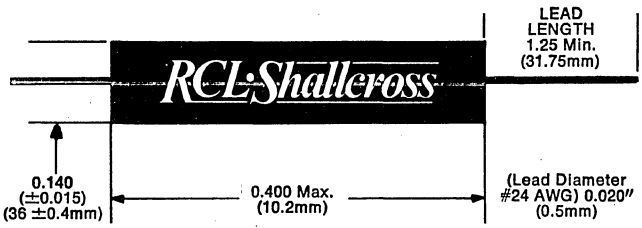
A Dual Purpose Device That Acts As Both A Wirewound Resistor and Fuse

GENERAL SPECIFICATIONS

Resistance Range: 0.2Ω to 200Ω.
Resistance Tolerance: 10% is standard, 5% and 2% definition.
Blow Characteristics: Per table — 2 pt. definition.
Operating Temperature: −55°C to +150°C
Temperature Coefficient: ±50 PPM/°C Max.

FEATURES

- Affords protection for semiconductor devices
- Eliminates fire hazard and circuit board damage to overheated components
- Eliminates unnecessary blowing due to transient conditions
- Reduces the number of discrete components required.



ELECTRICAL SPECIFICATIONS

RCL Style	Res (Ω)	Steady-State		Blow Condition I			Blow Condition II		
			W (Power Dissipation in Watts)		W (Power Dissipation in Watts)	T (Max.) Max. Fuse Blow Time		W (Power Dissipation in Watts)	T (Max.) Max. Fuse Blow Time
F501	0.2	2.2A	1.0W	10A	20W	500ms	25A	125W	50ms
F502	0.2	2.2A	1.0W	10A	20W	300ms	25A	125W	30ms
F503	0.5	1.4A	1.0W	6A	18W	10sec	15A	112W	100ms
F504	0.5	1.4A	1.0W	6A	18W	500ms	15A	112W	50ms
F505	0.5	1.4A	1.0W	6A	18W	50ms	15A	112W	10ms
F506	1.0	1.0A	1.0W	4A	16W	10sec	10A	100W	100ms
F507	1.0	1.0A	1.0W	4A	16W	500ms	10A	100W	50ms
F508	1.0	1.0A	1.0W	4A	16W	50ms	10A	100W	10ms
F509	2.0	700ma	1.0W	3A	18W	10sec	7A	98W	50ms
F510	2.0	700ma	1.0W	3A	18W	200ms	7A	98W	50ms
F511	2.0	700ma	1.0W	3A	18W	50ms	7A	98W	10ms
F512	5.0	450ma	1.0W	2A	20W	200ms	4.5A	101W	50ms
F513	5.0	400ma	0.8W	1.5A	10W	50ms	4.0A	80W	10ms
F514	5.0	350ma	0.6W	1.0A	5W	100ms	1.4A	10W	20ms
F515	10	300ma	0.9W	1.2A	14W	200ms	3.0A	90W	10ms
F516	10	300ma	0.9W	1.0A	10W	100ms	1.3A	17W	50ms
F517	10	200ma	0.4W	600ma	3.6W	100ms	900ma	8W	50ms
F518	20	220ma	1.0W	600ma	7.2W	10sec	900ma	8W	100ms
F519	20	220ma	1.0W	600ma	7.2W	100ms	900ma	8W	50ms
F520	20	150ma	0.4W	350ma	2.4W	500ms	450ma	4W	50ms
F521	50	140ma	1.0W	400ma	8.0W	500ms	600ma	18W	50ms
F522	50	130ma	0.8W	350ma	6.1W	100ms	450ma	10W	50ms
F523	50	80ma	0.3W	200ma	2.0W	200ms	240ma	2.9W	50ms
F524	100	100ma	1.0W	250ma	6.2W	10sec	300ma	9.0W	100ms
F525	100	80ma	0.6W	200ma	4.0W	200ms	250ma	6.2W	250ms
F526	100	60ma	0.4W	140ma	1.4W	10sec	180ma	2.0W	200ms
F527	200	70ma	1.0W	200ma	8.0W	10sec	250ma	12.5W	100ms
F528	200	60ma	0.8W	150ma	4.0W	100ms	250ma	12.5W	10ms

Call or write factory for complete information

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831

RCL·Shallcross PRECISION WIREWOUND RESISTORS

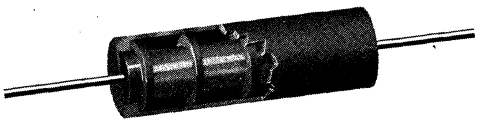
MIL-R-93, RB TYPE

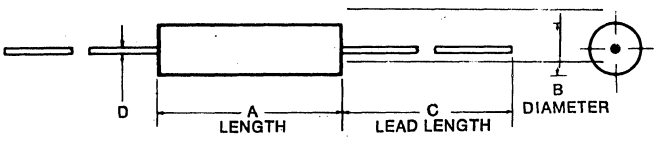
VA, SP and 7000 Series, Axial Lead

ELECTRICAL AND DIMENSIONAL SPECIFICATIONS

Shallcross VA Style	MIL-R-93[2]	Dimensions A ±.032	B ±.015	C	D Awg.	Watts MIL 125°C	Watts Commercial[1] 85°C	Max. Volt. DC	Approx. Weight Grams	Max. Resistance
• 10	RB56	.343	.250	2.0	20	.125	.250	200	1.0	350K
• 11		.295	.250	1.5	22	.125	.250	150	.3	250K
• 12	RB55	.500	.250	2.0	20	.150	.300	300	1.0	525K
13		.625	.250	1.5	20	.200	.400	500	1.5	800K
• 14	RB54	.750	.250	2.0	20	.250	.500	300	2.0	850K
16		1.0	.250	1.5	20	.500	1.0	750	3.0	1.25Meg
19		.812	.312	1.5	20	.500	1.0	300	3.5	5.0Meg
30		.343	.375	1.5	20	.125	.250	300	2.0	1.0Meg
• 32		.500	.375	1.5	20	.250	.500	300	3.5	1.5Meg
• 34	RB53	.750	.375	2.0	20	.330	.660	500	4.5	2.0Meg
• 36	RB52	1.0	.375	2.0	20	.500	1.0	750	6.0	2.5Meg
38		1.5	.375	1.5	20	.750	1.500	1000	7.5	3.5Meg
39		2.0	.375	1.5	20	1.250	2.500	1200	10.0	4.0Meg
52		.500	.500	1.5	20	.330	.660	300	5.5	2.0Meg
• 54		.750	.500	1.5	20	.500	1.0	500	7.0	3.0Meg
• 56		1.0	.500	1.5	20	.750	1.5	750	8.5	4.0Meg
• 58		1.5	.500	1.5	20	1.0	2.0	1000	11.5	5.0Meg
• 59		2.0	.500	1.5	20	1.250	2.5	1200	12.5	10.0Meg
SP Style		SUBMINIATURES								
• 20		.250	.187	1.5	22	.100	.200	150	.3	125K
• 21		.375	.187	1.5	22	.125	.250	300	.3	200K
• 22		.500	.187	1.5	22	.150	.300	300	.3	300K
23		.625	.187	1.5	22	.175	.350	600	1.0	400K
26		1.0	.187	1.5	22	.250	.500	1000	1.5	500K
40		.500	.160	1.5	22	.100	.200	300	.3	500K
• 41		.250	.125	1.5	22	.050	.100	100	.2	125K
• 42		.375	.125	1.5	22	.065	.125	200	.2	200K
• 43		.500	.125	1.5	22	.075	.150	200	.3	300K
47		.187	.100	1.5	24	.025	.050	75	.1	50K
• 48		.312	.100	1.5	24	.030	.060	100	.1	100K
49		.437	.100	1.5	24	.040	.075	100	.2	150K
• 68		.250	.085	1.5	24	.020	.040	100	.1	50K
69		.375	.085	1.5	24	.025	.050	100	.1	100K

• Standard Style [1] Commercial ratings may be applied at 125°C provided 175°C max. operating temperature is permissible. [2] MIL-R-93 Approved.





RCL Style	MIL-R-93 Style	Dia. ±.015	Lgth. ±.032	RCL Max. Watts	MIL Max. Watts	MIL Style Max. Res. 0.001 (.0254)	RCL Style 0.0005 (.0127)	Non-Inductive Winding	Lead Dia. AWG D	Metric Dimensions Dia. ±.4 mm	Metric Dimensions Lgth. ±.8 mm	Metric Dimensions Lead Dia. D mm
7002		.110	.220	.1			100K	NO	#24	2.8	5.6	0.5
7003		.100	.260	.05			150K	NO	#24	2.5	6.6	0.5
7004		.100	.300	.05			250K	YES	#24	2.5	7.6	0.5
7005		.125	.250	.1			300K	YES	#22	3.2	6.3	0.6
7006		.125	.3125	.1			350K	YES	#22	3.2	7.9	0.6
7007		.1875	.375	.125			700K	YES	#22	4.8	9.5	0.6
7008		.250	.250	.150			1Meg	YES	#22	6.3	6.3	0.6
7009	RB-56	.250	.343	.25	.125	127K	1.4Meg	YES	#20	6.3	8.7	0.8
7010	RB-55	.250	.500	.33	.15	226K	3Meg	YES	#20	6.3	12.7	0.8
7020	RB-54	.250	.750	.50	.25	511K	4.4Meg	YES	#20	6.3	19.0	0.8
7030	RB-53	.375	.750	.60	.33	750K	8Meg	YES	#20	9.5	19.0	0.8
7040	RB-52	.375	1.000	1.00	.50	1.5Meg	12Meg	YES	#20	9.5	25.4	0.8
7044		.500	.500	.50			7Meg	YES	#20	12.7	12.7	0.8
7045		.500	.625	.60			8Meg	YES	#20	12.7	15.9	0.8
7045A		.437	.625	.60			9Meg	YES	#20	11.1	15.9	0.8
7050	†RB-57	.500	1.00	1.25	.75	2Meg	14Meg	YES	#20	12.7	25.4	0.8
7050A		.437	1.00	1.25			13Meg	YES	#20	11.1	25.4	0.8
7060	†RB-58	.500	1.50	1.50	1.0	3Meg	20Meg	YES	#20	12.7	38.1	0.8
7070	†RB-59	.500	2.00	2.00	1.25	5Meg	30Meg	YES	#20	12.7	50.8	0.8

† For reference only

PC and 4000 Series

Printed Circuit Board Style

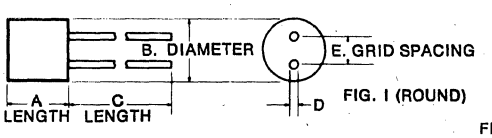


FIG. I (ROUND)

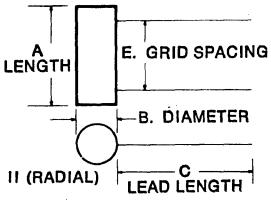
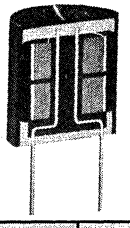


FIG. II (RADIAL)



ELECTRICAL AND DIMENSIONAL SPECIFICATIONS

Shallcross PC Style	PC Style MIL-R-93	Fig.	Dimensions A ±.032	B ±.015	C 1" Min.	D Awg.	E ±.010	Watts MIL 125°C	Watts Commercial[1] 85°C	Maximum Voltage DC	Approx. Weight Grams	Maximum Resistance
1		I	.250	.250	1.0	22	.200	.100	.200	150	.3	150K
3		I	.359	.265	1.0	22	.200	.125	.250	150	1.0	250K
4		I	.375	.375	1.0	20	.200	.250	.500	300	2.5	500K
8	RB71	I	.312	.250	1.0	22	.200	.125	.250	300	.3	150K
340		II	.500	.160	1.0	22	.406	.100	.200	300	.3	500K

[1] Commercial ratings may be applied at 125°C provided 175°C max. operating temperature is permissible.

RCL Style	MIL-R-93 Style	Fig. I Length (A)	Fig. I Diameter (B)	MIL Style Max. R Using .001 (25.4 μ)	RCL Style* Max. R Using .0006 (15.2 μ)	RCL Style** Max. Wattage	Standard Lead Spacing (±0.010)	Lead Diameter (AWG)	Metric Dimensions Length (mm)	Metric Dimensions Diameter (mm)	Metric Dimensions Standard Lead Spacing (mm ±0.25)	Metric Dimensions Lead Diameter (mm)
4060	RB-71	.312 ±.032	.250 ±.025	100K	500K	.250**	.200	#22	7.9 ±0.8	6.3 ±0.6	5.08	0.6
4061		.375 ±.032	.250 ±.025	160K	800K	.250	.200	#22	9.5 ±0.8	6.3 ±0.6	5.08	0.6
4062		.437 ±.032	.250 ±.025	160K	800K	.250	.200	#22	11.1 ±0.8	6.3 ±0.6	5.08	0.6
4063		.375 ±.032	.375 ±.015	185K	1Meg	.333	.200	#20	9.5 ±0.8	9.5 ±0.4	5.08	0.8
4064		.437 ±.032	.375 ±.015	250K	1.3Meg	.333	.200	#20	11.1 ±0.8	9.5 ±0.4	5.08	0.8
4065	RB-70	.500 ±.032	.375 ±.015	301K	1.5Meg	.333**	.200	#20	12.7 ±0.8	9.5 ±0.4	5.08	0.8
4066		.375 ±.032	.437 ±.015	450K	2Meg	.400	.300	#20	9.5 ±0.8	11.1 ±0.4	7.62	0.8
4067		.437 ±.032	.437 ±.015	600K	3Meg	.400	.300	#20	11.1 ±0.8	11.1 ±0.4	7.62	0.8
4068		.500 ±.032	.437 ±.015	700K	3.5Meg	.400	.300	#20	12.7 ±0.8	11.1 ±0.4	7.62	0.8

* Not applicable for MIL Styles (RB). ** Max. Wattage for MIL-R-93 Styles is 0.125 for RB-71 and 0.250 for RB-70.
Lead length 1½" (38.1 mm) Minimum. Tinned, weldable leads. RB-70 and RB-71, Lead length 1" ±⅛" (25.4 ±3.18 mm).

Call or write factory for complete information

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831
SHALLCROSS, INC., U.S. 70 East, Smithfield, NC 27577 • (919) 934-5181

RCL·Shallcross ESTABLISHED RELIABILITY PRECISION WIREWOUND RESISTORS

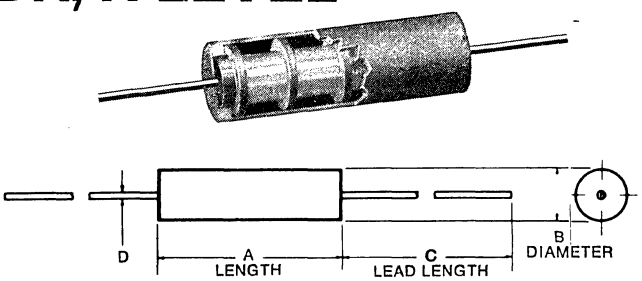
MIL-R-39005, TYPE RBR, R LEVEL

HR Series

Mil Tolerance Range For HR & ER Series:

RBR	Value	Tol. Minimum
52, 53, 55, 56, & 71	≥ 10Ω ≥ 0.1Ω	±.01% ±1%
54	≥ 4.99Ω ≥ 0.1Ω	±.01% ±1%
80 & 81	≥ 1000Ω ≥ 100Ω ≥ 10Ω	±0.01% ±0.02% ±0.10%

±1.0% (F); ±0.1% (B); ±0.5% (D); ±0.05% (A); ±0.02% (Q); ±0.01% (T).



ELECTRICAL AND DIMENSIONAL SPECIFICATIONS

Shallcross HR Style	HR Style MIL-R-39005	Dimensions A ±.032	B ±.015	C Min.	D Awg.	Watts MIL 125°C	Watts Commercial [1] 85°C	Maximum DC Voltage	Approx. Weight Grams	Maximum Resistance
1		.250	.250	1.0	22	.100	.200	150	.3	150K
3		.359	.265	1.0	22	.125	.200	150	1.0	250K
4		.375	.375	1.0	20	.250	.500	300	2.5	500K
• 5 [2]		.500	.250	1.0	22	.250	.500	300	1.0	500K
6		.375	.250	1.0	22	.125	.250	300	1.0	300K
7		.500	.375	1.0	20	.330	.660	300	3.0	600K
• 8	RBR71 [3,4]	.312	.250	1.0	22	.125	.250	300	.3	150K
9		.750	.375	1.0	20	.500	1.0	600	4.5	1.0Meg
• 10	RBR56 [3,4]	.343	.250	1.5	20	.125	.250	200	1.0	350K
11	RBR75	.295	.250	1.5	22	.125	.250	150	.3	250K
• 12	RBR55 [3,4]	.500	.250	1.5	20	.150	.300	300	1.0	525K
13		.625	.250	1.5	20	.200	.400	500	1.5	800K
• 14	RBR54 [3,4]	.750	.250	1.5	20	.250	.500	500	2.0	850K
16		1.0	.250	1.5	20	.500	1.0	750	3.0	1.25Meg
19	RBR76	.812	.312	1.5	20	.500	1.0	500	3.5	5.0Meg
• 20		.250	.187	1.5	22	.100	.200	150	.3	125K
• 21		.375	.187	1.5	22	.125	.250	300	.3	200K
• 22	RBR74	.500	.187	1.5	22	.125	.300	300	.3	300K
23		.625	.187	1.5	22	.175	.350	600	1.0	400K
26		1.0	.187	1.5	22	.250	.500	1000	1.5	500K
30		.343	.375	1.5	20	.125	.250	300	2.0	1.0Meg
• 32		.500	.375	1.5	20	.250	.500	300	3.5	1.5Meg
• 34	RBR53 [3,4]	.750	.375	1.5	20	.330	.660	500	4.5	2.0Meg
• 36	RBR52 [3,4]	1.0	.375	1.5	20	.500	1.0	750	6.0	2.5Meg
38		1.50	.375	1.5	20	.750	1.5	1000	7.5	3.5Meg
39		2.00	.375	1.5	20	1.250	2.5	1200	10.0	4.0Meg
40		.500	.160	1.5	22	.100	.200	300	.3	500K
• 41		.250	.125	1.5	22	.050	.100	100	.2	125K
• 42		.375	.125	1.5	22	.065	.125	200	.2	200K
43		.500	.125	1.5	22	.075	.150	200	.3	300K
47		.187	.100	1.5	24	.025	.050	75	.1	50K
• 48		.312	.100	1.5	24	.030	.060	100	.1	100K
49		.437	.100	1.5	24	.040	.075	100	.2	150K
52		.500	.500	1.5	20	.330	.660	300	5.5	2.0Meg
54		.750	.500	1.5	20	.500	1.0	500	7.0	3.0Meg
• 56	RBR57	1.0	.500	1.5	20	.750	1.5	750	8.5	4.0Meg
• 68		.250	.085	1.5	24	.020	.040	100	.1	50K
69		.375	.085	1.5	24	.025	.050	100	.1	100K
340 [5]	RBR81	.500 Max.	.160 Max.	1.0	24	.100	.200	300	.55	175K
341 [5]	RBR80	.325 Max.	.160 Max.	1.0	24	.100	.200	150	.40	50K

• **Standard Style**....[1] Commercial ratings may be applied at 125°C max. provided 175°C max. operating temperature is permissible. [2] Printed Circuit Style — See previous page for dimension diagram. Standard grid spacing 200″. [3] Available in failure rate levels M, P and R. [4] MIL-R-39005 Approved. [5] Printed Circuit Style — See pevious page, Figure II for dimension diagram. Standard grid spacing for HR 340 is .400″ ±.005″ and for HR 341 is .225″ ±.005″.

2000 ER, 4000 ER & 7000 ER Series

FIG. "A" — AXIAL LEAD

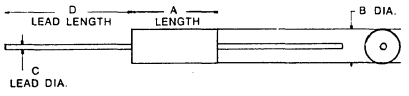


FIG "B" — PLUG-IN

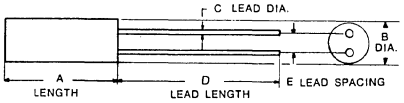
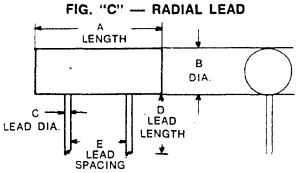


FIG. "C" — RADIAL LEAD



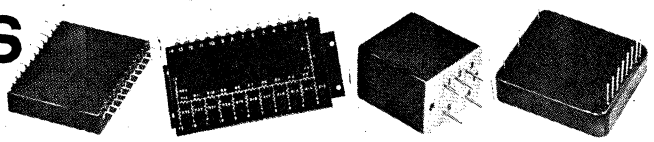
RCL Style	Military Style	MIL Resistance Range (Ohms)	Power Rating (Watts)	Fig.	Maximum Dimensions Length A	Diam. B	Lead Diam. C	Min. Lead Length D	Lead Spacing E ±0.005	Approx. Weight (Grams)	Style
7040-ER	RBR 52	0.1-1,200,000	0.5	A	1.020 (25.91)	0.39 (9.9)	0.034 (0.86)	1.5 (38.1)	N.A.	6.0	Axial
7030-ER	RBR 53	0.1-1,100,000	0.33	A	0.770 (19.6)	0.39 (9.9)	0.034 (0.86)	1.5 (38.1)	N.A.	4.5	Axial
7020-ER	RBR 54	0.1-562,000	0.25	A	0.770 (19.6)	0.265 (6.7)	0.034 (0.86)	1.5 (38.1)	N.A.	2.0	Axial
7010-ER	RBR 55	0.1-332,000	0.15	A	0.520 (13.21)	0.265 (6.7)	0.034 (0.86)	1.5 (38.1)	N.A.	1.0	Axial
7009-ER	RBR 56	0.1-220,000	0.125	A	0.364 (9.2)	0.265 (6.7)	0.034 (0.86)	1.5 (38.1)	N.A.	1.0	Axial
4060-ER	RBR 71	0.1-150,000	0.125	B	0.343 (8.7)	0.281 (7.1)	0.027 (0.69)	0.875 (22.2)	0.200 (5.1)*	0.3	Plug-In
R2407-ER	RBR 80	10.0-120,000	0.1	C	0.325 (8.3)	0.160 (4.06)	0.022 (0.56)	1.0 (25.4)	0.225 (5.7)	6.0	Radial
R2408-ER	RBR 81	10.0-250,000	0.1	C	0.50 (12.7)	0.160 (4.06)	0.022 (0.56)	1.0 (25.4)	0.400 (10.2)	6.0	Radial

(Metric dimensions in mm are in parenthesis) *±0.010 (±0.254)

Call or write factory for complete information

RCL ELECTRONICS, INC., 195 McGregor Street, Manchester, NH 03102 • (603) 627-3831
SHALLCROSS, INC., U.S. 70 East, Smithfield, NC 27577 • (919) 934-5181

RCL/Shallcross DISCRETE RESISTOR NETWORKS & MATCHED SETS



NETWORKS

Network quality is determined by the qualities of its individual resistors and the packaging and mounting expertise of its assembler. RCL/Shallcross offers a unique background of experience, data, manufacturing and testing skills for its wirewound resistor networks. PARAMETERS: (1) Resistance ratios to .001%, (2) Resistor tolerances to ±.005% (at ambient), (3) Ratio tolerances as close as .01% (over a range of temperatures), (4) Stability to ±.001% per year.

MATCHED SETS

Two or more resistors can be matched with relative tolerance much higher than each one's individual tolerance. Characteristics most often matched are: (1) DC Resistance at one or more temperatures, (2) AC and DC Voltage ratios, (3) Temperate Coefficients and (4) Phase Shifts. Principle advantages of matched sets are: (a) Very tight relative tolerances, (b) Lower cost than networks of comparable accuracy and (c) Flexibility in locating components during design and packaging. An engineering staff at RCL/Shallcross is ready to assist you in specifying your matched set requirements.

Consideration of the following requirements will provide our engineering staff with adequate information to complete your specification and quotation:

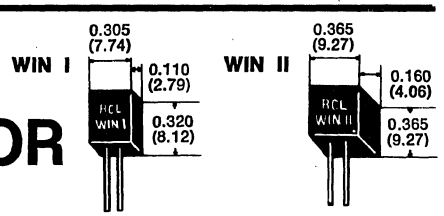
A. CIRCUIT

Resistance values .....
Resistance tolerances .....
Ratio/Ratios .....
Ratio tolerance (Ambient) .....
(over operating temperature range) .....
Wattage dissipation ..... per resistor ..... total
Frequency in Hz if AC .....
Ambient Temperature ..... °C
Operating temperature range − ..... °C to + ... °C
Maximum applied voltage .....
Schematic .....

B. CASE

Maximum volume ..... cu. in.
Case dimensions
..... length, ... width, ... height, ... diameter
Mounting: lugs ..... studs .....
screw holes (recessed) ..... other .....
Lead material ..... gauge ..... lead length
..... special spacing .....

RCL/Shallcross WIN HIGH DENSITY MODULAR RESISTOR



SPECIFICATIONS

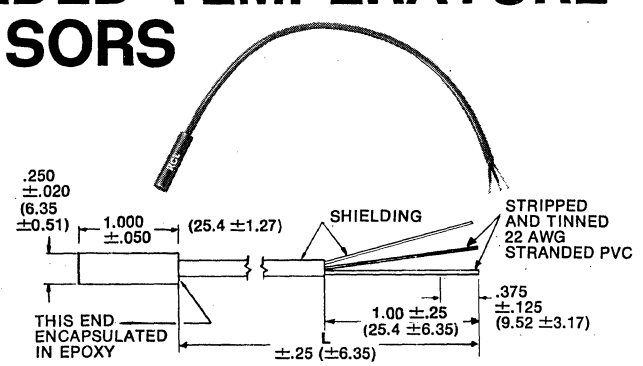
Resistance Range	Tolerance Avail.		T.C. Avail. PPM/°C (0°C to +85°C)	
	Win I	Win II	Win I	Win II
0.1Ω to .99Ω	Consult Factory	±10%	Consult Factory	±90 PPM
1.0Ω to 24.9Ω	Consult Factory	±3%	Consult Factory	±30 PPM
25Ω to 99.9Ω	±0.25%	±0.25%	±5 PPM	±5 PPM
100Ω to 199Ω	±0.1%	±0.1%	±5 PPM	±5 PPM
200Ω to 499Ω	±0.1%	±0.05%	±3 PPM	±3 PPM
500Ω to 699Ω	±0.05%	±0.02%	±3 PPM	±3 PPM
700Ω to 999.9Ω	±0.02%	±0.01%	±3 PPM	±3 PPM
1K to 125K	±0.02%	±0.01%	±2 PPM	±2 PPM
125K to 500K	N.A.	±0.01%	N.A.	±2 PPM

Wattage	0.3W at 85°C
Voltage	200 VDC
Resistance Range	Win I 0.1Ω to 125K Win II 0.1Ω to 500K
T.C. Tracking	To ±2PPM/°C
Stability	25 PPM/Year
Rise Time	Up to 25 nSec. Avail. Consult Factory
Noise	Negligible
Lead Spacing	S = 0.150 ±0.010 (3.81 ±0.254)
Size (Maximum) Win I	H ± 0.320 (8.12) L = 0.305 (7.74) W = 0.110 (2.79)
Size (Maximum) Win II	H ± 0.365 (9.27) L = 0.365 (9.27) W = 0.160 (4.06)

RCL/Shallcross MOLDED TEMPERATURE SENSORS

RCL offers a standard line of epoxy encapsulated sensing resistors for temperature compensating applications. The standard resistance tolerance ±5% with tighter tolerances available on special order. Cable lengths from 2.0″ to 48.0″ (50.80 to 1219.2 mm) are available with 6.0″ (152.40 mm) standard. Operating temperature range is −55°C to +105°C. Repeatability of tempco within a given lot is ±100 PPM.

RCL Style	Resistance Range	PPM/°C Average Tempco 0°C — 100°C
TC35	10Ω — 50KΩ	3500 ±350
TC45	10Ω — 10KΩ	4500 ±450
TC55	10Ω — 5KΩ	5500 ±550



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RES NET® ULTRA PRECISION METAL FILM RESISTORS & NETWORKS

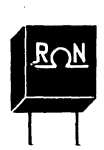
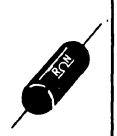
RESISTANCE TOLERANCES — 0.005% to 1%

TEMPERATURE COEFFICIENT — 1, 2, 5, or 10ppm/°C

FEATURES

- Long Term Stability: 25ppm/year
- Noise Factor: Below 30db
- Inductance: Approx. .05 microhenry
- Capacitance: Below 0.5 picofarad
- Voltage Coefficient: < 2ppm/volt
- Rise Time: Less than 1ns without ringing

PERFORMANCE MEETS OR EXCEEDS REQUIREMENTS OF MIL-R-55182

	S-50	S-100	X-100	S-120	S-300	S-302	C-200	C-201	C-202
									
Resistance Range and Wattage	1 ohm to 50K .125 watt	1 ohm to 150K .3 watt	1 ohm to 150K .3 watt	20 ohms to 700K .3 watt	50 ohms to 1 Meg. .5 watt	75 ohms to 1.5 Meg. .75 watt	1 ohm to 50K .125 watt	1 ohm to 75K .125 watt	1 ohm to 200K .25 watt
Size	H .200 ± .020 L .295 ± .010 W .100 ± .010	H .320 ± .020 L .295 ± .010 W .100 ± .010	H .320 ± .020 L .295 ± .010 W .100 ± .010	H .320 ± .020 L .565 ± .020 W .150 ± .010	H .520 ± .020 L .565 ± .020 W .150 ± .010	H .520 ± .020 L .810 ± .010 W .150 ± .010	L .250 ± .10 D .125 ± .010	L .300 ± .01 D .125 ± .01	L .500 ± .020 D .250 ± .010
Lead Spacing	.150 ± .010	.150 ± .010	Center	.400 ± .020	.400 ± .020	.650 ± .020	Center	Center	Center

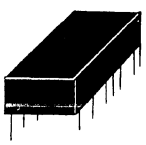
CUSTOM RESISTOR NETWORKS

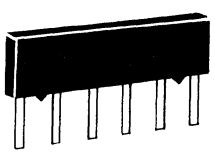
DUAL-IN-LINE (DIP)
SINGLE-IN-LINE (SIP)

MATCHING & TRACKING
AS GOOD AS .005% I PPM/°C
PER CUSTOMER SPECIFICATIONS

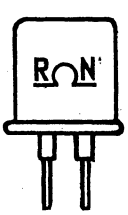
Other Packages Available

Complete Custom
Packaging Capability



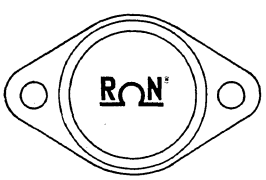


ULTRA-PRECISION HERMETIC SEAL METAL FILM HS-100



Resistance to 150K
Tolerance to .005%
TC to 1PPM/°C

PRECISION HERMETIC SEAL METAL FILM POWER RESISTOR P-300

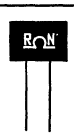
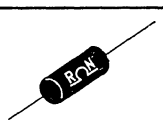
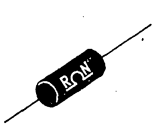


Power: 10 Watts (Heat Sink)
3 Watts (Free Air)
Tolerance to ±.01%
TC to 10ppm/°C
Standard TO-3 Package

FILMET®
NEW ECONOMY SERIES / HIGH PRECISION METAL FILM RESISTORS

COST COMPETITIVE WITH WIRE-WOUND

TC = 10ppm/°C Tolerance to .01%

STYLE	OUTLINE DWG.	MAX. DIMENSIONS	RESISTANCE RANGE
EP-50		H = .200 L = .320 W = .120 LS = .150	10Ω — 50K .125 Watt
EP-100		H = .345 L = .320 W = .120 LS = .150	10Ω — 150K .3 Watt
EP-200		L = .250 D = .125	10Ω — 50K .125 Watt
EP-202		L = .500 D = .250	10Ω — 200K .3 Watt

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Against this enviable background our engineers envision even greater challenges in solving future OEM and industrial resistor application problems. For prompt, practical answers to your requirements, send us your prints or specs.

AXIAL LEAD

No.	Watts	Resistance Min. Max.	Dimensions O.D. x Lgth.
3 AX	3	0.1- 10,000	¼ max. x 5/16
5 AX	5	0.1- 30,000	11/32 max. x 1 1/16
10 AX	10	0.1- 50,000	13/32 max. x 1 5/16

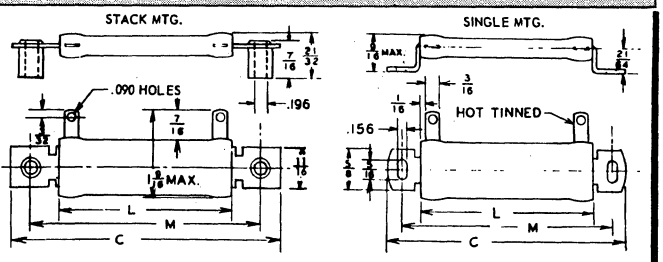
FIXED LUG

No.	Wattage	Resistance Min.-Max.	Max. Dimensions O.D. x Lgth.
1 M	5	0.1- 11,000	5/16 x 1
1¾ M	10	0.1- 50,000	5/16 x 1¾
2 E	20	0.25-100,000	7/16 x 2
2 B	25	0.25-100,000	5/16 x 2
4 B	50	0.5-175,000	5/16 x 4
6½ C	100	1.0-300,000	¾ x 6½
8½ R	160	1.0-300,000	1⅛ x 8½
10½ R	200	1.0-400,000	1⅛ x 10½

ADJUSTABLE

No.	Wattage	Resistance Min.-Max.	Max. Dimensions O.D. x Lgth.
1¾ MA	10	1.0- 10,000	5/16 x 1¾
2 BA	25	1.0- 25,000	5/16 x 2
4 BA	50	1.0-100,000	5/16 x 4
6 BA	75	1.0-100,000	5/16 x 6
6½ CA	100	1.0-100,000	¾ x 6½
8½ RA	160	1.0-100,000	1⅛ x 8½
10½ RA	200	1.0-100,000	1⅛ x 10½

FLAT OVAL



Watts* Free Air	Core—L	Min. Ohms	Max. Ohms	Mounting	C	M
30	1¼	0.1	10K	Single Stack	2⅛ 2½	1¾ 2
40	2	0.2	30K	Single Stack	2⅞ 3¼	2½ 2¾
55	3½	0.3	60K	Single Stack	4⅜ 4¾	4 4¼
65	4¾	0.4	85K	Single Stack	5⅝ 6	5¼ 5½
75	6	0.5	100K	Single Stack	6⅞ 7¼	6½ 6¾

* Ratings of flat oval resistors based on mounting on steel panel 10″ x 10″ x .040″. When mounted on non-metallic surface, reduce wattage approximately 15%.

RIBBON-WOUND RESISTORS

Watts	Core Size D	Core Size L	Ohms Min. Res.	Ohms Max. Res.	Watts	Core Size D	Core Size L	Ohms Min. Res.	Ohms Max. Res.
400	1⅛	11¼	0.24	18.00	135	¾	5	0.06	4.25
375	1⅛	10½	0.22	16.50	105	¾	4	0.04	3.00
300	1⅛	8½	0.17	13.00	100	¾	3½	0.03	2.40
240	1⅛	6½	0.11	8.20	135	5/16	6	0.06	5.50
185	1⅛	5	0.09	6.40	105	5/16	5	0.05	3.65
180	¾	6½	0.08	6.00	90	5/16	4	0.04	2.75

Available with adjustable tap bands or with tapped windings.

NON-INDUCTIVE RESISTORS: for high frequency power circuits. Available in all fixed-lug types, 10 watts and larger. Standard tolerances: ±10%.

RESISTANCE TOLERANCES: Standard: ±5%, 1.0 ohm and over. Special: down to ±1%.

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resistors, inc.

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ENGINEERING, MANUFACTURING

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Long Distance Phone: (312) 652-7555
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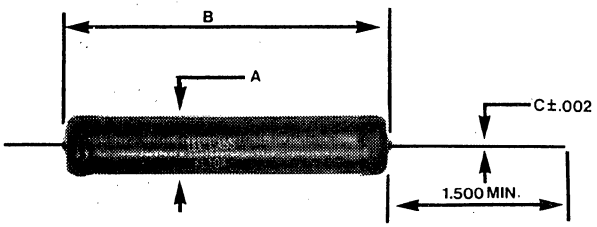
Our resistors are made for perfectionists... by perfectionists!

TYPE EL silicone power

MEET OR EXCEEDS MIL-R-26



Tel Labs Style	Mil Desig. (RW)	Diameter (A)	Length (B)	Lead Size (C)	Wattage 275°C	Wattage 350°C
EL¼		.090±.031	.215±.031	.020	0.5W	1.0W
EL½		.090±.031	.280±.031	.020	0.5W	1.0W
EL1A	RW70	.090±.031	.395±.031	.020	1.0W	1.25W
EL1B		.090±.031	.530±.031	.020	1.0W	1.25W
EL1C		.135±.031	.335±.031	.025	1.0W	2.0W
EL2		.250±.031	.625±.062	.032-.040	3.0W	4.0W
EL2A		.187±.031	.825±.062	.032	3.25W	4.5W
EL2B		.187±.031	.625±.062	.032	3.0W	3.5W
EL2C		.250±.031	.562±.062	.032-.040	3.0W	4.0W
EL2D		.250±.031	.500±.062	.032-.040	3.0W	4.0W
EL2E	RW59, 69	.195±.031	.500±.062	.032	2.5W	3.5W
EL2F		.187±.031	.500±.062	.032	2.5W	3.0W
EL2G		.187±.031	.430±.062	.032	2.5W	3.0W
EL2H		.187±.031	.385±.062	.032	2.5W	3.0W
EL21	RW79	.195±.031	.560±.062	.032	3.0W	3.5W
EL3		.295±.031	.500±.062	.032-.040	3.0W	4.0W
EL5	RW74	.290±.062	.925±.093	.032-.040	5.0W	6.0W
EL5A	RW57, 67	.350±.062	1.000±.093	.032-.040	5.0W	6.5W
EL7		.290±.062	1.200±.093	.032-.040	5.0W	6.5W
EL7A		.350±.062	1.360±.093	.032-.040	5.0W	7.0W
EL10A	RW58, 68	.350±.062	1.815±.093	.040	10.0W	12.0W

Send for our new catalog covering our complete line of fixed wire wound resistors.

Additional items include:

TYPE VR - Vitreous Coated
TYPE EH - Aluminum Housed
TYPE BL - Beryllium Oxide
TYPE PR - Subminiature Printed Circuit
TYPE Q81 - Special Temperature Compensation
TYPE Q239 - Special 4-Terminal Device

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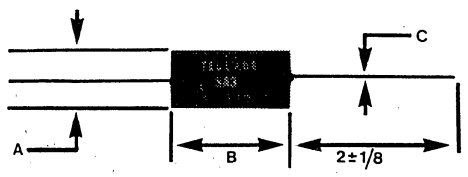
TYPE SA epoxy

DESIGNED TO MEET OR EXCEED MILR93D

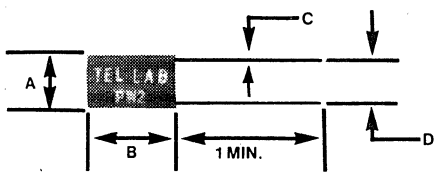


Tel Labs Style	Mil R93D Desig.	Diam. A ± .015	Length B ± .031	Lead Diam. C.	MAX. VALUE Mil.	MAX. VALUE Comm.	WATTAGE Mil.	WATTAGE Comm.	MAX. VOLTAGE Mil.	MAX. VOLTAGE Comm.
SA1	RB55	.250	.500	.032	226 K	1.1 Meg	.15W	.3W	400	400
SA2	RB54	.250	.750	.032	448 K	2 Meg	.25W	.4W	300	400
SA3	RB53	.375	.750	.032	750 K	8 Meg	.333W	.5W	300	400
SA4	RB52	.375	1.000	.032	1.5 Meg	10 Meg	.5W	.75W	600	800
SA5	RB57	.500	1.000	.032	2 Meg	16 Meg	.75W	1.0W	800	1000
SA6	RB58	.500	1.531	.032	3 Meg	24 Meg	1.0W	1.5W	900	1200
SA7	RB59	.500	2.031	.032	5.11 Meg	24 Meg	1.25W	2.0W	1200	1800
SA11		.250	.625	.032		400 K		.33W		800
SA13		.312	.937	.032		1.2 Meg		.5W		800
SA16	RB56	.250	.375	.032	127 K	205 K	.125W	.25W	200	200
SA19		.250	.250	.032		500 K		.2W		200
SA18		.500	.500	.032		3 Meg		.5W		.500

subminiatures

Tel Labs Style	Diameter A ±.015	Length B ±.031	Lead Diam. C.	Maximum Value	Maximum Wattage	Maximum Voltage
SA9	.135	.312	.025	400 K	.08W	100
SA10	.185	.500	.025	500 K	.2W	100
SA20	.165	.500	.025	400 K	.150W	100, 200
SA21	.187	.375	.025	500 K	.125W	100, 200
SA22	.150	.400	.025	190 K	.07W	100
SA24	.125	.250	.020	75 K	.05W	100
SA25	.110	.300	.020	85 K	.05W	100
SA26	.125	.375	.025	140 K	.05W	100
SA29	.100	.300	.025	80 K	.05W	100
SA30	.200	.405	.025	550 K	.13W	100
SA31	.100	.220	.020	70 K	.04W	100

TYPE PW series



Mil R 93D Desig.	Tel Labs Style	A ± .015	B ± .032	C	D ± .015	MAX. VALUE Mil.	MAX. VALUE Comm.	WATTAGE Mil.	WATTAGE Comm.	MAX. V. Mil.	MAX. V. Comm.
RB71	PW1	.250	.312	.025	.200	100K	125K	.125W	.15W		300
	PW2	.250	.406	.025	.200		175K		.2W		600
RB70	PW20	.375	.500	.032	.200,.250	301K	375K	.250W	.33W	150	600
	PW40	.468	.625	.032	.250,.300		500K		.3W		600
	PW31	.500	.625	.032	.250,.300		1.75 Meg		.6W		600
	PW10	.406	1.250	.032	.250,.300		1.0 Meg		1.0W		1200
	PW50	.531	1.000	.032	.250,.300		3.0 Meg		1.0W		1200

CONTENTS

A Few Words About TRW 2

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Metal Film GP¼ Series 12

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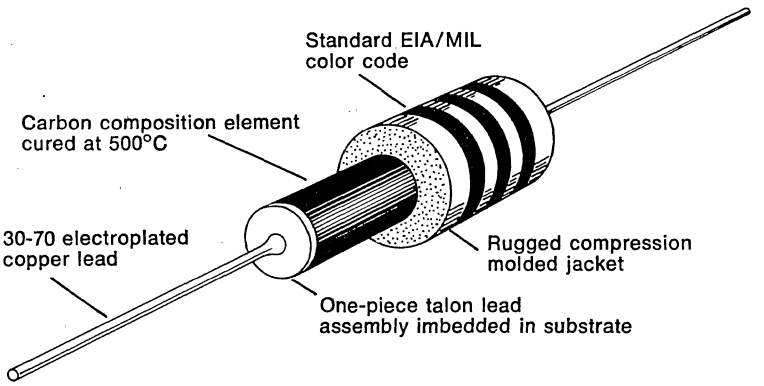
GENERAL-PURPOSE CARBON COMPOSITION RESISTORS

IBT SERIES*

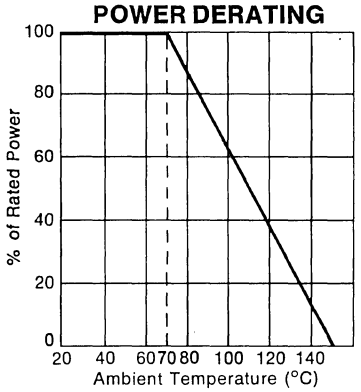
- ¼ watt to 1 watt
- 10 ohms to 22 megohms
- ±5% tolerance



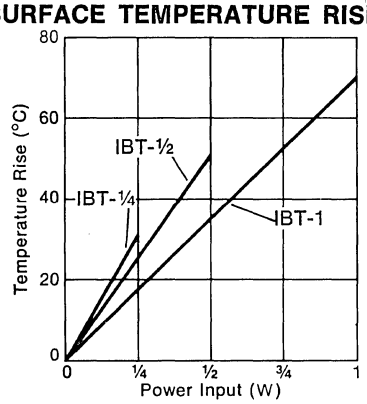
SPECIFICATIONS

Electrical Characteristics	IBT-¼	IBT-½	IBT-1
MIL-R-11 Style	RC07	RC20	RC32
Resistance Range	10Ω to 1MΩ	10Ω to 22MΩ	10Ω to 10MΩ
Tolerance	±5% (Series E24)	±5% (Series E24)	±5% (Series E24)
Rated Power	0.25W @ 70°C	0.50W @ 70°C	1W @ 70°C
Max. Continuous Working Voltage	250V	350V	500V
Surface Temperature Rise	32°C @ 0.25W	50°C @ 0.5W	70°C @ 1W
Average Shunt Capacitance	0.15 pF	0.175 pF	0.30 pF
Dielectric Withstanding Voltage — Atmospheric Pressure	500V RMS, min.	700V RMS, min.	1000V RMS, min.
— At 87mm of Mercury	325V RMS, min.	450V RMS, min.	625V RMS, min.
Insulation Resistance — Dry	10^5MΩ min.	10^5MΩ min.	10^5MΩ min.
Wet	10^3MΩ min.	10^3MΩ min.	10^3MΩ min.
Performance Characteristics			
Operating Temperature Range	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C
Voltage Coefficient	−0.025%/V max.	−0.025%/V max.	−0.020%/V max.
Life (Method 108, MIL-STD-202, Cond. D)	±2.50%	±5%	±5%
Short Time Overload (6.25 x Rated Power, 5 sec.)	±1%	±1.50%	±1.50%
Moisture Resistance (Method 106, MIL-STD-202)	±8%	±1.50%	±3%
Temperature Cycling (Method 102, MIL-STD-202, Cond. D)	±1%	±0.75%	±1%
Low Temperature Operation (MIL-R-11, Para 4.6.7; −65°C)	±0.75%	±0.50%	±1%
Terminal Strength (Method 211, MIL-STD-202, Cond. A, D)	±0.30%	±0.50%	±0.50%
Resistance to Soldering (Method 210, MIL-STD-202, Cond. A)	±2%	±1.50%	±2%
Shock, Medium Impact (Method 205, MIL-STD-202, Cond. C)	±1%	±0.50%	±0.50%
Vibration, High Frequency (Method 204, MIL-STD-202, Cond. D)	±1%	±0.50%	±0.50%

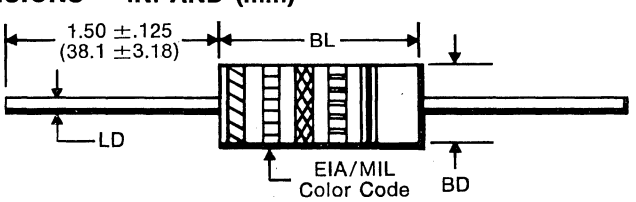
POWER DERATING



SURFACE TEMPERATURE RISE



DIMENSIONS — IN. AND (mm)



TRW Type	Body Length BL	Body Diameter BD	Lead Diameter LD
IBT-¼	.250 ±.015 (6.35 ±.30)	.090 ±.008 (2.29 ±.20)	.025 ±.001 (.635 ±.03)
IBT-½	.390 ±.010 (9.91 ±.30)	.140 ±.008 (3.56 ±.20)	.031 ±.001 (.787 ±.03)
IBT-1	.562 ±.010 (14.3 ±.30)	.225 ±.008 (5.72 ±.20)	.040 ±.001 (1.02 ±.03)

* Manufactured in Italy

HOW TO ORDER

Sample Part No.:

IBT - ½ - 680k - 5%

Type

Power Rating at 70°C
¼, ½ or 1 watt

Resistance
Standard EIA/MIL values for carbon composition resistors. See specification table for range.

±5% Tol.	±5% Tol.	±5% Tol.	±5% Tol.
1.0	1.8	3.3	5.6
1.1	2.0	3.6	6.2
1.2	2.2	3.9	6.8
1.3	2.4	4.3	7.5
1.5	2.7	4.7	8.2
1.6	3.0	5.1	9.1

Tolerance
±5%

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

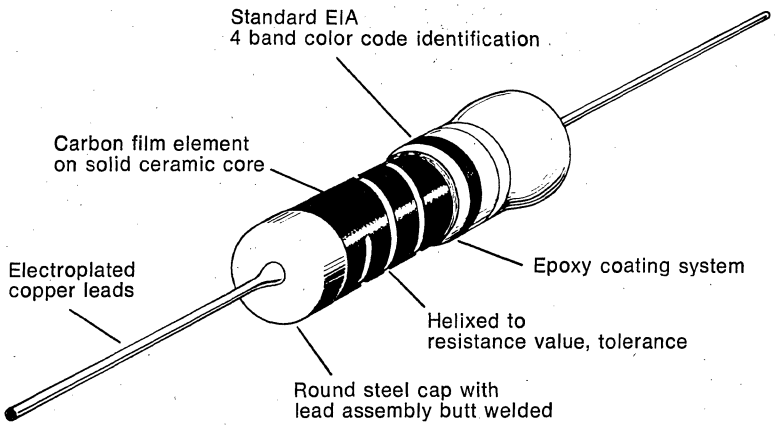
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
401 N. BROAD STREET, PHILADELPHIA, PA 19108 / PHONE (215) 922-8900 / TWX 710-670-2286

TRW

GENERAL-PURPOSE CARBON FILM RESISTORS

CF SERIES*

- ¼ watt to 1 watt
- 1 ohm to 4.7 megohms
- ±5% tolerance



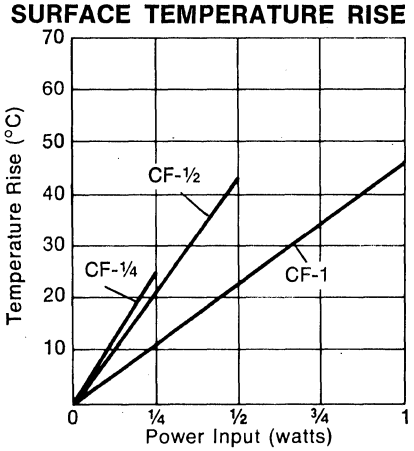
SPECIFICATIONS

Type	CF-¼	CF-½	CF-1
Resistance, Standard	1 ohm to 4.7 megohms	2 ohm to 2.2 megohms	2 ohm to 2.2 megohms
Tolerances, Standard	±5%	±5%	±5%
Power Rating	¼ watt @ 70°C	½ watt @ 70°C	1 watt @ 70°C
Maximum Continuous Working Voltage	250 volts	350 volts	500 volts
Minimum Insulation Resistance—Dry	1000 megohms	1000 megohms	1000 megohms
Minimum Dielectric Withstanding Voltage—Atmospheric	500 volts	500 volts	500 volts
Load Life—Typical ΔR Less Than	±3%	±3%	±3%

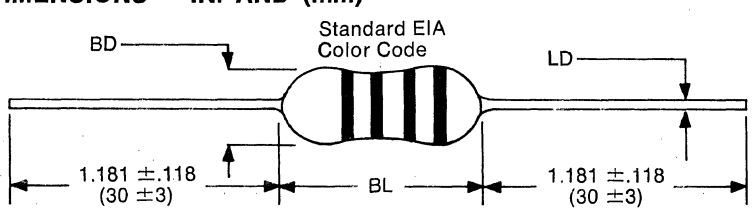
RESISTANCE-TEMPERATURE CHARACTERISTIC

Nominal Resistance (ohms)	Typical Temperature Coefficient (ppm/°C)		
	CF-¼	CF-½	CF-1
100 ohms to 10K	−100 to −400	+350 to −350	+350 to −350
11K to 100K	−150 to −500	+350 to −350	+350 to −350
110K to 1 megohm	−200 to −1000	+350 to −500	+350 to −500
1.1 megohm to 4.7 megohms	−800 to −1500	+350 to −800	+350 to −800

SURFACE TEMPERATURE RISE



DIMENSIONS — IN. AND (mm)



TRW Type	Body Length BL	Body Diameter BD	Lead Diameter LD
CF-¼	.276 ±.039 (7±1)	.091 ±.020 (2.3 ±0.5)	.024 ±.002 (0.6 ±0.05)
CF-½	.354 ±0.39 (9 ±1)	.146 ±.020 (3.7 ±0.5)	.028 ±.002 (0.7 ±0.05)
CF-1	.630 ±.039 (16 ±1)	.217 ±.020 (5.5 ±0.5)	.031 ±.002 (0.8 ±0.05)

HOW TO ORDER

Sample Part No.: **CF - ¼ - 47Ω - 5%**

TRW Type

Power Rating at 70°C
¼, ½ or 1 watt

Resistance
Standard Resistance Value Multipliers:

±5% Tol.	±5% Tol.	±5% Tol.	±5% Tol.
1.0	1.8	3.3	5.6
1.1	2.0	3.6	6.2
1.2	2.2	3.9	6.8
1.3	2.4	4.3	7.5
1.5	2.7	4.7	8.2
1.6	3.0	5.1	9.1

Tolerance
±5%

* Made in Singapore or Korea

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

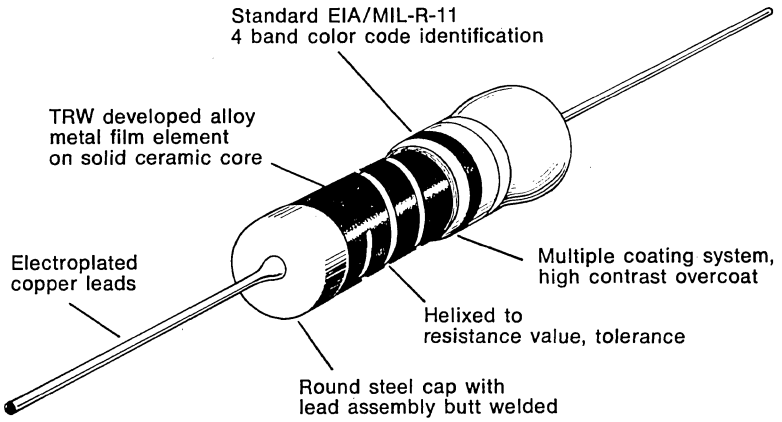
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
401 N. BROAD STREET, PHILADELPHIA, PA 19108 / PHONE (215) 922-8900 / TWX 710-670-2286

TRW

GENERAL-PURPOSE METAL FILM RESISTORS

GP¼ SERIES

- ☐ Dual rating for ¼ watt and ½ watt applications
- ☐ Metal film environmental performance
- ☐ 10 ohms to 1 megohm
- ☐ ±2% or ±5% tolerance
- ☐ ±200 ppm/°C temperature coefficient
- ☐ Low noise



SPECIFICATIONS

Resistance Values: 10Ω through 1.0 Meg

Resistance Tolerance: ¼W application ±2%, ±5% — ½W application ±5%

Power Rating @ 70°C: ¼W, ½W

Temperature Coefficient of Resistance: ±200 ppm

Temperature Range: −55°C to +155°C

Continuous Working Voltage: 250V

Insulation Resistance: 1000 Megohms

Noise: −5 dB to −30 dB

Lead Material: Electroplated Copper

Construction: TRW developed alloy metal film on solid ceramic core

PERFORMANCE DATA (MAX ΔR)

Shock, Medium Impact & Vibration High Frequency: .5% +.05Ω

Load Life 100% Power @ 70% 2% +.5Ω

Short Time Overload: .5% +.05Ω @ 2.5 x Rated Voltage for 5 sec.

High Temperature Exposure: 2% +.5Ω @ 155°C

Low Temperature Operation: .5% +.05Ω

Hot Spot Surface Temperature Rise: ¼W 20°C, ½W 40°C

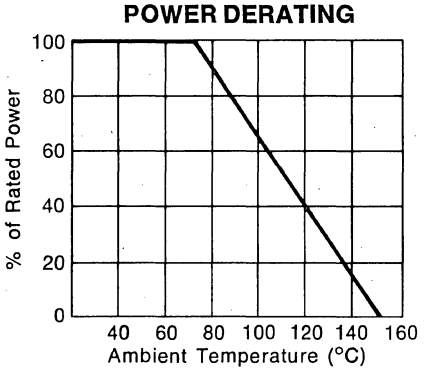
Temperature Cycling: .5% +.05Ω

Moisture Resistance: ¼W 2% - 1.5% +.05Ω
¼W 5% - 2% +.05Ω —
½W 5% - 3% +.05Ω

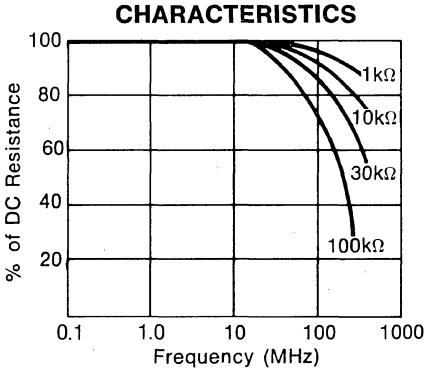
Solder Heat: .5% +.05Ω

Terminal Strength: .5% +.05Ω

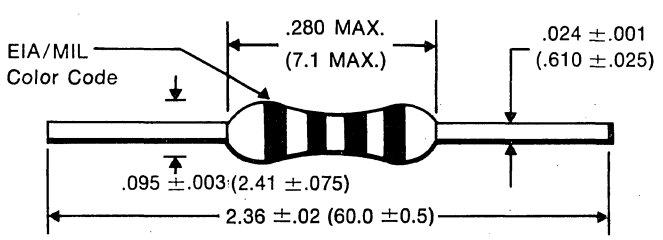
POWER DERATING



HIGH FREQUENCY CHARACTERISTICS



DIMENSIONS — IN. AND (mm)



The GP¼ is a superior dual rated, general purpose metal film resistor. Available as either a 5% general purpose or a 2% semi precision resistor, this conformally coated device exhibits a temperature coefficient of ±200 ppm/°C — far superior to the industry average.

Since it can perform in ¼W and ½W applications, the compact GP¼ saves valuable "real estate" in circuit boards while offering versatility for inventory purposes. This space saving capability coupled with the GP¼'s compatibility with automatic insertion equipment makes it the ideal alternative to carbon composition and carbon film resistors for computer, telecommunications, instrumentation, and many automotive applications.

All the quality and reliability exhibited by TRW Resistive Products for several decades are manufactured into the GP¼. The well established, time tested evaporated metal film process that has been utilized so successfully by our Burlington, Iowa plant is used to manufacture the GP¼. The same sturdy ceramic end cap construction and quality materials have been combined with an automated assembly technique that results in TRW quality at a lower price.

HOW TO ORDER

Sample Part No.:

GP¼ - 47Ω - 2%

TRW Type

Resistance Value

10Ω to 1.0 Meg in the following standard EIA/MIL decade values:

±2% and ±5% tolerance			
10.0	18.0	33.0	56.0
11.0	20.0	36.0	62.0
12.0	22.0	39.0	68.0
13.0	24.0	43.0	75.0
15.0	27.0	47.0	82.0
16.0	30.0	51.0	91.0

Tolerance

±2% or ±5%

Standard Packaging:

EIA RS-296D-Class 1-Tape and Reel 5000 pieces per value per reel

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

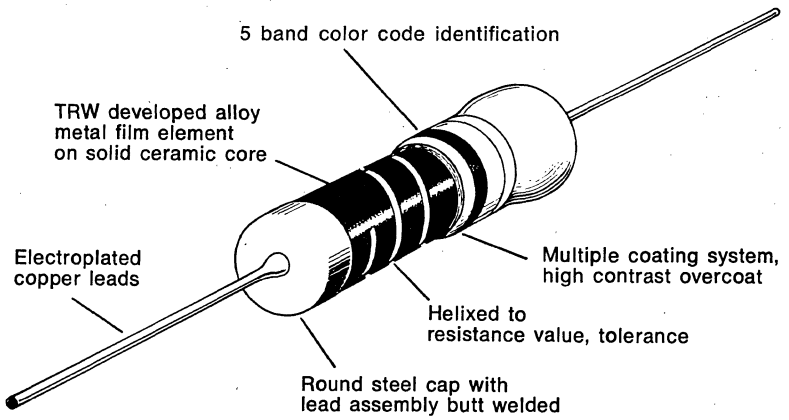
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TRW

RN55DXXXF EQUIVALENT METAL FILM

GP55 SERIES

- ☐ Metal film stability
- ☐ ±1% tolerance
- ☐ ±100 ppm/°C temperature coefficient
- ☐ 10 ohm to 1 megohm
- ☐ Dual ¼ and ½ watt rated
- ☐ Meets or exceeds MIL-R-10509 and R-22684
- ☐ E.I.A. (5 color band) standard



SPECIFICATIONS

Resistance Values: 10Ω through 1.0 Meg; higher values available; consult factory.

Resistance Tolerance: ¼W application ±1% ½W application ±1%

Power Rating @ 70°C: ¼W, ½W

Temperature Coefficient of Resistance: ±100 ppm

Temperature Range: −55°C to 155°C

Continuous Working Voltage: 250 V

Insulation Resistance: 1000 Megohms

Noise: −5 dB to −30 dB

Lead Material: Electroplated Copper

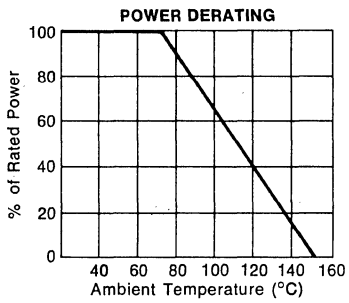
Construction: TRW developed alloy metal film on solid ceramic core

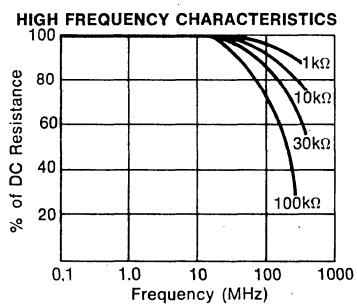
The GP55 is a quality, metal film resistor which is intended to help component engineers and circuit designers upgrade or replace carbon composition and carbon film resistors in most circuit applications. The standard unit comes in a 1% absolute tolerance and a temperature coefficient of ±100 ppm.

GP55 meets or exceeds all parameters of MIL-R-10509 (RN55) and MIL-R-22684 (RL07) and has been lab and field tested with many hours of proven reliability. RS-296D, Class I tape and reel is standard, making the GP55 ideal for high volume, automatic insertion applications.

This precision 1% unit has been designed to be dual-rated (¼ watt and ½ watt), thereby saving printed circuit space while being more cost effective. E.I.A. color banding (5 band) is also standard facilitating identification on printed circuit boards.

GP55 is approved and in use by many leading companies in the telecommunications, computer, automotive and instrumentation industries. Improve your cost effectiveness by converting to GP55.



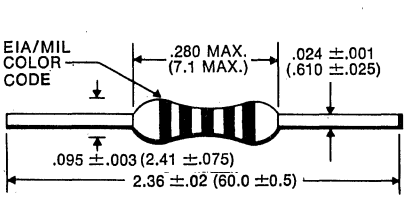


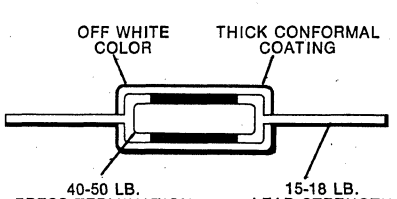
PERFORMANCE DATA*

Test	Typical ΔR GP55 (1%)	MIL-R-10509	MIL-R-22684	MIL-R-39017
Temperature Coefficient (ppm)	±100	+200 −500	±200	±100
Load Life 70°C @ ¼W - 1000 Hrs.	0.5%	1.0%	2.0%	2.0%
Hi-Temperature Exposure (155°C) (No Load)	0.5%	N.A.	N.A.	2.0%
Moisture Resistance	0.5%	1.5%	1.5%	1.0%
Temperature Cycling −55°C to 155°C	0.1%	0.5%	1.0%	0.25%
Low Temperature Operation - 65°C	0.1%	0.5%	0.5%	0.25%
Short Time Overload	0.25%	0.5%	0.5%	0.5%
Terminal Strength	0.1%	0.2%	0.5%	0.25%
Resistance to Solder Heat (350°C)	0.05%	0.5%	0.5%	0.25%
Shock	0.05%	0.5%	0.5%	0.25%
Vibration	0.05%	0.5%	0.5%	0.5%
Rated Voltage (RMS)	250	200	200	200
Resistance Range	10Ω-1 megΩ	10Ω-301KΩ	10Ω-1 megΩ	10Ω-1 megΩ

* NOTE: Above table shows typical GP55 performance compared to military specifications.

DIMENSIONS — IN. AND (mm)





HOW TO ORDER

Sample Part No.: **GP55 - XXXX - ±1%**

TRW Type

Resistance Value
Standard MIL resistance code
10Ω to 1.0 Meg in the following standard EIA/MIL decade values:

±1% tol.	±1% tol.	±1% tol.	±1% tol.	±1% tol.	±1% tol.
1.00	1.47	2.15	3.16	4.64	6.81
1.02	1.50	2.21	3.24	4.75	6.98
1.05	1.54	2.26	3.32	4.87	7.15
1.07	1.58	2.32	3.40	4.99	7.32
1.10	1.62	2.37	3.48	5.11	7.50
1.13	1.65	2.43	3.57	5.23	7.68
1.15	1.69	2.49	3.65	5.36	7.87
1.18	1.74	2.55	3.74	5.49	8.06
1.21	1.78	2.61	3.83	5.62	8.25
1.24	1.82	2.67	3.92	5.76	8.45
1.27	1.87	2.74	4.02	5.90	8.66
1.30	1.91	2.80	4.12	6.04	8.87
1.33	1.96	2.87	4.22	6.19	9.09
1.37	2.00	2.94	4.32	6.34	9.31
1.40	2.05	3.01	4.42	6.49	9.53
1.43	2.10	3.09	4.53	6.65	9.76

Tolerance
5000 pcs per reel is standard.
2500 pc reel available; consult factory.

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

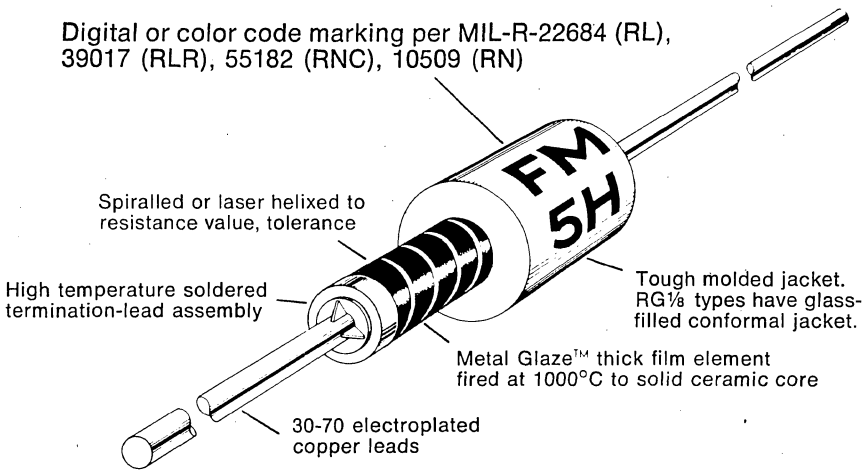
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TRW

PRECISION MIL-QUALIFIED METAL GLAZE™ RESISTORS

RG SERIES

- ☐ ⅛ watt to 3 watts
- ☐ 1 ohm to 3 megohms
- ☐ 0.5% to 5% tolerance; 0.1% in selected ranges
- ☐ ±25 ppm/°C to ±200 ppm/°C



SPECIFICATIONS

TRW Type	MIL Type	Marking	Tolerance (±%)	T.C. (ppm/°C)	TRW Power Rating (watts)	MIL Power Rating (watts)	Volt Rating	TRW Resistance Range	MIL Approved Resistance Range	Nominal Size
RG⅛[1]	—	Band	2, 5	200	¼ @ 70°C	—	200	10Ω to 1.5MΩ	—	⅛ W
RG¼	—	Band	5	200	½ @ 70°C	¼ @ 70°C	250	10Ω to 3MΩ	—	¼ W
RG½	—	Band	5	200	1 @ 70°C	—	350	10Ω to 3MΩ	—	½ W
RG1	—	Band	5	200	1 @ 70°C	—	500	4.3Ω to 3MΩ	—	1W
GS-3	—	Stamp	1, 2, 5	50, 100	{3 @ 25°C 2 @ 70°C	—	1000	10Ω to 2MΩ	—	1W
(Replaces RG2, RG42)										
T0-50[1]	—	Stamp	1	100	¼ @ 70°C	—	200	10Ω to 800KΩ	—	⅛ W
T2-50[1]	—	Stamp	1	50	⅛ @ 70°C	—	200	10Ω to 800KΩ	—	⅛ W
TF07	—	Band/Stamp	1, 2, 5	100	½ @ 70°C	—	250	1Ω to 9.9Ω	—	¼ W
TF20	—	Band/Stamp	1, 2, 5	100	1 @ 70°C	—	350	1Ω to 9.9Ω	—	½ W
GF-55[4]	(Flame Resistant)	Stamp	1	100	½ @ 70°C	—	200	10Ω to 2MΩ	—	¼ W
GF-07[4]	(Flame Resistant)	Stamp	2, 5	100	½ @ 70°C	—	250	10Ω to 2MΩ	—	¼ W
GF-60[4]	(Flame Resistant)	Stamp	1	100	1 @ 70°C	—	300	10Ω to 2MΩ	—	½ W
GF-20[4]	(Flame Resistant)	Stamp	2, 5	100	1 @ 70°C	—	350	10Ω to 2MΩ	—	½ W
GF-3[4]	(Flame Resistant)	Stamp	1, 2, 5	200	3 @ 25°C 2 @ 70°C	—	500	10Ω to 2MΩ	—	1W
RG07	RL07	Band	2, 5	200	½ @ 70°C	¼ @ 70°C	250	4.3Ω to 3MΩ	51Ω to 150KΩ	¼ W
RG20	RL20	Band	2, 5	200	1 @ 70°C	½ @ 70°C	350	4.3Ω to 3MΩ	4.3Ω to 470KΩ	½ W
RG32	RL32	Band	2, 5	200	1 @ 70°C	1 @ 70°C	500	4.3Ω to 3MΩ	10Ω to 1MΩ	1W
RGR05[1]	RLR05/R[2]	Stamp	1, 2	100	⅛ @ 70°C	⅛ @ 70°C	200	10Ω to 150ΩK	10Ω to 150KΩ	⅛ W
RGR07	RLR07/R[2]	Stamp	1, 2	100	¼ @ 70°C	¼ @ 70°C	250	10Ω to 1MΩ	10Ω to 1MΩ	¼ W
RGR20	RLR20/R[2]	Stamp	1, 2	100	½ @ 70°C	½ @ 70°C	350	4.3Ω to 1MΩ	4.3Ω to 1MΩ	½ W
RGR32	RLR32/R[2]	Stamp	1, 2	100	1 @ 70°C	1 @ 70°C	500	10Ω to 1MΩ	10Ω to 1MΩ	1W
T0-55	RN55D	Stamp	.5, 1[3]	100	½ @ 70°C	⅛ @ 70°C	200	10Ω to 3MΩ	10Ω to 301KΩ	¼ W
T2-55	RN55C	Stamp	.5, 1[3]	50	¼ @ 70°C	1/10 @ 125°C	200	10Ω to 3MΩ	49.9Ω to 100KΩ	¼ W
T9-55	RN55E	Stamp	.5, 1[3]	25	¼ @ 70°C	1/10 @ 125°C	200	10Ω to 3MΩ	49.9Ω to 100KΩ	¼ W
T0-60	RN60D	Stamp	.5, 1[3]	100	¾ @ 70°C	¼ @ 70°C	300	10Ω to 3MΩ	10Ω to 1MΩ	½ W
T2-60	RN60C	Stamp	.5, 1[3]	50	½ @ 70°C	⅛ @ 125°C	250	10Ω to 3MΩ	49.9Ω to 499KΩ	½ W
T9-60	RN60E	Stamp	.5, 1[3]	25	½ @ 70°C	⅛ @ 125°C	250	10Ω to 3MΩ	49.9Ω to 499KΩ	½ W
T0-65	RN65D	Stamp	.5, 1[3]	100	1 @ 70°C	½ @ 70°C	350	10Ω to 3MΩ	10Ω to 1MΩ	1W
T2-65	RN65C	Stamp	.5, 1[3]	50	½ @ 70°C	¼ @ 125°C	300	10Ω to 3MΩ	49.9Ω to 1MΩ	1W
T9-65	RN65E	Stamp	.5, 1[3]	25	½ @ 70°C	¼ @ 125°C	300	10Ω to 3MΩ	49.9Ω to 1MΩ	1W
TH55	RNC55H/S[2]	Stamp	.5, 1[3]	50	1/10 @ 125°C	1/10 @ 125°C	200	10Ω to 499KΩ	10Ω to 499KΩ	¼ W
TK55	RNC55K/S[2]	Stamp	.5, 1[3]	100	1/10 @ 125°C	1/10 @ 125°C	200	10Ω to 499KΩ	10Ω to 499KΩ	¼ W
TJ55	RNC55J/S[2]	Stamp	.5, 1[3]	25	1/10 @ 125°C	1/10 @ 125°C	200	10Ω to 499KΩ	10Ω to 499KΩ	¼ W
TH60	RNC60H/S[2]	Stamp	.5, 1[3]	50	⅛ @ 125°C	⅛ @ 125°C	250	10Ω to 1MΩ	10Ω to 1MΩ	½ W
TK60	RNC60K/S[2]	Stamp	.5, 1[3]	100	⅛ @ 125°C	⅛ @ 125°C	250	10Ω to 1MΩ	10Ω to 1MΩ	½ W
TJ60	RNC60J/S[2]	Stamp	.5, 1[3]	25	⅛ @ 125°C	⅛ @ 125°C	250	10Ω to 1MΩ	10Ω to 1MΩ	½ W
TH65	RNC65H/S[2]	Stamp	.5, 1[3]	50	¼ @ 125°C	¼ @ 125°C	300	49.9Ω to 1MΩ	49.9Ω to 1MΩ	1W
TK65	RNC65K/S[2]	Stamp	.5, 1[3]	100	¼ @ 125°C	¼ @ 125°C	300	49.9Ω to 1MΩ	49.9Ω to 1MΩ	1W
TJ65	RNC65J/S[2]	Stamp	.5, 1[3]	25	¼ @ 125°C	¼ @ 125°C	300	49.9Ω to 1MΩ	49.9Ω to 1MΩ	1W

NOTES:
[1] Conformally coated construction on all ⅛ W nominal size resistors
[2] Failure rate symbol; R=.01%/1000 Hours at 60% Conf. Level, S=.001%
[3] .1% tolerance available
[4] Contact factory for details of flame-resistant specifications

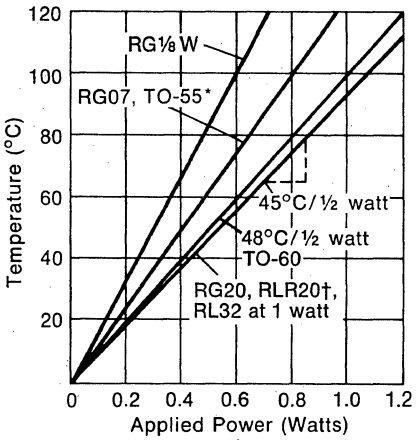
AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

ESTABLISHED RELIABILITY MIL SPECIFICATIONS

RLR and RNC products listed above are qualified to the appropriate established reliability MIL Specification.

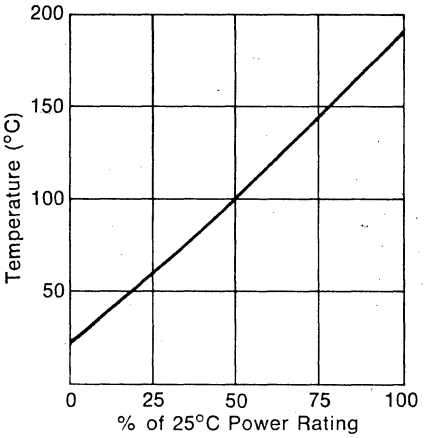
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

RG, "TO" FILM TEMPERATURE RISE

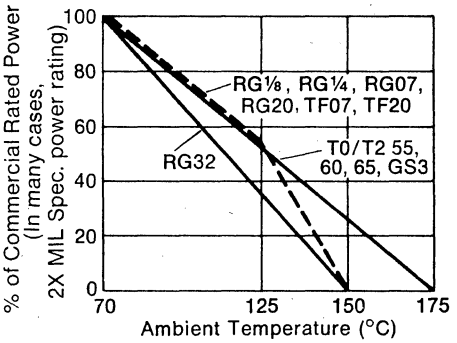


* .025-in. leads
† .032-in. leads

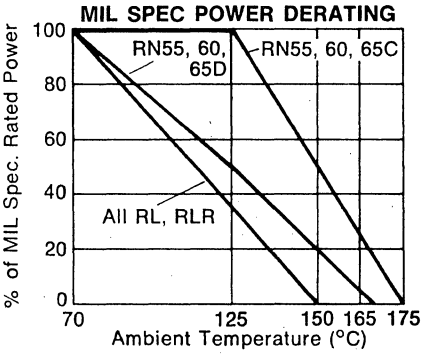
GS-3 SURFACE TEMPERATURE RISE



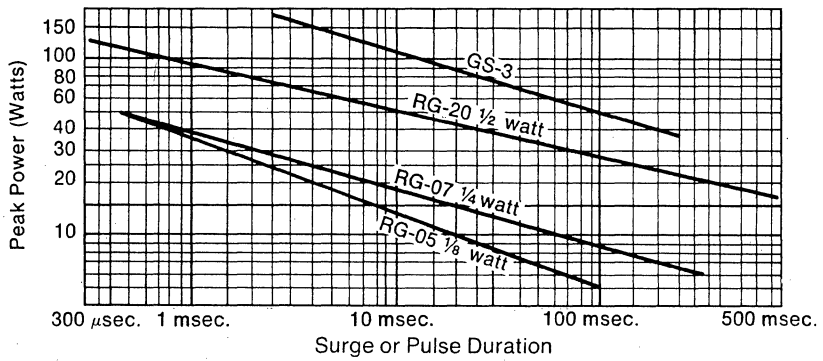
COMMERCIAL POWER DERATING



MIL SPEC POWER DERATING

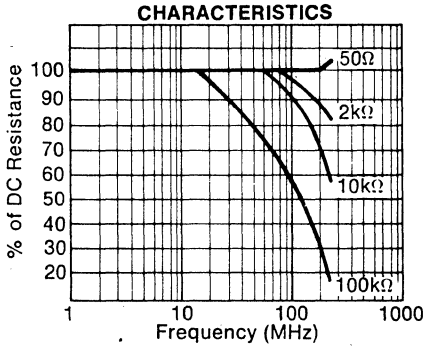


SURGE CAPABILITY

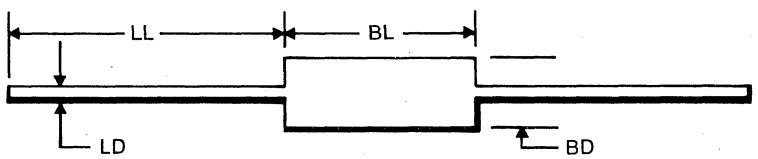


Note: Average power dissipation is not to exceed the component power rating at 70°C.

RG¼ HIGH-FREQUENCY CHARACTERISTICS



DIMENSIONS — IN. and (mm)



Nominal Size	Body Length BL	Body Diameter BD	Lead Length LL	Lead Diameter LD	Clean Lead
⅛ watt RLR05	0.150 ±0.020 (3.8 ±0.3)	0.066 ±0.008 (1.7 ±0.2)	1.00 ±0.125 (25.4 ±3.2)	0.016 (0.41)	0.244 0.187
¼ watt RLR07	0.250 ±0.015 (6.4 ±0.4)	0.090 ±0.008 (2.3 ±0.2)	1.50 ±0.125 (38.1 ±3.2)	0.025 (0.64)	0.310 0.300
½ watt RLR20	0.390 ±0.010 (9.9 ±0.3)	0.140 ±0.008 (3.6 ±0.2)	1.50 ±0.125 (38.1 ±3.2)	0.025/0.032 (0.64/0.81)	0.450 0.450
1 watt RLR32	0.562 ±0.031 (14.3 ±0.8)	0.190 ±0.008 (4.8 ±0.2)	1.50 ±0.125 (38.1 ±3.2)	0.025/0.040 (0.64/1.02)	0.682 0.625
GS-3	0.515 ±0.010 (13.1 ±0.3)	0.225 ±0.008 (5.7 ±0.2)	1.50 ±0.125 (38.1 ±3.2)	0.032 (0.81)	0.575

HOW TO ORDER

Sample Part No.:

RG¼ - 220K - 5%

TRW Type
See specification table for types available.

Resistance
Standard EIA/MIL resistance values for metal film resistors. See specification table for range.

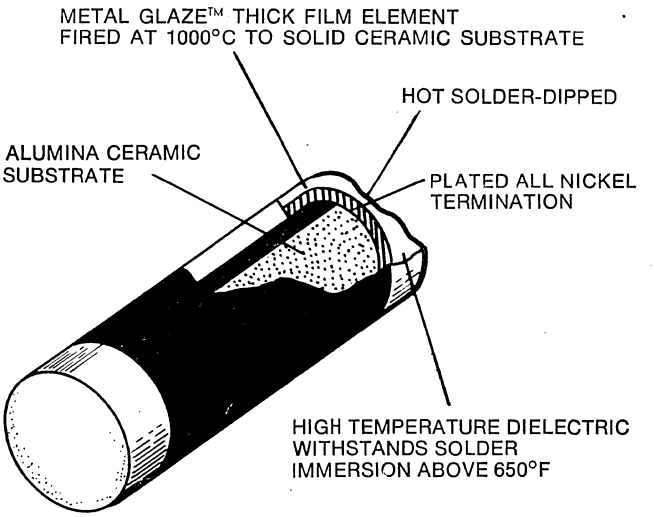
Tolerance
±0.1% to ±5%
See specification table for availability.

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

RG CHIP RESISTORS

- ☐ Metal Glaze™ Technology from TRW's RG resistor line. Proven reliability for over 15 years
- ☐ Low TCR — All < 100 ppm/°C
- ☐ Standard size 3.2 x 1.5mm (0.126″ x 0.057″). Compatible with chip placement equipment from Panasonic, Universal, and others
- ☐ Hot solder-dipped nickel contacts withstand prolonged (>60 sec.) immersion in solder with no de-wetting of contacts
- ☐ Bonds to circuit boards with standard techniques using adhesives or solder paste
- ☐ Completely interchangeable with rectangular chips
- ☐ Packaging in bulk or 8 mm tape reels, taping per EIA —RS481



SPECIFICATIONS

Resistance Range: 3Ω to 1 meg*, plus zero-ohm jumpers
Tolerances: 1%, 2% & 5%
Temperature Coefficient: <100 ppm/°C for all tolerances*
Rated Wattage: ⅛ W @ 70°C†
Rated Continuous Working Voltage: √.125 x R or 200V, whichever is less
Commercial RCWV: √.25 x R or 200V, whichever is less
Maximum Overload Voltage: 400V
Temperature Range: −55°C to +150°C
Insulation Resistance: 10,000 Meg min.

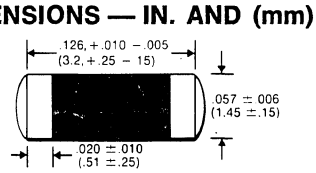
* Contact factory for other resistance values and other temperature coefficients, or for color banding.

† CHP⅛ may safely be double-rated to ¼W operation @ 70°C under normal conditions. Derate to zero at 150°C.

COMPARISON WITH MELF CHIP RESISTORS

RG chips are smaller in size than MELF chips, use thick-film technology rather than carbon films, and have plated nickel terminations, not pressed-on end caps. This also eliminates the typical "dog-bone" outline seen on MELF's. Unlike MELF's, RG chips are available in standard 8mm tape.

DIMENSIONS — IN. AND (mm)



ACTUAL SIZE

8 mm Tape Packaging

COMPARISON WITH CURRENT RECTANGULAR CHIPS

Thick film technology is used in manufacturing of RG chips and rectangular chips. Both have the same standard outline of 3.2 x 1.6mm. Both are available in standard 8mm tape which current chip placement equipment uses.

The RG chip's visible difference is its miniaturized cylindrical shape which makes it somewhat thicker than many resistor chips. This difference poses no problem however in packaging, or in handling, or in placement of the chips onto glue-dotted PCB's by current available chip inserters since they handle both types completely interchangeably.

A major advantage of the RG chip design is its unsurpassed solderability. It is the only resistor chip to offer all nickel contacts. They are completely silver-free . . . are hot soldered dipped, and provide maximum assurance of reliable solder connections without problems of leaching or de-wetting.

Some other advantages include low TCR, ¼ W rating capability, and availability of 1% chips at 5%-type prices. Color band marking is coming soon. All of these technological features are part of the RG family of precision resistors, which has had a proven record of performance for over 15 years.

PERFORMANCE DATA (Maximum △R)

Temperature Coefficient:	0 ±100 ppm/°C
Thermal Shock:	±0.5%
Low-Temperature Operation:	±0.25%
Short-Time Overload	±1% (±.25% for R ≤ 100K ohm or E ≤ 100V)
Commercial Short-Time Overload:	±2.5%
High-Temperature Exposure:	±0.5%
Resistance to Bonding Exposure:	±0.25%
Resistance to Solder Immersion:	±2% 60 sec at 325°C
Solderability:	95% min. coverage 60 sec at 325°C
Moisture Resistance:	±0.5%
Life Test:	±0.5%
Commercial Life:	±2%
Terminal Adhesion Strength:	±1%, No mechanical damage
Resistance to Board Bending:	±1%, No mechanical damage

HOW TO ORDER

Sample Part No.

CHP⅛ - 100 - 2203 - F - BLK

TRW Type

Temperature Coefficient

Resistance
1st 3 significant figures plus 4th digit multiplier
Examples: 2203 = 220,000 ohms
51R0 = 51.0 ohms
Available in STD EIA values

Tolerance
F = 1%, G = 2%, J = 5%

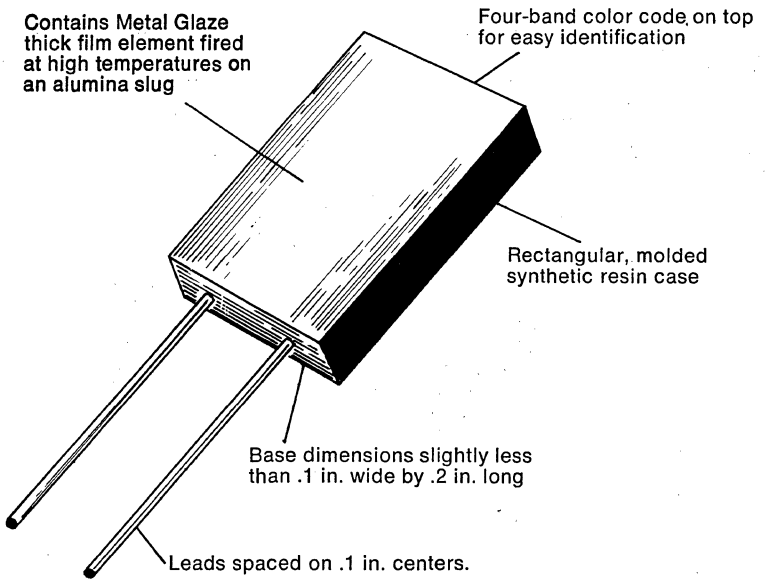
Packaging Code
BLK for bulk, CST for tape.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

RADIAL LEAD MOLDED METAL GLAZE RESISTORS

RGU SERIES*

- ☐ Take up half the PC board area of comparably rated axial-lead resistors
- ☐ Project 0.39 in. from the board surface when installed
- ☐ Can be placed individually, or grouped in rows, in any direction on standard predrilled PC boards
- ☐ Available on carrier tape and are auto-insertable with existing equipment



SPECIFICATIONS

Resistance Range: 10 ohms to 1 megohm

Tolerance (E96, E24): ±1%, ±2%, ±5%

Temperature Coefficient: ±50, ±100 ppm/°C

Voltage Coefficient: Less than 30 ppm/V

Maximum Continuous Working Voltage: 350V RMS

Dielectric Withstanding Voltage: 1000V RMS min.

Insulation Resistance: Greater than 10^4 Megohms, except top surface

Power Rating: ½ watt at 70°C

Temperature Range: −55°C to +155°C for 56 days, −65°C to +175°C

Stability 70°C, 5000 h: ±0.5%

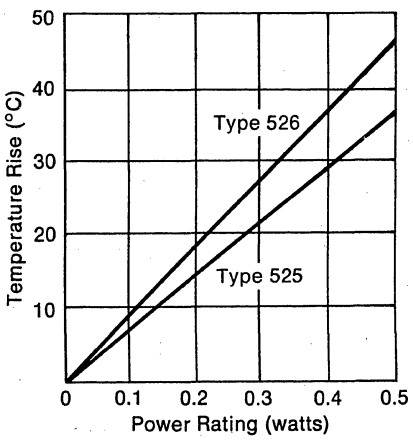
Damp Heat Steady State (40°C, 90 to 95% R.H., 56 days, 5 VDC): 1.0%

Failure Rate (V_O=155°C): <5 x 10^{-9}/h

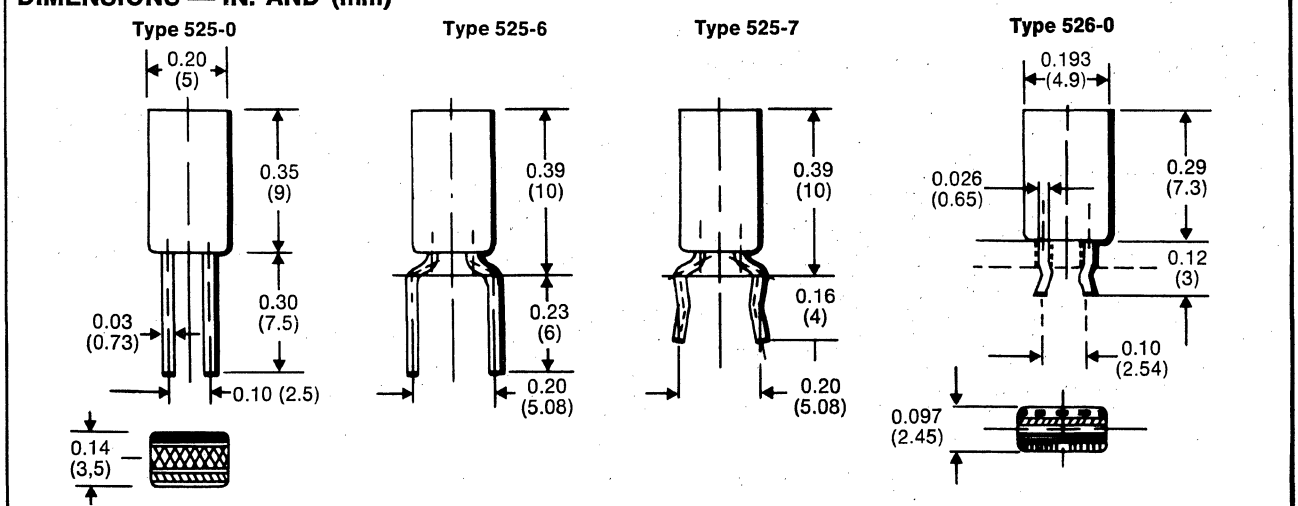
STANDARDS

Electrical properties according to MIL-R 22684

TEMPERATURE RISE



DIMENSIONS — IN. AND (mm)



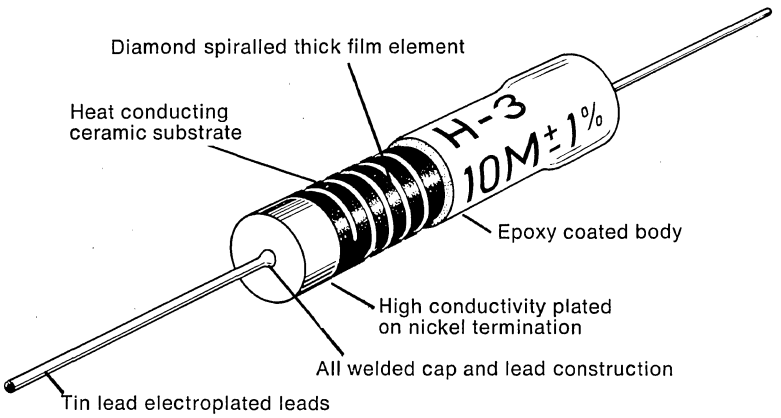
* Manufactured in West Germany

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

PRECISION, HIGH-VOLTAGE THICK FILM RESISTORS

CGH SERIES

- ¼ watt to 15 watts
- 100K to 500 megohm range
- ±0.5%, ±1%, ±2% or ±5% tolerance
- TC or ±50 ppm/°C or ±100 ppm/°C



SPECIFICATIONS

TRW Type	Power Rating at 70°C (watts)[1]	Voltage Rating (volts)[2]	Resistance Range (ohms)	Tolerance (±%)	Maximum TCR (±ppm/°C)	VCR (ppm/V)
CGH-¼	¼	750	100KΩ to 50MΩ	.5, 1, 2, 5	50, 100	0 to −5
CGH-½	½	1,500	100KΩ to 100MΩ	.5, 1, 2, 5	50, 100	0 to −5
CGH-1	1	3,000	500KΩ to 100MΩ	.5, 1, 2, 5	50, 100	0 to −5
CGH-2	2	5,000	1MΩ to 200MΩ	.5, 1, 2, 5	50, 100	0 to −5
CGH-3	3	10,000	1MΩ to 300MΩ	.5, 1, 2, 5	50, 100	0 to −5
CGH-5	5	20,000	1MΩ to 500MΩ	.5, 1, 2, 5	50, 100	0 to −5

NOTES:
(1) Other wattage ratings available on request. Consult factory. For power rating above 70°C, see derating curve.
(2) Voltage rating shown is the rated DC continuous working voltage or the sine-wave RMS absolute maximum voltage at commercial line frequency. For DC applications the absolute maximum permissible voltage is 1.5 times the value shown for low repetition short-time-overload or pulse conditions of 10 seconds or less duration.
(3) Typical voltage coefficient of resistance is -1 to -2 ppm/V measured at full rated voltage and 10% rated voltage.

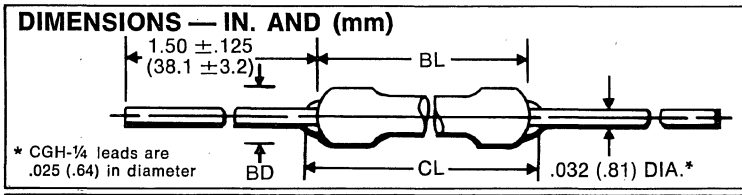
CGH-7.5 thru -15 contact factory for specifications and higher or lower resistance values.

ENVIRONMENTAL PERFORMANCE

Test Condition[1]	Maximum ΔR (±3σ)	Typical[2] ΔR
Temperature Shock	±0.25%	±0.10%
Short-Time Overload (1.5 times rated V for 10 sec.)	±0.20%	±0.10%
Solder Effect	±0.15%	±0.05%
Terminal Strength	±0.20%	±0.05%
Moisture Resistance (no load or polar)	±0.50%	±0.20%
Load Life (1000 Hours at 70°C)	±1.0%	±0.25%
Shelf Life (1 year at 25°C)	±0.10%	±0.03%
High-Temperature Exposure		
(150°C for 2000 Hours)	±0.75%	±0.03%
(175°C for 2000 Hours)	±1.0%	±0.40%
Dielectric Breakdown[3]		
(¼ and ½ watt size)	2000 VDC, 1500 VAC	
(1-watt through 5-watt size)	3500 VDC, 2500 VAC	
Dielectric Strength[4]	±0.15%	±0.05%
Insulation Resistance at 500 VDC	10^9 ohms min.	10^{11} ohms typ.

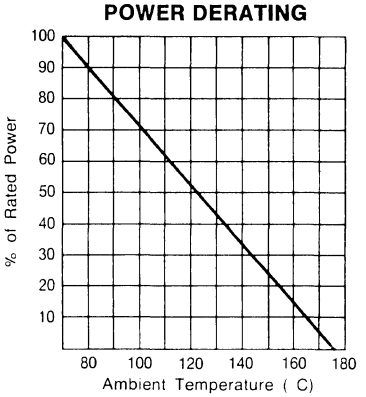
NOTES:
(1) Test method per MIL-STD-202 unless otherwise indicated.
(2) Typical defined as that percent change which will include a minimum of 50% of the measured changes in resistance from a variety of lots representing various unit sizes and ranges.
(3) Values shown are the maximum safe dielectric voltage applied from a V block or foil wrapping which extends the complete body length of the resistor under test.
(4) Percent change after the maximum safe dielectric voltage is applied for 1 minute.

DIMENSIONS — IN. AND (mm)

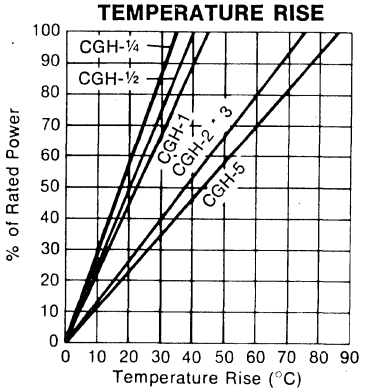


TRW Type	Body Length BL	Body Diameter BD	Clean Lead to Clead Lead CL
CGH-¼	0.275 ±0.031 (6.98 ±0.79)	0.088 ±0.010 (2.22 ±0.25)	0.400 (10.16)
CGH-½	0.400 ±0.031 (10.16 ±0.79)	0.138 ±0.016 (3.51 ±0.41)	0.525 (13.34)
CGH-1	0.690 ±0.062 (17.53 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	0.900 (22.86)
CGH-2	1.062 ±0.062 (26.97 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	1.250 (31.75)
CGH-3	2.062 ±0.062 (52.37 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	2.250 (57.15)
CGH-5	3.062 ±0.062 (77.77 ±1.57)	0.297 ±0.031 (7.54 ±0.79)	3.250 (82.55)

POWER DERATING



TEMPERATURE RISE



HOW TO ORDER

Sample Part No.:

CGH-3 - 50 ppm/°C - 22M - 1%

TRW Type
CGH-¼, CGH-½, CHG-1, CGH-2, CGH-3 or CGH-5

Temperature Coefficient
±100 ppm/°C, ±50 ppm/°C

Resistance
Standard EIA/MIL values for metal film resistors. See specificaiton chart for range

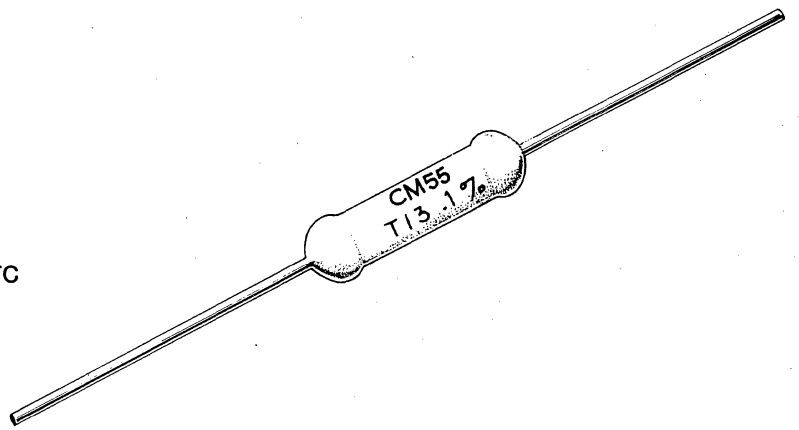
Tolerance
±0.5%, ±1%, ±2%, ±5%

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

TRW

LOW TC INDUSTRIAL PRECISION METAL FILM RESISTOR

CM55 SERIES



- ☐ High reliability
- ☐ 10 ppm/°C and 15 ppm/°C standard TC
- ☐ Non-measurable noise
- ☐ Superior moisture performance
- ☐ Tailored or standard values
- ☐ Highest stability metal film available

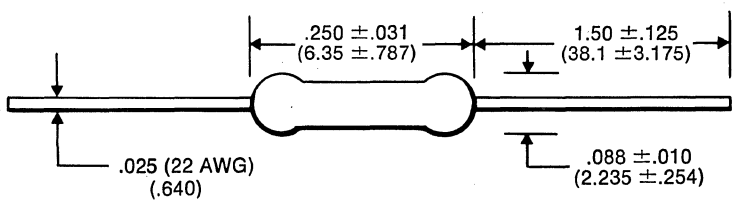
SPECIFICATIONS

TRW Model	Resistance Range	Tolerance (±%)	T.C.	Power Rating @ 85°C (watts)	Voltage Rating (volts)
CM55	50Ω-250KΩ	1.0, 0.5, 0.25, 0.1	T13,T10,T9	⅛	300

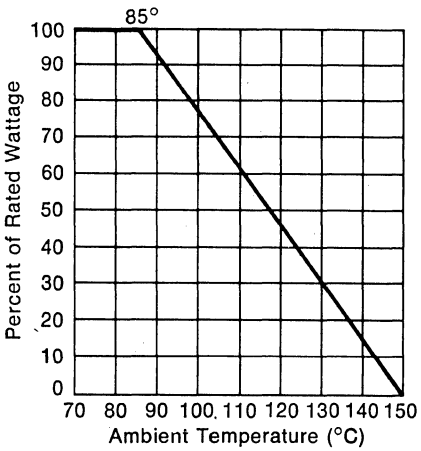
PERFORMANCE DATA

Test Conditions Per MIL-R-55182, Except Where Noted	Typical ΔR%
1,000 Hour Loadlife (Rated Power @ 85°C)	±0.02
Humidity	±0.04
Thermal Shock (Tested Per Method 107, MIL-STD 202, Condition F)	±0.01
Effect of Solder (Tested Per Method 210, MIL-STD 202)	±0.01
Dielectric Withstanding	±0.01
Shock and Vibration	+0.01
Short Time Overload	+0.01
Insulation Resistance	>10,000 Meg
Noise Index	<−30 dB
Voltage Coefficient	<0.05 ppm/Volt
1-Year Shelf Life	±30 ppm

DIMENSIONS — IN. AND (mm)



POWER DERATING



PACKAGING

Bulk Package: 250/Pack

Lead Tape & Reel: Per EIA Spec RS-296D

Special lead tape & reel and anti static packaging available; consult factory.

HOW TO ORDER

Sample Part No.:

CM55 T13 0.1% 100k

TRW Type
CM55

TC
T13 (10 ppm),
T10 (15 ppm),
T9 (25 ppm)

Tolerances
.1%, .25%, .5%

Resistance
Standard EIA/MIL values for metal film resistors, see specification table for range

The new cost-effective CM55 resistor is the offspring of a marriage of proven TRW technologies and state-of-the-art high speed production equipment. The new conformal outer coating has proven its reliability under extensive performance testing. Many of those tests were performed to military specifications.

The CM55 utilizes the same film system and cap/lead attachment which has proven its reliability over the years in TRW's ultra precision MAR product. Other characteristics exhibited by the CM55 are low inductance, smaller size for a given power rating, and much improved cost effectiveness.

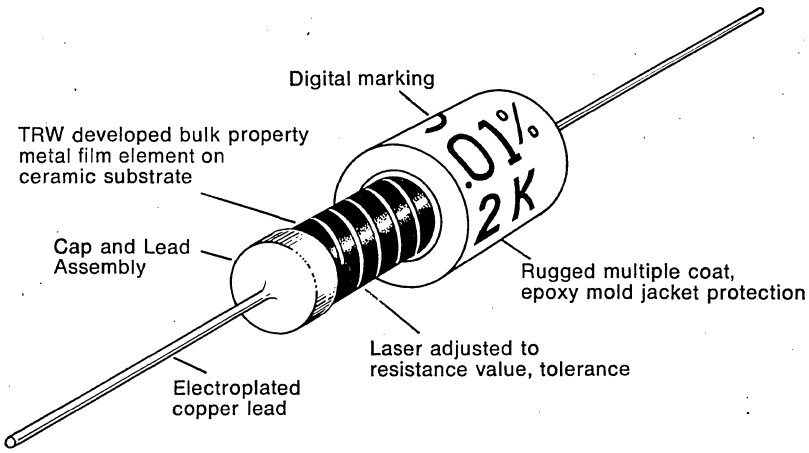
Matched sets of CM55 resistors are available, which provide the ultimate in resistor matching and temperature coefficient tracking. Resistor matching to ±.005% and temperature coefficient tracking as low as ±2 ppm/°C is available in matched sets. Consult the factory for details.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

ULTRA-PRECISION TAILORED-T.C. METAL FILM RESISTORS

MTR SERIES

- ☐ 1/20 watt to 1/4 watt
- ☐ 50 ohms to 1.0 megohm
- ☐ Any TC from −100 to +150 ppm/°C
- ☐ Tolerances from ±1.0% to±0.01%

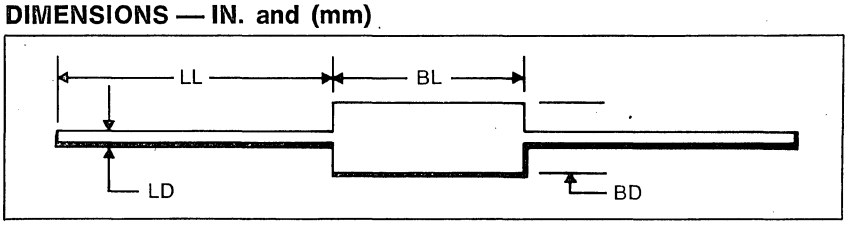


SPECIFICATIONS

TRW Type	Resistance Range* (ohms)	Temperature Coefficients† −20°C to +85°C (± ppm/°C)	Tolerances (±%)	Power Rating at 85° (watts)	Voltage Rating (volts)
MTR3	50Ω to 100kΩ	Any T.C. from −100 to +150	1.0, 0.5, 0.25, 0.1, 0.05, 0.02, 0.01	1/20	200
MTR5	50Ω to 250kΩ	Any T.C. from −100 to +150	1.0, 0.5, 0.25, 0.1, 0.05, 0.02, 0.01	1/10	250
MTR6	50Ω to 500kΩ	Any T.C. from −100 to +150	1.0, 0.5, 0.25, 0.1, 0.05, 0.02, 0.01	1/8	300
MTR7	50Ω to 1.0MΩ	Any T.C. from −100 to +150	1.0, 0.5, 0.25, 0.1, 0.05, 0.02, 0.01	1/4	500

* Wider ranges are available. Consult the TRW plant in Corpus Christi or your nearest TRW sales office.
† T.C. tolerances available to ±5 ppm/°C.

DIMENSIONS — IN. and (mm)



TRW/IRC Type	Body Length BL	Body Diameter BD	Lead Length LL	Lead Diameter LD
MTR3	.191 (4.85)	.082 (2.08)	1.00 ±.062 (25.4 ±1.57)	.016 (.406)
MTR5	.281 (7.14)	.102 (2.59)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)
MTR6	.425 (10.8)	.155 (3.94)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)
MTR7	.650 (16.5)	.195 (4.95)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)

For precision circuits where a high degree of temperature stability is required, MTR Series metal film resistors can be used to reduce the temperature effects of other components.

One common application is compensating for capacitors in RC filters and other RC circuits. By using an MTR resistor with a T.C. of the same magnitude but opposite slope, capacitor temperature coefficients from −100 to +150 ppm/°C can be effectively compensated to zero.

These resistors are also effective for improving the characteristics of amplifiers.

HOW TO ORDER

Sample Part No.:

MTR5 - +50 ppm/°C - 100k - 0.25%

TRW Type
MTR3, MTR5, MTR6 or MTR7. See specification table for power rating.

Temperature Coefficient
Any T.C. from −100 pmm/°C to +150 ppm/°C

Resistance
Standard EIA/MIL values for metal film resistors. See specification table for range.

Tolerance
±1.0% to ±0.01%. See specification table for availability.

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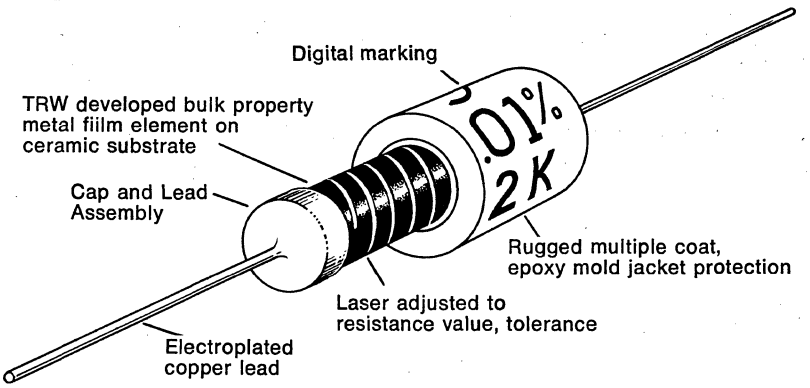
TRW

ULTRA-PRECISION METAL FILM RESISTOR

MAR SERIES

- ☐ High reliability
- ☐ Ultra low temperature coefficient
- ☐ Non-measurable noise
- ☐ Superior moisture performance
- ☐ Tailored or standard values
- ☐ Highest stability metal film available
- ☐ Matched sets and networks



SPECIFICATIONS

TRW Model	Resistance Range by Tolerance (ohms)					Resistance Range by TC (ohms)			Power Rating @ 85°C (Watts)	Voltage Rating (Volts)
	.5%	.25%	.1%	.02 & .05%	.01%	T-10	T-13	T-16		
MAR3	10-250K	10-250K	10-250K	10-150K	10-150K	10-250K	10-150K	10-125K	1/20	200
MAR5*	10-500K	10-500K	10-500K	10-250K	10-250K	10-500K	10-350K	10-300K	1/10	250
MAR6	10-1 Meg	10-1 Meg	10-1 Meg	10-500K	10-500K	10-1 Meg	10-700K	10-500K	1/8	300
MAR7	10-3 Meg	10-3 Meg	10-3 Meg	10-700K	10-700K	10-3 Meg	10-1.5 Meg	10-1 Meg	1/4	500

* The MAR5 resistor is qualified to Characteristics H, J and K and to Tolerances B, O and F of MIL-R-55182(E). Approved resistance range is 49.9Ω to 150KΩ.

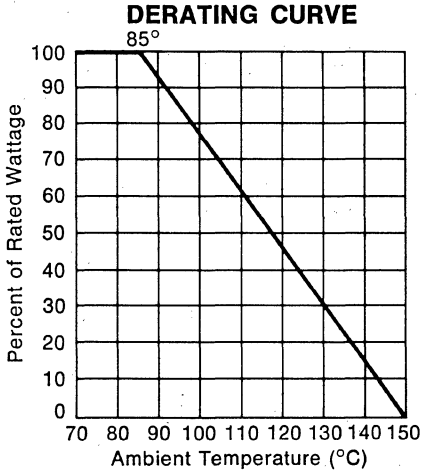
The MAR resistors meet the need for an ultra precision metal film resistor with characteristics that are superior to other precision resistor techniques. Among these are higher reliability, lower inductance, smaller size for a given power rating, and cost effectiveness.
The proprietary coatings and epoxy mold jacket provides a virtual hermetic seal.

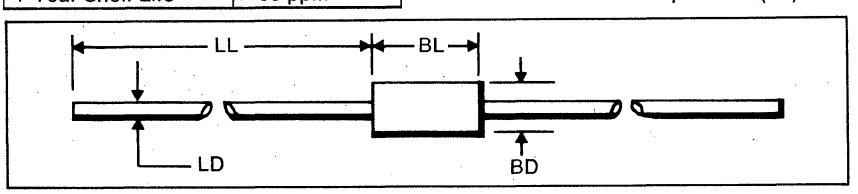
Matched sets of MAR resistors are available, which provides the ultimate in resistor tolerance matching and temperature tracking. Resistance matching to ±.005% and temperature coefficient tracking as low as ±1 ppm/°C are available in matched sets and to ±.01% and ±2 ppm/°C in modular assemblies of resistors.

PERFORMANCE DATA

Test Conditions Per MIL-R-55182, Except Where Noted	Typical ΔR%
1,000 Hour Loadlife (rated power @ 85°C)	±0.02
Humidity	±0.04
Thermal Shock (tested per method 107, MIL-STD 202, Condition F)	±0.01
Effect of Solder (tested per method 210, MIL-STD 202)	±0.01
Dielectric Withstanding	±0.01
Shock and Vibration	+0.01
Short Time Overload	+0.01
Insulation Resistance	>10,000 Meg
Noise Index	<−30 dB
Voltage Coefficient	<0.05 ppm/Volt
1-Year Shelf Life	±30 ppm

DERATING CURVE





DIMENSIONS — IN. and (mm)

TRW/IRC Type	Body Length BL	Body Diameter BD	Lead Length LL	Lead Diameter LD
MAR3	.191 (4.85)	.082 (2.08)	1.00 ±.062 (25.4 ±1.57)	.016 (.406)
MAR5	.281 (7.14)	.102 (2.59)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)
MAR6	.425 (10.8)	.155 (3.94)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)
MAR7	.650 (16.5)	.195 (4.95)	1.50 ±.125 (38.1 ±3.18)	.025 (.635)

HOW TO ORDER

Sample Part No.:

MAR6 - T16 - 15K - 0.02%

TRW
MAR3 (1/20 watt at 85°C),
MAR5 (1/10 watt at 85°C),
MAR6 (1/8 watt at 85°C) or
MAR7 (1/4 watt at 85°C).

Temperature Coefficient
T16 (±5 ppm/°C),
T13 (±10 ppm/°C) or
T10 (±15 ppm/°C).
See specification table for availability.

Resistance
Standard EIA/MIL values for metal film resistors.
See specification table for range.

Tolerance
±0.01%, ±0.02%, ±0.05%, ±0.1%, ±0.25% or ±0.5%.
See specification table for availability.

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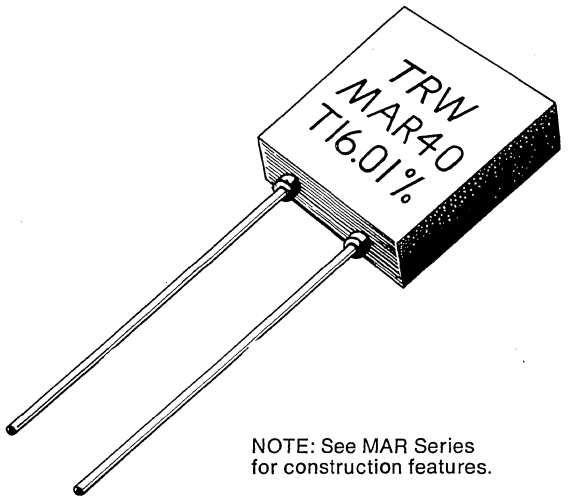
TRW

ULTRA-PRECISION METAL FILM RESISTORS

MAR40 SERIES

- ☐ High power ultra-precision resistor
- ☐ Tight temperature coefficient
- ☐ High reliability construction
- ☐ Tolerance to ±0.005%
- ☐ Rugged solid epoxy encapsulation
- ☐ Custom reliability screening available
- ☐ Matched sets



NOTE: See MAR Series for construction features.

SPECIFICATIONS

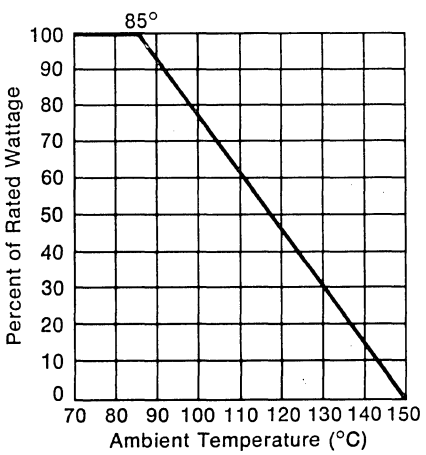
TRW Type	TC Code	Standard Temperature Coefficient		Standard Resistance Range (ohms)	Resistance Tolerance	Power Rating @ 85°C(watts)	Voltage Rating (volts)
MAR40	T16	0 ±5 ppm/°C 0 ±10 ppm/°C	0 to 60°C −55° to 125°C	20-250K (Below 50Ω not available in 0.01% Tol.)	0.005, 0.01, 0.02, 0.05, 0.1, 0.25, 0.5, 1.0	0.3	250
MAR40	T18	0 ±2 ppm/°C 0 ±5 ppm/°C	0 to 60°C −55° to 125°C	50-250K		0.3	250

The MAR40 Series of ultra-precision resistors combines the benefits of proven TRW metal film reliability, non-measurable noise, and superior frequency response with very low temperature characteristics, convenient radial lead design, and efficient use of printed circuit board "real estate".

The shelf life and load life stability characteristics are derived from our expertise with the MAR Series of axial leaded resistors. The physical size coincides nicely with the military standard RNC90. The internal construction utilizes the high reliability, noble metal, "end cap" technology of the MAR. In short, the design engineers can take an effective step towards product reliability and long, service-free life, by specifying the MAR40. The MAR40 may be specified to any custom value needed and/or purchased in matched sets with tolerances placed on the nominal ratios and close tracking of temperature coefficients.

The MAR40 ultra-precision resistor can be made to exact specifications without the usual delays in delivery of prototypes. The flexibility of the MAR40 manufacturing process allows quick response to customer delivery.

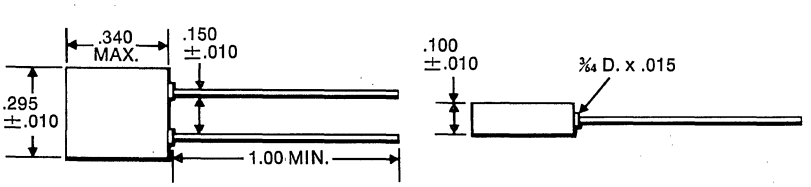
POWER DERATING



PERFORMANCE DATA

Test Conditions Per MIL-R-55182, Except Where Noted	Typical ΔR%
1000 Hour Loadlife (Rated Power At 85°C)	±0.02
Humidity	±0.04
Thermal Shock (Tested Per Method 107, MIL-STD 202, Condition F)	±0.01
Effect of Solder (Tested Per Method 210, MIL-STD 202)	±0.01
Dielectric Withstanding Voltage	±0.01
Shock and Vibration	±0.01
Short Time Overload	±0.01
Insulation Resistance	>10,000 Meg
Noise Index	<−30 dB
Voltage Coefficient	<0.05 ppm/Volt
1-Year Shelf Life	±30 ppm

DIMENSIONS — INCHES



HOW TO ORDER

Sample Part No.:

MAR40 - T16 - 91K - 0.02%

TRW Type

Temperature Coefficient
T16 (±5 ppm),
T18 (±2 ppm)

Resistance Ranges
See table above

Tolerance
±1%, ±.5%, ±.25%, ±.1%
±.05%, ±.02%, ±.01%, ±.005% *

* ±.005% tolerance available; consult factory.

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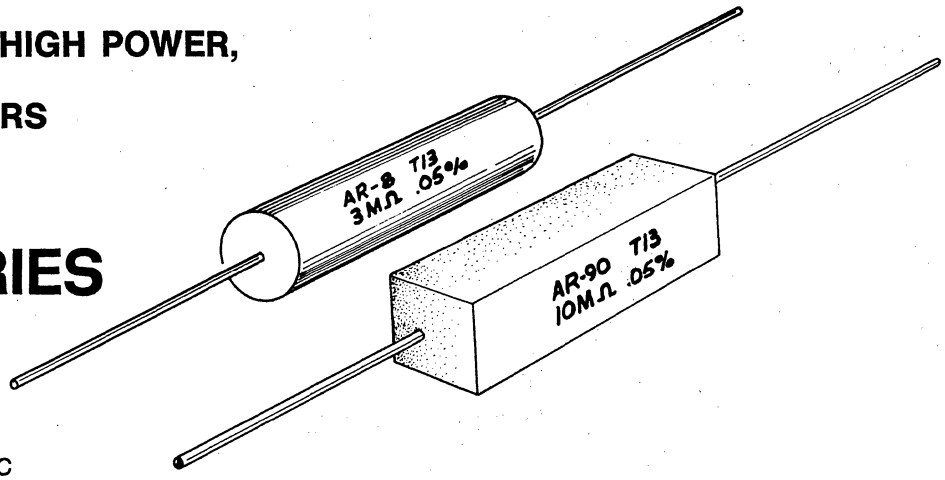
TRW

ULTRA-PRECISION, HIGH POWER, HIGH RESISTANCE THIN FILM RESISTORS

AR8 and AR90 SERIES



- ☐ 0.5 watt or 1.0 watt rating
- ☐ 100 ohms to 10 megohms
- ☐ Tolerance to ±0.02%
- ☐ Standard TCs from ±5 ppm/°C to ±15 ppm/°C

SPECIFICATIONS

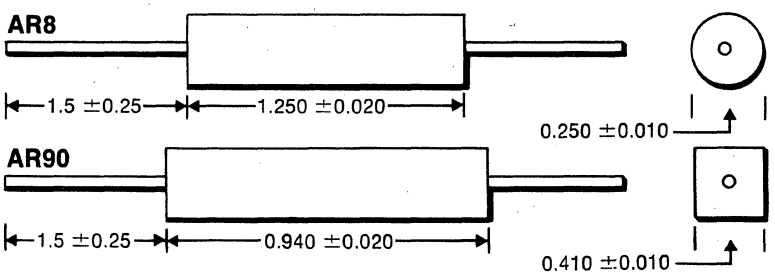
TRW Type	TC Code	Resistance Range (ohms)	Tolerance (±%)	Power Rating at 85°C (watts)	Voltage Rating (volts)
AR8	T16, T13 T10	100Ω to 6MΩ	1.0, 0.5, 0.25, 0.1, 0.05, 0.02	0.5	1000
AR90	T16, T13 or T10	100Ω to 10MΩ	1.0, 0.5, 0.25, 0.1, 0.05, 0.02	1.0	1500

* Not available below 100 ohms.

ENVIRONMENTAL PERFORMANCE

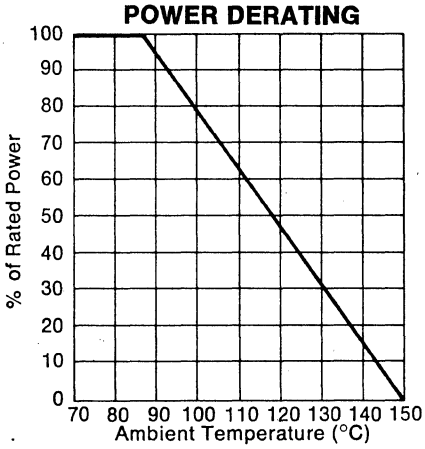
Test Conditions per MIL-R-55182, except where noted	Typical ΔR%
1000-Hour Load Life (Rated Power at 85°C)	±0.02
Humidity	±0.04
Temperature Cycle (tested per Method 102, MIL-STD 202, Condition C)	±0.01
Effect of Solder (tested per Method 210, MIL-STD 202)	±0.01
Dielectric Withstanding Voltage	±0.01
Shock and Vibration	±0.01
Short-Time Overload	±0.01
Insulation Resistance	>10,000 MegΩ
Noise Index	<−30 dB
Voltage Coefficient	<0.05 ppm/volt
1-Year Shelf Life	±50 ppm

DIMENSIONS — INCHES



LEAD DIAMETER 0.025 ±0.002 (22 AWG)

POWER DERATING



TEMPERATURE COEFFICIENTS

T.C. Code	Temperature Coefficient
T16	±5 ppm/°C from 0 to 60°C, ±10 ppm/°C from −55° to +125°C
T13	±10 ppm/°C from −20° to +85°C
T10	±15 ppm/°C from −20° to +85°C

HOW TO ORDER

Sample Part No.:

AR8 - T16 - 91k - 0.02%

TRW Type
AR8 (0.5 watt at 85°C) or AR90 (1.0 watt at 85°C).

Temperature Coefficient
T16, T13 or T10. See specification table for availability.

Resistance
Standard EIA/MIL values for metal film resistors. See specification table for range.

Tolerance
±1.0% to ±0.02%. See specification table for exact tolerances available.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
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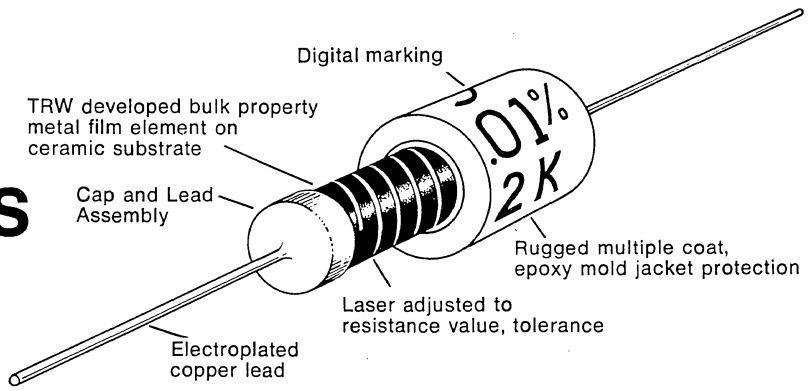
TRW

ULTRA-PRECISION THIN FILM DISCRETE RESISTOR

MAR MATCHED SETS

- ☐ 1/20 watt to 1/4 watt
- ☐ 10 ohms to 3 megohms
- ☐ Tolerances from ±0.01% to ±1.0%; Ratios to 0.005%
- ☐ TCs of ±5, ±10 and ±15 ppm/°C; Tracking to 1 ppm/°C



DISCRETE RESISTOR SPECIFICATIONS

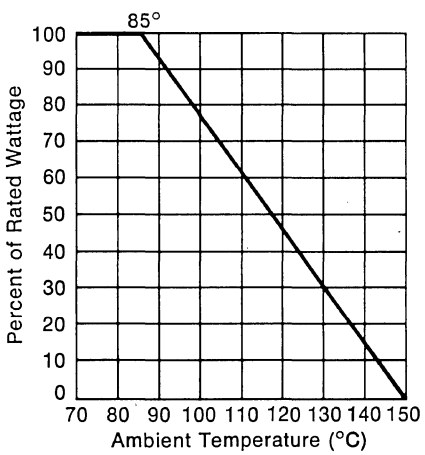
TRW Type	Discrete Resistance Range by Tolerance by Size (ohms)					Discrete Resistance Range by TC (ohms)			Power Rating @ 85°C (Watts)	Voltage Rating (Volts)
	.5%	.25%	.1%	.02 & .05%	.01%	T-10	T-13	T-16		
MAR3	10-250K	10-250K	10-250K	10-150K	10-150K	10-250K	10-150K	10-125K	1/20	200
MAR5*	10-500K	10-500K	10-500K	10-250K	10-250K	10-500K	10-350K	10-300K	1/10	250
MAR6	10-1 Meg	10-1 Meg	10-1 Meg	10-500K	10-500K	10-1 Meg	10-700K	10-500K	1/8	300
MAR7	10-3 Meg	10-3 Meg	10-3 Meg	10-700K	10-700K	10-3 Meg	10-1.5 Meg	10-1 Meg	1/4	500

* The MAR5 resistor is qualified to Characteristics H, J and K and to Tolerances B, O and F of MIL-R-55182(E). Approved resistance range is 49.9Ω to 150KΩ.

ENVIRONMENTAL PERFORMANCE

Test Conditions per MIL-R-55182, except where noted	Typical ΔR%
1,000-Hour Load Life (Rated Power at 85°C)	±0.02
Humidity	±0.04
Thermal Shock (tested per Method 107 MIL-STD 202, Condition F)	±0.01
Effect of Solder (Tested per Method 210, MIL-STD-202)	±0.01
Dielectric Withstanding	±0.01
Shock and Vibration	+0.01
Short-Time Overload	+0.01
Insulation Resistance	>10000 MegΩ
Noise Index	<−30 dB
Voltage Coefficient	<0.05 ppm/volt
1-Year Shelf Life	±30 ppm

DERATING CURVE



RATIO ACCURACY AND TC TRACKING SPECIFIATIONS

Ratio to Master	TC Track 0° to 70°C	Resistance Ratio Accuracy
1:1	1 ppm	.005%
10:1	1 ppm	.01%
100:1	2 ppm	.01%
1000:1	3 ppm	.02%

The performance of most precision resistor circuits requires that the relationship of all the resistors used be held to exacting tolerances in relation to each other. This tight tolerance relationship can be accomplished in two ways. One is to specify absolute tolerances so that no resistor can deviate from any other resistor by more than twice this tolerance. The other is to specify matched sets of resistors where the relationship between resistors, rather than absolute tolerances, is tightly controlled in many designs, the absolute values are not so critical as the maintenance of a precise relationship among the set during changing ambients.

Matched resistor sets using the MAR series of resistors provide a decade or greater improvement in performance at significantly less cost than individually specified resistors. While others of our resistor products can be specified as matched sets, the MAR Series is recommended for most critical applications.

Specifying matched resistor sets requires that the resistance ratio tolerance be specified along with allowable absolute tolerance; and the temperature coefficient tracking tolerance be specified with the basic TC.

Two examples of specifying matched sets are shown below. Other design considerations permitting, it is more economical to specify ratios to a reference resistor than to each other. However, if required, the MAR series offers the inherent precision and stability for either method.

A knowledge of the availability of these two ways to achieve extreme stability offers options to the designer which may prevent overspecifying, with attendant economic considerations.

SPECIFICATION EXAMPLES

Example No. 1

Resistor	Ohms	Watts	Absolute Tolerance %	Absolute TC (ppm/°C)	Ratio Tolerance Referenced To R_1 (%)	TC Tracking Referenced To R_1 (ppm/°C)
R_1	1K	1/8	±1	±25	—	—
R_2	2K	1/8	±1	±25	0.02	5
R_3	4K	1/8	±1	±25	0.04	10
R_4	8K	1/8	±1	±25	0.08	20

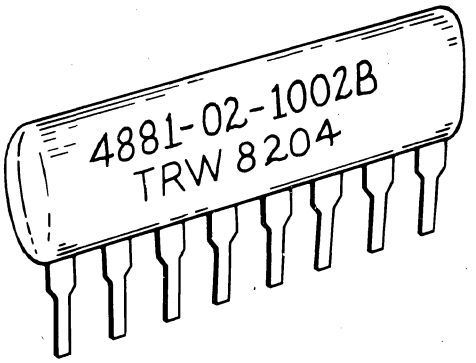
Example No. 2

Resistor	Ohms	Watts	Absolute Tolerance %	Absolute TC (ppm/°C)
R_1	10K	.25	±.1	±15
R_2	100K	.25	±.1	±15
R_3	1M	.125	±.25	±15

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TRW

TaNFilm® CONFORMALLY COATED
SIP NETWORKS



- ☐ High precision
- ☐ Low profile
- ☐ High component density
- ☐ Superior TCR tracking
- ☐ 3 standard sizes
- ☐ Proven reliability

SPECIFICATIONS

Resistance Ranges:
Schematic C: 49.9Ω to 50KΩ
Schematic F: 20Ω to 50KΩ
Schematic G: 20Ω to 100KΩ
Higher resistance values available

Resistance Tolerances: ±.1%, ±.25%, ±.5%, ±1%, ±2%

Temperature Coefficient of Resistance: ±25 ppm°C, ±50 ppm/°C, ±100 ppm/°C, −100 ±25 ppm/°C

TCR Tracking: 5 ppm/°C, except Schematic C below 500Ω (20 ppm/°C)

Temperature Range: −55°C to +150°C

Noise: Less than −25 dB

Power Rating @ 70°C:

	Wattage			
		Network		
Schematic	Resistor	6 Pin	8 Pin	10 Pin
C, F	.12	.6	.84	1.08
G	.12	.36	.48	.60

Lead Material: Gold plated copper

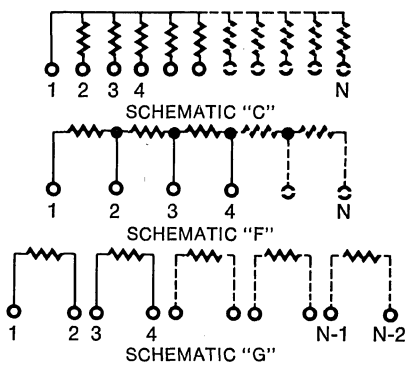
Substrate Material: 99.5% pure alumina ceramic

Construction: Epoxy conformal coating

Custom circuits and special testing available

Contact factory for any special features required.

STANDARD CIRCUITS



PERFORMANCE DATA

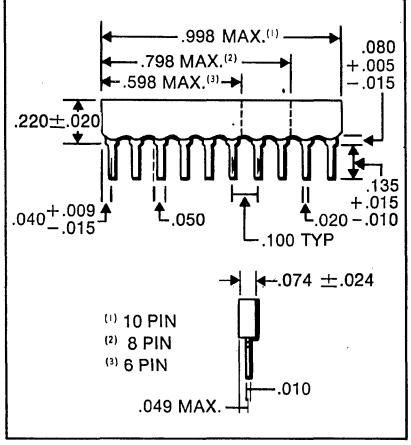
	MIL-R-83401 Limits (ΔR%)			TaNFilm Test Data (ΔR%)	
Test Per MIL-R-83401	M	K	H	Maximum	Typical
Thermal Shock	.5	.5	.25	.1	.02
Power Conditioning	.5	.5	.5	.1	.02
Low Temperature Operation	.5	.25	.1	.1	.02
Short Time Overload	.5	.25	.1	.05	.02
Terminal Strength	.25	.25	.25	.1	.02
Resistance to Soldering Heat	.25	.25	.1	.1	.02
Moisture Resistance	.5	.5	.4	.1	.03
Shock	.25	.25	.25	.1	.02
Vibration	.25	.25	.25	.1	.02
Life	2.0	.5	.5	.1	.05
High Temperature Exposure	1.0	.5	.2	.1	.05
Low Temperature Storage	.5	.25	.1	.1	.05
25°C Double Load	2.0	.5	.5	.05	.03

Where precision as well as long term reliability and stabiltiy are required in a small amount of space, the conformally coated SIP is the answer. This low profile SIP resistor network exhibits all the outstanding performance characteristics inherent in TaNFilm products.

Our TaNFilm manufacturing process of sputtering Tantalum Nitride on to ceramic substrates ensures uniform temperature characteristics of all the resistors in the networks. The resistance film is then anodically passivated to improve its stability and to make it virtually impervious to environmental elements.

When you need high precision and ultimate reliability in a limited space, the TaNFilm SIP is the solution. The conformally coated SIP network can be tailored to meet special circuit configurations with multiple resistance values.

DIMENSIONS — INCHES



HOW TO ORDER

Sample Part No.:

4881 — 03 — 1001 — B

Model

4801	9-resistor, 10 pin SIP, one common lead (Schematic C)
4881	7-resistor, 8 pin SIP, one common lead (Schematic C)
4861	5-resistor, 6 pin SIP, one common lead (Schematic C)
4808	9-resistor, 10 pin SIP, series resistors (Schematic F)
4888	7-resistor, 8 pin SIP, series resistors (Schematic F)
4868	5-resistor, 6 pin SIP, series resistors (Schematic F)
4809	5-resistor, 10 pin SIP, Isolated (Schematic G)
4889	4-resistor, 8 pin SIP, Isolated (Schematic G)
4869	3-resistor, 6 pin SIP, Isolated (Schematic G)

Tolerance
Standard MIL tolerance code:
B = ±.1%, C = ±.25%,
D = ±.5%, F = ±1%, G = ±2%

Resistance
Standard MIL resistance code
Example: 1001 = 1000Ω

Characteristic

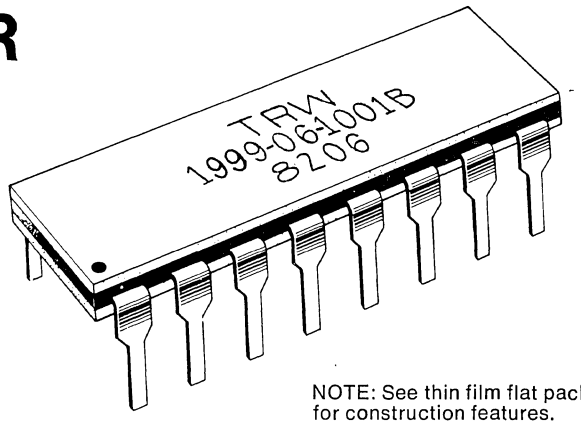
Code	Classification	TCR (ppm/°C)
00	Commercial grade	−100 ±25
01	Commercial grade	±100
02	Commercial grade	±50
03	Commercial grade	±25

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TRW

TaNFilm® DIP RESISTOR NETWORKS

- ☐ MIL qualifiied to both MIL-R-83401/01 and MIL-R-83401/02
- ☐ Tightest qualified tolerance available: ±0.1%
- ☐ Best qualified TC: ±50 ppm/°C; available to ±25 ppm/°C
- ☐ Superior TCR tracking to 5 ppm/°C
- ☐ Ratios available to 0.03%
- ☐ Special mechanical and electrical configurations available with military screening



NOTE: See thin film flat pack for construction features.

SPECIFICATIONS

MIL Qualified Resistance Values:
Schematic A: 100Ω to 100KΩ
Schematic B: 100Ω to 70KΩ
Higher and lower resistance values available

Resistance Tolerances: ±.1%, ±.25%, ±.5%, ±1%, ±2%

Temperature Coefficient of Resistance: ±50 ppm/°C, ±100 ppm/°C, ±300 ppm/°C, −100 ±25 ppm

TCR Tracking: 5 ppm/°C, except Models 1987 & 1998 below 500Ω (20 ppm/°C)

Temperature Range: −55°C to +150°C

Power Rating @ 70°C:

Model	Wattage Resistor	Wattage Network
1987	.1	1.3
1998	.1	1.5
1989	.2	1.4
1999	.2	1.6

Noise: Less than −25 dB

Lead Material: Gold plated copper

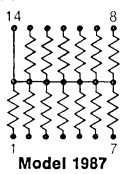
Substrate Material: 99.5% pure alumina ceramic

Construction: Ceramic sandwich epoxy encapsulant

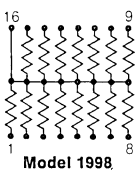
Custom Circuit and Special Testing Available

Contact factory for any special features required

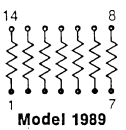
STANDARD CIRCUITS



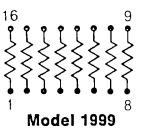
Model 1987



Model 1998



Model 1989



Model 1999

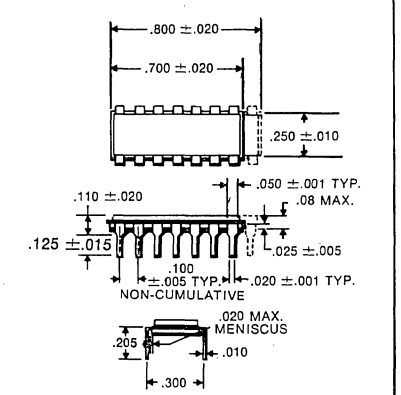
PERFORMANCE DATA

Test Per MIL-R-83401	MIL-R-83401 Limits (ΔR%) M	K	H	TaNFilm Test Data (ΔR%) Maximum	Typical
Thermal Shock	.5	.5	.25	.1	.02
Power Conditioning	.5	.5	.5	.1	.02
Low Temperature Operation	.5	.25	.1	.1	.02
Short Time Overload	.5	.25	.1	.05	.02
Terminal Strength	.25	.25	.25	.1	.02
Resistance to Soldering Heat	.25	.25	.1	.1	.02
Moisture Resistance	.5	.5	.4	.1	.03
Shock	.25	.25	.25	.1	.02
Vibration	.25	.25	.25	.1	.02
Life	2.0	.5	.5	.1	.05
High Temperature Exposure	1.0	.5	.2	.1	.05
Low Temperature Storage	.5	.25	.1	.1	.05
25°C Double Load	2.0	.5	.5	.05	.03

TaNFilm resistor networks are designed for use in applications requiring a high degree of reliability, stability, tight tolerance, close TCR tracking, and low noise. Our continuous feed, high vacuum sputtering process insures uniform properties from network to network. Precise state-of-the-art laser trimming enables us to easily zero in the tightest ratios. Gold-plated copper leads are thermal pulse bonded to large-area gold conductor pads on the ceramic substrate assuring the most relaible termination and long-term stability. Anodically passivated Tantalum Nitride resistor material offers performance far superior to military specifications and excellent environmental protection. Over 40 billion continuous resistor operating hours in the field without a defect-related failure clearly demonstrates the reliability of our TaNFilm product.

The versatile nature of our photo-etch process makes it readily adaptable to meet special customer requirements. Custom circuit designs and special mechanical configurations can be easily achieved with a modest set up charge. Full military screening is also available with all units.

DIMENSIONS — INCHES



HOW TO ORDER

Sample Part No.:

1999 — 06 — 1001 — B

Model

Model	Description
1989	7-resistor 14 Pin DIP, straight thru (MIL-R-83401-01, schematic A)
1999	8-resistor 16 Pin DIP, straight thru (MIL-R-83401-02, schematic A)
1987	13-resistor, 14 Pin DIP, one common lead (MIL-R-83401-01, schematic B)
1998	15-resistor, 16 Pin DIP, one common lead (MIL-R-83401-02, schematic B)

Tolerance
Standard MIL tolerance code:
B = ±.1%, C = ±.25%,
D = ±.5%, F = ±1%, G = ±2%

Resistance
Standard MIL resistance code
Example: 1001 = 1000Ω

Characteristic

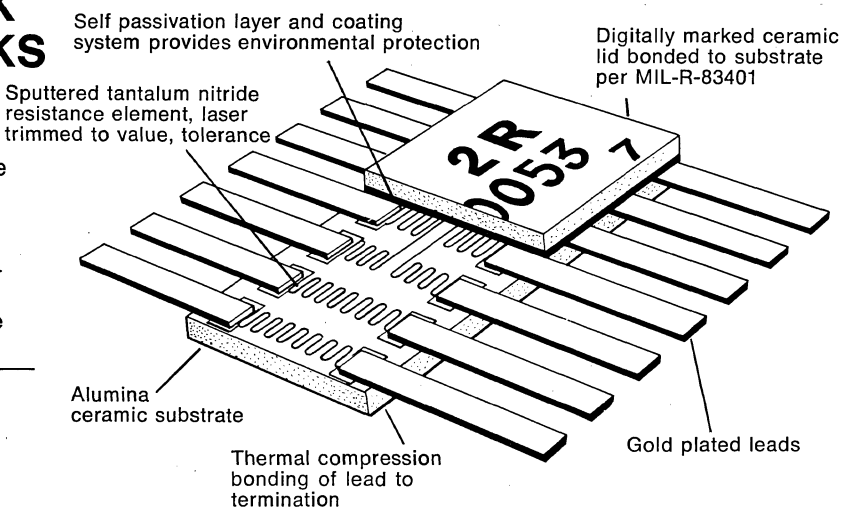
Code	Classification	TCR (ppm/°C)
00	Commercial grade	−100 ±25
01	Commercial grade	±100
02	Commercial grade	±50
03	Commercial grade	±25
04	MIL-R-83401M	±300
05	MIL-R-83401K	±100
06	MIL-R-83401H	±50
07	MIL-R-83401H	±25

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TaNFilm® FLAT-PACK RESISTOR NETWORKS

- ☐ Qualified to MIL-R-83401/03, Characteristic H
- ☐ Available with custom testing
- ☐ Ultra precision — Absolute tolerance to ±0.1% — Ratios to 0.03%
- ☐ Superior temperature performance Absolute T.C. to ±25 ppm/°C T.C. tracking: 5 ppm/°C standard — 3 ppm/°C available
- ☐ Custom schematics readily available
- ☐ Special mechanical configurations



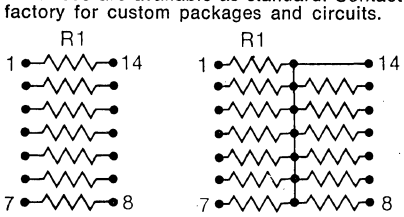
SPECIFICATIONS

Mil Qualified Resistance Ranges:
Schematic A: 49.9Ω to 100K
Schematic B: 49.9Ω to 56K
Higher resistance values available
Resistance Tolerances: ±.1%, ±.25%, ±.5%, ±1%, ±2%
Temperature Coefficient of Resistance: ±25 ppm°C, ±50 ppm/°C, ±100 ppm/°C, ±300 ppm/°C, −100 ±25 ppm/°C
TCR Tracking: Referenced to R1, is ±5 ppm/°C except Model 8987 below 500 ohm, which is ±20 ppm/°C
Temperature Range: −55° to +150°C
Noise: Less than −25 dB
Power Ratings: .1 watt per resistor, .5 watt per network at 70°C
1.0 watt per network at 25°C
Ratio Tolerance: to ±.03%
Lead Material: Gold plated copper alloy
Substrate Material: High alumina ceramic
Construction: Ceramic sandwich package
Custom Circuits: R-2R, BCD
Custom Screening Procedures
Packages: up to 20 leads

Contact factory for all custom packages and circuits

STANDARD CIRCUITS

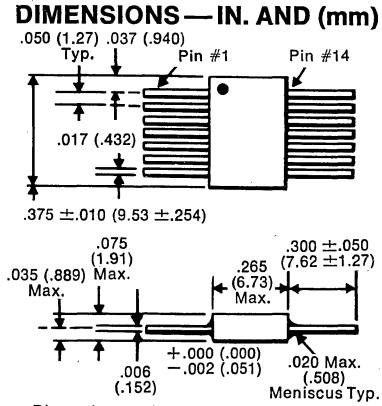
Both "A" and "B" schematics of MIL-R-83401 — RZ 030 are available as standard. Contact factory for custom packages and circuits.



Model 8989
MIL-R-83401
Schematic A

Model 8987
MIL-R-83401
Schematic B

DIMENSIONS — IN. AND (mm)



Dimensional tolerances unless otherwise specified ±.005 (.127)

TaNFilm resistor networks are designed for use in applications requiring a high degree of reliability, stability, tight tolerance, close TCR tracking, and low noise. The sputtering process for resistor formation has been perfected to allow a continuous feed production line under high vacuum conditions, thus, insuring uniformity of properties between networks. Precise state of the art laser trimming makes tight ratios easily achievable. The gold plated copper leads are thermal pulse bonded to large area gold conductor pads on the ceramic substrate assuring the most reliable termination and long term stability. The Tantalum Nitride resistor material is anodically passivated for excellent environmental protection and performance far superior to military specifications. Reliability has been demonstrated in field usage with over 40 billion continuous resistor operating hours without a defect related failure.

Our TaNFilm process enables us to manufacture networks containing different resistance values and still maintain the tight tolerances and tracking characteristics of networks containing only a single resistance value. The nature of our photo-etch process makes it readily adaptable to meet each individual customer's needs. Custom circuit designs and special mechanical configurations can be easily achieved with a modest set up charge while maintaining our high standards of precision and reliability.

PERFORMANCE DATA

Test Per MIL-R-83401	MIL-R-83401 Limits (ΔR%) M	K	H	TaNFilm Test Data (ΔR%) Maximum	Typical
Thermal Shock	.5	.5	.25	.1	.02
Power Conditioning	.5	.5	.5	.1	.02
Low Temperature Operation	.5	.25	.1	.1	.01
Short Time Overload	.5	.25	.1	.05	.01
Terminal Strength	.25	.25	.25	.1	.01
Resistance to Soldering Heat	.25	.25	.1	.1	.02
Moisture Resistance	.5	.5	.4	.1	.03
Shock	.25	.25	.25	.1	.03
Vibration	.25	.25	.25	.1	.03
Life	2.0	.5	.5	.1	.05
High Temperature Exposure	1.0	.5	.2	.1	.05
Low Temperature Storage	.5	.25	.1	.1	.02
25°C Double Load	2.0	.5	.5	.05	.03

HOW TO ORDER

Sample Part No.:

8987 — 05 — 1001 — B

Model

Model	Network Schematic
8989	7-resistors (MIL-R-83401-03, Schematic A)
8987	13-resistors (MIL-R-83401-03, Schematic B)

Characteristic

Code	Classification	TCR (ppm/°C)
00	Commercial grade	−100 ±25
01	Commercial grade	±100
02	Commercial grade	±50
03	Commercial grade	±25
04	MIL-R-83401M	±300
05	MIL-R-83401K	±100
06	MIL-R-83401H	±50
07	MIL-R-83401H	±25

Tolerance
Standard MIL tolerance code:
B = ±.1%, C = ±.25%,
D = ±.5%, F = ±1%, G = ±2%

Resistance
Standard MIL resistance code
Example: 1001 = 1000Ω

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

See MIL-R-83401 for Military numbering system

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
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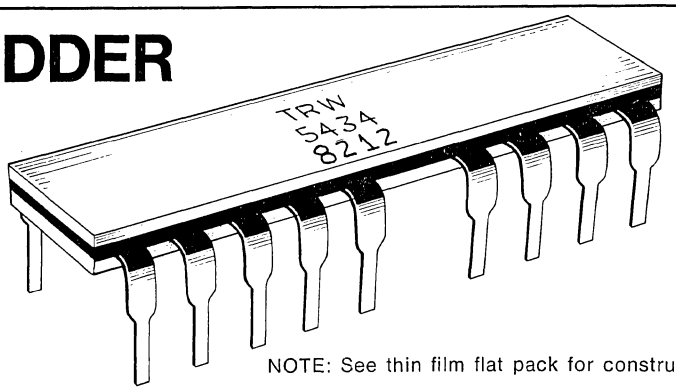
TRW

TaNFilm® R-2R LADDER

12-BIT, 20-PIN DIP

- ☐ Proven reliability
- ☐ 12 bit, ±½ LSB accuracy over 10,000 hour life
- ☐ Passivated TaNFilm for superior environmental performance
- ☐ ±122 ppm ladder accuracy over −55°C to +125°C
- ☐ Standard DIP package
- ☐ 5 standard R values



NOTE: See thin film flat pack for construction features.

The 5430 series R-2R ladder utilizes the unique characteristics of the TaNFilm process to provide the ±½ LSB, 12 bit accuracy required for precision data conversion. Our continuous sputtering process deposits Tantalum Nitride resistance film over an entire substrate of 99.5% pure alumina, ensuring virtually identical resistance temperature characteristics of all resistors in the ladder. This guarantees no degradation in ladder accuracy over the full military temperature range of −55°C to +125°C.

Anodic passivation of the resistance film results in outstanding environmental performance. More importantly, since the aging process of this film results in a slight continuation of this passivation, all resistors change at the same rate. Consequently, voltage ratios required for ladder accuracy are very stable over long term, 10,000 hour load and temperature conditions.

Large area thermocompression bonding of gold plated leads eliminates the need for fine wire bonds and provides the ultimate in strength and reliability. In addition the combination of high alumina substrate for thermal conductivity and 1.5 mil minimum resistor line width enhances reliability for the most severe applications. Reliability and stability of TaNFilm networks are proven with years of MIL-R-83401 testing and qualification.

SPECIFICATIONS

Ladder Resistance Values (R): 5K, 10K, 20K, 25K, 50K

Ladder Resistance Tolerance: ±5%

Maximum Input Voltage: 20V

Settling Time (to 0.1% of final value): 100n sec.

Temperature Range: −55°C to +125°C

External Switch Compensation (Note 1):
Models 5431-5434 — 5Ω
Model 5435 — 500Ω

Ladder Voltage Accuracy: ±122 ppm

Application Resistor Tolerance Ratio (Note 2): 0.04%

Lead Material: Gold plated copper alloy

STABILITY

TaNFilm 12 bit ladders exhibit ±122 ppm maximum voltage ratio error after the following tests (per MIL-R-83401 except as noted):

Operating Life: 1000 Hrs. Full Load 100°C

Short Time Overload: 10 Sec. 2.5 x Rated Voltage

Thermal Shock: 10 cycles −65°C to +150°C

High Temperature Exposure: 100 Hrs. @ 125°C

Moisture Cycle, Load: 10 Days

Soldering Heat: 10 Sec. @ 260°C

Shock: 100 g's for 6 Milliseconds

Vibration: 20 g's

Terminal Strength: 4.5 Lbs.

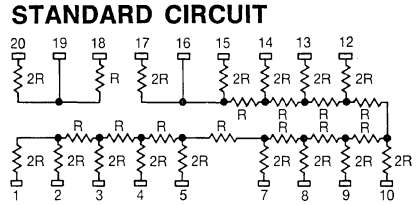
Note 1 — Consult factory for other switch compensation.

Note 2 — Ratio matching of each application resistor to ladder output resistance. Consult factory for other accuracy requirements.

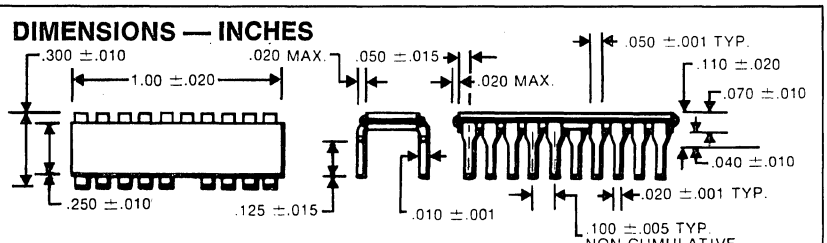
HOW TO ORDER

Model	Description
5431	5/10K, 12 bit, 20 pin DIP, R-2R ladder
5432	10/20K, 12 bit, 20 pin DIP, R-2R ladder
5433	20/40K, 12 bit, 20 pin DIP, R-2R ladder
5434	25/50K. 12 bit, 20 pin DIP, R-2R ladder
5435	50/100K, 12 bit, 20 pin DIP, R-2R ladder

STANDARD CIRCUIT



DIMENSIONS — INCHES



Testing R-2R Ladder Networks

Conversion Accuracy Testing

TRW tests its R-2R ladders functionally by comparing the output of the DUT (device under test) with the output of a standard ladder having an accuracy of 1 ppm. The ladder networks are activated one bit at a time, starting with bit one and continuing to the LSB (least significant bit). See Figure 1. A calculator controlled scanner having low thermal mercury relays is used for the switching. The reference voltage being applied to the corresponding bit of each ladder (standard and DUT) is 10 volts. The output voltage error is measured using a calculator control DVM and is stored in the calculator memory. After all bits have been read, the plus and minus sums are found by adding the appropriate errors of all bits. Normally each of these sums must be less than one half the output of a perfect ladder with only its least significant bit energized. This is 122 ppm for 12 bit ladders. This procedure guarantees monotonicity and a worst case accuracy of less than ½ LSB.

Output Resistance Testing

The output resistance is determined by making a single measurement. All bits are connected to common and the resistance between the "OUT" terminal and common is measured. The value will be the R value of the ladder. When switch compensation is accounted for, the output reistance is ±5% of the nominal value of R.

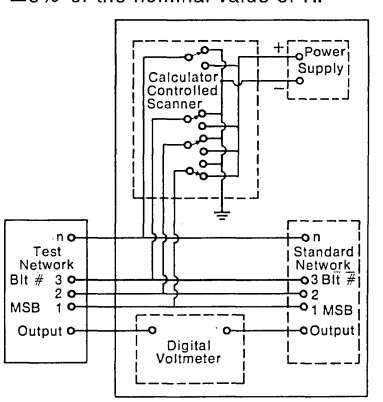
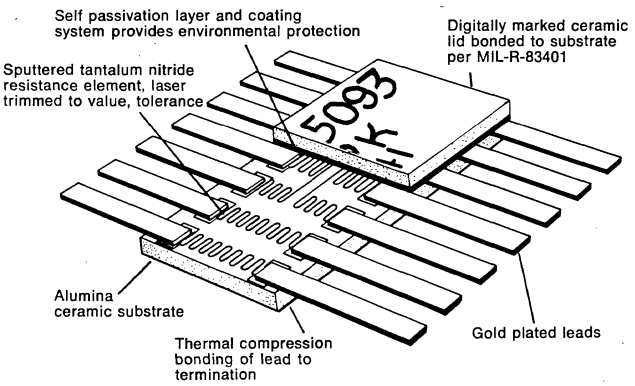


Figure 1. Conversion Accuracy Tester

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TaNFilm® R-2R LADDER
8-BIT, 16-PIN FLAT PACK

- ☐ 8 bit resolution
- ☐ Space saving size
- ☐ Superior environmental performance
- ☐ Ladder accuracy of ±½ LSB over −55°C to +125°C
- ☐ Standard 16 pin flat pack
- ☐ High reliability
- ☐ 4 standard R values



TRW's 5090 series of 8 bit, R-2R ladders combines the accuracy required for precise data conversion with the increased space efficiency that makes the flat pack such a popular package. In addition to being smaller, this particular part is ideally suited to airborne applications because of its light weight.

The unique characteristics used in our TaNFilm construction ensure high reliability and stability of the R-2R ladders. Our process of sputtering Tantalum Nitride resistance film onto 99.5% pure alumina substrates in a vacuum guarantees uniform temperature characteristics of all the resistors in the ladders. Also, TRW's R-2R ladders maintain ±½ LSB ratio accuracy throughout the full military temperature range of −55°C to +125°C.

To ensure superior environmental performance and the highest reliability available, the resistance film is anodically passivated. Aging of Tantalum Nitride networks is a slow continuation of this passivation so that all resistors in the ladder change at the same rate. Thus, voltage ratios are maintained over a 10,000 hour life and no degradation of performance occurs throughout extreme temperature conditions.

Thermocompression bonding of gold plated leads onto large gold bonding areas guarantees ultimate strength and reliability and eliminates the need for fine wire bonding. The superiority of TaNFilm networks has been proven through years of qualification testing to MIL-R-83401 specifications. Data is available upon request.

SPECIFICATIONS

Ladder Resistance Values (R): 5K, 10K, 20K, 25K

Ladder Resistance Tolerance: ±5%

Maximum Input Voltage: 20V

Settling Time (to 0.1% of final value): 100n sec.

External Switch Compensation (Note 1): 5Ω

Temperature Range: −55° to +125°C

Ladder Voltage Accuracy (Note 2): ±½ LSB

Lead Material: Gold plated copper alloy

STABILITY

TaNFilm 8 bit ladders maintain ±½ LSB accuracy after the following tests (per MIL-R-83401 except as noted):

Operating Life: 1000 Hrs. Full Load 125°C

Short Time Overload: 10 Sec. 2.5 x Rated Voltage

Thermal Shock: 10 cycles −65°C to +150°C

Moisture Cycle, Load: 10 Days

High Temperature Exposure: 100 Hrs. @ 125°C

Soldering Heat: 10 Sec. @ 260°C

Shock: 100 g's for 6 Milliseconds

Vibration: 20 g's

Terminal Strength: 1.5 Lbs.

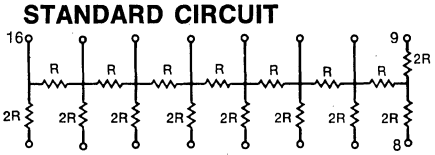
Note 1 — Consult factory for other switch compensation.

Note 2 — Higher accuracies available upon request.

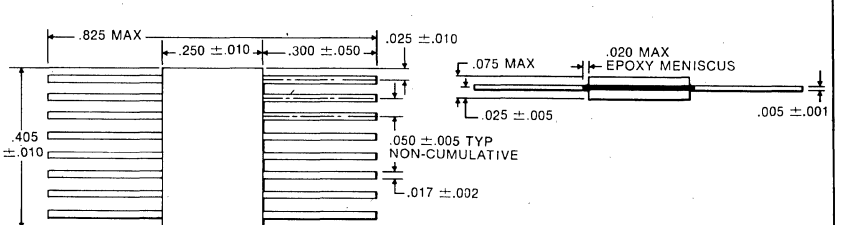
HOW TO ORDER

Model	Description
5091	5/10K, 8 bit, 16 pin flat pack, R-2R ladder
5092	10/20K, 8 bit, 16 pin flat pack, R-2R ladder
5093	20/40K, 8 bit, 16 pin flat pack, R-2R ladder
5094	25/50K, 8 bit, 16 pin flat pack, R-2R ladder

STANDARD CIRCUIT



DIMENSIONS — INCHES



Testing R-2R Ladder Networks

Conversion Accuracy Testing

TRW tests its R-2R ladders functionally by comparing the output of the DUT (device under test) with the output of a standard ladder having an accuracy of 1 ppm. The ladder networks are activated one bit at a time, starting with bit one and continuing to the LSB (least significant bit). See Figure 1. A calculator controlled scanner having low thermal mercury relays is used for the switching. The reference voltage being applied to the corresponding bit of each ladder (standard and DUT) is 10 volts. The output voltage error is measured using a calculator controlled DVM and is stored in the calculator memory. After all bits have been read, the plus and minus sums are found by adding the appropriate errors of all bits. Normally each of these sums must be less than one half of the output of a perfect ladder with only its least significant bit energized. This is 1952 ppm for 8 bit ladders. This procedure guarantees monotonicity and a worst case accuracy of less than ½ LSB.

Output Resistance Testing

The output resistance is determined by making a single measurement. All bits are connected to common and the resistance between the "OUT" terminal and common is measured. The value will be the R value of the ladder. When switch compensation is accounted for, the output resistance is ±5% of the nominal value of R.

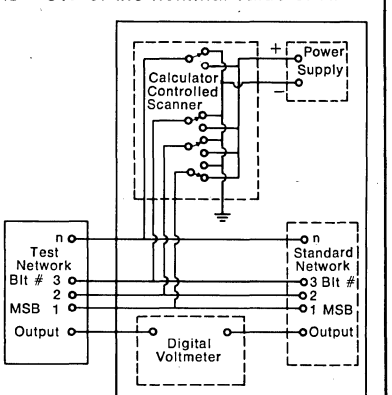


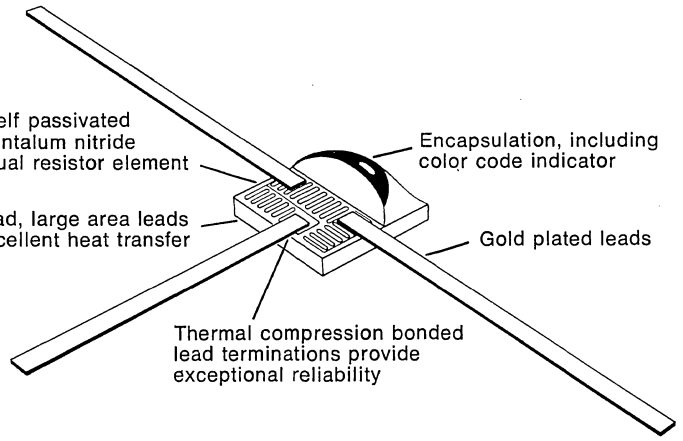
Figure 1. Conversion Accuracy Tester

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TaNFilm® SUBMINIATURE DUAL NETWORK

TaNTee SERIES

- ☐ Subminiature (0.075″ x 0.075″)
- ☐ Dual resistor, center lead common
- ☐ Available with custom testing
- ☐ Ultra precision — Absolute tolerance to ±1% — Ratios to: 0.1%
- ☐ Superior temperature performance Absolute T.C. to ±25 ppm/°C — T.C. tracking: 5 ppm/°C standard
- ☐ High frequency operation



SPECIFICATIONS

Resistance Range, each R: 10Ω to 10KΩ (See chart and schematic below)
Power Rating: ¼W @ 85°C (sum of power in both resistors)
Resistor Tolerance:
Absolute Tolerance — ±5% standard, ±1% available
Ratio Tolerance — To .1%
Moisture Resistance, ΔR: ±0.4% max.
Thermal Shock, ΔR: ±0.25% max. (5 cycles, −65°C to +125°C)
Temperature Coefficient:
Absolute — To ±25 ppm/°C
Tracking — To 5 ppm
Load Life, ΔR: ±.5% max. (1000 hrs. @ 70°C @ Rated Load)
Noise: −20 db max.
Short Time Overload, ΔR: ±0.1% max. (2.5 x rated voltage for 5 seconds)

NOTE: TaNTee resistors meet the performance requirements of MIL-R-83401, characteristic H

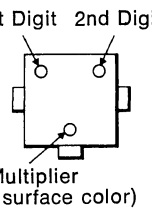
The TaNTee Series of TaNFilm resistor networks provide a miniature, two-resistor network adaptable to many circuit requirements. The tanalum nitride film resistors are deposited on a 25 mil thick ceramic chip .075″ x .075″, and are protected by a rugged epoxy coating. Gold plated copper leads are bonded to termination pads on the ceramic chip, resulting in a strong, reliable lead connection.

Tantalum nitride is an extremely stable metal film resistor material capable of high operating power levels and also exceptional environmental performance. The TaNTee dual resistor's physical size and construction make it ideally suited for high frequency applications. The excellent TC tracking of the two resistors on the chip provides a very stable voltage ratio, which is critical in many applications.

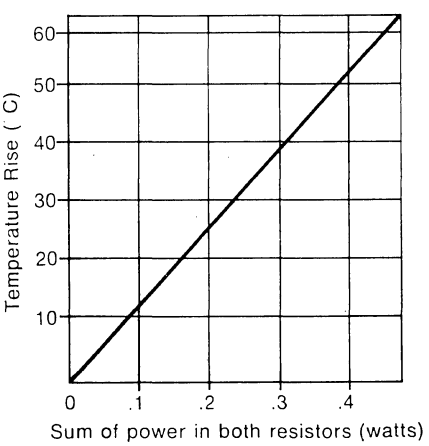
Standard Resistances				
10	16	27	43	68
11	18	30	47	75
12	20	33	51	82
13	22	36	56	91
15	24	39	62	
5% EIA Values				

1st and 2nd Digit		Multiplier
Black = 0	Green = 5	Black = X1
Brown = 1	Blue = 6	Brown = X10
Red = 2	Violet = 7	Red = X100
Orange = 3	Grey = 8	Orange = X1000
Yellow = 4	White = 9	

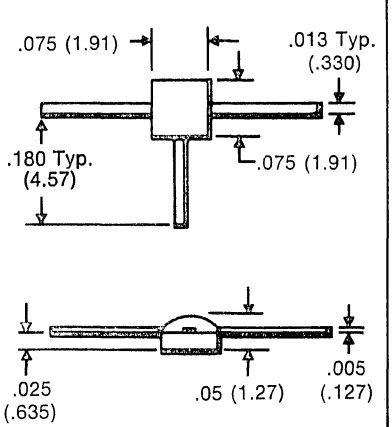
COLOR CODING



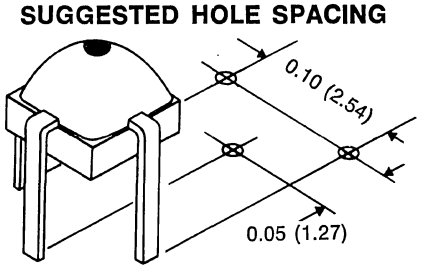
TEMPERATURE RISE ABOVE AMBIENT



DIMENSIONS — IN. AND (mm)

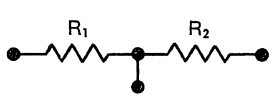


SUGGESTED HOLE SPACING



NOTE: TaNTee Dual Resistors are supplied only with non-formed leads.

STANDARD CIRCUIT



HOW TO ORDER

Sample Part No.:

TaNTee 2-X X X

Product Family

Resistance Value When $R_1 = R_2$*
(* When R_1 does not equal R_2, consult factory.)
First Digit

Second Digit

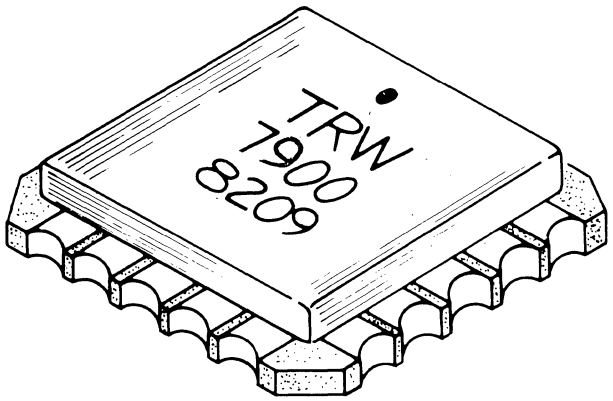
Multiplier
(Number of Zeros)

Example: 2100 = 10Ω
2101 = 100Ω
2103 = 10,000Ω

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TaNFilm®
CHIP CARRIER
RESISTOR NETWORKS

- ☐ Increased component density
- ☐ Ideal for vapor phase reflow soldering
- ☐ Best tolerances: 0.1% absolute — 0.02% ratio
- ☐ Superior temperature performances: Absolute T.C. to ±25 ppm/°C — Tracking 5 ppm/°C standard
- ☐ Custom schematics readily available
- ☐ Meets JEDEC standard for Type 'C' package



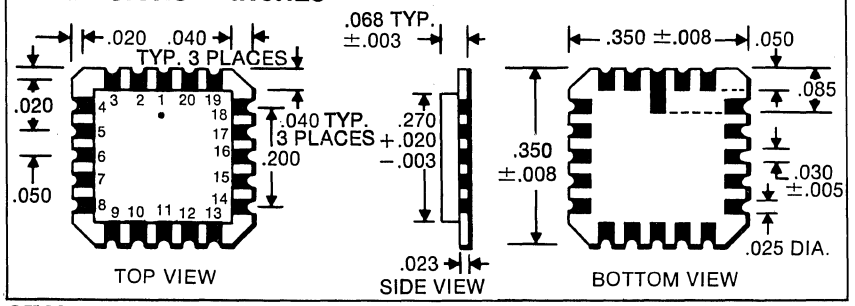
SPECIFICATIONS

Resistance Values: 50Ω to 50KΩ standard; up to 100KΩ on special order
Resistance Tolerances: ±.1%, ±.25%, ±.5%, ±1%, ±2%
Temperature Coefficient of Resistance: ±25 ppm/°C, ±50 ppm/°C, ±100 ppm/°C, ±300 ppm/°C
TCR Tracking: 5 ppm/°C
Temperature Range: −55°C to +150°C
Noise: Less than −25 dB
Power Rating @ 70°C: .1 watt/resistor, .5 watt/network
Meets JEDEC standard for type 'C' package
Terminations: Gold over nickel over copper
Substrate Material: 99.5% pure alumina ceramic
Construction: Ceramic chip/epoxy encapsulant
Custom circuits and special testing available
Contact factory for any special features required.

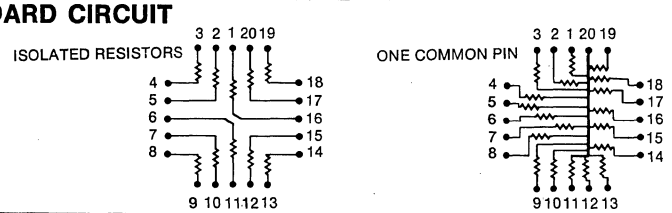
PERFORMANCE DATA

	MIL-R-83401 Limits (ΔR%)			TaNFilm Test Data (ΔR)	
Test Per MIL-R-83401	M	K	H	Maximum	Typical
Thermal Shock	.5	.5	.25	.1	.05
Power Conditioning	.5	.5	.5	.1	.05
Low Temperature Operation	.5	.25	.1	.1	.02
Short Time Overload	.5	.25	.1	.05	.02
Terminal Strength	.25	.25	.25	.1	.05
Resistance to Soldering Heat	.25	.25	.1	.1	.02
Moisture Resistance	.5	.5	.4	.1	.03
Shock	.25	.25	.25	.1	.03
Vibration	.25	.25	.25	.1	.03
Life	2.0	.5	.5	.1	.05
High Temperature Exposure	1.0	.5	.2	.1	.05
Low Temperature Storage	.5	.25	.1	.1	.05
25°C Double Load	2.0	.5	.5	.05	.03

DIMENSIONS — INCHES



STANDARD CIRCUIT



The TRW TaNFilm chip carrier network offers higher lead density, increased component count, lower installed resistor cost, better reliability, and is ideal for use with the latest production technique — vapor phase reflow solder process. In addition, the TaNFilm leadless chip carrier network provides all the unique qualities of our other TaNFilm package configurations. Testing has demonstrated performance to MIL-R-83401 Characteristic H.

The proven TaNFilm manufacturing process enhances reliability through elimination of wire bonds. Precise state-of-the-art laser trimming provides close tolerances and tight ratios. The TaNFilm process enables us to manufacture custom circuit configurations and multiple resistance values without sacrificing the tightest tolerance and tracking characteristics of precision networks. The Tantalum Nitride resistor material is passivated for environmental protection surpassing military requirements and guaranteeing exceptional ratio stability over the full range of military environments.

For applications requiring a high degree of reliability, stability, accuracy and low noise, plus advantages of new resistor packing, specify the TRW leadless chip carrier configuration resistor network.

HOW TO ORDER

Sample Part No.:

7900 - 01 - 1001 - B

Model
7900 19-resistor, pin #20 common, min. 50Ω, max. 20K
7909 10-resistor, isolated resistors, min. 50Ω, max. 50K

Characteristic

Code	TCR (ppm/°C)
00	−100±25
01	±100
02	±50
03	±25

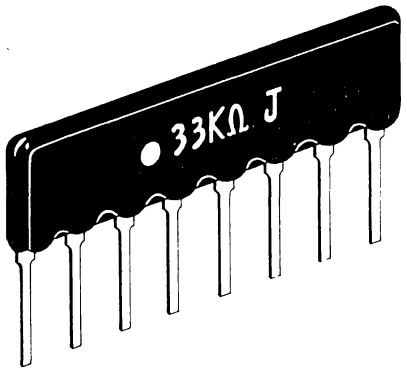
Resistance
Standard MIL resistance code
Example: 1001 = 1000Ω

Tolerance
Standard MIL tolerance code
B = ±.1%, C = ±.25%, D = ±.5%, F = ±1%, G = ±2%

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

TRW

THICK FILM CONFORMAL COATED SIP NETWORKS *



- ☐ 4 through 14-pin packages
- ☐ Project .256 in. from circuit board
- ☐ Circuits -1, -3 and -5 are standard
- ☐ Other circuits available on request

SPECIFICATIONS

ELECTRICAL

Resistance Range: 22Ω to 1.0 MegΩ
Resistance Tolerance: ±2% and ±5%
Temperature Coefficient: ±200 ppm/°C
Max. Continuous Working Voltage: 50V
Operating Temp.: −40°C to +150°C

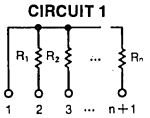
PHYSICAL

Element: Fused thick-film composition
Substrate: 96% Alumina
Body: Conformal Coated
Terminals: Solder Plated Steel
Lead Pull: 2.2 pounds
Lead Solderability: MIL-STD-202. Method 208
Resistance to Soldering Heat: MIL-STD-202E, Method 210A, Cond. A
Marking Resistance to Solvents: MIL-STD-202, Method 215

ENVIRONMENTAL PER MIL-R-83401

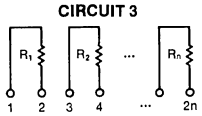
Short Time Overload: ±.5%
Terminal Strength: ±.5%
Resistance to Solder Heat: ±.5%
Moisture Resistance: ±2%
Load Life: ±2%
Temperature Cycling: ±.5%

CIRCUIT 1



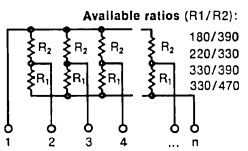
$R_1 = R_2 ... = R_n$
(n=3 to 13)

CIRCUIT 3



$R_1 = R_2 ... = R_n$
(n=2 to 7)

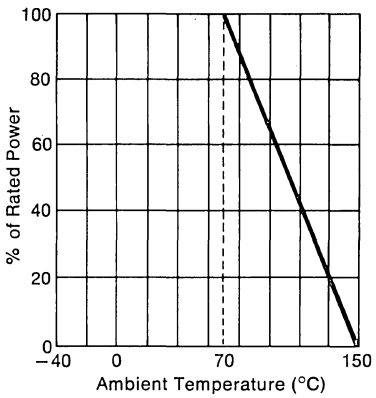
CIRCUIT 5



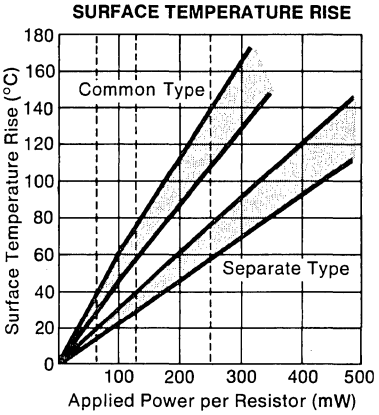
(n=5 to 11)

STANDARD CIRCUITS

POWER DERATING



SURFACE TEMPERATURE RISE



STANDARD RESISTANCE (OHMS)

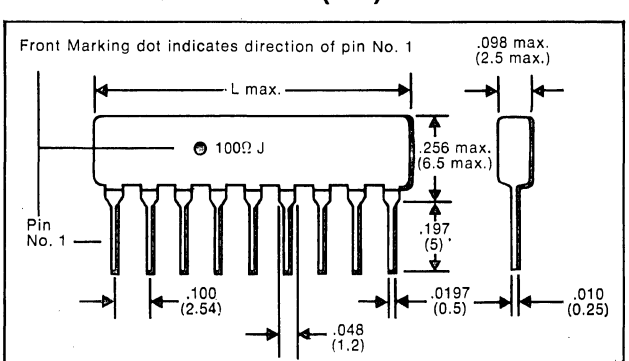
22	82	(330)	1.2K	(4.7K)	18K	68K	270K
27	(100)	390	1.5K	5.6K	(22K)	82K	330K
(33)	120	(470)	1.8K	(6.8K)	27K	(100K)	390K
39	(150)	560	(2.2K)	8.2K	33K	120K	470K
(47)	180	(680)	2.7K	(10K)	39K	150K	560K
(56)	(220)	820	(3.3K)	12K	(47K)	180K	680K
68	(270)	(1K)	3.9K	(15K)	56K	220K	820K

(*) Preferred standard resistance values available immediately from stock. 1M

POWER RATING AT 70°C

Circuit Type	One Element	MAX. POWER IN ONE NETWORK (WATTS)										
		4-PIN	5-PIN	6-PIN	7-PIN	8-PIN	9-PIN	10-PIN	11-PIN	12-PIN	13-PIN	14-PIN
—1	.125	.375	.5	.625	.75	.875	1	1.05	1.15	1.25	1.35	1.45
—3	.25	.50	—	.75	—	1	—	1.05	—	1.25	—	1.45
—5	.125	—	.5	.625	.75	.875	1	1.05	1.15	1.25	1.35	1.45

DIMENSIONS — IN. AND (mm)



No. of Pins	L max inches (mm)
4	0.43 (10.66)
5	0.53 (13.2)
6	0.63 (15.8)
7	0.73 (18.3)
8	0.83 (20.9)
9	0.93 (23.4)
10	1.03 (25.9)
11	1.13 (28.5)
12	1.23 (31.0)
13	1.33 (33.6)
14	1.43 (36.1)

* Manufactured in Japan

HOW TO ORDER

Sample Part No.: **C 10 - 3 - 223 - G**

- Product Family (C = .256 SIP)
- Number of Pins (4 through 14)
- Circuit Type (1, 3 or 5)
- For Circuits 1 or 3, 2 Digit Range and Digit Multiplier
- For Circuit 5, ratio of R1/R2
- Tolerance (G = 2%, J = 5%)

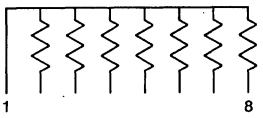
AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

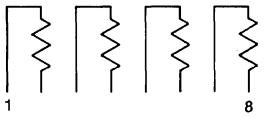
THICK FILM MOLDED 6-, 8- AND 10-PIN, .350-IN. SIP NETWORKS

STANDARD CIRCUITS

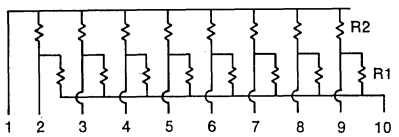
CIRCUIT 1

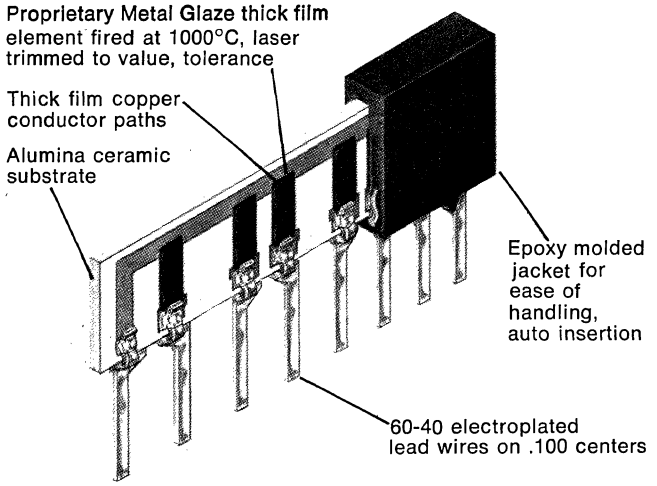


CIRCUIT 3



CIRCUIT 5





SPECIFICATIONS

ELECTRICAL

Resistance Range: 22Ω to 1 Meg
Resistance Tolerance: ±2% and ±5%
Temperature Coefficient: ±150 ppm/°C
TC Tracking: 50 ppm/°C typical
Max. Continuous Working Voltage: 50V
Operating Temperature: −55°C to 150°C

PHYSICAL

Element: Fused thick-film composition
Substrate: 96% Alumina
Body: Molded epoxy
Terminals: Tinned copper
Lead Pull: 4.5 pounds
Lead Solderability: MIL-STD-202, Method 208, and MIL-STD-883, Method 2003
Resistance to Soldering Heat: MIL-STD-202E, Method 210A, Cond. C
Marking Resistance to Solvents: MIL-STD-202, Method 215

ENVIRONMENTAL PER MIL-R-83401

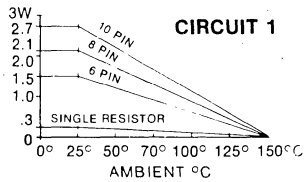
TCR: ±150 PPM/°C
Thermal Shock: ±.50%
Power Conditioning: ±.50%
Low Temperature Operation: ±.25%
Short Time Overload: ±.25%
Terminal Strength: ±.25%
Resistance to Solder Heat: ±.25%
Moisture Resistance: ±.50%
Shock: ±.25%
Vibration, High Frequency: ±.25%
Life: ±1.0%
25°C Power Rating: ±1.0%
High Temperature Exposure: ±.50%
Low Temperature Storage: ±.25%
Insulation Resistance: 10,000 Megohms

POWER RATING

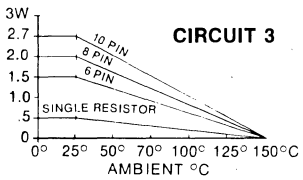
	6 PIN	8 PIN	10 PIN
Circuit 1—Total package	1.5W	2.1W	2.7W
Single resistor	.3W	.3W	.3W
Circuit 3—Total package	1.5W	2.0W	2.5W
Single resistor	.5W	.5W	.5W
Circuit 5—Total package	—	2.0W	2.7W
Single resistor	—	.17W	.17W

(Rating @ 70°C is 67% or 25° rating)

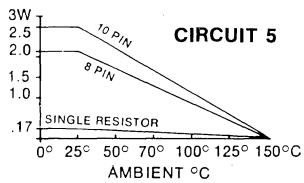
CIRCUIT 1



CIRCUIT 3



CIRCUIT 5

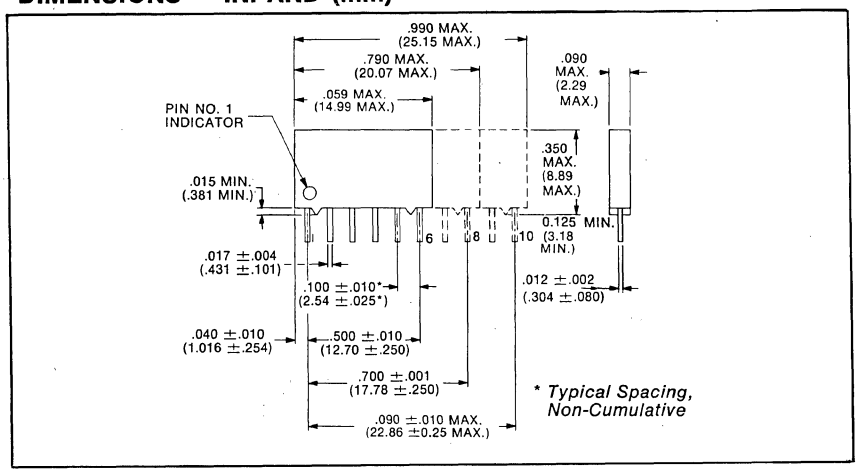


STANDARD RESISTANCE VALUES (OHMS)

22	82	330	1.0K	3.3K	10K	33K	100K	330K
27	100	390	1.2K	3.9K	12K	39K	120K	390K
33	120	470	1.5K	4.7K	15K	47K	150K	470K
39	150	560	1.8K	5.6K	18K	56K	180K	560K
47	180	680	2.2K	6.8K	22K	68K	220K	680K
56	220	820	2.7K	8.2K	27K	82K	270K	820K
68	270							1 MEG

* R2/R1 ratio = 1.2 (minimum) to 2.2 (maximum). R1 Minimum = 50 Ohm; R2 Maximum = 1000 Ohm.

DIMENSIONS — IN. AND (mm)



HOW TO ORDER

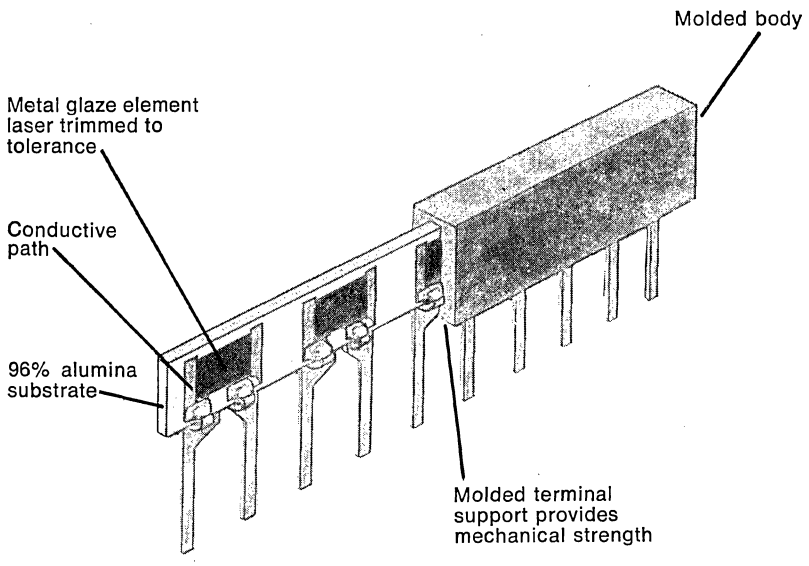
8 10 - 3 - 223 - G

Product Family (8 = .350″ SIP)
No. of Pins
Circuit Type (1 = N-1) (3 = N/2) (5 = Terminator)
2 Digit Range and Digit Multiplier or, for Circuit 5, R_1/R_2
Tolerance (G = 2%, J = 5%)

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

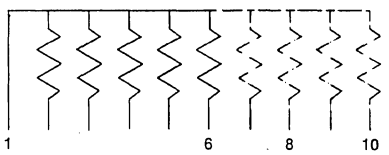
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

THICK FILM MOLDED 8- AND 10-PIN, .195-IN. SIP NETWORKS

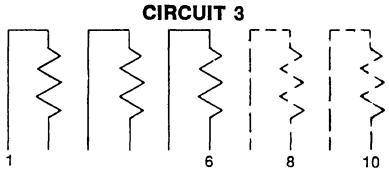


STANDARD CIRCUITS

CIRCUIT 1



CIRCUIT 3



SPECIFICATIONS

ELECTRICAL

Resistance Range: 22Ω to 150K
Resistance Tolerance: ±2% and ±5%
Temperature Coefficient: ±150 ppm/°C
TC Tracking: 50 ppm/°C typical
Max. Continuous Working Voltage: 50V
Operating Temperature: −55°C to 150°C

PHYSICAL

Element: Fused thick-film composition
Substrate: 96% Alumina
Body: Molded epoxy
Terminals: Tinned copper
Lead Pull: 4.5 pounds
Lead Solderability: MIL-STD-202, Method 208, and MIL-STD-883, Method 2003
Resistance to Soldering Heat: MIL-STD-202E, Method 210A, Cond. C
Marking Resistance to Solvents: MIL-STD-202, Method 215

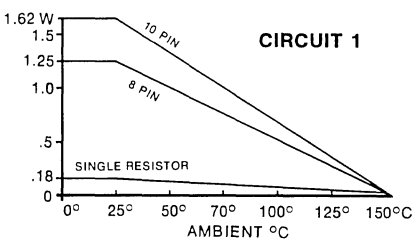
ENVIRONMENTAL PER MIL-R-83401

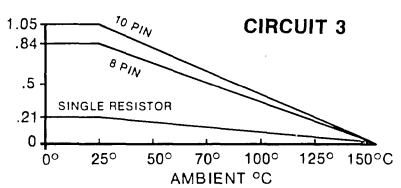
TCR: ±150 PPM/°C
Thermal Shock: ±.50%
Power Conditioning: ±.50%
Low Temperature Operation: ±.25%
Short Time Overload: ±.25%
Terminal Strength: ±.25%
Resistance to Solder Heat: ±.25%
Moisture Resistance: ±.50%
Shock: ±.25%
Vibration, High Frequency: ±.25%
Life: ±1.0%
25°C Power Rating: ±1.0%
High Temperature Exposure: ±.50%
Low Temperature Storage: ±.25%
Insulation Resistance: 10,000 Megohms

POWER RATING

	8 PIN	10 PIN
Circuit 1—Total package	1.25W	1.62W
Single resistor	.18W	.18W
Circuit 3—Total package	.84W	1.05W
Single resistor	.21W	.21W

(Rating @ 70°C is 67% of 25° rating)

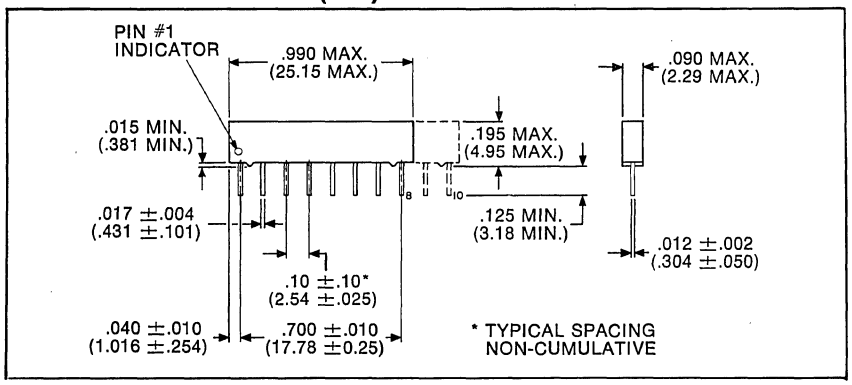




STANDARD RESISTANCE VALUES (OHMS)

22	82	330	1.0K	3.3K	10K	33K	100K
27	100	390	1.2K	3.9K	12K	39K	120K
33	120	470	1.5K	4.7K	15K	47K	150K
39	150	560	1.8K	5.6K	18K	56K	
47	180	680	2.2K	6.8K	22K	68K	
56	220	820	2.7K	8.2K	27K	82K	
68	270						

DIMENSIONS — IN. AND (mm)



HOW TO ORDER

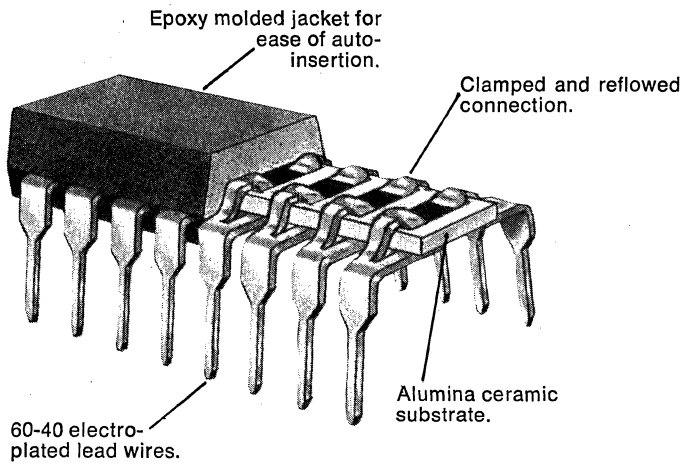
6 08 - 1 - 223 - G

Product Family (6 = .195" SIP)
No. of Pins
Circuit Type (1 = N-1) (3 = N/2)
2 Digit Range and Digit Multiplier
Tolerance (G = 2%, J = 5%)

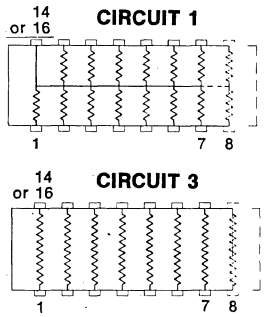
AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

THICK FILM MOLDED 14- AND 16-PIN DIP NETWORKS



STANDARD CIRCUITS



SPECIFICATIONS

ELECTRICAL

Resistance Range: 22Ω to 1 Meg
Resistance Tolerance: ±2% and ±5%
Temperature Coefficient: ±150 ppm/°C
TC Tracking: 50 ppm/°C typical
Max. Continuous Working Voltage: 100V
Operating Temperature: −55°C to 150°C

PHYSICAL

Element: Fused thick-film composition
Substrate: 96% Alumina
Body: Molded epoxy
Terminals: Tinned copper
Lead Pull: 4.5 pounds
Lead Solderability: MIL-STD-202, Method 208, and MIL-STD-883, Method 2003
Resistance to Soldering Heat: MIL-STD-202E, Method 210A, Cond. C
Marking Resistance to Solvents: MIL-STD-202, Method 215

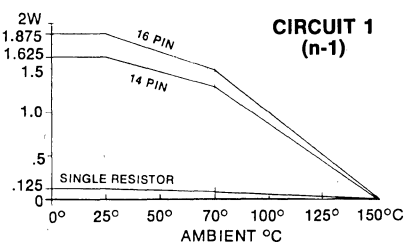
ENVIRONMENTAL PER MIL-R-83401

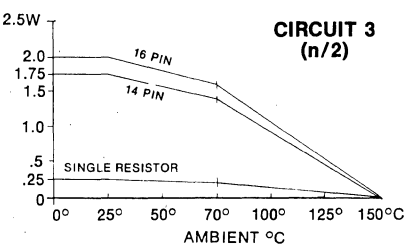
TCR: ±150 PPM/°C
Thermal Shock: ±.50%
Power Conditioning: ±.50%
Low Temperature Operation: ±.25%
Short Time Overload: ±.25%
Terminal Strength: ±.25%
Resistance to Solder Heat: ±.25%
Moisture Resistance: ±.50%
Shock: ±.25%
Vibration, High Frequency: ±.25%
Life: ±1.0%
25°C Power Rating: ±1.0%
High Temperature Exposure: ±.50%
Low Temperature Storage: ±.25%
Insulation Resistance: 10,000 Megohms

POWER RATING

	14 PIN	16 PIN
Circuit 1—Total package	1.625W	1.875W
Single resistor	.125W	.125W
Circuit 3—Total package	1.75W	2.00W
Single resistor	.25W	.25W

(Rating @ 70°C is 80% of 25° rating)

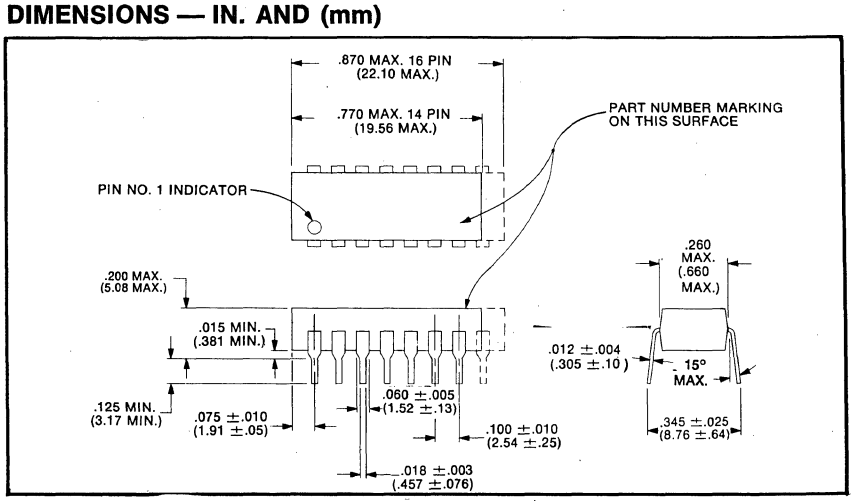




STANDARD RESISTANCE VALUES (OHMS)

22	82	330	1.0K	3.3K	10K	33K	100K	330K
27	100	390	1.2K	3.9K	12K	39K	120K	390K
33	120	470	1.5K	4.7K	15K	47K	150K	470K
39	150	560	1.8K	5.6K	18K	56K	180K	560K
47	180	680	2.2K	6.8K	22K	68K	220K	680K
56	220	820	2.7K	8.2K	27K	82K	270K	820K
68	270							1 MEG

DIMENSIONS — IN. AND (mm)



HOW TO ORDER

5 14 - 1 - 223 - G

Product Family (5 = DIP)
No. of Pins
Circuit Type (1 = N-1) (3 = N/2)
2 Digit Range and Digit Multiplier
Tolerance (G = 2%, J = 5%)

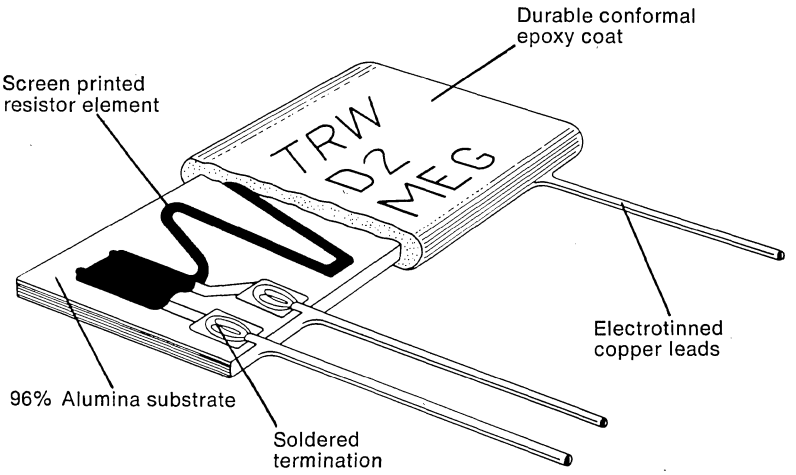
AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

THICK FILM HIGH VOLTAGE DIVIDERS

RD SERIES

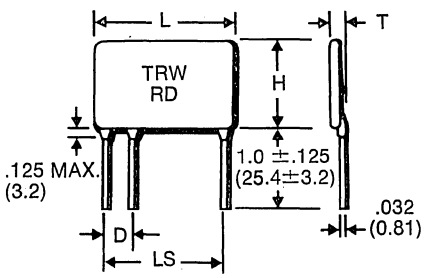
- ☐ TRW proprietary thick film materials and technology
- ☐ Space-saving thin body design
- ☐ PC board compatible
- ☐ High voltage stability
- ☐ Wide resistance and ratio selection
- ☐ For use in CRT circuits, voltage multipliers, power supplies, voltage readout sensing



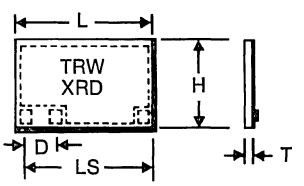
SPECIFICATIONS

Power Rating: 3 to 7 watts
Resistance Range: 1MΩ to 500MΩ
Max. DC Voltage: 10 kV to 20 kV
Resistance Tolerance: 10%, 20%
Ratios: 1:1 to 2000:1
Ratio Tolerance: 3% to 5%
Ratio Tracking: ±50 ppm/°C
Temperature Coefficient: ±200 ppm/°C overall, ±50 ppm/°C ratio
Voltage Coefficient: 5 ppm/V overall, 5 ppm/V ratio
1000 Hour 25°C Load Life ΔR: 2% overall, 1% ratio
Moisture Resistance: 1% overall, 0.5% ratio
Operating Temp.: −55°C to +150°C

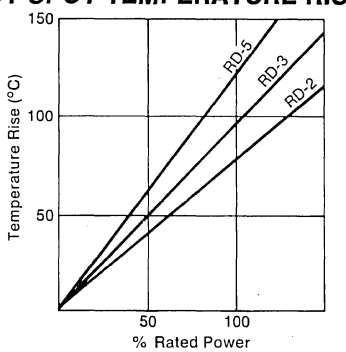
STANDARD CONFIGURATION



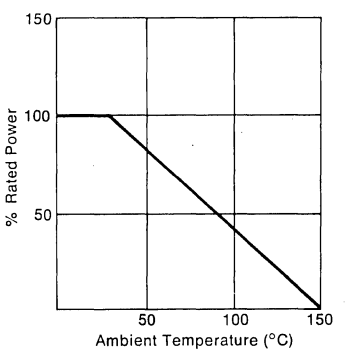
ALTERNATE CONFIGURATION



HOT SPOT TEMPERATURE RISE



POWER DERATING



TRW Type	25°C Power Rating	Max.* DC Voltage	Physical Dimensions† — In. and (mm)			
			L ±.062 (1.57)	H ±.062 (1.57)	LS ±.062 (1.57)	T Max.
RD-2	3 watts	10KV	1.03 (26.16)	1.03 (26.16)	0.90 (22.86)	.150 (3.81)
RD-3	4 watts	15KV	1.53 (38.86)	1.03 (26.16)	1.40 (35.56)	.150 (3.81)
RD-5	7 watts	20KV	2.03 (51.56)	1.03 (26.16)	1.80 (45.72)	.150 (3.81)
XRD-2	3 watts	10KV	1.00 (25.40)	1.00 (25.40)	0.90 (22.86)	.05 (1.27)
XRD-3	4 watts	15KV	1.50 (38.10)	1.00 (25.40)	1.40 (35.56)	.05 (1.27)
XRD-5	7 watts	20KV	2.00 (50.80)	1.00 (25.40)	1.80 (45.72)	.065 (1.65)

* Power and voltage rating can be higher for potted applications. Consult factory for overrating information
† Tolerance for XRD dimensions L, H, LS, and D is ±.01" (±.254mm)
NOTE: The XRD is an RD unit without leads. It is provided with screen printed epoxy overcoat and exposed soldered termination pads, and is designed for use in potted assembly applications.

D — TYPICAL NOMINAL DIMENSION

TRW Type	R1/R2 Ratio Range				
	Up to 1:1	2:1 to 5:1	6:1 to 25:1	25:1 to 99:1	100:1 & Up
RD-2 XRD-2	.40 (10.2)	.30 (7.6)	.30 (7.6)	.30 (7.6)	.20 (5.1)
RD-3 XRD-3	.70 (17.8)	.40 (10.2)	.30 (7.6)	.20 (5.1)	.20 (5.1)
RD-5 XRD-5	.70 (17.8)	.40 (10.2)	.40 (10.2)	.20 (5.1)	.20 (5.1)

HOW TO ORDER

Sample Part No.:

RD-3 - 10M ±10% - 25:1 - ±5%

TRW Type

Resistance Value (megohms) See specification table for values available

Resistance Tolerance (±10%, ±20%)

Divider Ratio (R1/R2)

Ratio Tolerance

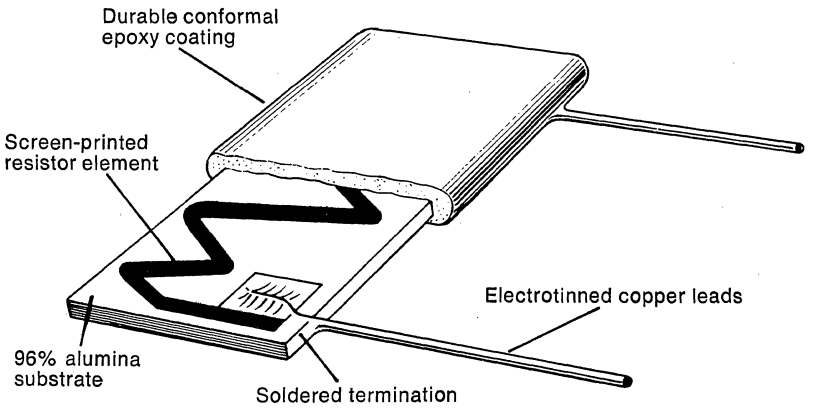
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

TRW

HIGH VOLTAGE THICK FILM RESISTORS

RB SERIES

- ☐ 1 watt to 5 watts
- ☐ 1 ohm to 500 megohms
- ☐ 10 KV to 25 KV
- ☐ 5% to 20% tolerance
- ☐ TCR of ±200 ppm/°C



FEATURES

- ☐ TRW proprietary non-noble thick film technology
- ☐ Space saving thin body design
- ☐ PC board compatible
- ☐ High voltage stability
- ☐ Low inductance design
- ☐ Backed by TRW high volume production capability

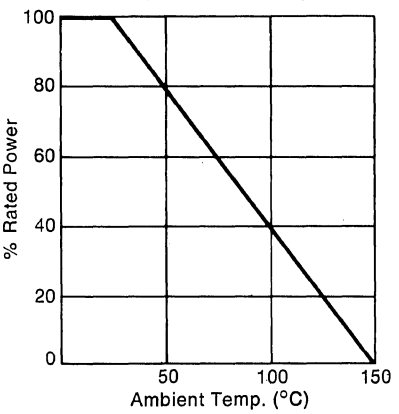
APPLICATIONS

- ☐ High voltage power resistors for use in:
  - Power supplies
  - Voltage multipliers
  - Electrostatic equipment
  - Copiers
- ☐ Low resistance - low inductance power resistors

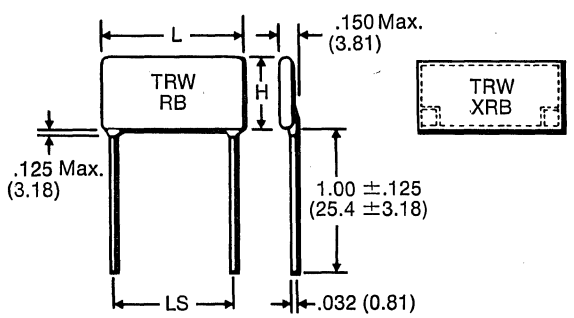
TYPICAL PERFORMANCE CHARACTERISTICS

Temperature Coefficient	±200 ppm/°C
Voltage Coefficient	±5 ppm/V
1000 hr 25°C Load Life	2%
Moisture Resistance	1%
Thermal Shock	0.5%
Operating Temperature	−55 to +150°C

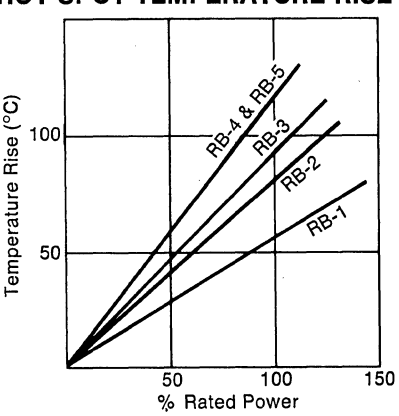
POWER DERATING



DIMENSIONS — IN. and (mm)



HOT SPOT TEMPERATURE RISE



TRW Type†	25°C Power Rating	Max. DC Voltage	Physical Dimensions L ±.062 (±1.57)	H ±.062 (±1.57)	LS ±.062 (±1.57)
RB-1	1 watt	10KV	1.03 (26.16)	.28 (7.11)	.90 (22.86)
RB-2	2 watts	10KV	1.03 (26.16)	.53 (13.46)	.90 (22.86)
RB-3	3 watts	15KV	1.53 (38.86)	.53 (13.46)	1.40 (35.56)
RB-4	4 watts	20KV	2.03 (51.56)	.53 (13.46)	1.90 (48.26)
RB-5	5 watts	25KV	2.53 (64.26)	.53 (13.46)	2.40 (60.96)

† All RB sizes are available in XRB style. The XRB is an RB unit without leads. It is provided with screen printed epoxy overcoat and exposed soldered termination pads. Designed for use in potted assembly applications.

HOW TO ORDER

Sample Part No.:

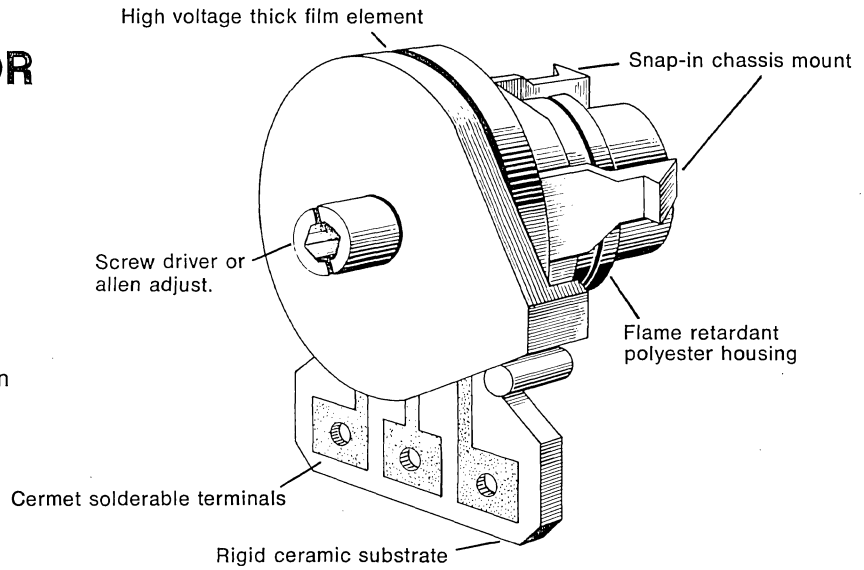
RB - 3 - 100 MegΩ - 5%

- **TRW Type**
- **Resistance Value**
- **Tolerance**

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

HIGH-VOLTAGE FOCUS RESISTOR

- ☐ 3 kV voltage rating
- ☐ Resistance ranges from 1 megohm to 100 megohms
- ☐ Rated 1 w at 65°C, derated to 0 at 105°C
- ☐ Potential applications include electrostatic copiers, CRT displays, computer terminals, video games and instrumentation
- ☐ Metal Glaze™ element



SPECIFICATIONS

Resistance Tolerance: Standard: ±20%; Special: ±10%

Voltage Rating: Across end terminals: 3000 VDC; Mounting plate to terminals: 7500 VDC

Tapers Available: Linear only ±20%

Terminal Minimum Resistance (Both Ends of Rotation): 10% of total resistance maximum

Temperature Coefficient (−55° to +105°C) ±400 ppm/°C

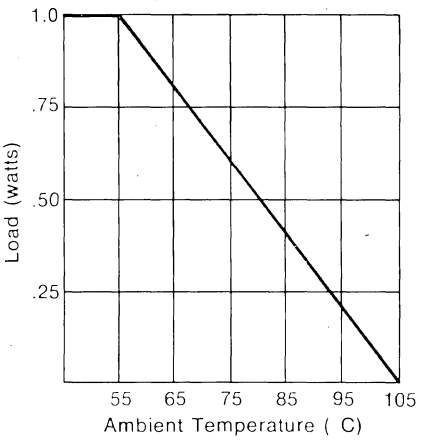
Voltage Coefficient: Less than 10 ppm/V

Rotational Torque: 1 - 8 in. oz.

Molded Materials: SE-O Rated

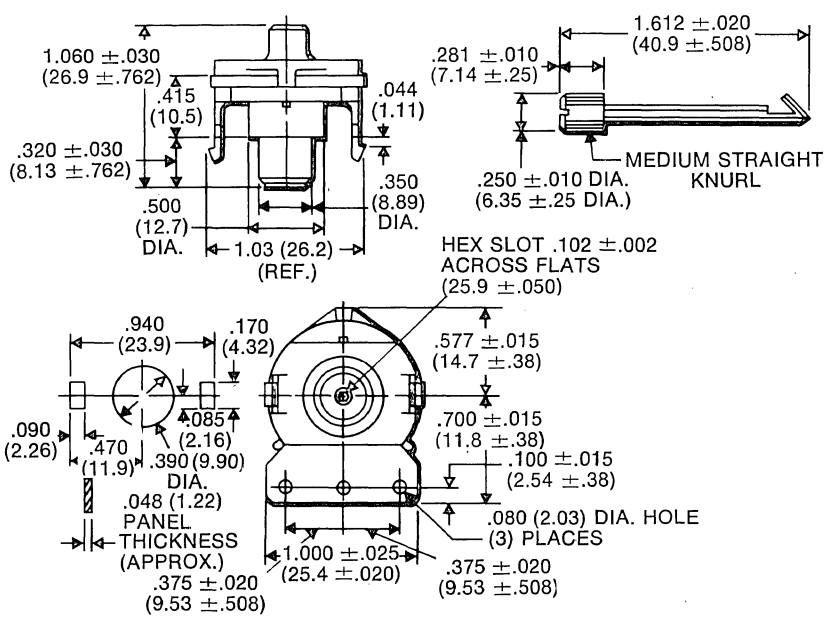
Environmental Performance:
- Load Life: Maximum △R after 1000 hours at 65°C ±5%
- Rotational Life (No Load): Maximum △R (after 500 cycles) ±10%
- Humidity (No Load): Maximum △R (after 240 hours at 40°C and 90 - 95% R.H.) ±5%

POWER DERATING



Note: Available with leads for PC board mounting.

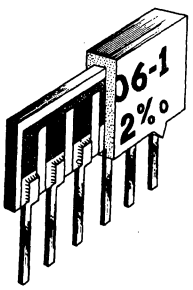
DIMENSIONS — IN. AND (mm)



RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

CUSTOM THICK FILM CIRCUITS

- ☐ High reliability
- ☐ Major size reduction compared to discrete components
- ☐ Cost effective in large quantities

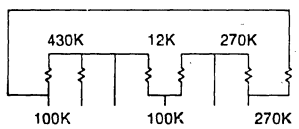


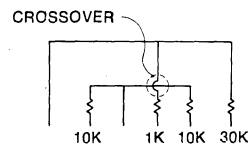
.350-in. SIP

RESISTOR-ONLY CIRCUITS

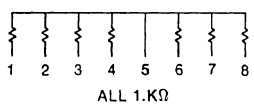
CIRCUIT VARIATIONS:

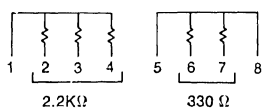
Overall the .350-in. SIP is the best choice for custom network requirements. A wide variety of circuits is possible with the extra "real estate" available on this size, including circuits requiring crossovers. Remember, however, that crossovers add significantly to the manufacturing cost of a network.

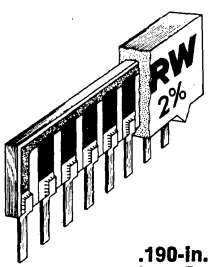




Straightforward variations to standard circuits of the .195-in. SIP are feasible, such as different common location(s), missing resistors, and multiple resistances.



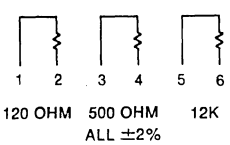


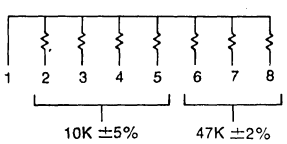


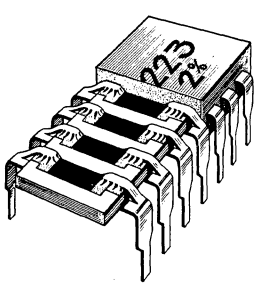
.190-in. Low-Profile SIP

MULTIPLE RESISTANCES:

Multi-value networks are available for both types. Values from 22 ohm to 1 Megohm, and multiple tolerances of ±2% and ±5% are also possible.



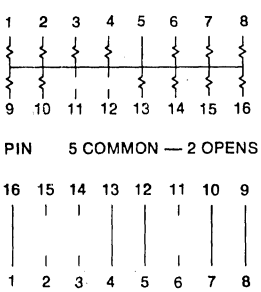




14- and 16-pin DIP

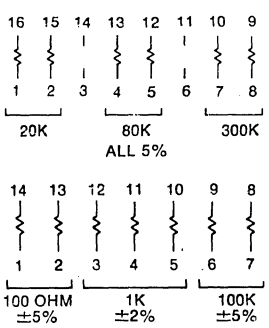
CIRCUIT VARIATIONS:

The position of the common pin can be varied, and open or shorted pins incorporated.



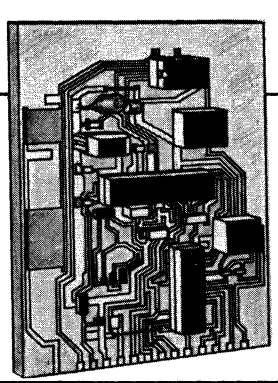
MULTIPLE RESISTANCES:

Values from 22 ohm to 1 Megohm are available, as are multiple tolerances of ±2% and ±5%.



ADDITIONAL FEATURES:

- Top Stamping — to customer specification; one 8-character line
- Missing Pins—removed external to SIP molded package, but within standoff profile
- TCR — ±150PPM
- Ratio Matching — ±2% between specified resistor pairs — ratios not to exceed 20:1



COMPLEX CUSTOM FUNCTIONAL CIRCUITS

Custom functional circuits are most applicable where size reduction and reliability are prime factors. Generally, outboard components (diodes, transistors, ICs and capacitors) are surface mounted. Resistors and conductors are screen printed and fired at 900 to 1000°C directly to the ceramic substrate.

TRW circuit features include:

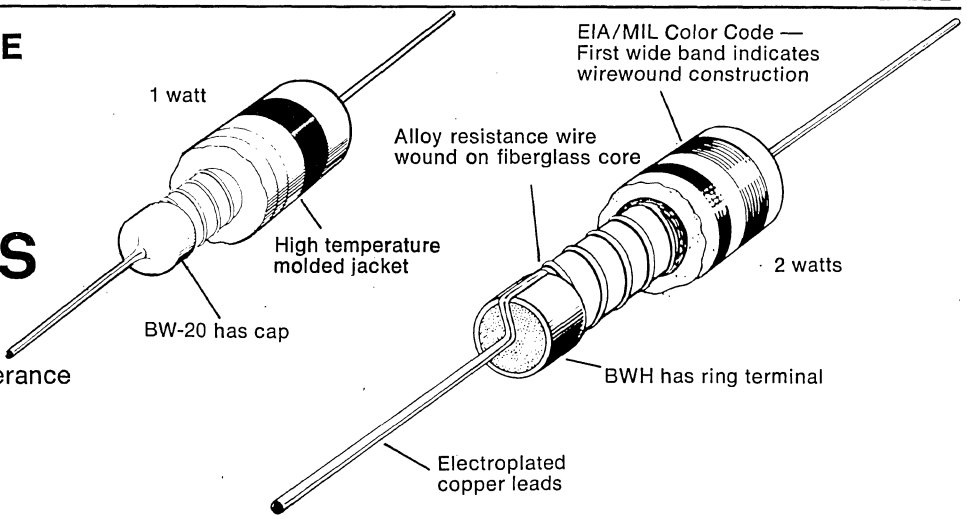
- High-conductivity, leach-resistant copper conductors
- 10-ohm to 10-megohm/square resistors
- Stability characteristics as in R-only circuits above
- Cost effectivity of non-noble Metal Glaze™ thick film

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

GENERAL-PURPOSE LOW-POWER MOLDED WIREWOUNDS

BW SERIES

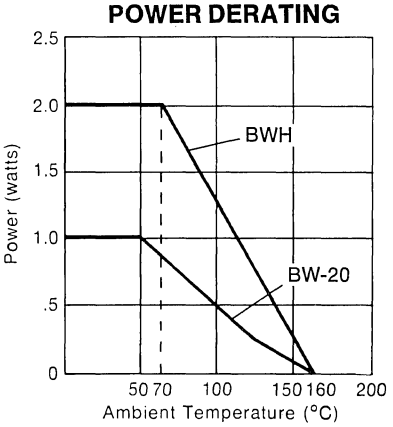
- ☐ 1 watt, 2 watts
- ☐ ±2%, ±5%, ±10% tolerance
- ☐ 0.05 ohm to 2400 ohms
- ☐ TCs as low as ±150 ppm/°C



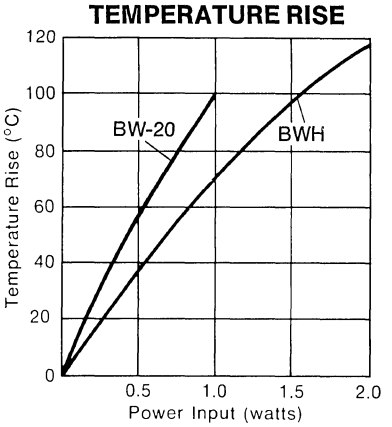
SPECIFICATIONS

TRW Type	BW-20	BWH
EIA RS-344 Style	CRU1	CRU2
MIL-R-11 Style Equivalent	RC20/RC32	RC32/RC42
Resistance - Standard	0.10 Ohms thru 1200 Ohms	0.05 Ohms thru 2400 Ohms
Tolerance - Standard	±2%, ±5%, ±10%	±5%, ±10%
Power Rating	1-watt @ 50°C ¾-watt @ 70°C ½-watt @ 100°C, derating to 0 @ 160°C	2-watts @ 70°C 1-watt @ 115°C ½-watt @ 137°C, derating to 0 @ 160°C
Load Life Stability, Max △R	1 watt @ 50°C: ±5%	2-watts @ 70°C: ±10%
Max. Continuous Working Voltage	$\sqrt{PR}$	$\sqrt{PR}$
Min. Insulation Resistance — Dry	10,000 Megohms	10,000 Megohms
Min. Insulation Resistance — Wet	100 Megohms	100 Megohms
Min. Dielectric Withstanding Voltage Atmospheric Pressure Reduced Pressure	 700 Volts, RMS 450 Volts, RMS	 1000 Volts, RMS 625 Volts, RMS
Hot Spot Temperature Rise	100°C @ 1 watt	115°C @ 2 watts
Current Noise	Negligible	Negligible
Marking	Standard EIA/MIL Color Code (double width first band)	Standard EIA/MIL Color Code (double width first band)

POWER DERATING



TEMPERATURE RISE

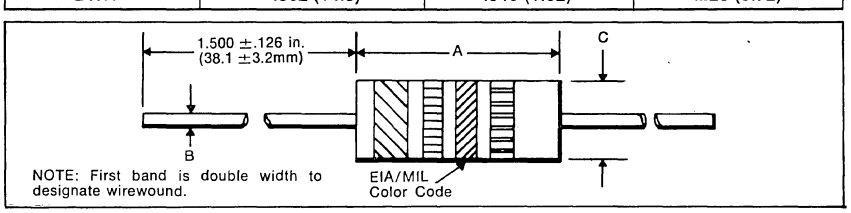


TEMPERATURE COEFFICIENT

TRW Type	Power Rating	Resistance Range	Temperature Coefficient Maximum △R
BW-20	1-watt	0.10Ω-0.15Ω 0.16Ω-0.62Ω 0.68Ω-1200Ω	+600 ppm or +0.06%/°C +300 ppm or +0.03%/°C ±150 ppm or ±0.015%/°C
BWH	2-watts	0.05Ω-0.16Ω 0.18Ω-0.68Ω 0.75Ω-2400Ω	+1000 ppm or +0.10%/°C +800 ppm or +0.08%/°C ±400 ppm or ±0.04%/°C

DIMENSIONS — IN. AND (mm)

TRW Type	A ±.010 (.25)	B ±.001 (.03)	C ±.008 (.20)
BW-20	.390 (9.91)	.032 (.813)	.140 (3.56)
BWH	.562 (14.3)	.040 (1.02)	.225 (5.72)



HOW TO ORDER

Sample Part No.:

BWH — 1k — 5%

TRW Type
BW-20 = 1-watt
BWH = 2-watts

Resistance Range
Expressed in ohms.
(Standard EIA/MIL Values)

Tolerance
±2%, ±5%, ±10%

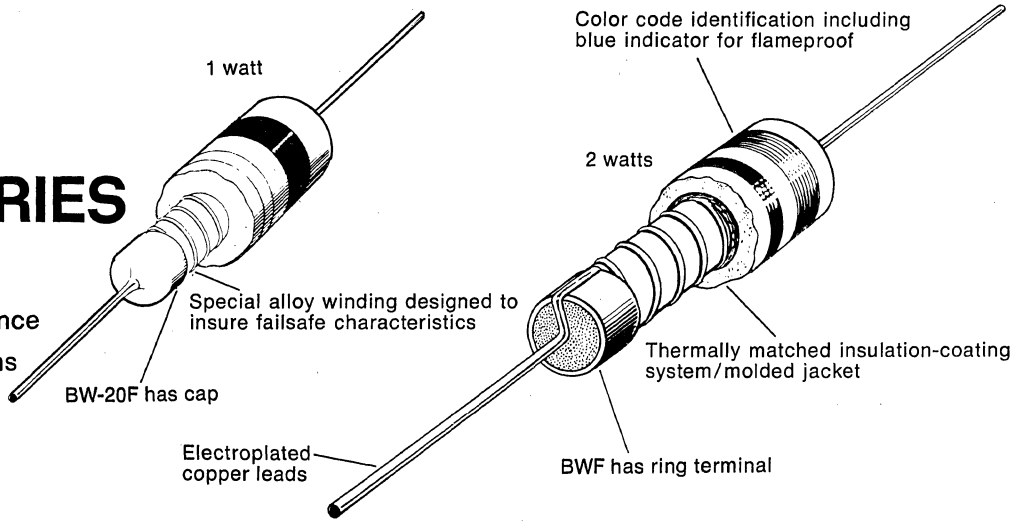
AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

FAILSAFE MOLDED WIREWOUNDS

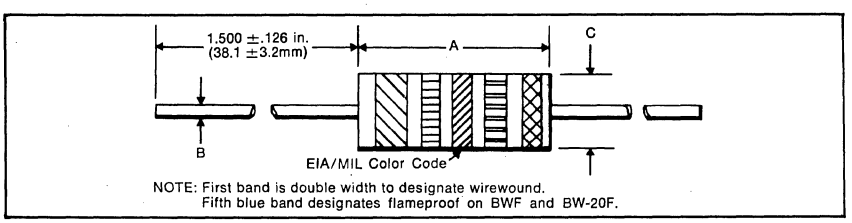
BWF SERIES

- ☐ 1 watt, 2 watts
- ☐ ±5%, ±10% tolerance
- ☐ 0.1 ohm to 1000 ohms
- ☐ TCs as low as ±150 ppm/°C



SPECIFICATIONS

TRW Type	BW-20F	BWF
EIA RS-334 Style	CRU-1	CRU2
MIL-R-11 Style Equiv.	RC20/RC32	RC32/RC42
Resistance Standard	0.10Ω thru 1000Ω	0.10Ω thru 1000Ω
Tolerance Standard	±5%, ±10%	±5%, ±10%
Power Rating	**1-watt @ 50°C ¾-watt @ 70°C, derating to 0 @ 160°C**	2-watt @ 70°C ½-watt @ 137°C, derating to 0 @ 150°C
Max. Continuous Working Voltage	$\sqrt{PR}$	$\sqrt{PR}$
Min. Insulation Resistance — Dry Wet	10,000 Megohms 100 Megohms	10,000 Megohms 100 Megohms
Min. Dielectric Withstanding Voltage Atmospheric Pressure Reduced Pressure	 700 Volts R.M.S. 450 Volts R.M.S.	 1000 Volts R.M.S. 625 Volts R.M.S.
Current Noise	Negligible	Negligible
Load Life Stability — Max. ΔR	1-watt @ 50°C — ±5%	2-watt @ 70°C — ±10%
Temperature Coefficient — Max. ΔR	For 0.1Ω, +1000 ppm or +0.10%/°C For 0.11Ω to 0.18Ω, +600 ppm or +0.06%/°C For 0.20Ω to 0.68Ω, +300 ppm or +0.03%/°C For 0.75Ω to 1000Ω, ±150 ppm or ±0.015%/°C	**For 0.10Ω, +1500 ppm or +0.15%/°C** For 0.11Ω to 0.16Ω, +1000 ppm or +0.10%/°C For 0.18Ω to 0.68Ω, +800 ppm or +0.08%/°C For 0.75Ω to 1000Ω, ±400 ppm or ±0.04%/°C

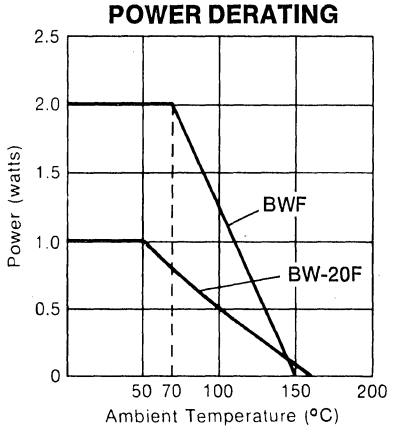


NOTE: First band is double width to designate wirewound.
Fifth blue band designates flameproof on BWF and BW-20F.

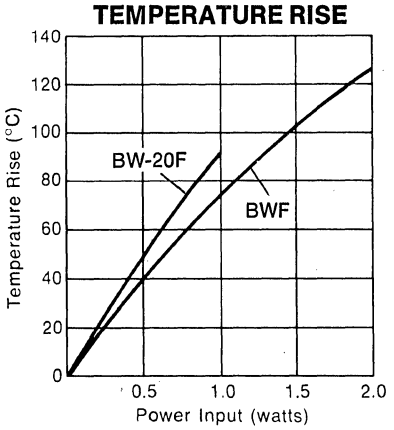
DIMENSIONS — IN. AND (mm)

TRW Type	A ±.010 (.25)	B ±.001 (.03)	C ±.008 (.20)
BW-20F	.390 (9.91)	.032 (.813)	.140 (3.56)
BWF	.562 (14.3)	.040 (1.02)	.225 (5.72)

POWER DERATING

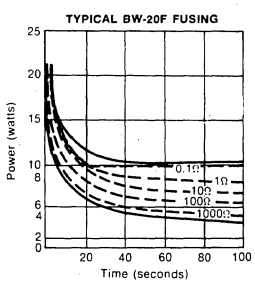


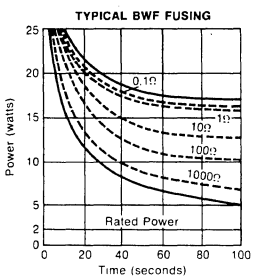
TEMPERATURE RISE



SPECIAL APPLICATIONS

A wide selection of special fusing times, temperature coefficients and very low resistances can be custom designed to your specific applications. Contact the factory for information.





HOW TO ORDER

Sample Part No.:

BW-20F - 1k - 5%

TRW Type
BW-20F = 1W
BWF = 2W

Resistance Value
Expressed in ohms

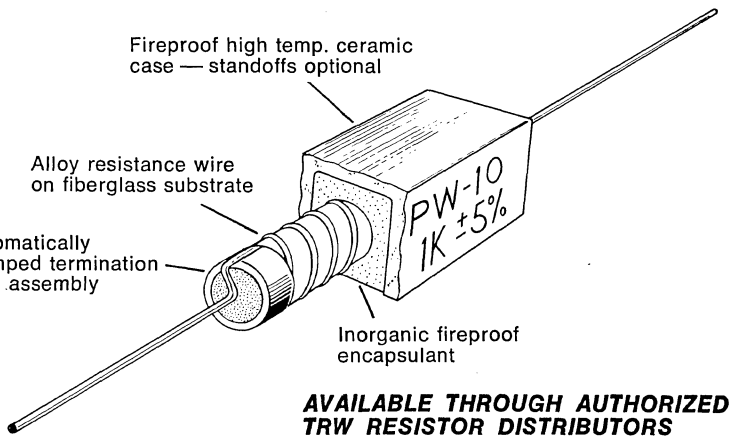
Tolerance
±5%, 10%

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

GENERAL-PURPOSE POWER WIREWOUNDS

PW SERIES

- ☐ 3 watts to 50 watts
- ☐ ±10%, ±5% tolerance
- ☐ 0.18 ohms to 30k ohms
- ☐ TCs from 300 ppm/°C to +5500 ppm/°C



AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

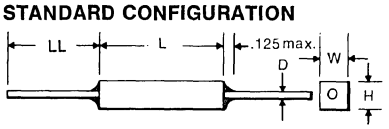
SPECIFICATIONS

TRW Type	Power Rating at 25°C (watts)	Standard Resistance Range (ohms)	Standard Temperature Coefficients		Special Temperature Coefficients		
			0.06%/°C over R range of	0.03%/°C over R range of	+0.55%/°C over R range of	+0.45%/°C over R range of	+0.26%/°C over R range of
PW-1	1	0.18 to 2.0K	0.18 to 0.62	0.68 to 2K	0.1 to 27	0.24 to 100	1.0 to 10
PW-2	2	0.18 to 2.4K	0.18 to 0.62	0.68 to 2.4K	0.1 to 30	0.24 to 130	1.0 to 10
PW-3	3	0.1 to 7.5K	0.1 to 0.27	0.30 to 7.5K	0.1 to 86	0.1 to 270	0.24 to 20
PW-5	5	0.1 to 8.5K	0.1 to 0.36	0.39 to 8.5K	0.1 to 68	0.1 to 300	0.27 to 22
PW-7	7	0.1 to 18K	0.1 to 0.56	0.62 to 18K	0.1 to 150	0.15 to 680	0.62 to 51
PW-10	10	0.18 to 30K	0.18 to 0.91	1.0 to 30K	0.1 to 240	0.24 to 1100	1.0 to 82
PW-15	15	0.18 to 30K	0.18 to 0.91	1.0 to 30K	0.1 to 240	0.24 to 1100	1.0 to 82
PW-18	18	0.18 to 22K	0.18 to 0.91	1.0 to 22K	0.1 to 200	0.24 to 1000	1.0 to 70
PW-22	22	0.27 to 12K	0.27 to 1.3	1.5 to 12K	0.15 to 360	0.36 to 1800	1.5 to 120
PW-25	25	0.27 to 10K	0.27 to 1.3	1.5 to 10K	0.15 to 300	0.36 to 1200	1.5 to 100
PW-30	30	0.5 to 1.2K	*	*	*	*	*
PW-40	40	0.65 to 1.5K	*	*	*	*	*
PW-50E	50	0.8 to 1.8K	*	*	*	*	*

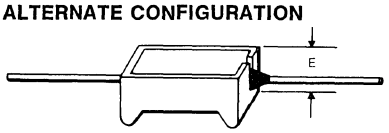
* Consult Factory

PW-1 TO PW-25

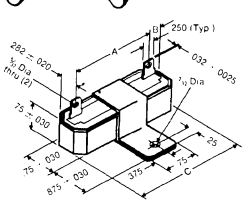
STANDARD CONFIGURATION



ALTERNATE CONFIGURATION



PW-30 TO PW-50E



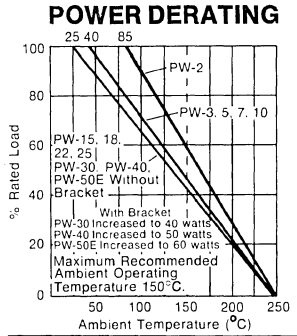
DIMENSIONS — IN. AND (mm)

TRW Type	L ±.03 (.8)	W ±.03 (.8)	H ±.03 (.8)	D-Dia. ±.002	E ±.03 (.8)	LL min.
PW-1	.58 (14.7)	.25 (6.35)	.25 (6.35)	.032 (.8)	—	1.44 (36.6)
PW-2	.69 (17.5)	.25 (6.35)	.25 (6.35)	.032 (.8)	.31 (7.87)	1.44 (36.6)
PW-3	.88 (22.4)	.31 (7.87)	.31 (7.87)	.036 (.9)	.38 (9.65)	1.44 (36.6)
PW-5	.88 (22.4)	.38 (9.65)	.34 (8.89)	.036 (.9)	.41 (10.4)	1.50 (38.1)
PW-7	1.39 (35.3)	.38 (9.65)	.34 (8.89)	.036 (.9)	.47 (11.9)	1.50 (38.1)
PW-10	1.88 (47.8)	.38 (9.65)	.34 (8.89)	.036 (.9)	.47 (11.9)	1.50 (38.1)
PW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036 (.9)	.63 (16.0)	1.50 (38.1)
PW-18	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036 (.9)	.63 (16.0)	1.50 (38.1)
PW-22	2.50 (63.5)	.50 (12.7)	.50 (12.7)	.040 (1.0)	.63 (16.0)	1.50 (38.1)
PW-25	2.50 (63.5)	.50 (12.7)	.50 (12.7)	.040 (1.0)	.63 (16.0)	1.50 (38.1)

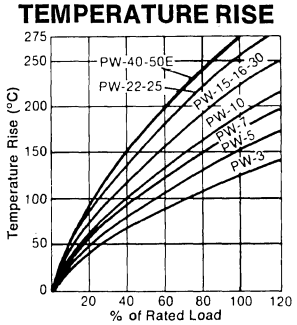
DIMENSIONS — IN. AND (mm)

TRW Type	A ±.02 (.5)	B ±.04 (1.0)	C ±.06 (1.5)
PW-30	2.00 (50.8)	.275 (7.0)	2.55 (64.8)
PW-40	2.45 (62.2)	.275 (7.0)	3.00 (76.2)
PW-50E	3.075 (78.1)	.275 (7.0)	3.625 (92.1)

POWER DERATING



TEMPERATURE RISE



HOW TO ORDER

Sample Part No.:

PW - 18 - 12k - 10%

TRW Type
PW

Power
18 = 18 watts
(See specification chart for other power ratings)

Resistance Value
Expressed in ohms
(Standard EIA/MIL Values)

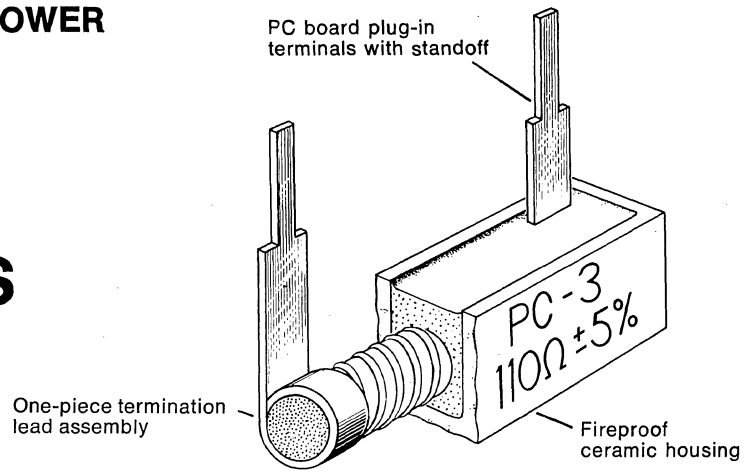
Tolerance
±10%, ±5% Standard

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

GENERAL-PURPOSE POWER WIREWOUNDS FOR PC BOARD APPLICATIONS

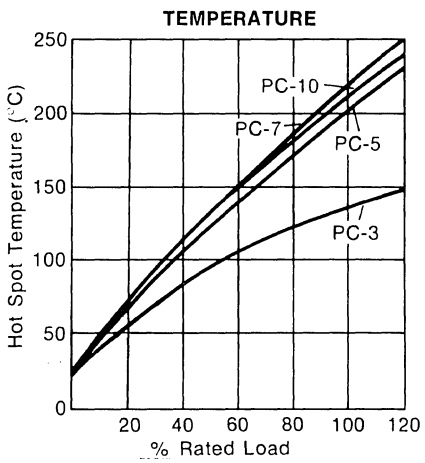
PC AND PCX SERIES

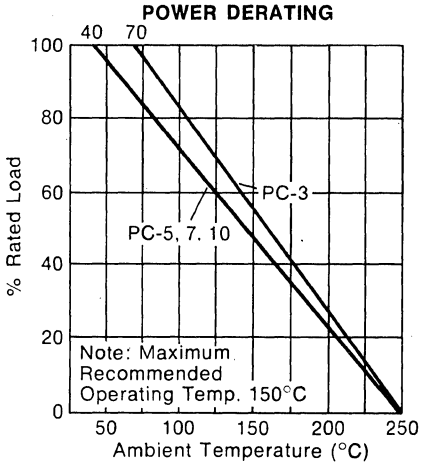
- ☐ 3 watts to 10 watts
- ☐ ±10%, ±5% tolerance
- ☐ 1 ohm to 1200 ohms
- ☐ ±400 ppm/°C TC



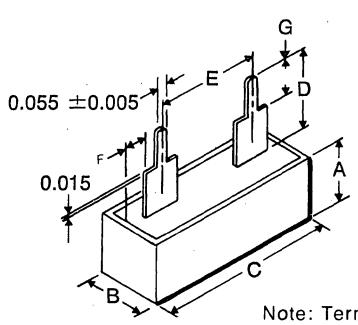
SPECIFICATIONS

TRW Type	Power at 25°C (watts)	Resistance Range (ohms)
PC-3	3	1 to 400
PC-5, PCX-5	5	1 to 400
PC-7, PCX-7	7	1 to 1000
PC-10, PCX-10	10	1 to 1200

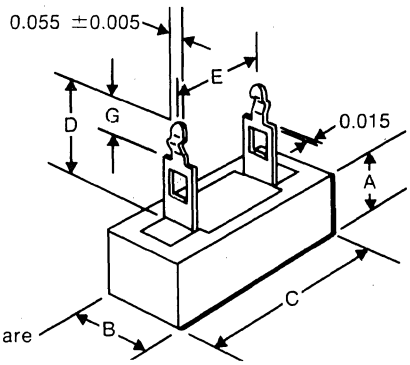




PC CONFIGURATION



PCX CONFIGURATION



Note: Terminals are tin coated steel

HOW TO ORDER

Sample Part No.:

PC - 7 - 560Ω - 5%

TRW Type

Power
7 = 7 watts (See specification chart for other power ratings

Resistance Value
Expressed in ohms
(Standard EIA/MIL Values)

Tolerance
±10%, ±5% standard

DIMENSIONS — IN. AND (mm)

TRW Type	A ±0.03 (0.8)	B ±0.03 (0.8)	C ±0.05 (1.2)	D ±0.03 (0.8)	E ±0.02 (0.51)	F	G ±0.01 (0.25)
PC-3	0.312 (7.92)	0.312 (7.92)	0.875 (22.2)	0.460 (11.7)	0.450 (11.4)	0.120 (3.05)	0.180 (4.57)
PC-5	0.343 (8.71)	0.375 (9.52)	0.875 (22.2)	0.445 (11.3)	0.450 (11.4)	0.120 (3.05)	0.180 (4.57)
PC-7	0.343 (8.71)	0.375 (9.52)	1.390 (35.3)	0.445 (11.3)	0.950 (24.1)	0.120 (3.05)	0.180 (4.57)
PC-10	0.343 (8.71)	0.375 (9.52)	1.875 (47.6)	0.445 (11.3)	1.450 (36.8)	0.120 (3.05)	0.180 (4.57)
PCX-5	0.343 (8.71)	0.375 (9.52)	0.875 (22.2)	0.445 (11.3)	0.450 (11.4)	—	0.180 (4.57)
PCX-7	0.343 (8.71)	0.375 (9.52)	1.390 (35.3)	0.445 (11.3)	0.950 (24.1)	—	0.180 (4.57)
PCX-10	0.343 (8.71)	0.375 (9.52)	1.875 (47.6)	0.445 (11.3)	1.450 (36.8)	—	0.180 (4.57)

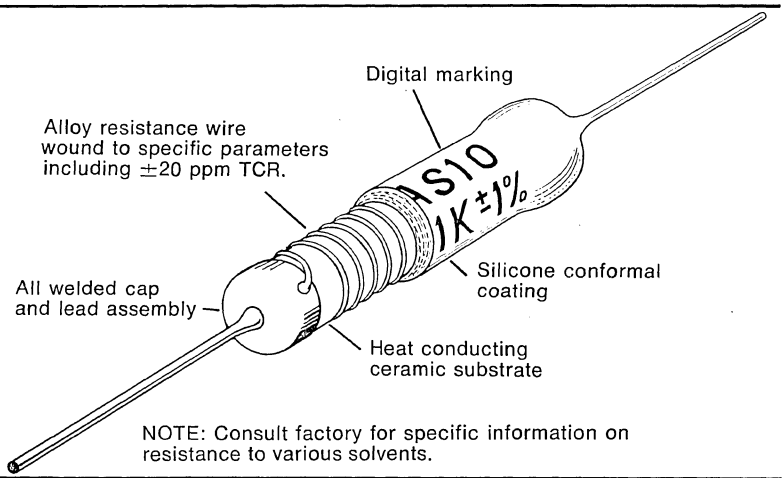
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

TRW

SEMI-PRECISION POWER WIREWOUNDS

AS SERIES

- ☐ ½ watt to 10 watts
- ☐ ±5%, ±3%, ±1%, ±.5%, ±.25%, ±.1% tolerance
- ☐ 0.1 ohm to 175k ohms
- ☐ ±20 ppm/°C

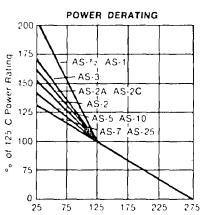


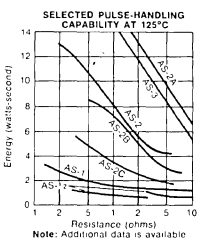
NOTE: Consult factory for specific information on resistance to various solvents.

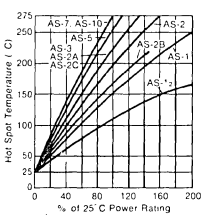
SPECIFICATIONS

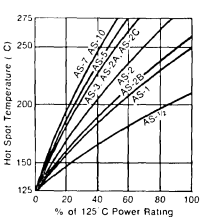
TRW Type	Equivalent MIL-R-26 Style	TRW Power Rating 275°C Max. Hot Spot (watts) 125°C	25°C	Commercial Range (ohms) Min.	Max.	Voltage Rating (volts)	Non-Inductive Range† (ohms) Min.	Max.	Available Resistance (ohms)‡ 0.1% Tol.	0.25% Tol.	0.5%, 1% Tol.	3%, 5% Tol.
AS-½		0.5	1	0.1	6K	100	*	*	5-2K	2.5-2K	1-6K	0.1-6K
AS-1	RW70U	1	2	0.1	7.5K	130	0.1	3.8K	5-3K	2.5-3K	1-7.5K	0.1-7.5K
AS-2	RW69V/ RW79U	2	3	0.1	20K	140	0.5	10K	5-4.2K	2.5-4.2K	1.20K	0.1-20K
AS-2B		3	4	0.1	24K	185	0.5	12K	5-4.5K	2.5-4.5K	1-24K	0.1-24K
AS-2C		2	3	0.1	18K	160	0.2	7.5K	5-4.2K	2.5-4.2K	1-18K	0.1-18K
AS-3		3	5	0.1	30K	200	0.5	15K	5-6.5K	2.5-6.5K	1-30K	0.1-30K
AS-5	RW74U/ RW67V	5	7	0.1	60K	400	0.8	30K	5-15.5K	2.5-15.5K	1-60K	0.1-60K
AS-7		7	9	0.1	90K	600	1.0	45K	5-22K	2.5-22K	1-90K	0.1-90K
AS-10	RW68V/ RW78U	10	14	0.1	175K	1000	3.0	50K	5-55K	2.5-55K	1-175K	0.1-175K

* Inductance on AS-½ is less than 1 μH at 1 MHz.
† To order non-inductive types, add the prefix "N". Example: NAS-1, NAS-2C, etc.
‡ Lower values available upon request.





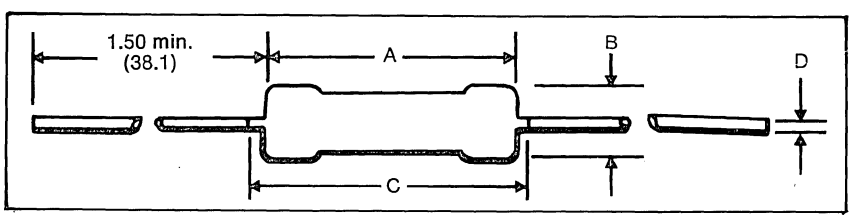




ENVIRONMENTAL TESTING

Test Condition	Max. ΔR
Load Life 1000 Hours	1.0%
Moisture Resistance	1.0%
Temperature Cycle	0.5%
Short Time Overload	0.5%

Test Condition	Max. ΔR
Low Temperature Operation	0.5%
Solder Heat	0.25%
Shock	0.5%
Vibration	0.5%



DIMENSIONS — IN. AND (mm)

TRW Type	Dim. A ±0.32	Dim. B (Max.)	Dim. C (Max.)	Dim. D (Lead Dia.)
AS-½	.312 (.79)	.094 (2.4)	.375 (9.6)	.020 (.5)
AS-1	.375 (9.6)	.125 (3.2)	.450 (11.4)	.020 (.5)
AS-2	.500 (12.7)	.250 (6.35)	.625 (15.9)	.032 (.8)
AS-2B	.562 (14.3)	.219 (5.6)	.687 (17.5)	.032 (.8)
AS-2C	.469 (11.9)	.157 (4.0)	.562 (14.3)	.032 (.8)
AS-3	.687 (17.5)	.282 (7.2)	.812 (20.6)	.040 (1.0)
AS-5	.875 (22.2)	.344 (8.8)	1.000 (25.4)	.040 (1.0)
AS-7	1.250 (31.8)	.344 (8.8)	1.375 (35.0)	.040 (1.0)
AS-10	1.812 (46.0)	.407 (10.4)	1.937 (49.2)	.040 (1.0)

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

HOW TO ORDER

Sample Part No.:

AS - 3 - 27Ω - .25%

TRW Type

Power
3=3 watts (See specification chart for other power ratings)

Resistance Value
Expressed in ohms
(Standard EIA/MIL Values)

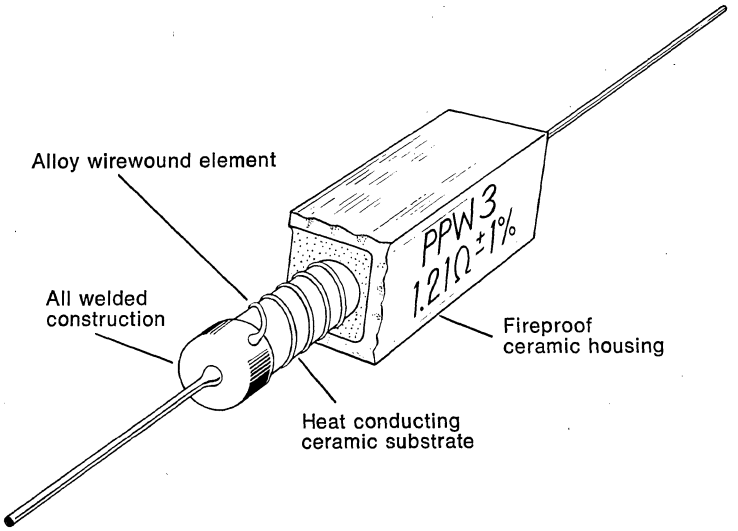
Tolerance
±5%, ±3%, ±1%,
±.5, ±.25, ±.1% standard

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

SEMI-PRECISION POWER WIREWOUNDS FOR PULSE AND SURGE APPLICATIONS

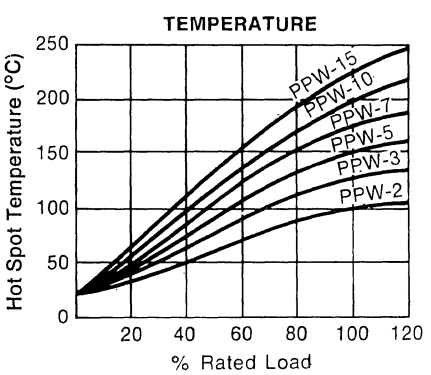
PPW SERIES

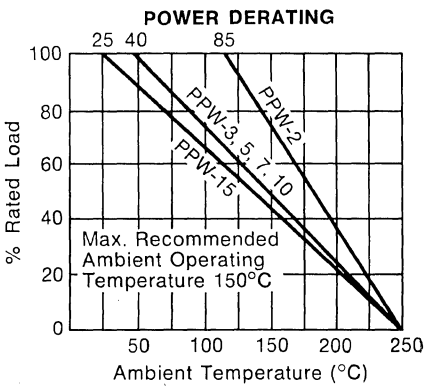
- ☐ 2 watts to 15 watts
- ☐ ±3%, ±2%, ±1% tolerance
- ☐ 1 ohm to 5000 ohms
- ☐ ±20 ppm/°C TC



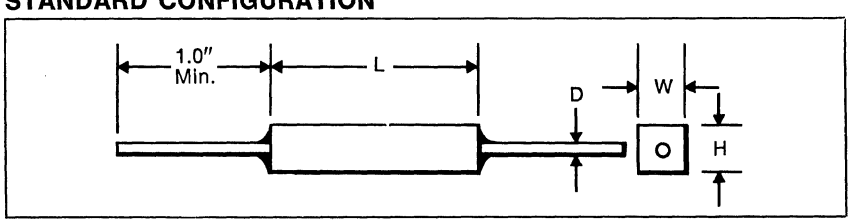
SPECIFICATIONS

TRW Type	Power at 25°C (watts)	Resistance Range (ohms)
PPW-2	2	1 to 1600
PPW-3	3	1 to 1600
PPW-5	5	1 to 1600
PPW-7	7	1 to 2500
PPW-10	10	1 to 5000
PPW-15	15	1 to 5000

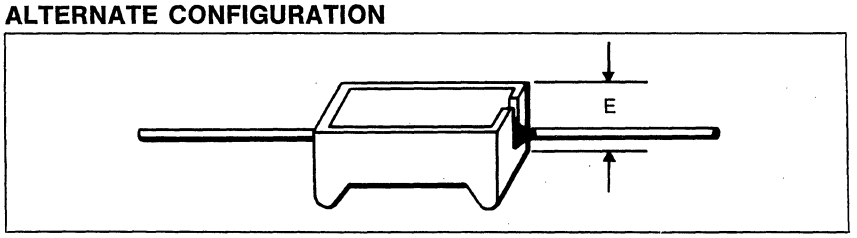




STANDARD CONFIGURATION



ALTERNATE CONFIGURATION



HOW TO ORDER

Sample Part No.:

PPW - 10 - 15Ω - 2%

TRW/IRC Type — PPW

Power
10 = 10 watts (See specification chart for other power ratings)

Resistance Value
Expressed In ohms
(Standard EIA/MIL Values)

Tolerance
±3%, ±2%, ±1% standard

DIMENSIONS — IN. AND (mm)

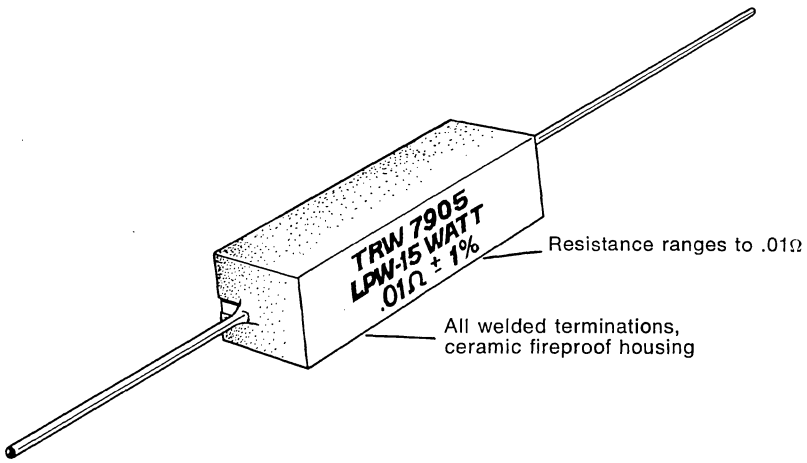
TRW Type	L ±.03 (.8)	W ±.03 (.8)	H ±.03 (.8)	D Diameter	E ±.03 (.8)
PPW-2	.69 (17.5)	.25 (6.35)	.25 (6.35)	.032 (.8)	.31 (7.87)
PPW-3	.88 (22.3)	.31 (7.87)	.31 (7.87)	.032 (.8)	.38 (9.65)
PPW-5	.88 (22.3)	.38 (9.65)	.35 (8.89)	.032 (.8)	.41 (10.4)
PPW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	.032 (.8)	.47 (11.9)
PPW-10	1.88 (47.7)	.38 (9.65)	.35 (8.89)	.032 (.8)	.47 (11.9)
PPW-15	1.88 (47.7)	.50 (12.7)	.50 (12.7)	.032 (.8)	.50 (12.7)

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

EXTREMELY-LOW-RESISTANCE POWER WIREWOUNDS

LPW SERIES

- ☐ 3 watts to 15 watts
- ☐ ±1%, ±2%, ±3%, ±5% tolerance
- ☐ .01 ohm to 1.0 ohm

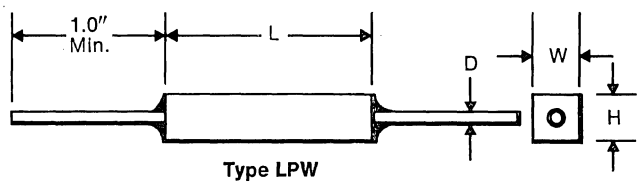


SPECIFICATIONS

TRW Type	Power at 25°C (watts)	Max. Current (amps)	Resistance Range (ohms)
LPW-3	3	10	.01 to 1.0
LPW-5	5	10	.01 to 1.0
LPW-7	7	20	.01 to 1.0
LPW-10	10	20	.01 to 1.0
LPW-15	15	20	.01 to 1.0

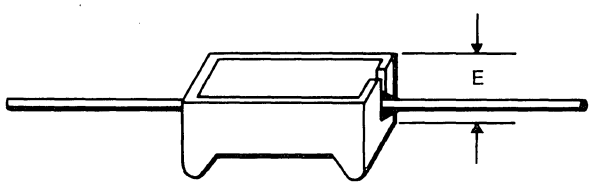
Note: Test points for LPW-3 and LPW-5 are 1.750 in. (44.45mm); test points for LPW-7, LPW-10 and LPW-15 are 2.500 in. (63.50mm).

STANDARD CONFIGURATION



Type LPW

ALTERNATE CONFIGURATION



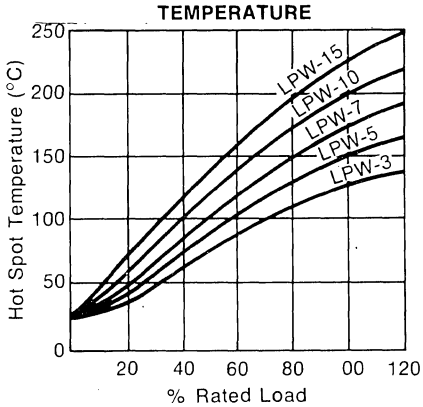
Type LPW-A

DIMENSIONS — IN. AND (mm)

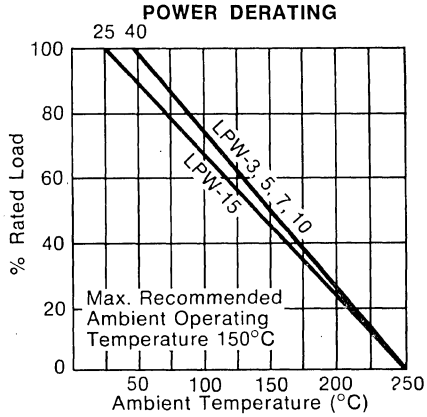
TRW Type	L +1/16, −1/32	W ±.03 (.8)	H ±.03 (.8)	D Diameter	E ±.03 (.8)
LPW-3	.88 (22.4)	.31 (7.87)	.31 (7.87)	.032*(.8)	.38 (9.65)
LPW-5	.88 (22.4)	.38 (9.65)	.35 (8.89)	.036*(.9)	.41 (10.4)
LPW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	.036*(.9)	.47 (11.9)
LPW-10	1.88 (47.8)	.38 (9.65)	.35 (8.89)	.036*(.9)	.47 (11.9)
LPW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	.036*(.9)	.50 (12.7)

* For resistances above .05 ohms, diameter D is .032 in. (.8mm)

TEMPERATURE



POWER DERATING



HOW TO ORDER

Sample Part No.:

LPW - 5 - .02Ω - 3%

TRW Type

Power
5 = 5 watts (See specification chart for other power ratings)

Resistance Value
Expressed in ohms
(Standard EIA/MIL Values)

Tolerance
±1%, ±2%, ±3%, ±5%, ±10% standard

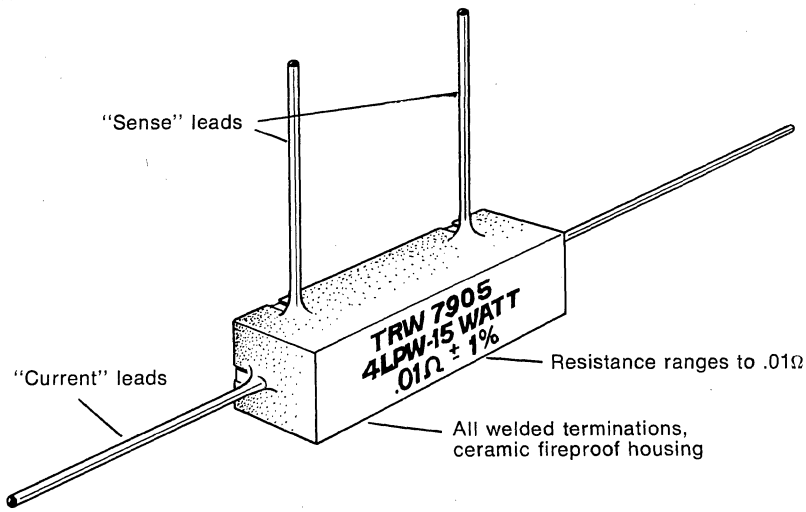
RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

TRW

FOUR-TERMINAL CURRENT-SENSING WIREWOUNDS

4LPW SERIES

- ☐ 3 watts to 15 watts
- ☐ ±1%, ±2% ±3%, ±5%, ±10% tolerance
- ☐ .01 ohm to 1.0 ohm

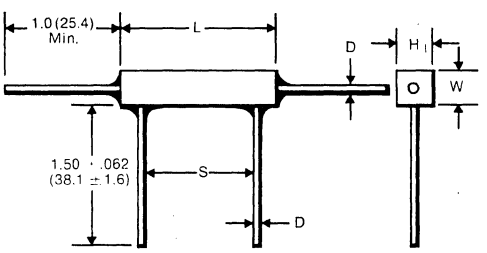


SPECIFICATIONS

TRW Type	Power at 25°C (watts)	Max. Current (amps)	Resistance Range (ohms)
4LPW-3	3	10	.01 to 1.0
4LPW-5	5	10	.01 to 1.0
4LPW-7	7	20	.01 to 1.0
4LPW-10	10	20	.01 to 1.0
4LPW-15	15	20	.01 to 1.0

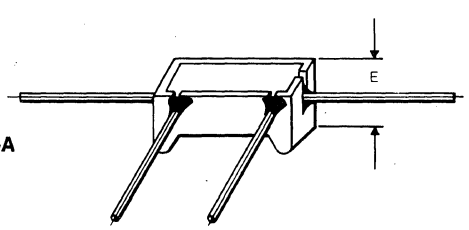
STANDARD CONFIGURATION

Type 4LPW



ALTERNATE CONFIGURATION

Type 4LPW-A

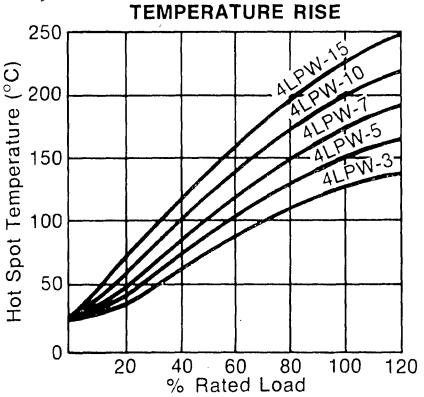


DIMENSIONS — IN. AND (mm)

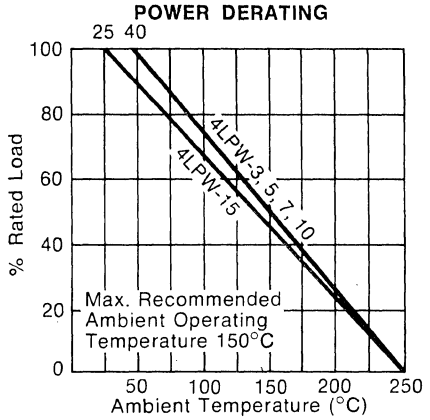
TRW Type	L +1/16, −1/32	W ±.03 (.8)	H ±.03 (.8)	S ±.062 (1.6)	D Diameter	E ±.03 (.8)
4LPW-3	.88 (22.4)	.31 (7.87)	.31 (7.87)	.563 (14.3)	.036* (.9)	.38 (9.65)
4LPW-5	.88 (22.4)	.38 (9.65)	.35 (8.89)	.563 (14.3)	.036* (.9)	.41 (10.4)
4LPW-7	1.39 (35.3)	.38 (9.65)	.35 (8.89)	1.013 (25.7)	.036* (.9)	.47 (11.9)
4LPW-10	1.88 (47.8)	.38 (9.65)	.35 (8.89)	1.388 (35.3)	.036* (.9)	.47 (11.9)
4LPW-15	1.88 (47.8)	.50 (12.7)	.50 (12.7)	1.388 (35.3)	.036* (.9)	.50 (12.7)

* For resistances above .05 ohms, diameter D is .032 in. (.8mm)

TEMPERATURE RISE



POWER DERATING



HOW TO ORDER

Sample Part No.:

4LPW - 15 - .01Ω - 1%

TRW

Power
15 = 15 watts (See specification chart for other power ratings)

Resistance Value
Expressed in ohms
(Standard EIA/MIL Values)

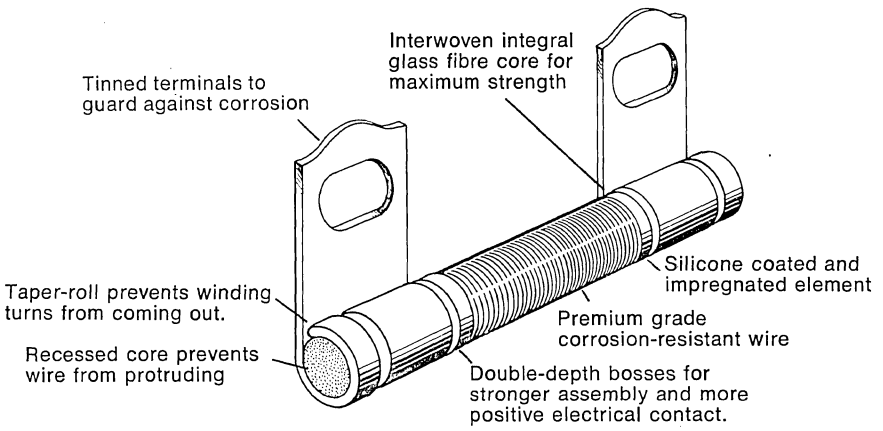
Tolerance
±1%, ±2%, ±3%, ±5%, ±10% standard

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241 / TELEX 572359

AUTOMOTIVE AND APPLIANCE POWER WIREWOUNDS

AW SERIES

- ☐ Appliance applications include food mixers, coffee makers, electric and electronic ranges, electric blankets, actuating heaters for bi-metal switches, toasters and deep fryers
- ☐ Automotive applications include horns, voltage regulators, ignition ballasts, instrument gauges, spark suppressors and windshield wipers



SPECIFICATIONS

RESISTANCE RANGE

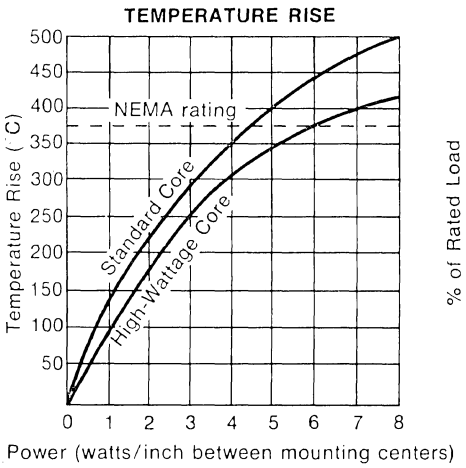
0.1 ohm minimum to 1000 ohms/in. of active length, or inside terminal dimension.

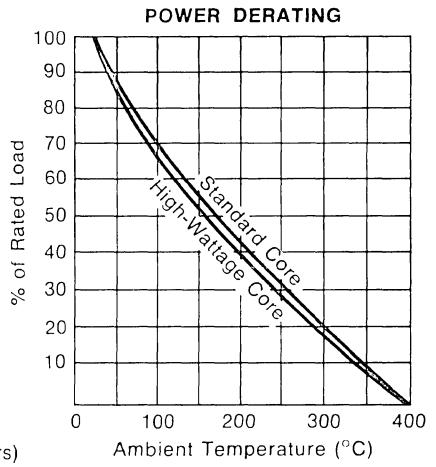
POWER RATINGS

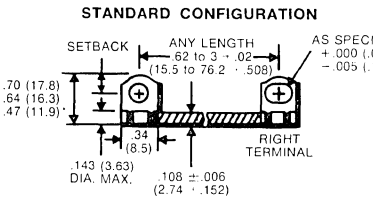
4.5 watts/in. between mounting centers on the standard AW, and 6 watts/in. between mounting centers on the high-wattage AW resistor. Higher wattages are available on low resistance values with special windings.

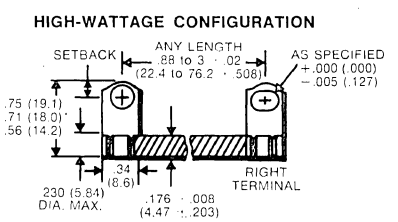
TOLERANCE

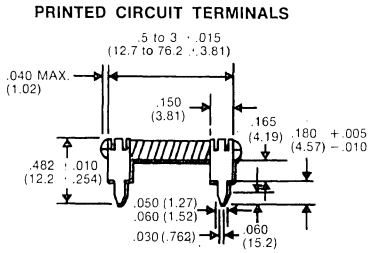
±10% tolerance is standard. Other tolerances are available on special orders.

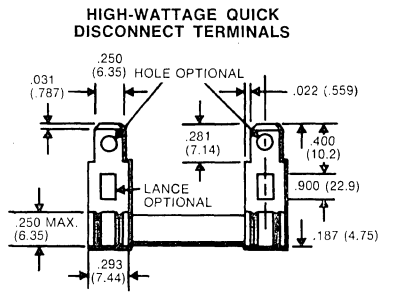












DESIGN AND CONSTRUCTION

The resistance elements of AW resistors are uniformly and tightly wound on glass fiber cores using premium quality wire. Tinned steel or tinned brass terminals are secured to the element by automatic assembly equipment. The high degree of automation used in manufacturing this resistor allows you to use a high-quality wirewound unit at low cost.

TERMINALS

Standard AW resistor terminals are 11/32 in. x .015 in. tinned steel or tinned brass. High-wattage AW resistor terminals are 11/32 in. x .020 in. tinned steel or tinned brass.

Over 50 styles of terminal mounting holes are tooled and immediately available. Any of these can be furnished with one or both mounting holes omitted and in any resistor length, within limits shown, from standard tooling. Other mounting hole sizes or terminal configurations can be made to your specification at a nominal cost.

STAMPING

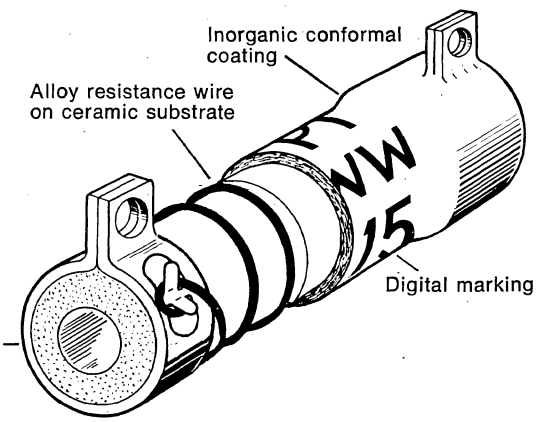
Resistance value is stamped on both sides of the left terminal in large numbers.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

FIXED, ADJUSTABLE AND TAPPED HIGH POWER WIREWOUNDS

PWW SERIES

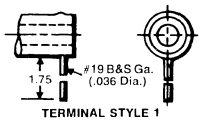
- ☐ 4 watts to 225 watts
- ☐ ±10%, ±5% tolerance
- ☐ 0.1 ohm to 175k ohms
- ☐ TCs from ±50 ppm/°C to ±400 ppm/°C



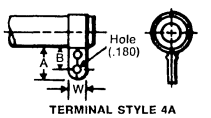
TUBULAR STYLE — FIXED

TRW Type	Power Rating at 25°C (Watts)	MIL Equivalent MIL Style	MIL Equivalent MIL Power Rating (Watts)	Core Dimension Length Inches (mm)	Core Dimension O.D. Inches (mm)	Core Dimension I.D. Inches (mm)	Terminals Standard	Terminals Special	Min. Resistance (ohms) **	Maximum Resistance (ohms) .0025 Wire	Maximum Resistance (ohms) .00175 Wire	Maximum Resistance (ohms) .0008 Wire
1A	5	—	—	1.00 (25.4)	.31 (7.9)	.19 (4.8)	13A	1†, 12A	0.10	530	1,550	15K
1¾A	12	RW29	11	1.75 (44.5)	.31 (7.9)	.19 (4.8)	13A‡	1, 12A	0.10	2,500	5,600	50K
1C	12	RW30	11	1.00 (25.4)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	900	2,500	20K
1½C	15	RW31	14	1.50 (38.1)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	2,000	6,300	50K
2C	20	RW32	17	2.00 (50.8)	.44 (11.2)	.27 (6.9)	13A‡	1, 12A	0.10	4,000	10K	80K
2D	25	—	—	2.00 (50.8)	.56 (14.2)	.38 (9.7)	12A	1, 4A, 13A	0.10	4,500	12K	100K
3C	26	RW33	26	3.00 (76.2)	.44 (11.2)	.27 (6.9)	12A	1, 13A	0.10	8,000	18K	150K
3D	35	—	—	3.00 (76.2)	.56 (14.2)	.38 (9.7)	12A	1, 4A, 13A	0.10	8,250	23.8K	200K
4D	50	—	—	4.00 (101.6)	.56 (14.2)	.38 (9.7)	12A	1, 4A, 13A	0.20	12K	35K	300K
4H	80	RW36	78	4.00 (101.6)	1.12 (28.4)	.75 (19.1)	4A	—	0.30	23K	68.5K	525K
6H	120	RW37	113	6.00 (152.4)	1.12 (28.4)	.75 (19.1)	4A	—	0.47	38K	112.5K	850K
6½H	130	—	—	6.50 (165.1)	1.12 (28.4)	.75 (19.1)	4A	—	0.56	41.5K	120K	900K
8H	160	RW38	159	8.00 (203.2)	1.12 (28.4)	.75 (19.1)	4A	—	0.68	54K	156K	1.15M
8½H	175	—	—	8.50 (215.9)	1.12 (28.4)	.75 (19.1)	4A	—	0.75	57K	167K	1.25M
10½H	225	RW47	210	10.50 (266.7)	1.12 (28.4)	.75 (19.1)	4A	—	0.91	72K	210K	1.5M

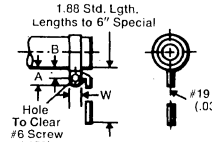
* 6 Watts † 8 watts ‡ 12A standard on adjustable type ** Except #1 terminal



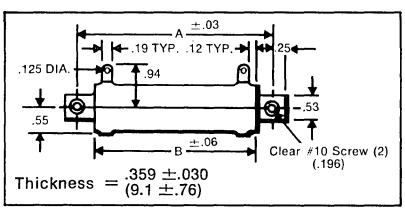
TERMINAL STYLE 1



TERMINAL STYLE 4A



TERMINAL STYLE 12A (NO LEAD) AND 13A (WITH LEAD)



Thickness = .359 ±.030 (9.1 ±.76)

FLAT STYLE — FIXED

TRW Type	Power Rating at 25°C (watts)	MIL Equivalent MIL Style	MIL Equivalent MIL Power Rating (watts)	Dimensions in Inches (mm) Mounting Center A	Dimensions in Inches (mm) Core Length B	Min. Resistance (ohms)	Maximum Resistance (ohms) .0025 Wire	Maximum Resistance (ohms) .00175 Wire	Maximum Resistance (ohms) .0014 Wire
FRW-20	30	RW20	21	2.00 (50.8)	1.25 (31.8)	0.10	2.75K	8K	15K
FRW-21	40	RW21	31	2.75 (69.9)	2.00 (50.8)	0.10	6K	18K	35K
FRW-22	55	RW22	53	4.25 (108)	3.50 (88.9)	0.20	13K	38K	75K
FRW-23	70	RW23	68	5.50 (140)	4.75 (121)	0.25	19K	56K	110K
FRW-24	95	RW24	91	6.75 (172)	6.00 (152)	0.35	25K	75K	140K

TUBULAR STYLE – ADJUSTABLE

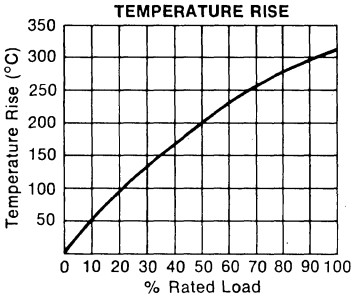
TRW Type	Power Rating at 25°C (watts)	Maximum Resistance (ohms) .0025 Wire	Maximum Resistance (ohms) .00175 Wire	Maximum Resistance (ohms) .0014 Wire
1¾AA	12	2.5K	5.6K	10K
2CA	20	3K	9.5K	10K
2DA	25	4.5K	12K	20K
3CA	26	6K	18K	31K
3DA	35	8.25K	23.8K	40K
4DA	50	12K	35K	60K
4EA	60	16K	45K	75K
4HA	80	23K	68.5K	110K
6HA	120	38K	112.5K	180K
6½HA	130	41.5K	120K	220K
8HA	160	54K	156K	280K
8½HA	175	57K	167K	300K
10½HA	225	72K	210K	350K

FLAT STYLE — ADJUSTABLE

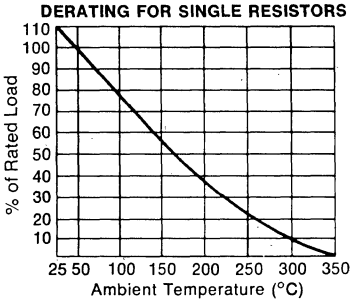
TRW Type	Power Rating at 25°C (watts)	Dimensions in Inches (mm) Mounting Center A	Dimensions in Inches (mm) Core Length B	Minimum Resistance (ohms)	Maximum Resistance (ohms) .0025 Wire	Maximum Resistance (ohms) .00175 Wire	Maximum Resistance (ohms) .0014 Wire
FRWA-21	40	2.75 (69.9)	2.00 (50.8)	0.1	6K	18K	35K
FRMA-22	55	4.25 (108)	3.50 (88.9)	0.2	13K	38K	75K
FRWA-23	70	5.50 (140)	4.75 (121)	0.25	19K	56K	110K
FRWA-24	95	6.75 (172)	6.00 (152)	0.35	25K	75K	140K

* Adjustable resistors are identified by adding the letter "A" to the designation of standard resistors.

TEMPERATURE RISE



DERATING FOR SINGLE RESISTORS



HOW TO ORDER

Sample Part No.:

FRWA - 23 - 470K - 10%

TRW Type
A = Adjustable

Power
23 = 70 watts (See specification chart for other power ratings)

Resistance Value
Expressed in ohms
(Standard EIA/MIL values)

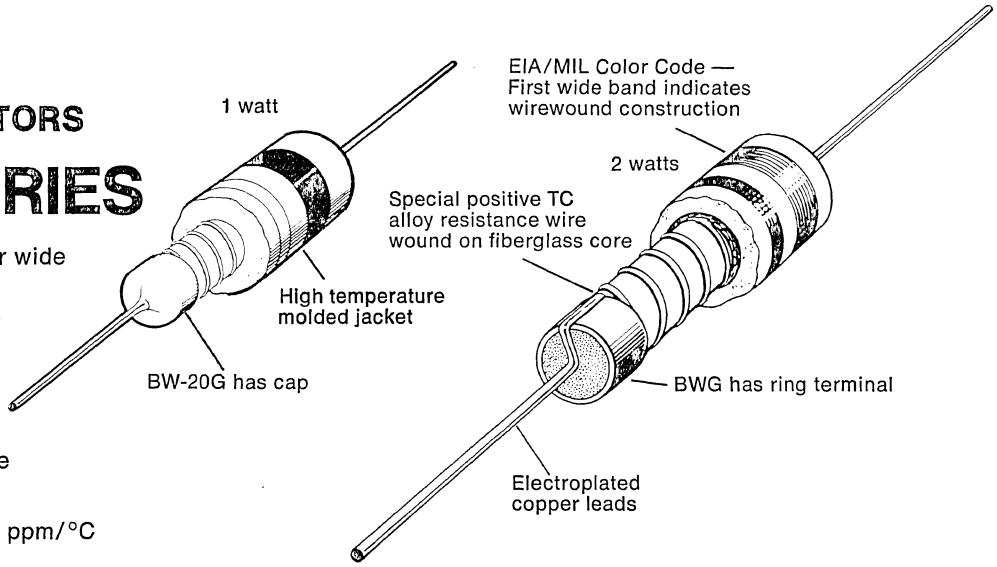
Tolerance
±5% standard for fixed resistors,
±10% standard for adjustable and tapped

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

WIREWOUND TEMPERATURE SENSING RESISTORS

BWG SERIES

- ☐ Excellent linearity over wide temperature span
- ☐ Fast response time
- ☐ Small size
- ☐ Economical cost
- ☐ 1 watt, 2 watts
- ☐ ±5%, ±10% tolerance
- ☐ 0.1 ohm to 300 ohms
- ☐ TCs as high as +5500 ppm/°C

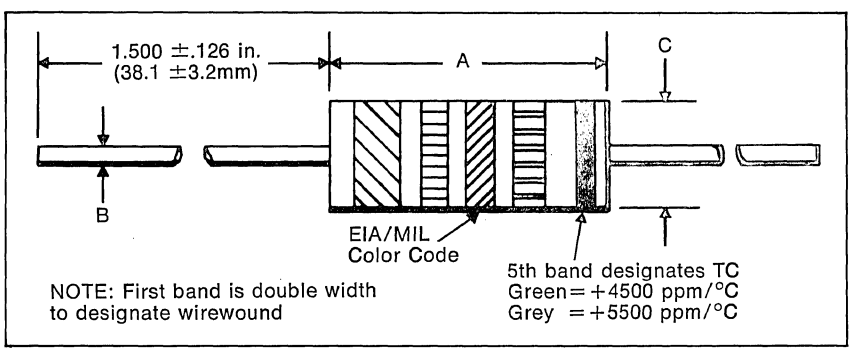


SPECIFICATIONS

Temperature Coefficient		Available Resistance in Ohms*	
PPM/°C	%/°C	BW-20G (1 watt)	BW (2 watts)
4500	0.45	0.10 to 100	0.20 to 300
5500	0.55	0.10 to 43	0.10 to 110

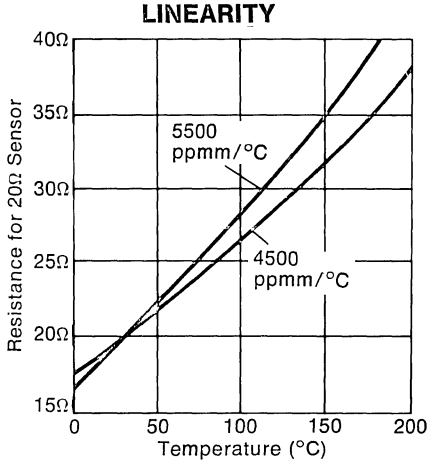
* As supplied "cold" resistance values — measured at room ambient temperature.

Temperature Range: −55°C to +150°
Power Rating: 1 watt @ 50°C for BW-20G, 2 watts @ 70°C for BWG
Standard Tolerance: ±5%, ±10%
Maximum Continuous Working Voltage: $E = \sqrt{PR}$
Minimum Dielectric Withstanding Voltage: 700V for BW-20G, 1000V for BWG
Minimum Insulation Resistance: 10,000 Meg Ω when dry, 100 Meg Ω when wet
Size Equivalent to RS344: CRU1 for BW-20G, CRU2 for BWG
Size Equivalent to MIL-R-11: RC-20 for BW-20G, RC-32 for BWG



NOTE: First band is double width to designate wirewound

LINEARITY



DIMENSIONS — IN. AND (mm)

TRW Type	A ±.010 (.25)	B ±.001 (.03)	C ±.008 (.20)
BW-20G	.390 (9.91)	.032 (.813)	.140 (3.56)
BWG	.562 (14.3)	.040 (1.02)	.225 (5.72)

HOW TO ORDER

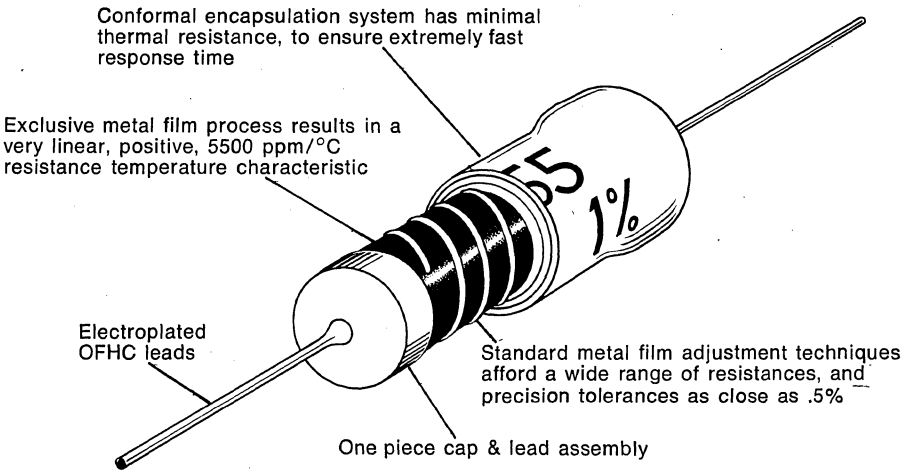
Consult factory.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241 / TELEX 572359

THIN FILM RESISTANCE TEMPERATURE SENSING ELEMENT

TD SERIES

- ☐ Proven metal film reliability
- ☐ Fast thermal response
- ☐ Positive temperature coefficient
- ☐ Close tolerance
- ☐ Superior linearity
- ☐ Ultra miniature



SPECIFICATIONS

Resistance Range at 25°C: TD50 - 100Ω to 2KΩ, TD55 - 100Ω to 3KΩ

Temperature Coefficient: +5000 ±100 ppm/°C at 25°C; +6000 ±120 ppm/°C at 100°C

Tolerance at 25°C: ±.5%, ±1% or ±2%

Oper. Temp. Range: −55°C to +175°C

Interchangeability Accuracy: ±.9°C @ 25°C for .5% tolerance — ±1.8°C @ 25°C for 1% tolerance — ±3.6°C @ 25°C for 2% tolerance

Accuracy Limits: ±1.5°C for .5% tolerance (−50°C to +100°C) — ±3°C for 1% tolerance (−50°C to +100°C) ±6°C for 2% tolerance (−50°C to +100°C)

Retracking Error: <.05% of nominal (−55°C to +175°C)

Resistance Ratio: R @ 125°C/R @ 25°C =1.57

Linearity: <1.2% maximum deviation from best straight line fit over any 100°C interval between −55°C and +175°C

Thermal Time Constant: TD50 - 3.7 sec. maximum, TD55 - 5.5 sec maximum. (Time to achieve 63.2% of an applied step change in still air)

Dissipation Constants: TD50 - 4.1 mW/°C, TD55 - 6.2 mW/°C (Power required to raise sensor temperature 1°C in still air at 25°C)

ENVIRONMENTAL PERFORMANCE

Type of Test	Maximum ΔR	Typical ΔR
Thermal Shock (5 Cycles, −55°C to +175°C)	.068%	.040%
Effect of Solder	.15%	.02%
Moisture Resistance	.50%	.15%
Load Life (2,000 hours @ +125°C)	.25%	.15%
High Temperature Exposure (2,000 hours @ +175°C)	.50%	.25%
Low Temperature Exposure (−65°C)	—	.05%
Dielectric Strength	.30%	.20%
Insulation Resistance	>100MΩ	—
Terminal Strength	.07%	.03%
Shock	.058%	.020%
High Frequency Vibration	.066%	.035%
Short Time Overload (1 watt, 1 minute)	.062%	.031%
Noise	—	−35 dB

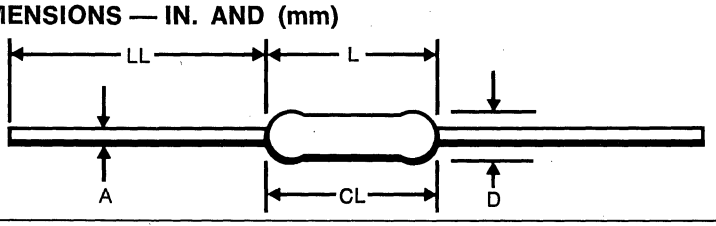
Note: Testing per MIL-R-55182, except noise.

TEMPERATURE VS. RESISTANCE

Degrees C	R in Ohms*	Degrees C	R in Ohms*	Degrees C	R in Ohms*
−55	633	+25	1000	+105	1442
−50	661	+30	1021	+110	1471
−45	682	+35	1044	+115	1504
−40	704	+40	1071	+120	1533
−35	726	+45	1099	+125	1568
−30	747	+50	1124	+130	1600
−25	769	+55	1150	+135	1634
−20	789	+60	1178	+140	1667
−15	811	+65	1206	+145	1701
−10	833	+70	1234	+150	1729
−5	857	+75	1264	+155	1769
0	882	+80	1292	+160	1803
+5	907	+85	1321	+165	1839
+10	924	+90	1350	+170	1873
+15	941	+95	1381	+175	1910
+20	968	+100	1411		

* Based on actual measurements of 1% tolerance TD Sensors that were 1000 ohms at 25°C

DIMENSIONS — IN. AND (mm)



TRW Type	Body Length L	Body Diameter D	Max. Clean Lead Length CL	Lead Length LL	Lead Gauge A
TD50	.152 ±.020 (3.86 ±0.51)	.065 ±.015 (1.65 ±0.38)	.200 (5.08)	1.00 (25.4)	#26 .016 (0.41)
TD55	.250 ±.031 (6.35 ±0.79)	.088 ±.010 (2.24 ±0.25)	.325 (8.26)	1.50 (38.1)	#22 .0253 (0.64)

HOW TO ORDER

Sample Part No.:

TD50 - 1% - 100 ppm/°C - 2KΩ

TRW Type
TD50 = ⅛ watt @ 70°C, 1/20 watt @ 125°C
TD55 = ⅛ watt @ 70°C, 1/10 watt @ 125°C

Tolerance*
±.5%, ±1% or ±2%

Temperature Coefficient*
+5000 ±100 ppm/°C @ 25°C
+6000 ±120 ppm/°C @ 100°C

Resistance*
Standard Resistances at 25°C
100Ω, 200Ω, 500Ω
1KΩ, 2KΩ, 3KΩ

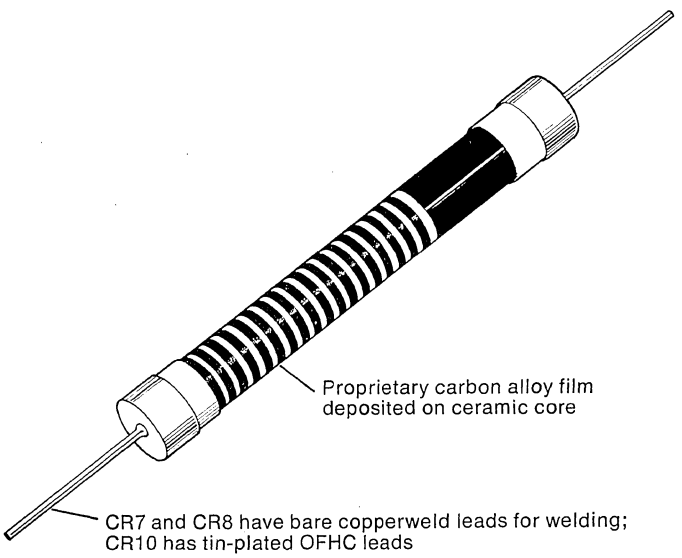
* Contact factory for non-standard T.C., tolerance and resistance requirements.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

SEMI-PRECISION HIGH VOLTAGE, HIGH TEMPERATURE CARBON ALLOY RESISTORS

CR SERIES

- ☐ Power ratings specified at 200°C
- ☐ Voltage ratings as high as 15,000 volts
- ☐ Completely inorganic construction with no outgassing
- ☐ Withstand an open flame of up to 1600°F

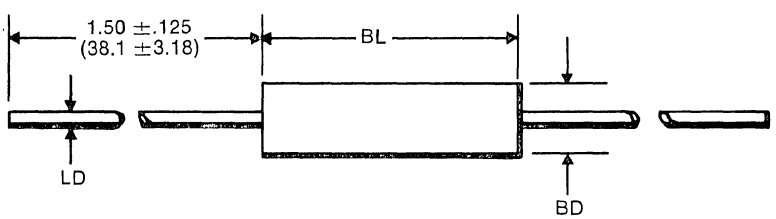


SPECIFICATIONS

TRW Type	Resistance Range (ohms)	Tolerance	Operating Temperature (°C)	Power Rating at 200°C* (watts)	Voltage Rating* (volts)
CR7	500 to 30 Meg	±5%	−65 to +350	1	8,000
CR8	1K to 50 Meg	±5%	−65 to +350	1.5	12,500
CR10	2K to 100 Meg	±5%	−65 to +350	3	15,000

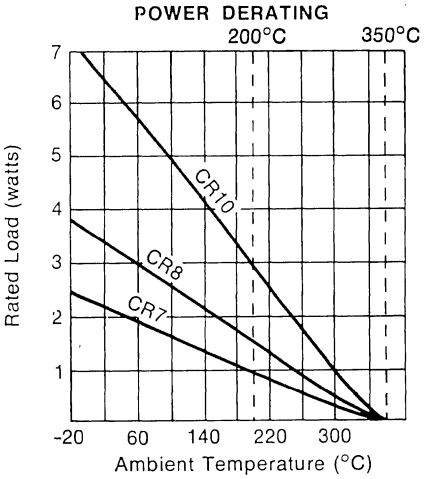
* Voltage and wattage dependent on resistance, operating temperature and environment (i.e. Oil, Air, Vacuum, Inert, etc.)

DIMENSIONS — IN. AND (mm)



TRW Type	Body Length (L Max.)	Body Diameter (D Max.)	Lead Gage (A)
CR7	.580 (14.7)	.157 (3.99)	#20 .032 (.813)
CR8	.938 (23.8)	.157 (3.99)	#20 .032 (.813)
CR10	2.125 (54.0)	.328 (8.33)	#20 .032 (.813)

POWER DERATING



HOW TO ORDER

Sample Part No.:

CR8 - 2M - 5%

Type
CR7 = 1w at 200°C
CR8 = 1.5w at 200°C
CR10 = 3w at 200°C

Resistance value (ohms)
See specification table for resistances available.

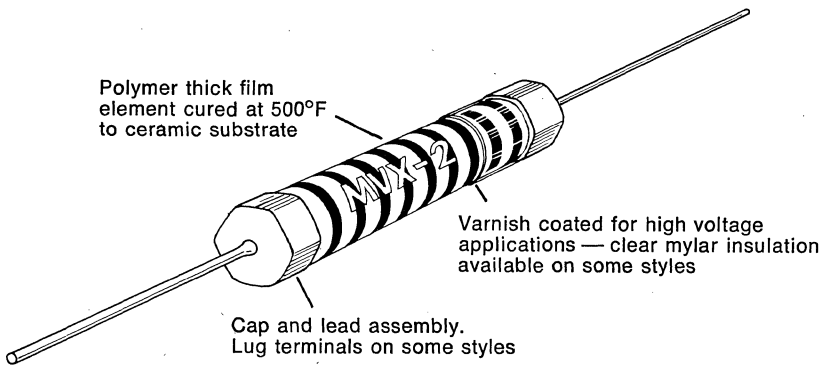
Tolerance
±5%

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
4222 S. STAPLES STREET, CORPUS CHRISTI, TX 78411 / PHONE (512) 992-7900 / TWX 910-876-1400

GENERAL-PURPOSE HIGH-VOLTAGE FILM RESISTORS

MV SERIES

- ☐ ½ watt to 90 watts
- ☐ 10k to 1000 megohm range
- ☐ ±5%, ±10%, or ±20% tolerance



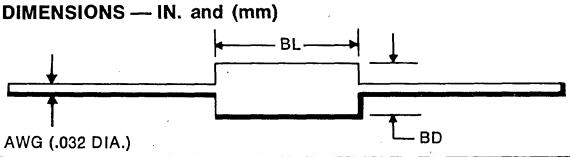
SPECIFICATIONS — LUG TERMINALS OR COLLODIAL SILVER TERMINALS

TRW Type	Standard Terminal Type	Special Terminals Available	Power Rating (Watts)	Peak Voltage Rating (KV)*	Minimum Available Resistance ±10% or ±20% Tolerance	Minimum Available Resistance ±5% Tolerance	Maximum Available Resistance (Megs)	Dimensions in Inches: Resistor Body Length BL	Resistor Body Diameter BD	Ceramic Inside Diameter	Width of Silver Bands #15 Term.
MVC-1	‡	Axial Leads	1	3.5	10K	100K	1,000	1.00 ±.03	.31 ±.03	THD #6-32	—
MVC-2	‡	Axial Leads	2	7.5	25K	100K	1,000	1.75 ±.03	.31 ±.03	THD #6-32	—
MVC-3	‡	Axial Leads	3	15.0	100K	100K	1,000	3.00 ±.03	.31 ±.03	THD #6-32	—
MVC-5	‡	Axial Leads	5	30.0	100K	200K	1,000	5.50 ±.06	.31 ±.03	THD #6-32	—
MVX-1	Axial Leads	—	1	3.5	100K	100K	1,000	1.00 ±.03	.25 ±.03	—	—
MVX-2	Axial Leads	—	2	10.0	100K	100K	1,000	2.00 ±.03	.25 ±.03	—	—
MVX-3	Axial Leads	—	3	15.0	100K	100K	1,000	3.00 ±.06	.25 ±.03	—	—
MVH-2	‡	—	4	15.0	100K	150K	1,000	2.50 ±.05	.56 ±.03	THD #6-32	—
MVH-4	‡	—	6	25.0	100K	400K	1,000	4.00 ±.06	.56 ±.03	THD #6-32	—
MVL	‡	—	5	30.0	100K	100K	1,000	4.50 ±.06	.50 ±.03	THD #10-32	—
MVF	#15	#12	2	5.0	100K	25K	1,000	1.75 ±.03	.31 ±.03	.19 ±.03	.38 ±.03
MVG	#15	#12, 16, 17	4	7.5	100K	100K	1,000	2.00 ±.03	.56 ±.03	.38 ±.03	.56 ±.06
MVK	#15	#12, 16, 17	10	20.0	100K	200K	1,000	5.00 ±.06	.56 ±.03	.38 ±.03	.56 ±.06
MVJ	#15	#12, 16, 17	5	10.0	100K	200K	1,000	3.00 ±.03	.56 ±.03	.38 ±.03	.56 ±.06
MVP	#15	#12, 16, 17	10	15.0	100K	400K	1,000	4.50 ±.06	.75 ±.03	.50 ±.03	.56 ±.06
MVA	#15	#16, 17	20	25.0	200K	1.0 Meg	1,000	6.50 ±.06	1.12 ±.03	.75 ±.03	.56 ±.06
MVO	#15	#16, 17	30	50.0	400K	2.0 Meg	1,000	10.50 ±.06	1.12 ±.03	.75 ±.03	.56 ±.06
MVQ	#15	#17	50	50.0	500K	3.5 Meg	1,000	10.50 ±.12	2.00 ±.05	1.56 ±.05	.88 ±.06
MVR	#15	#17	90	100.0	1 Meg	7.0 Meg	1,000	18.5 ±.12	2.00 ±.05	1.56 ±.05	.88 ±.06

‡ Solder lug or screw mounted

* Rated continuous working voltage determined by $E = \sqrt{PR}$ E should not exceed value listed in column above

DIMENSIONS — IN. and (mm)

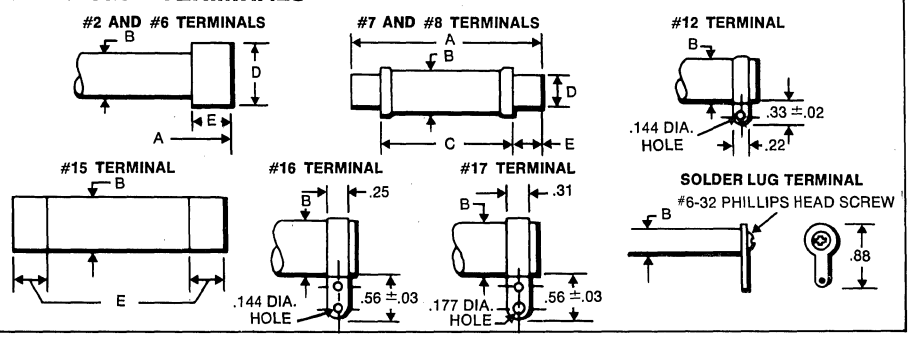


FERRULE TERMINALS

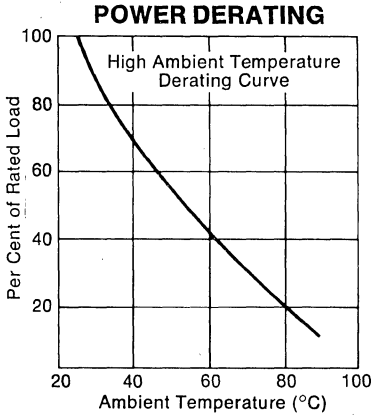
TRW Type	Power Rating at 25°C Ambient (watts)	(KV) Rating* Voltage Peak	Type Terminal	"A" (Max.) Length Overall	Dimensions in Inches: Nominal Diameter "B"	Ferrule Spacing "C"	Ferrule Diameter "D"	Ferrule Length "E"
MVP-2	10	15.0	#2	4.56	.75 ±.03	—	.91 ±.03	.50 ±.06
MVO-7	30	50.0	#7	12.00	1.12 ±.03	10.81 ±.06	.81 ±.03	.50 ±.06
MVO-8	30	50.0	#8	12.00	1.12 ±.03	10.81 ±.06	1.12 ±.03	.50 ±.06
MVQ-8	50	50.0	#8	11.72	2.00 ±.05	10.56 ±.16	1.12 ±.03	.56 ±.03
MVR-8	90	100.0	#8	19.94	2.00 ±.05	18.56 ±.16	1.12 ±.03	.56 ±.03

* Rated continuous working voltage determined by $E = \sqrt{PR}$ E should not exceed value listed in column above

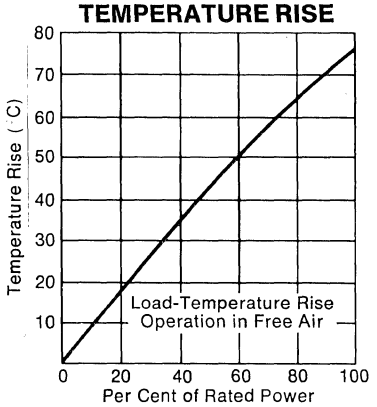
STANDARD TERMINALS



POWER DERATING



TEMPERATURE RISE



HOW TO ORDER

Sample Part No.:

MVX1 - 510M - 10%

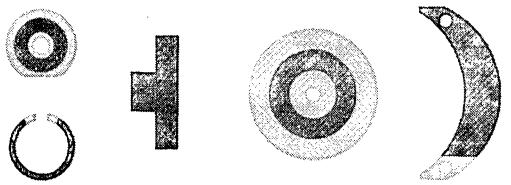
TRW Type
See specification table for types and power ratings available.

Resistance
10K ohms to 1000M ohms in standard EIA/MIL values. See specification table for exact range.

Tolerance
±20%, ±10% or ±5%. See specification table for availability.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

RESISTANCE STRIPS & DISCS



SPECIFICATIONS

ELEMENTS

TRW resistance strips consist of a high grade paper-base phenolic laminate with the resistance material permanently bonded to the surface. Disc resistors are simply die stamped from a resistance strip.

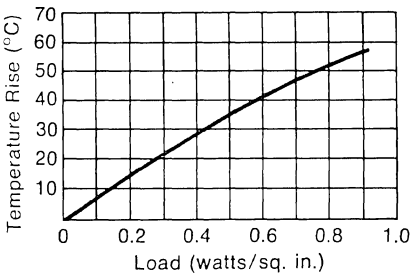
Strips can be supplied with a low-resistance colloidal silver contact coating over any portion of the surface where a low-resistance positive contact is desired. On discs, inner and outer rings of colloidal silver are applied to provide contact with coaxial line fixtures.

For both strips and discs, mechanical pressure type contacts must be used rather than soldered connections.

RESISTANCE VALUES

Strips are available with resistances from 19 ohms/square to 1.0 megohm/square. Standard disc values range from 5 ohms to 100,000 ohms.

TEMPERATURE RISE



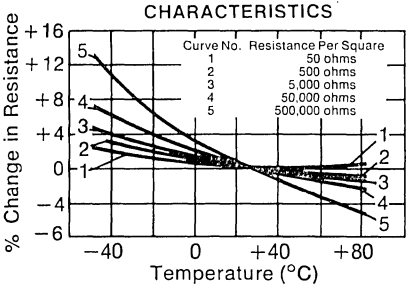
TOLERANCE

Standard tolerance is ±20%. Special tolerances of ±15% and ±10% are available on special order.

VOLTAGE RATING

Maximum rated voltage is 500 volts per inch of current path.

TEMPERATURE-RESISTANCE CHARACTERISTICS



VOLTAGE COEFFICIENT

The voltage coefficient of resistance is negative and varies from approximately −0.001%/volt/inch of active strip length (for coatings of 19 ohms/square) to −0.03%/volt/inch of active strip length (for coatings of 1.0 megohm/square).

TEMPERATURE COEFFICIENT

The temperature coefficient of resistance between 25° and 80°C varies from +0.05%/°C (for coatings of 19 ohms/square) to −0.12%/°C (for coatings of 1.0 megohm/square). Approximate temperature resistance characteristics for temperatures ranging from −55° to +80°C may be determined from the curve above.

AGING

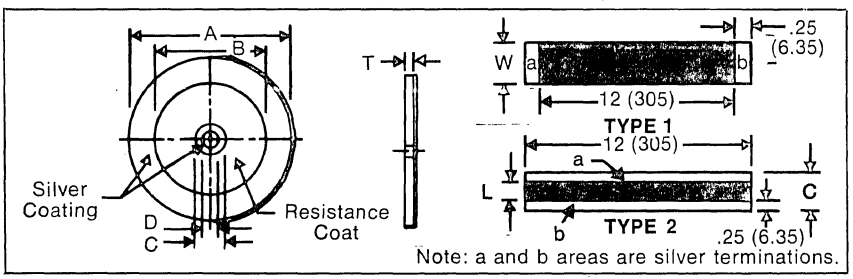
At room temperature, the resistance will remain within ±5% of the original value over extended periods of time.

HUMIDITY

Change of resistance during exposure to 90% relative humidity for 100 hours at 40°C is approximately +5% for low-resistance coatings. This increases somewhat with resistance value. At completion of the humidity test, the resistance returns very closely to its original values within a few days.

POWER RATINGS

Maximum power load should be such that the maximum surface operating temperature does not exceed 80°C. The allowable load per square inch for an ambient temperature of 25°C on a resistance strip suspended in free air is 0.95 watts.



Note: a and b areas are silver terminations.

DISC DIMENSIONS* — IN. AND (mm)

TRW Style	A	B	C	D	T† ±.005 (.127)
DRT	.25 (6.35)	.22 (5.59)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRU	.28 (7.11)	.22 (5.59)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRX	.38 (9.65)	.28 (7.11)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRB	.50 (12.7)	.38 (9.65)	.12 (3.04)	.076 (1.93)	.027 (.686)
DRD	.63 (16.0)	.44 (11.2)	.19 (4.83)	.076 (1.93)	.027 (.686)
DRF	.75 (19.1)	.50 (12.7)	.25 (6.35)	.076 (1.93)	.027 (.686)
DRJ	1.00 (25.4)	.75 (19.1)	.25 (6.35)	.076 (1.93)	.027 (.686)
DRN	1.50 (38.1)	1.25 (31.8)	.25 (6.35)	.076 (1.93)	.027 (.686)

* Special sizes available on request. Sizes include standard dimensions for colloidal silver contact rings.
† Other thicknesses available on special order.

STRIP DIMENSIONS — IN. AND (mm)

TYPE 1

Length Between Terminals ±.06	Total Strip Width (W) ±.03	Thickness Thickness ±.005
12 (305)	0.88 (22.4)	.027 (.686)
12 (305)	1.19 (30.2)	.027 (.686)
12 (305)	1.38 (35.1)	.027 (.686)
12 (305)	1.50 (38.1)	.027 (.686)
12 (305)	1.75 (44.5)	.027 (.686)
12 (305)	2.75 (69.9)	.027 (.686)

TYPE 2

Width (W) ±.06	L ±.03	C ±.03	Thickness ±.005
12 (305)	.38 (9.7)	0.88 (22.4)	.027 (.686)
12 (305)	.69 (17.5)	1.19 (30.2)	.027 (.686)
12 (305)	.88 (22.4)	1.38 (35.1)	.027 (.686)
12 (305)	1.00 (25.4)	1.50 (38.1)	.027 (.686)
12 (305)	1.25 (31.8)	1.75 (44.5)	.027 (.686)
12 (305)	2.25 (57.2)	2.75 (69.9)	.027 (.686)

HOW TO ORDER

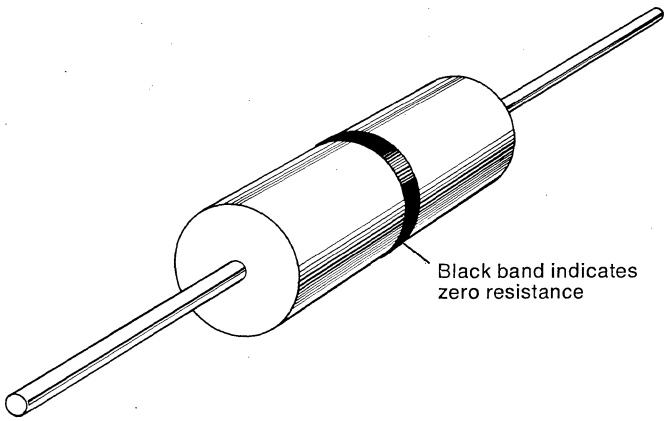
To order standard resistance strips, specify the type of strip desired, total width of strip, resistance value in ohms/square, and quantity desired. For special resistance strips, provide these specifications and as much information as possible about the proposed application.

Standard concentric disc resistors should be ordered by the disc type, total resistance between silver terminals, and resistance tolerance. For special concentric discs, give all dimensions shown on the drawing at left, plus total resistance between silver terminals and resistance tolerance.

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

MOLDED JUMPER WIRES ZEROHM

- ☐ Straight-through wire — no internal connections
- ☐ Molded jacket is standard ¼-watt size
- ☐ Supplied on lead tape and reel for automatic insertion



SPECIFICATIONS

Maximum Resistance: 0.01 ohm

Lead Material: Leads are copperclad steel with TRW's 30/70 solder alloy coating to allow both welding and soldering operations

Body Material: Electrical grade, high performance, molding compound

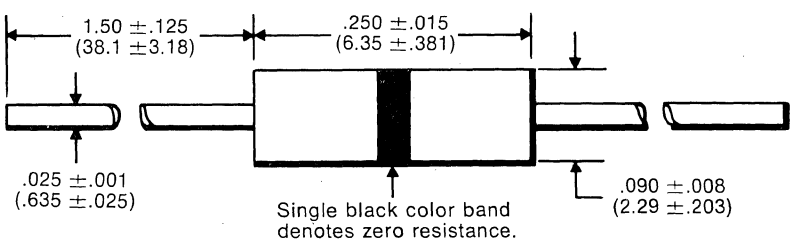
Minimum Insulation Resistance: Dry, 10,000 megohm; Wet, 100 megohm

Minimum Dielectric Withstanding Voltage: Atmospheric, 500V RMS; Reduced, 325V RMS

Insulation Flammability: Resistor insulation is self extinguishing within 10 seconds after externally applied flame is removed

Current Rating: 25 amps at 25°C, derating to 0 amps at 150°C

DIMENSIONS — IN. AND (mm)



APPLICATIONS

Molded jumper wires or crossovers, as they are sometimes called, are basically interconnection devices between points on a PC board.

Generally they are used for the following reasons:

- Inability to connect two points on a PC board due to other circuit paths which must be crossed over.
- An after-the-fact design change that requires new point connections.
- Circuit tuning by changing point connections.

TRW's molded jumper wires offer a quick simple solution to these problems. They are especially suited for automatic machine insertion on lead tape, and are available in all packaging styles including pre-cut and formed leads for manual insertion.

AVAILABLE THROUGH AUTHORIZED TRW RESISTOR DISTRIBUTORS

RESISTIVE PRODUCTS DIVISION, TRW ELECTRONIC COMPONENTS GROUP,
P.O. BOX 1860, BOONE, NC 28607 / PHONE (704) 264-8861 / TWX 510-936-3241

TRW SALES OFFICES

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TRW/ECG
2707 Artie Street, Suite 12
(205) 533-7600

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SCOTTSDALE (85251)
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6728 E. Avalon Dr., Suite A
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(213) 478-0183

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Straube Associates
2551 Casey Avenue
(415) 969-6060

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Q. T. Wiles & Associates
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WESTMINISTER (80030)
Straube Associates
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TRW/ECG
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TRW/ECG
6220 S. Orange Blossom Trail
Suite 151, Bldg. 1
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TRW/ECG
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NORCROSS (30092)
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1074B N. Cole Road, P.O. Box 4545
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TRW/ECG
5725 E. River Road, Suite 635
(312) 693-7730

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R. O. Whitesell & Associates
3426 Taylor Street
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R. O. Whitesell & Associates
6691 E. Washington Street
(317) 359-9283

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R. O. Whitesell & Associates
1825 S. Plate, Suite A
(317) 457-9127

IOWA
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1172 W. Galbraith Road
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CLEVELAND (44131)
R. O. Whitesell & Associates
6000 W. Creek Road, Suite 21
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1360 Old Freeport Rd., Suite 1-B
(412) 963-6161

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R. O. Whitesell & Associates
942 Snapp Ferry Road
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AUSTIN (78731)
TRW/ECG
3409 Executive Center Drive, Suite 139
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TRW/ECG
2267 Trawood Building #3
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DALLAS (75379)
TRW/ECG
17000 Dallas Parkway, Suite 200
P.O. Box 796668
(214) 248-8000

HOUSTON (77074)
TRW/ECG
9000 S.W. Freeway, Suite 116
(713) 772-5541

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3509 South Main Street
(801) 263-2640

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P.O. Box 1090
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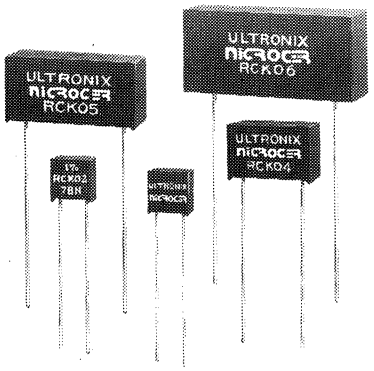
(303) 242-0810



metal foil resistor nicrocer® process

very high precision and stability

MIL QUALIFICATION TO RNC90Y

FEATURES

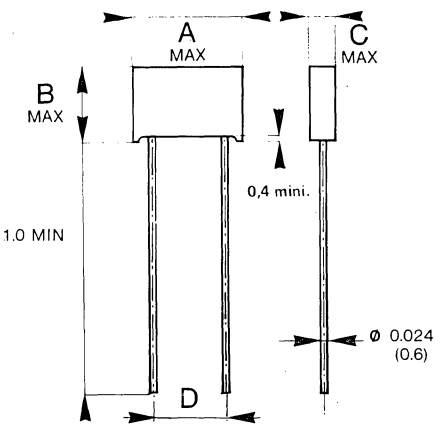
- VERY TIGHT TOLERANCES ±0.005% to ±1% – Matching to 0.002%
- VERY LOW TEMPERATURE COEFFICIENT
  typical « ±3 ppm/°C (−55° to +155°C) ± 1 ppm (0°C to + 60°C)
  tracking to 0.5 ppm/°C
- VERY HIGH STABILITY < 25 ppm/year or < *50 ppm/3 years (shelf life)*
- *NEGLIGIBLE RISE TIME approx. 1 X 10^{-9}* sec.

STANDARD ELECTRICAL SPECIFICATIONS

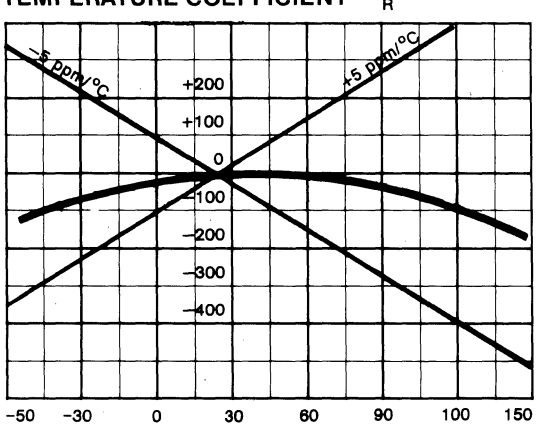
ULTRONIX TYPE	MIL TYPE	70°C RATING	125°C RATING	MAX. WORKING VOLTAGE	RESISTANCE RANGE (OHMS)			
					±0.005%	±0.02% ±0.01%	±0.05%	±0.1%, ±0.2% ±0.5%, ±1%
RCK02A	RNC90Y	0.5W	0.33W	300V	50Ω-200K	25Ω-200K	10Ω-200K	1Ω-200K
RCK04	–	1.0W	0.6W	350V	50Ω-400K	25Ω-400K	10Ω-400K	2Ω-400K
RCK05/05A	–	1.2W	0.9W	500V	150Ω-600K	75Ω-600K	30Ω-600K	3Ω-600K
RCK06	–	1.5W	1.2W	650V	200Ω-800K	100Ω-800K	40Ω-800K	4Ω-800K

PHYSICAL CONFIGURATIONS

Type	Dim. A	Dim. B	Dim. C	Dim. D
RNC90Y	.320 (8.13)	.375 (9.52)	.120 (3.05)	.150 (3.81)
RCK02A	.295 (7.5)	.315 (8.0)	.098 (2.5)	.150 (3.81)
RCK04	.591 (15)	.413 (10.5)	.138 (3.5)	.400 (10.16)
RCK05	.890 (22.6)	.413 (10.5)	.138 (3.5)	.700 (17.78)
RCK05A	.890 (22.6)	.413 (10.5)	.138 (3.5)	.650 (16.51)
RCK06	1.200 (30.5)	.531 (13.5)	.256 (6.5)	.900 (22.86)



TEMPERATURE COEFFICIENT $\frac{\Delta R}{R}$ ppm



The T.C. of RCK resistors is always better than ± 5 ppm/°C in the temperature range −55°C to +155°C.

More generally, the T.C. is positive towards the very low temperatures, typical values +3 ppm/°C for −55°C.

It is negative towards the high temperatures, typical value −3 ppm/°C for +155°C.

For temperature variations of about 20 to 30°C from the 25°C ambient temperature, the T.C. is very low.

In the temperature range 0°C to +60°C it can be reduced to a value below ± 1 ppm/°C.

For a group of resistors, T.C. matching can be made to better than ± 0.5 ppm/°C.

Consult **ULTRONIX**.

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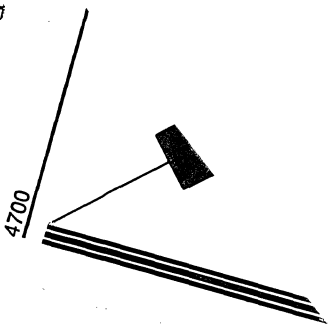
metal
niRo



SPECIFICATIONS

ELECTRICAL

RESISTANCE RANGE	1Ω to 80
RESISTANCE TOLERANCE	± 0.005
POWER RATING	0.5 W to
T.C. LIMIT	± 5 ppm
DIELECTRIC VOLTAGE	750 V RMS
INSULATION RESISTANCE	> 10^6M
THERMAL RESISTANCE	0.14°C/mW
THERMO-ELECTRIC EFFECT	0.5 µV for 1°C of difference between leads

MECHANICAL

MECHANICAL	insulated case
RESISTIVE ELEMENT	nickel-chromium
TERMINAL LEADS	tinned copper or UE6P weldable solderable type C MIL-STD 1276
UNIT WEIGHT	0.3-1-2-4g

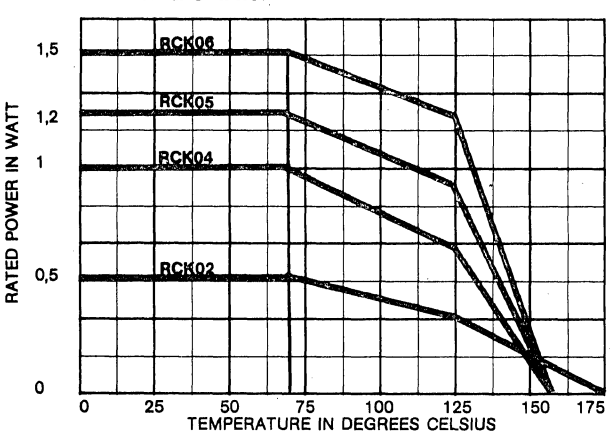
ENVIRONMENTAL

TEMPERATURE LIMITS	−55°C +175°C

ENVIRONMENTAL PERFORMANCE SPECIFICATIONS

TESTS	REQUIREMENTS MIL-R-55182E	REQUIREMENTS NF C 83220 CECC 40300	TYPICAL DRIFTS
OVERLOAD	±0.05%	±0.01%	±0.002%
TEMPERATURE CYCLING	±0.05%	±0.01%	±0.002
TERMINAL STRENGTH	±0.02%	±0.01%	±0.001%
RESISTANCE TO SOLDERING HEAT	±0.02%	±0.01%	±0.002%
VIBRATIONS (LIFE TEST)	±0.02%	±0.01%	±0.002%
MOISTURE RESISTANCE	±0.05% Insulation R. > 10^2MΩ	-	±0.003% Insulation R. > 10^4MΩ
LOAD LIFE	±0.05% ±0.05% @ 175°C	±0.05% -	±0.005% ±0.01%
HIGH TEMPERATURE EXPOSURE	-	±0.05% @ 155°C	±0.005%
HUMIDITY (STEADY STATE) 56 DAYS	-	±0.05% Insulation R. > 10^2MΩ	±0.003% Insulation R. > 10^4MΩ

POWER RATING CHART

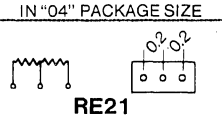


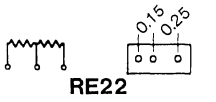
POWER RATING

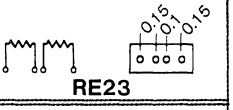
In order to increase the stability, it is recommended to reduce the nominal power (Pn) in relation to tolerance,
± 0.1% to ± 0.05% reduction 1/4 Pn
± 0.02% to ± 0.01% reduction 1/2 Pn
± 0.005% reduction 3/4 Pn.

RESISTOR NETWORKS

IN "04" PACKAGE SIZE







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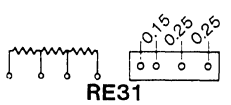

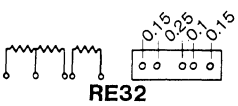

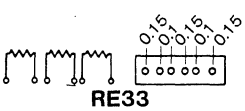

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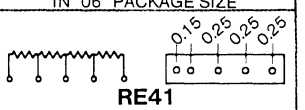

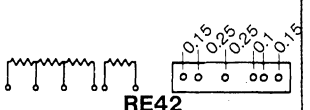

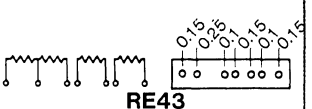

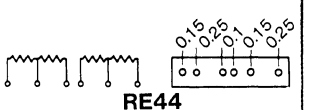

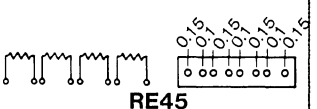

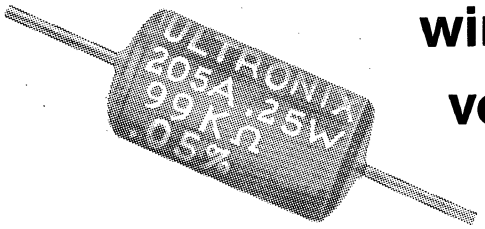

wirewound resistors
very high precision and stability

P.O. Box 1090
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MIL QUALIFICATION TO MIL-R-39005 AND MIL-R-93

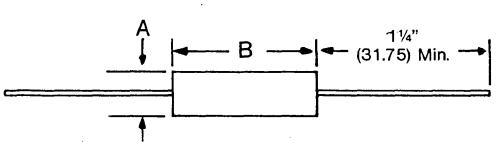
SPECIFICATIONS

MINIMUM VALUES
Generally 0.1Ω for 1% and 0.5% and 10Ω for 0.1% and tighter.

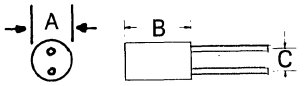
TOLERANCES (±)
Standards are 0.005%, 0.01%, 0.02%, 0.05%, 0.1%, 0.5% and 1% depending on style and value.

TEMPERATURE COEFFICIENTS
± 5 ppm/°C standard for 10Ω and above. Higher T.C.'s on low ohmic values.
±1 ppm/°C available. TC match to ±0.5 ppm/°C.
High T.C.'s up to + 6000 ppm/°C are available.

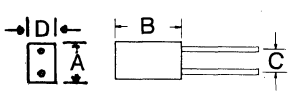
ULTRONIX TYPE	MIL STYLE		MAXIMUM VALUE Ω			POWER RATING AT 125°C (WATTS)		MAX. VOLTS	DIMENSIONS ± .020				LEADS (AWG)
	MIL-R 93	MIL-R 39005	MIL-R 93	MIL-R 39005	COMM.	MIL	COMM.		A	B	C	D	
123A	–	–	–	–	60K	–	0.05	150	.100 (2.54)	.230 (5.84)	–	–	24
118A	–	–	–	–	160K	–	0.05	150	.130 (3.30)	.180 (4.57)	–	–	26
122A	–	–	–	–	175K	–	0.05	150	.123 (3.12)	.218 (5.54)	–	–	24
102A	–	–	–	–	250K	–	0.10	150	.110 (2.79)	.250 (6.35)	–	–	24
101A	–	–	–	–	318K	–	0.10	300	.130 (3.30)	.375 (9.53)	–	–	22
101P	–	–	–	–	400K	–	0.12	150	.300 (7.62)	.320 (8.13)	.150 (3.81)	.110 (2.79)	22
103A	–	–	–	–	400K	–	0.10	150	.150 (3.81)	.300 (7.62)	–	–	22
105A	–	–	–	–	468K	–	0.125	300	.160 (4.06)	.500 (12.7)	–	–	22
102P	–	–	–	–	680K	–	0.12	150	.250 (6.35)	.250 (6.35)	.125 (3.18)	.125 (3.18)	22
184A	–	–	–	–	810K	–	0.125	300	.187 (4.75)	.375 (9.53)	–	–	22
185A	–	RBR74	–	6.52K	900K	0.125	0.125	300	.188 (4.78)	.500 (12.70)	–	–	22
202A	RB56	RBR75	42K	150K	925K	0.125	0.25	200	.250 (6.35)	.310 (7.85)	–	–	20
203A	RB56	RBR56	42K	220K	1M	0.125	0.25	200	.250 (6.35)	.343 (7.85)	–	–	20
202PA	–	–	–	–	1.2M	–	0.15	300	.250 (6.35)	.250 (7.75)	.200 (4.44)	–	22
203PA	RB71	RBR71	100K	150K	1.3M	0.125	0.25	150	.270 (6.86)	.320 (8.13)	.200 (5.08)	–	22
203PC	—	–	–	–	1.3M	–	0.25	150	.250 (6.35)	.312 (7.93)	.150 (3.81)	–	22
205A	RB55	RBR55	80K	332K	1.9M	0.15	0.33	400	.250 (6.35)	.500 (12.70)	–	–	20
207A	RB54	RBR54	170K	562K	3.0M	0.25	0.50	800	.250 (6.35)	.750 (19.05)	–	–	20
308A	–	RBR76	–	–	3.0M	–	0.60	800	.312 (7.92)	.810 (20.57)	–	–	20
210A	–	–	–	–	4.0M	–	0.50	800	.250 (6.35)	1.00 (25.40)	–	–	20
307A	RB53	RBR53	320K	1.1M	5.3M	0.33	0.60	800	.375 (9.53)	.750 (19.05)	–	–	20
310A	RB52	RBR52	610K	1.21M	7.3M	0.50	1.00	800	.375 (9.53)	1.00 (25.40)	–	–	20
510A	RB57	RBR57	830K	1.37M	10M	0.75	1.25	800	.500 (12.70)	1.00 (25.40)	–	–	20
515A	–	–	–	–	30M	–	1.50	1200	.500 (12.70)	1.50 (38.10)	–	–	20
517A	–	–	–	–	40M	–	1.75	1200	.500 (12.70)	1.75 (44.45)	–	–	20
520A	–	–	–	–	40M	–	2.00	1200	.500 (12.70)	2.00 (50.80)	–	–	20



STYLES XXXA



STYLES XXX PA/PC



STYLES XXX P

P.O. Box 1090
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wirewound resistors

axial leaded power

MIL QUALIFICATION TO MIL-R-39007 and MIL-R-26

POWER WIREWOUND RESISTOR SELECTION GUIDE

POWER RATING AT 25 C MAXIMUM VALUE				PRODUCT SELECTION		
COMMERCIAL	MIL-R-26 CHAR U	MIL-R-26 CHAR V	MIL-R-39007	ULTRONIX	MIL R 26	MIL R 39007
1W/1.5K	-	-		MS101		
1W/1.25K	1W/1K	-	-	MS1	RW81	
1.5W/1.25K	-	-	1W 1.00K	MS1B		RWR81
2W/3.16K	1W/3.16K	-	-	MS2	RW70	
2W/3.16K	2W/2.67K	-	-	MS2	RW80	
2W/3.16K	-	-	2W 3.16K	MS2B		RWR80
3W/10K	-	3W/2K	-	CS3	RW69	
3W/11K	-	-	3W 4.12K	MS3B		RWR89
3W/11K	3W/10.5K	-	-	CS4	RW79	
4W/20K	-	-	-	CS5		
5W/38K	5W/12.1K		5W/12.1K	CS6	RW74	RWR74
6.5W/45K	-	6.5W/8.2K	-	CS7	RW67	
7W/38K	-	-	7W/12.4K	CS6		RWR84
8W/84K	-	-	-	CS8		
10W/115K	10W/39.2K	-	10W/39.2K	CS10	RW78	RWR78
11W/115K	-	11W/20K	-	CS11	RW68	

SPECIFICATIONS

MINIMUM RESISTANCE

0.1Ω for solenoid winding depending on tolerance
10Ω for non-inductive winding

TOLERANCES AVAILABLE

±0.1%, 0.25%, 0.5%, 1%, 3%, 5%, & 10%

TEMPERATURE COEFFICIENTS

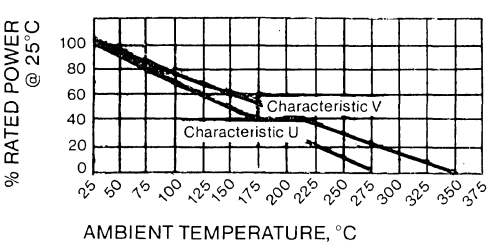
Standard ± 90PPM/°C R<1Ω
± 50PPM/°C 1Ω≤R<10Ω
± 20PPM/°C R≥ 10
Special to + 6000PPM/°C

NON INDUCTIVE WINDING–ADD PREFIX N

Divide maximum resistance by two.
Multiply maximum working voltage by 0.707
Where possible, specify maximum inductance or capacitance allowable at a specific frequency.

POWER RATING:

In order to maintain a constant maximum hot spot temperature, it is necessary to limit the applied power to the resistor when operating in environments having an ambient temperature higher than 25°C. The chart below shows this operating for characteristic U resistors of 1% tolerance and characteristic V resistors of 3% and looser tolerance.



Closer tolerances require further derating as follows:

Tolerance	% of rated power at 25°C.
±0.5%	72
±0.25%	61
±0.1%	50

ULTRONIX TYPE	DIMENSIONS						
	Ø/Diameter, D		Length, L		Ø/Lead		
	inch	mm	inch	mm	AWG	inch	mm
MS 101	.093 max	2.4 max	.343 max	8.7 max	24	.020	0.51
MS 1	.085 ± .020	2.16 ± 0.51	.250 ± 0.31	6.35 ± 0.79	24	.020	0.51
MS 2	.094 ± .031	2.39 ± 0.79	.406 ± .031	10.31 ± 0.79	24	.020	0.51
MS 3	.187 ± .031	4.75 ± 0.79	.560 ± .062	14.22 ± 1.57	20	.032	0.81
CS 3	.200 ± .031	5.08 ± 0.79	.500 ± .062	12.70 ± 1.57	20	.032	0.81
CS 4	.187 ± .031	4.75 ± 0.79	.560 ± .062	14.22 ± 1.57	20	.032	0.81
CS 5	.187 ± .031	4.75 ± 0.79	.812 ± .062	20.62 ± 1.57	20	.032	0.81
CS 6	.312 ± .031	7.92 ± 0.79	.875 ± .062	22.22 ± 1.57	18	.040	1.02
CS 7	.312 ± .031	7.92 ± 0.79	1.000 ± .062	25.40 ± 1.57	20	.032	0.81
CS 8	.469 ± .031	11.91 ± 0.79	1.375 ± .062	34.92 ± 1.57	18	.040	1.02
CS10 & CS11	.375 ± .031	9.52 ± 0.79	1.780 ± .062	45.21 ± 1.57	18	.040	1.02

LEAD LENGTH = 1.50 (38.10) MIN

wirewound resistors

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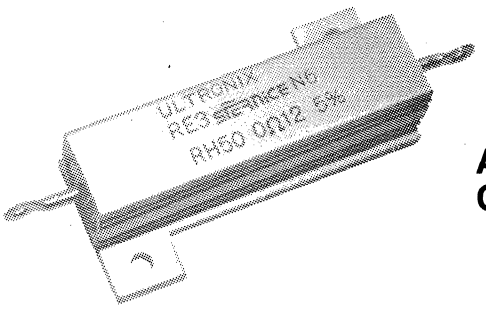


10 TO 50 WATTS

ALUMINUM HOUSED — CHASSIS MOUNT

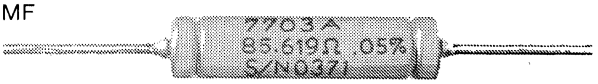
The RH Series provides high dissipation, light weight and small volume, complete environmental protection, electrical insulation 10^7 MΩ, mechanical strength, easy mounting, high stability <0.05%/year, low temperature coefficient, low ohmic values.

Ultronix Type	Power Rating at 25 C	Max. Rated Voltage	Max. Value (ohms)	Minimum Value (ohms) vs. Tolerance						Length ±.02 (.5)	Height Max.
				0.1%	0.5%	1%	2%	5%	10%		
RH5	10W	160V	11.8K	4.7	1.2	0.6	0.3	0.1	0.01	.64 (16.3)	.35 (8.9)
RH10	12.5W	250V	17K	4.7	1.2	0.6	0.3	0.1	0.009	.75 (19)	.43 (11)
RH25	25W	550V	54K	1.4	0.15	0.06	0.03	0.015	0.0075	1.10 (28)	.59 (15)
RH50	50W	1285V	130K	1.4	0.15	0.06	0.03	0.015	0.0075	1.97 (50)	.59 (15)

Power Rating based on proper heat sinking: 413cm² for RH5 and RH10, 536cm² for RH25 and RH50

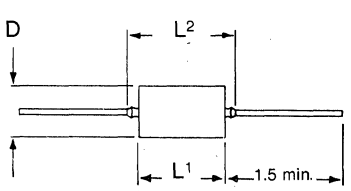
HERMETICALLY SEALED – ULTRA-HIGH STABILITY

- Accuracy to 25 ppm absolute
- Shelf life to 10 ppm/year
- Temperature coefficient to ±1 ppm/°C
- Zero voltage coefficient
- Noise free
- Low thermal EMF

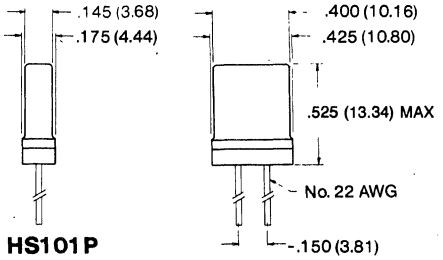


Ultronix Type	Power Rating at 25°C	Maximum Rated Voltage	Maximum Value (ohms)	Dimensions			Leads AWG
				D ±.01 (.25)	L1 ±.02 (.51)	L2 ±.03 (.76)	
HS185A	.125W	300	1.72M	.187 (4.75)	.500 (12.70)	.625 (15.88)	22
HS205A	.25W	300	3.16M	.250 (6.35)	.500 (12.70)	.562 (14.27)	20
HS207A	.4W	600	5.88M	.250 (6.35)	.750 (19.05)	.812 (20.62)	20
HS210A	.5W	600	9.80M	.250 (6.35)	1.000 (25.40)	1.063 (27.00)	20
HS307A	.6W	600	11.0M	.375 (9.53)	.750 (19.05)	.850 (21.59)	20
HS310A	.8W	600	18.4M	.375 (9.53)	1.000 (25.40)	1.060 (26.92)	20
HS510A	1.0W	600	40.5M	.500 (12.70)	1.050 (25.40)	1.120 (28.45)	20
HS520A	1.8W	900	81.5M	.500 (12.70)	2.000 (50.80)	2.160 (54.86)	20

Ultronix Type	Power Rating at 125°C	Maximum Rated Voltage	Maximum Value (ohms)	
HS101P	.3W	300	450K	Dimensions: see drawing.



HSXXXA



HS101P

(Available without standoff)

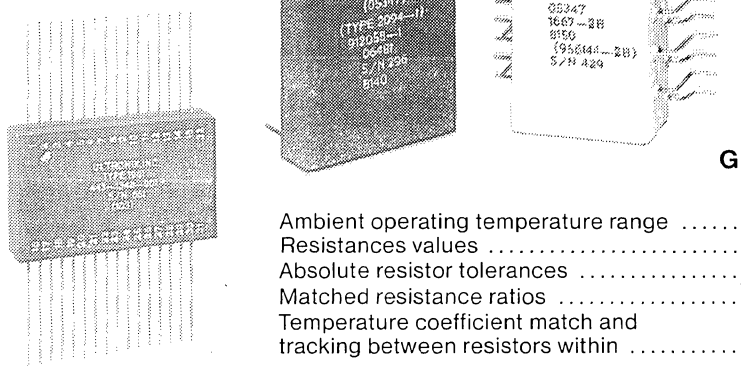
ULTRONIX INC SIERRICE
P.O. Box 1090
Grand Junction
Colorado 81502

(303) 242-0810

wirewound networks and custom requirements

CALL FOR OUR APPLICATIONS ENGINEERS TO ASSIST YOU WITH YOUR DESIGN REQUIREMENTS

CUSTOM DESIGNED NETWORKS AND MATCHED SETS



Matched resistor sets and custom designed networks are available from Ultronix for equipment design requiring close ratio matching and temperature tracking of resistors.

Our networks are used in a wide variety of applications such as communications satellites, precision instrumentation, aircraft controls, etc.

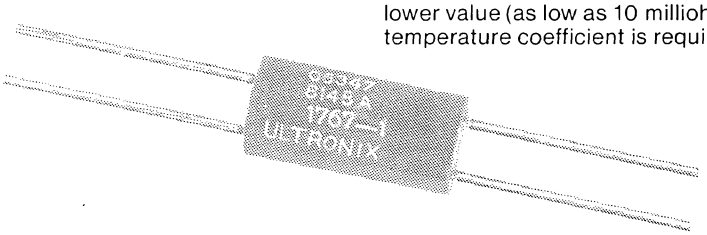
GENERAL SPECIFICATIONS AVAILABLE

Ambient operating temperature range	−55°C to 125°C
Resistances values	0.1 ohm to 40M ohm
Absolute resistor tolerances	up to ±0.005%
Matched resistance ratios	up to ±0.001%
Temperature coefficient match and tracking between resistors within	±1 ppm from 0°C to +85°C

Low reactance and rise times as low as 0.02 microseconds.
AC resistance match at frequence determined by user.

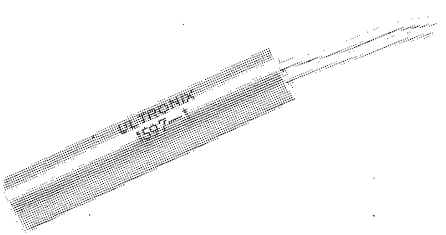
VERY LOW OHM, ULTRA PRECISION FOUR TERMINAL CURRENT SHUNTS

Ultronix manufactures a large variety of four-terminal resistors and networks for specialized applications. These are used in requirements of lower value (as low as 10 milliohms) where high precision and low temperature coefficient is required.



CUSTOM WIREWOUND TEMPERATURE SENSORS

Ultronix temperature sensors are available with temperature coefficients from −50 to +6000 PPM/°C. Various alloys and metals are used to obtain the required range of resistance change with temperature for trimming, tracking, compensation and matching. These units may be in metal housings such as brass, aluminum, or stainless steel, or molded in various epoxies or silicone.



COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

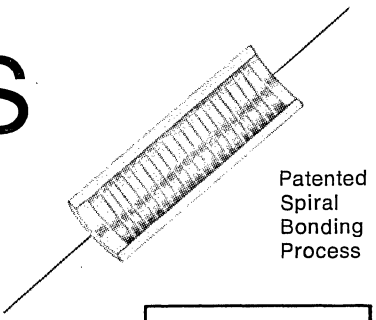
WPS word processing software

Y

YIG yttrium iron garnet

The New VAMISTOR

Hermetically Sealed, Established High Reliability Metal Film RESISTORS



Patented Spiral Bonding Process

EXCLUSIVE FEATURES OF VAMISTOR RESISTORS

Unique Patented Construction Produces Highest Reliability
Capable of handling twice the power of other film resistors of the same size.

FEATURES:

- Inherent High Reliability by Design.
- Inside Metal Film is Contamination-Free.
- Hermetic Seal Requires No Outer Sleeve.
- Higher Wattage in Standard Dimensions.
- Low Noise Level.
- Low Voltage Coefficient.
- Leakage Rate Less Than 1 x 10^{-9} CC/Sec.
- Nonflammable Epoxy Insulation.
- Exceeds MIL-R-55182 (Refer to Derating Curve) Performance Explanations.
- Standard Temperature Coefficients to 0 ±10 PPM/°C.
- Matched Sets, Both Tolerances and TC Available.
- Tolerances 1%, 0.5%, 0.25%, 0.1%.

Special Units Available

- HI-REL Resistors to exceed MIL specs
- Matched sets to meet any level
- Special TC Coefficients to 0°PPM

VAMISTOR TYPES APPROVED PER MIL-R-55182

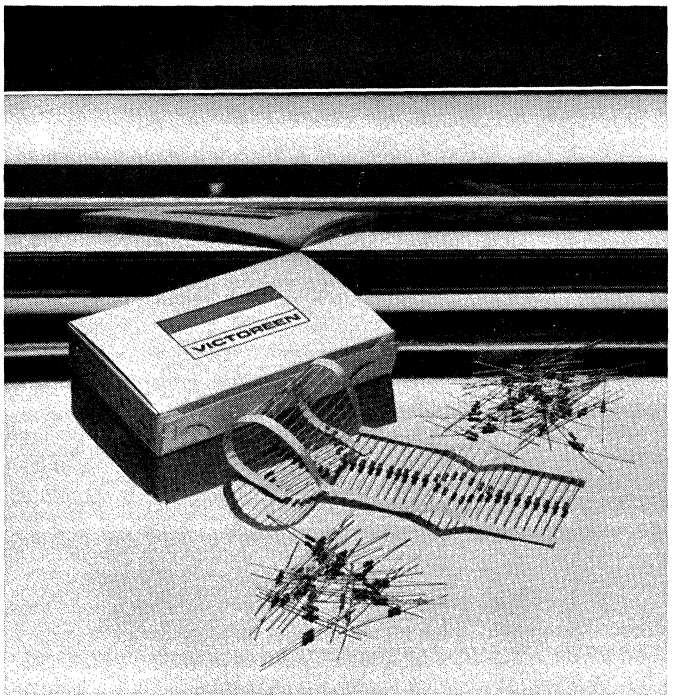
Unique Patented Construction Produces The Highest Reliability

MILITARY TYPE	STYLE CHAR.	VAMISTOR STYLE	TC ppm/°C	RESISTANCE RANGE	BODY LENGTH	BODY DIAMETER	LEAD LENGTH	LEAD DIAMETER	ACTUAL SIZE
RNC55 RNR55 RNN55 (1/10 Watt)	C H E J K	HS47-2B HR47-2B HS47-2A HR47-2A HR47-2K	50 50 25 25 100	24.9 OHMS to 200K	.250 ±.031 (6.35 ±.787)	.109 ±.031 (2.78 ±.787)	1 1/2 ±1/8 (38.1 ±3.18)	.025 ±.002 (.635 ±.050)	
RNC60 RNR60 RNN60 (1/8 Watt)	C H E J K	HS48-2B HR48-2B HS48-2A HR48-2A HR48-2K	50 50 25 25 100	24.9 OHMS to 499K	.375 ±.062 (9.52 ±1.57)	.125 +.040 −.031 (3.17 +1.02−.787)	1 1/2 ±1/8 (38.1 ±3.18)	.025 ±.002 (.635 ±.050)	
RNC65 RNR65 RNN65 (1/4 Watt)	C H E J K	HS55-2B HR55-2B HS55-2A HR55-2A HR55-2K	50 50 25 25 100	24.9 OHMS to 1 MEG.	.625 +.031 −.094 (15.87 +.787 −2.39)	.188 +.062 −.031 (4.77 +1.57−.787)	1 1/2 ±1/8 (38.1 ±3.18)	.025 ±.002 (.635 ±.050)	
RNC70 RNR70 RNN70 (1/2 Watt)	C H E J K	HS52-2B HR52-2B HS52-2A HR52-2A HS52-2K	50 50 25 25 100	24.9 OHMS to 1.5 MEG.	.750 +.125 −.062 (19.04 +3.17 −1.57)	.250 +.078 −.031 (6.35 +1.98−.787)	1 1/2 ±1/8 (38.1 ±3.18)	.032 ±.002 (.813 ±.050)	
RNC75 RNR75 (1 Watt)	E J	HS50-2A HR50-2A	25 25	24.9 OHMS to 2 MEG.	1.062 ±.062 (26.97 ±1.57)	.375 +.062 −.031 (9.52 +1.57−.787)	1 1/2 ±1/8 (38.1 ±3.18)	.032 ±.002 (.813 ±.050)	

(Metric dimensions shown in parenthesis)

THE NEW VAMISTOR Corp. 115 Industrial Park, Sevierville, TN 37862

Sales & Corporate Office: PHONE: 615/453-0001



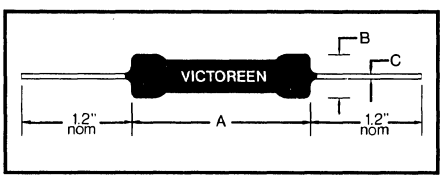
VICTOREEN Carbon & Metal Film Resistors

From general purpose thru extreme precision, Victoreen now offers low-priced Carbon and Metal Film Resistors.

In addition to our broad based stock, custom stocking plans are available to fit your needs.

VCF-125,250,500 (Carbon Film)

- Wide resistance range: 1 ohm to 10M ohm
- Tolerances available: 1, 2 & 5%
- Packaging variety: Bulk, Tape & Reel, Ammo Pack
- Cut and form leads available as required
- Custom stocking plans available
- Epoxy conformal coated

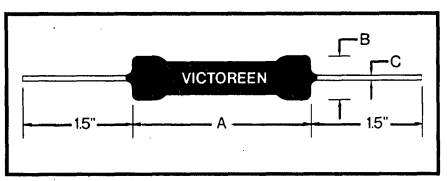


Dimensions (in inches)

Type	A Max. Length	B Max. O.D.	C Nominal
VCF-125	0.150	0.080	0.020
VCF-250	0.270	0.110	0.024
VCF-500	0.410	0.160	0.024

VMF-55,60 (Metal Film)

- Wide Temperature Coefficient range: 25, 50, 100PPM/°C
- Tolerances available: 0.25%, 0.5%, 1%, 2%, 5%
- Packaging variety: Bulk, Tape & Reel, Ammo Pack
- Cut and form leads available as required
- Custom stocking plans available
- Epoxy conformal coated



Dimensions (in inches)

Type	A Max. Length	B Max. O.D.	C Nominal
VMF-55	0.275	0.105	0.024
VMF-60	0.400	0.155	0.028

Capabilities

Type	Resistance Range (ohm)	Power Rating (@ 70°C.)	Voltage Rating
VCF-125	1 - 1M	1/8W	200V
VCF-250	1 - 10M	1/4W	250V
VCF-500	1 - 10M	1/2W	350V
VMF-55	10 - 1M	1/4W	250V
VMF-60	10 - 1M	1/2W	500V

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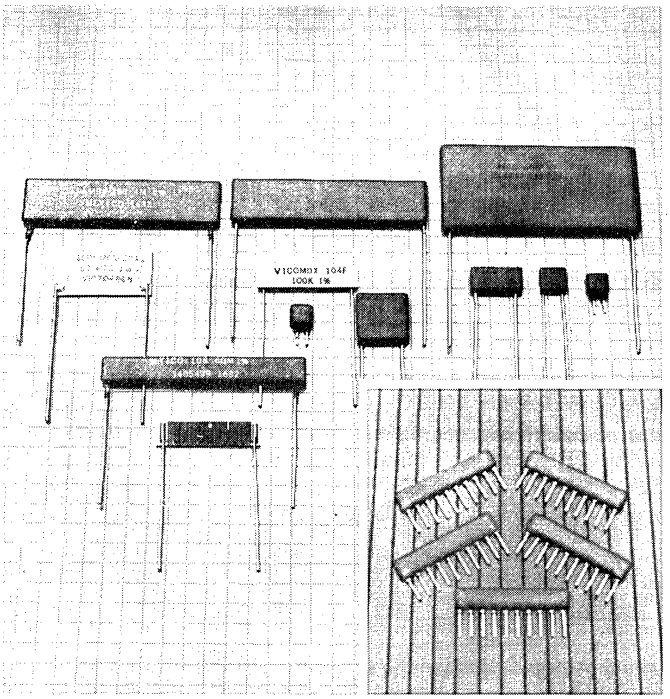
Cleveland, Ohio 44104
(216) 795-8200

VICTOREEN Slim-Mox and S.I.P. Networks

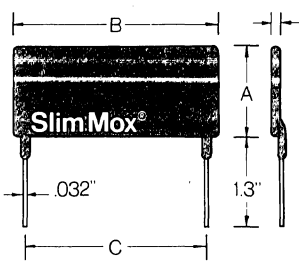
Slim-Mox Resistors are ideal for applications where high voltage/high impedance or high density packaging are benefits to the designer.

S.I.P. Networks are available from 47 ohm to 2.2 megs, with stocking plans available to fit your needs.



Slim-Mox

- Stocking values available
- Wide resistance range to 50,000 Meg ohm
- Voltage capability to 18 KV
- Power rating to 5 Watts
- Tolerances from 0.5 to 20%
- Epoxy conformal coated



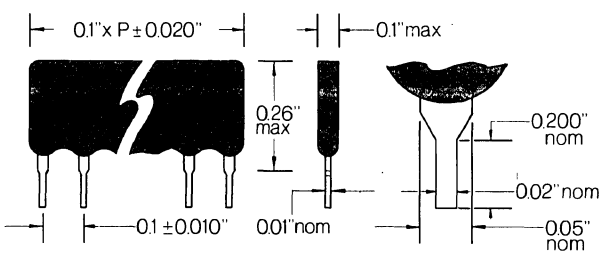
SLIM-MOX	A Max. Length	B Max. O.D.	C Nominal
102	0.34	0.58	0.4
104	0.34	1.08	0.9
108	0.34	2.08	1.9
202	0.59	0.58	0.4
204	0.59	1.08	0.9
208	0.59	2.08	1.9
308	0.84	2.08	1.9

Capabilities

Type	Resistance Range (ohm)	Power Rating (@ 70°C.)	Voltage Rating
SLIM MOX-102	1K-10,000M	0.5W	2500V
SLIM MOX-104	1K-50,000M	1.0W	5000V
SLIM MOX-108	1K-50,000M	2.0W	10,000V
SLIM MOX-202	1K-30,000M	1.0W	5000V
SLIM MOX-204	1K-50,000M	2.0W	10,000V
SLIM MOX-208	1K-50,000M	4.0W	15,000V
SLIM MOX-308	1K-50,000M	5.0W	18,000V

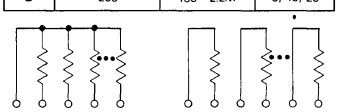
VNK-1V,2V

- Wide resistance range: 47 ohm to 2.2 Meg ohm
- Tolerances available: 2, 5, 10 & 20%
- Bulk package
- Custom stocking plans available
- Epoxy conformal coated
- 5 to 14 pin configurations available



Capabilities

Code	Temperature Coefficient (PPM/°C)	Resistance Range (ohm)	Tolerance (%)
A	150	47 - 2.2M	2, 5
B	200	100 - 2.2M	5, 10, 20



Type 1V
Pin One Common

Type 2V
Isolated Elements

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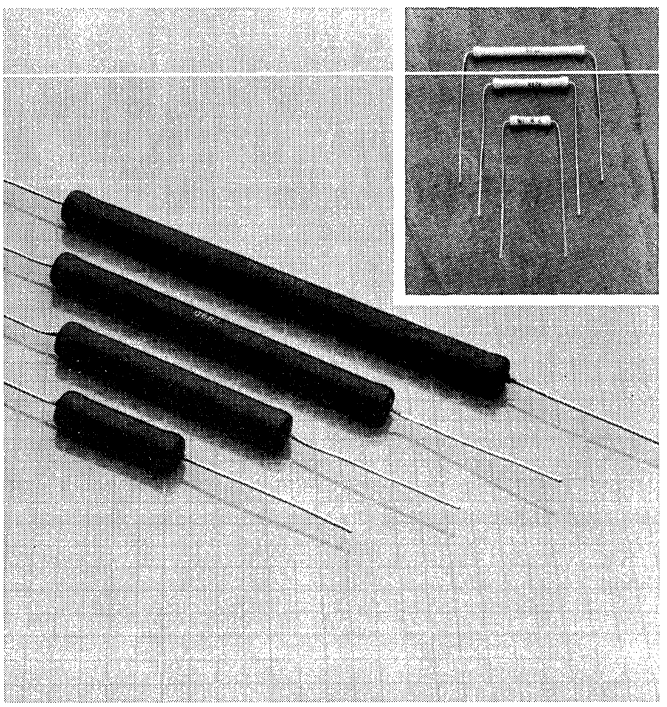
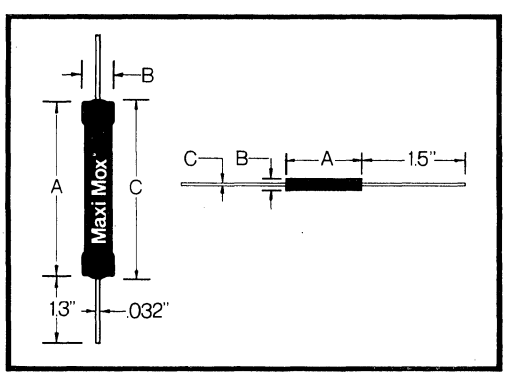
VICTOREEN
High Voltage Mini and Maxi Mox Resistors

Mini and Maxi Mox Resistors have historically been custom-manufactured resistors.
NOW AVAILABLE FROM STOCK.



Mini-Mox/ Maxi-Mox

- Stocking values available
- Wide resistance range to 50,000 Meg ohm
- Voltage capability to 37.5 KV
- Power rating to 12.5 Watts
- Tolerances from 0.5 to 15%
- Epoxy conformal coated



Capabilities

Type	Resistance Range (ohm)	Power Rating (@ 70°C.)	Voltage Rating
MOX-200	1M - 1000M	.25W	500V
MOX-300	1M - 1000M	.50W	1000V
MOX-400-24	1K - 20,000M	.25W	1000V
MOX-750-24	1K - 30,000M	.50W	2000V
MOX-1125-24	1K - 50,000M	1.00W	5000V
MOX-1A	10K-20,000M	1.5W	7500V
MOX-2A	20K-30,000M	3.0W	15,000V
MOX-3A	30K-30,000M	4.5W	22,500V
MOX-4A	40K-50,000M	6.0W	30,000V
MOX-5A	50K-50,000M	7.5W	37,500V

Dimensions (in inches)

		A Max. Length	B Max. O.D.	C Nominal
MINI-MOX	200	0.275	0.105	0.024
	300	0.435	0.145	0.028
	400-24	0.500	0.150	0.020
	750-24	0.840	0.150	0.020
	1125-24	1.235	0.150	0.020
MAXI-MOX	1A	1.140	0.345	1.2
	2A	2.140	0.345	2.2
	3A	3.140	0.345	3.2
	4A	4.140	0.345	4.2
	5A	5.140	0.345	5.2

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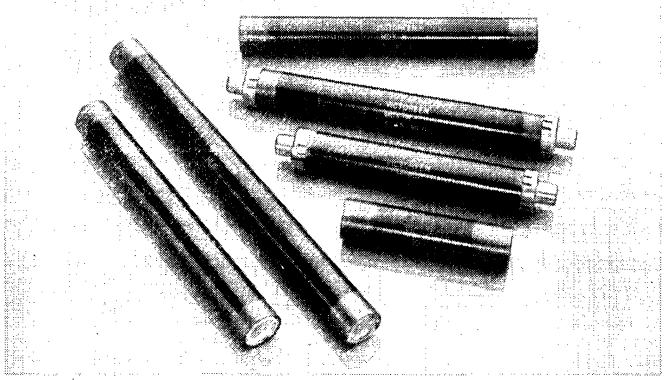
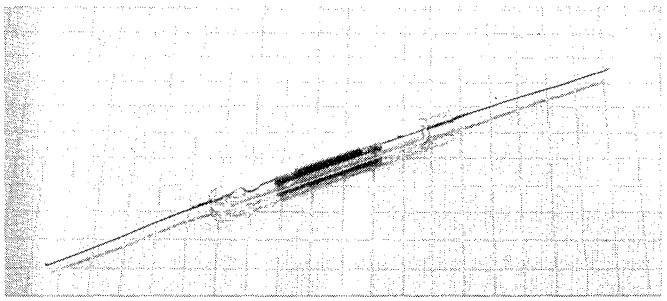




VICTOREEN Power-Mox and RX-1 Hi-Megs

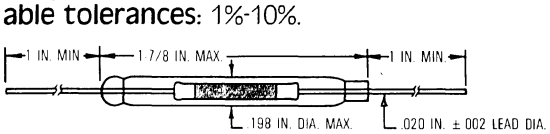
From one extreme to the other, Power-Mox Resistors for the high power/high voltage needs, RX-1 Resistors for the lower voltage, high impedance applications. Also for any applications in between.

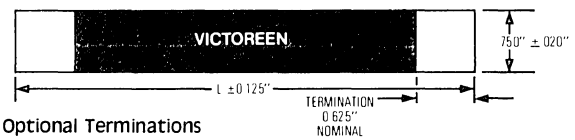
Power-Mox Series

Victoreen's Power-Mox series is ideal for applications where high power, voltage and stability are required. With power and voltage ratings to 60 watts and 60KV respectively, this series of resistors when used in applications such as x-ray, power supplies and electrostatic precipitaters, becomes the key to quality, high reliability end products.

RX-1 Hi-Megs

VICTOREEN'S HI-MEG RESISTORS were originally designed for use in electrometer circuits where a high order of performance is required. HI-MEG resistors achieve a high degree of accuracy and stability, and operate at this high level for a long period of time. The HI-MEGS are manufactured in accordance with MIL-R-14293A, characteristic T, and therefore are measured at 25 volts. Reference to the average voltage coefficient curve below will indicate that deviations from the marked resistance value may be encountered when used at higher voltages. By special order, Victoreen can supply resistors with resistance measurements at specified voltages. **Resistance range:** 10 Meg ohm-1,000,000 Meg ohm. **Available tolerances:** 1%-10%.





Optional Terminations

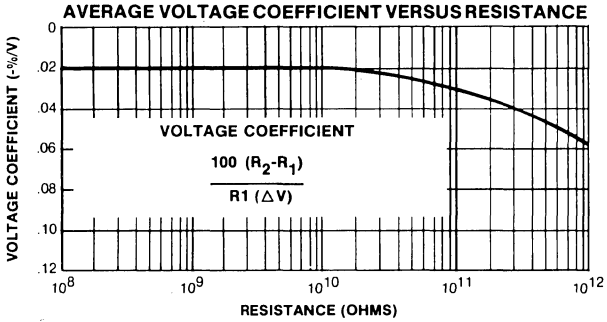
A. 1/4-20 Threaded End Cap B. 0.40" Ferrule C. Radial Bands

Capabilities

Type	Length	Resistance Range	Voltage Rating*	Power Rating (@ 70°C.)
MOX-F	3.0	10K - 3000 Meg	20KV	22.5W
MOX-G	4.5	10K - 5000 Meg	30KV	34.0W
MOX-H	6.0	10K - 7000 Meg	45KV	45.0W
MOX-J	8.0	10K - 10,000 Meg	60KV	60.0W

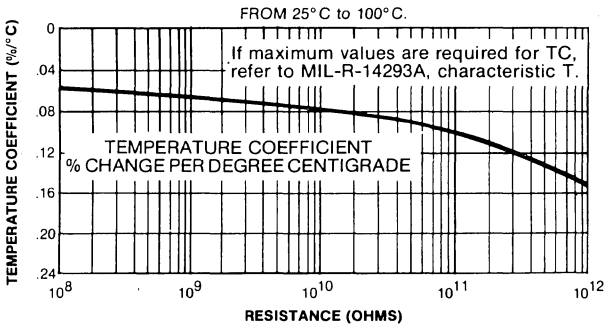
* When used above 40KV, some method of corona suppression is required.

AVERAGE VOLTAGE COEFFICIENT VERSUS RESISTANCE



AVERAGE VOLTAGE COEFFICIENT VERSUS RESISTANCE

FROM 25°C to 100°C.



VICTOREEN

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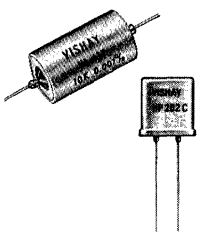
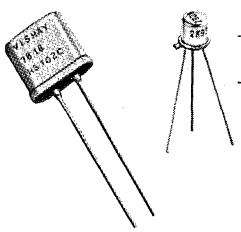
Precision Resistive Component Selection Guide

Hermetically-Sealed Resistors; Metrology & Laboratory Group



Model Number	Resistance (Ohms)	Tolerance[1]	Power at 25°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Nominal Dimensions Inch (mm)
VHA412	5-100k	To ±0.001%	0.3W	250	+0.6ppm/°C ±1.5ppm/°C (0°C To +25°C) −0.6ppm/°C ±1.5ppm/°C (+25°C To +60°C) +2.2ppm/°C ±2.0ppm/°C (−55°C To +25°C) −1.8ppm/°C ±2.0ppm/°C (+25°C To +125°C)		0.0005% 1 Year; 0.001% 3 Years	0.002% 2000 Hrs. 0.1W@60°C	0.625 (15.88) L x 0.375 (9.53) Dia.
VHA414	5-200k		0.5W	350					1.000 (25.4) L x 0.375 (9.53) Dia.
VHA512*	5-300k		0.75W	350					0.625 (15.88) L x 0.500 (12.7) Dia.
VHA516-4*	5-400k		1.0W	500					
VHA516-5*	5-500k		1.25W	500					1.000 (25.4) L x 0.500 (12.7) Dia.
VHA516-6*	5-600k		1.5W	500					
VHA518-7*	5-700k		1.75W	600					1.500 (38.1) L x 0.500 (12.7) Dia.
VHA518-8*	5-800k		2.0W	600					
VHA518-9*	5-900k		2.25W	600					
VHA518-10	5-1meg		2.5W	600					
VHP202C	5-100k		0.3W	300	Less than 1ppm/°C (0°C To + 125°C)				0.195 (4.95) W x 0.445 (11.30) L x 0.430 (10.92) H. Max. Lead Spacing 0.150 (3.81) Nom.
VHP100	20-100k		0.3W	300					

Hermetically-Sealed Resistors; Industrial & Aerospace Group



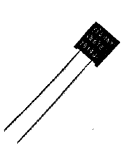
Model Number	Resistance (Ohms)	Tolerance[1]	Power at 70°C	Power at 125°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Maximum Dimensions Inch (mm) W x L x H
VHS555[4]	1-100k	To ±0.005%	0.6W	0.3W	300	+0.6ppm/°C ±1.5ppm/°C (0°C To +25°C) −0.6ppm/°C ±1.5ppm/°C (+25°C To +60°C) +2.2ppm/°C ±2.0ppm/°C (−55°C To +25°C) −1.8ppm/°C ±2.0ppm/°C (+25°C To +125°C)		0.0005% 1 Year; 0.001% 3 Years	0.0025% 2000 Hrs. 0.1W@60°C	0.195 (4.95) x 0.445 (11.30) x 0.430 (10.92) Lead Spacing 0.150 (3.81) Nom.
VHS102C	1-100k									
VHM-1	5-25k	To ±0.01%	0.2W	0.1W	45				0.015% 2000 Hrs. 0.3W@125°C 0.01% 10,000 Hrs. 0.05W@125°C	0.210 (5.33) H x 0.230 (5.84) Dia. (Standard TO-18 Case)

Hermetically Sealed Precision Power & Current Sensing Resistors

Model Number	Resistance (Ohms)	Tolerance[1]	Power at 25°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Maximum Dimensions Inch (mm) W x L x H
VHP-3	0.1-80k	To ±0.01%	10W[5]	750	+0.6ppm/°C ±1.5ppm/°C (0°C To +25°C) −0.6ppm/°C ±1.5ppm/°C (+25°C To +60°C) +2.2ppm/°C ±2.0ppm/°C (−55°C To +25°C) −1.8ppm/°C ±2.0ppm/°C (+25°C To +125°C)		0.0005%/Yr.	0.05% 2000 Hrs. @ 25°C	0.346 (8.79) x 1.530 (38.86) x 1.000 (25.4) (Standard TO-3 Case)

(For 4 terminal model specify VHP-4)

Established Reliability Resistors; Ermil Style RNC90Y (Mil-R-55182/9, Char. Y)



Model Number	Resistance (Ohms)	Tolerance[1]	Power at 70°C	Power at 125°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Dimensions Inch (mm) W x L x H
RNC90Y[4] (S555)	4.99-100k[6]	To ±0.005%	0.6W	0.3W	300	+0.6ppm/°C ±1.5ppm/°C (0°C To +25°C) −0.6ppm/°C ±1.5ppm/°C (+25°C To +60°C) +2.2ppm/°C ±2.0ppm/°C (−55°C To +25°C) −1.8ppm/°C ±2.0ppm/°C (+25°C To +125°C)		0.0025% 1 Year; 0.005% 3 Years	0.015% 2000 Hrs. 0.3W@125°C	0.105 (2.67) x 0.302 (7.67) x 0.326 (8.28) Dim. Tol. ±0.010 (0.25) Lead Spacing 0.150 (3.81) Nom.

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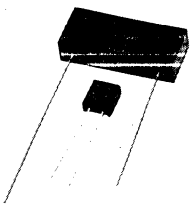
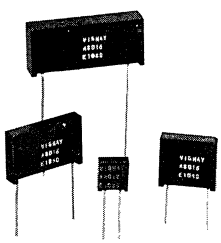
Precision Resistors; High Performance Industrial & Aerospace Group



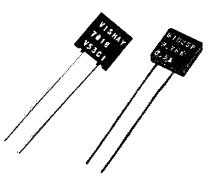
Model Number	Resistance (Ohms)	Tolerance[1]	Power at 70°C	Power at 125°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Maximum Dimensions Inch (mm) W x L x H
S102C[4]	1-100k	To ±0.005%	0.6W	0.3W	300	+0.6ppm/°C (0°C To +25°C) −0.6ppm/°C (+25°C To +60°C) +2.2ppm/°C (−55°C To +25°C) −1.8ppm/°C (+25°C To +125°C)	±1.5ppm/°C ±1.5ppm/°C ±2.0ppm/°C ±2.0ppm/°C	0.0025% 1 Year; 0.005% 3 Years	0.05% 2000 Hrs. 0.1W@70°C 0.015% 2000 Hrs. 0.3W@125°C 0.05% 10,000 Hrs. 0.3W@125°C	0.105 (2.67) x 0.302 (7.67) x 0.326 (8.28) Dim. Tol. ±0.010 (0.25) Lead Spacing: 0.150 (3.81) Nominal
S104D	1-200k		1.0W	0.5W	350					0.160 (4.06) x 0.575 (14.61) x 0.530 (13.46) Lead Spacing: 0.400 (10.16) Nominal
S105D	1-300k		1.5W	0.75W	350					0.160 (4.06) x 0.820 (20.83) x 0.530 (13.46) Lead Spacing: 0.650 (16.51) Nominal
S106D	0.5-600k		2.0W	1.0W	500					0.260 (6.60) x 1.190 (30.23) x 0.530 (13.46) Lead Spacing: 0.900 (22.86) Nominal

Extended Range High Performance Industrial Precision Resistors



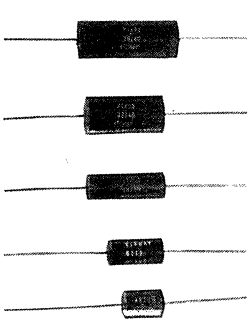
Model Number	Resistance (Ohms)	Tolerance[1]	Power @ 85°C	Power @ 125°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Maximum Dimensions Inch (mm) W x L x H
E102C[4]	100k-250k	To ±0.005%	0.2W (150k-250k)	0.3W (100k-150k)	300	+0.6ppm/°C (0°C To +25°C) −0.6ppm/°C (+25°C To +60°C) +2.2ppm/°C (−55°C To +25°C) −1.8ppm/°C (+25°C To +125°C)	±1.5ppm/°C ±1.5ppm/°C ±2.0ppm/°C ±2.0ppm/°C	0.0025% 1 Year; 0.005% 3 Years	0.005% 2000 Hrs. 0.1W@70°C 0.01% 2000 Hrs. 0.3W@70°C 0.05% 2000 Hrs. 0.3W@125°C	0.105 (2.67) x 0.302 (7.67) x 0.326 (8.28) Dim. Tol. ±0.010 (0.25) Lead Spacing: 0.150 (3.81) Nominal
E104D	200k-500k		0.5W	—	400					0.160 (4.06) x 0.575 (14.61) x 0.530 (13.46) Lead Spacing: 0.400 (10.16) Nominal
E105D	300k-750k		0.75W	—	600					0.160 (4.06) x 0.820 (20.83) x 0.530 (13.46) Lead Spacing: 0.650 (16.51) Nominal
E106D	400k To 1 Meg.		1.0W	—	800					0.260 (6.60) x 1.190 (30.23) x 0.530 (13.46) Lead Spacing: 0.900 (22.86) Nominal

Value Engineered & Standard Stock Precision Resistors



Model Number	Resistance (Ohms)	Tolerance[1]	Power at 70°C	Power at 125°C	Max. Work. Voltage	Nominal TCR[2] (−55°C to +125°C)	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Maximum Dimensions Inch (mm) W x L x H
V53C1[4]	1Ω-100k	To ±0.02%	0.6W	0.3W	300	±10 ppm/°C (Ref. @ 25°C)	0.003% 1 Year	0.05% 2000 Hrs. @125°C	0.105 (2.67) x 0.302 (7.67) x 0.326 (8.28) Dim. Tol. ±0.010 (0.25) Lead Spacing: 0.150 (3.81) Nominal
V53C5	1Ω-200k		1.0W	0.5W	350				0.160 (4.06) x 0.575 (14.61) x 0.530 (13.46) Lead Spacing: 0.400 (10.16) Nominal
V53C6	1Ω-300k		1.5W	0.75W	350				0.160 (4.06) x 0.820 (20.83) x 0.530 (13.46) Lead Spacing: 0.650 (16.51) Nominal
V53C7	0.5Ω-600k		2.0W	1.0W	500				0.260 (6.60) x 1.190 (30.23) x 0.530 (13.46) Lead Spacing: 0.900 (22.86) Nominal

Axial Leaded Resistors



Model Number	Resistance (Ohms)	Tolerance[1]	Power at 70°C	Power at 125°C	Work. Voltage	Nominal TCR[2] (−55°C to +125°C)	Shelf-Life Stability (Max. ΔR)[3]	Load-Life Stability (Max. ΔR)[3]	Nominal Dimensions Inch (mm)
VTA-52 (RBR-52)	1.150KΩ	1.0 to .01%	1.0W	.5W	300V	+10ppm/°C (−55°C to +125°C)	25ppm 1 year	0.05% 2000 Hrs. @125°C	1.00 (25.4)L x .375 (9.53) dia.
VTA-53 (RBR-53)			.66W	.33W					.750 (19.05)L x .375 (9.53) dia.
VTA-54 (RBR-54)			5W	.25W					.750 (19.05)L x .260 (6.60) dia.
VTA-55 (RBR-55)			.3W	.15W					.500 (12.70)L x .260 (6.60) dia.
VTA-56 (RBR-56)			.25W	.125W					.356 (9.04)L x .260 (6.60) dia.

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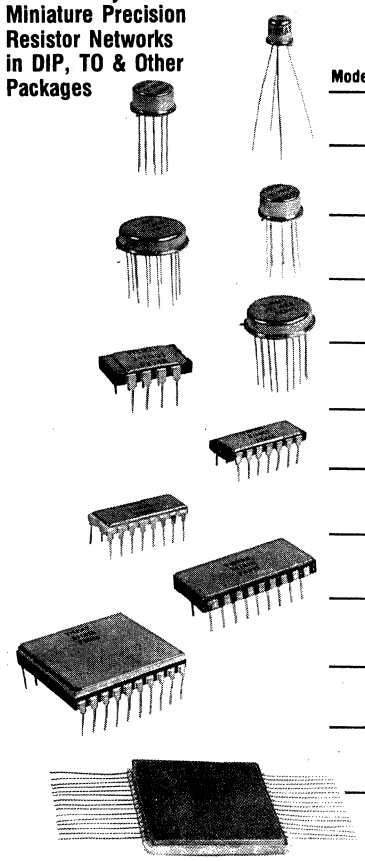
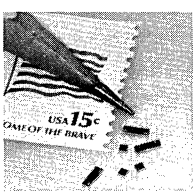
Hermetically Sealed Miniature Precision Resistor Networks in DIP, TO & Other Packages



Model Number	Type Package	Max. No. of V5 x 5 Resistor	R Value of each Individual Resistor	Tol. Ratio Between Resistors @25°C	TCR Ratio Between Resistors 0°C to +60°C (Ref. @25°C)	TCR Ratio Between Resistors −55°C to +125°C (Ref. @25°C)	Maximum Dimension (Excluding leads) inch (mm)
1403	4 pin TO-18	5					0.200 (5.08) H x 0.212 (5.38) Dia. 0.100 (2.54) pin circle
1413	8 pin TO-5	9					0.200 (5.08) H x 0.370 (9.40) Dia. 0.200 (5.08) pin circle
1417	8 pin TO-5	12					0.200 (5.08) H x 0.362 (9.19) Dia. 0.230 (5.84) pin circle
1419	10 pin TO-5	12					0.200 (5.08) H x 0.362 (9.19) Dia. 0.230 (5.84) pin circle
1421	12 pin TO-8	49					0.200 (5.08) H x 0.602 (15.29) Dia. 0.400 (10.16) pin square
1422	16 pin TO-8	49			Standard Spread: ±1.5 ppm/°C	Standard Spread: ±2.0 ppm/°C	0.200 (5.08) H x 0.602 (15.29) Dia. 0.400 (10.16) pin square
1442	8 pin DIP	12	30k	to 0.005%	Maximum Spread: ±2.5 ppm/°C Available To: 0.5 ppm/°C	Maximum Spread: ±2.3 ppm/°C Available To: 0.5 ppm/°C	0.10 (2.55) H × 0.53 (13.47)L × 0.-32 (8.16) 0.300 (7.62) pin spacing
1445	14 pin DIP	30					0.100 (2.54) H x 0.778 (20.54) L x 0.296 (7.52)W 0.300 (7.62) pin spacing
1446	16 pin DIP	36					0.100 (2.54) H x 0.81 (20.57) L x 0.298 (7.57)W 0.300 (7.62) pin spacing
1457	18 pin DIP	80					0.150 (3.81) H x 1.007 (25.58) L x 0.5 (12.7)W 0.300 (7.62) pin spacing
1460	20 pin 1"x1" Plug-in	221					0.220(5.59) H × 1.01 (25.65) L × 0.90 (22.85) W 0.900 (22.86) pin spacing
1476	30 pin 1"x1" Flatpack	225					0.125 (3.17) H x 1.148 (29.16) L x 0.950 (24.13)W 0.06 (1.52) axial lead pin spacing

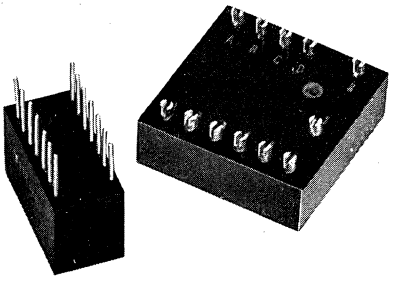
Micro (V5x5) & Minichip (V15x5) Resistors for Hybrid Microcircuits



Model Number	Resistance (Ohms)	Trim Range	Tolerance[1]	Power at 70°C	Max. Work. Voltage	Nominal TCR[2]	Standard TCR Spread from Nominal[2]	Shelf-Life Stability (Max. Δ R)[3]	Load-Life Stability (Max. Δ R)[3]	Nominal Chip Dimensions Inch (mm) L x W x T
V5X5	5-5k	0 To 1.2x Nominal Prevalue	To ±0.02% (±0.005%)[4]	0.05W	40	+0.6ppm/°C (0°C To +25°C)	±1.5ppm/°C	0.005%/Yr; 0.0005%/Yr Hermetically Packaged	0.05% 2000 Hrs. @ 70°C	0.050 (1.27) x 0.050 (1.27) x 0.020 (0.508)
						−0.6ppm/°C (+25°C To +60°C)	±1.5ppm/°C			
						+2.2ppm/°C (−55°C To +25°C)	±2.0ppm/°C			
V15X5	5-30k	0 To 1.3x Nominal Prevalue		0.1W	40	−1.8ppm/°C (+25°C To +125°C)	±2.0ppm/°C			0.150 (3.81) x 0.050 (1.27) x 0.020 (0.508)

(Higher resistance ranges and larger size chips available)

Standard and Custom Resistance Networks



CUSTOM AND STANDARD BINARY LADDER NETWORKS, BCD LADDERS, ETC.

- Up to 16 bits
- ½ LSB to ±0.001 full-scale accuracy
- 25-ppm total impedance stability over 3 years

Besides designing completely custom precision networks to your most demanding specifications, Vishay offers standard binary R-2R ladder networks in 4-bit to 16-bit configurations (voltage-fed) with resistance values from 1 ohm to 50kΩ; 2R to 100kΩ.

Three basic package styles (nominal dimensions): **Profile 500,** 0.750" (19.05 mm) W x 0.500" (12.70 mm) H. **Profile 375,** 1.230" (31.24 mm) W x 0.365" (9.27 mm) H. Lengths dependent on number of bits: min. 0.700" (17.78 mm) for 4-bit Profile 500 to 2.14" (54.35 mm) for 16-bit ladder; min. 0.730" (18.54 mm) for Profile 375 to 2.59" (65.78 mm) for 15-bit package. **Profile 200,** 1.0" (25.4 mm) W x 1.0" (25.4 mm) L x 0.200" (5.08 mm) H only.

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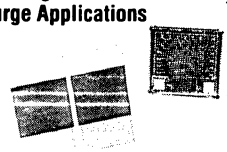
Precision Power Plate Resistors for Current Sensing & Power Surge Applications



Model Number	Resistance (Ohms)	Tolerance[1]	Power at 125°C (Per Sq. In.)	Resistance Element Area Square Inch (mm)		Nominal TCR[2]	Shelf-Life Stability (Max. Δ R)[3]	Load-Life Stability (Max. Δ R)[3]	Nominal Plate Dimensions Inch (mm) L x W x T
V3PR-300589	10-5k	To ±0.005%[8]	10W[9]	1.00	(25.40)	±2 ppm/°C	0.0025%/Yr.	0.03% 2000 Hrs. @125°C	1.000 (25.4) x 1.000 (25.4) x 0.025 (0.635)
V3PR-300586	0.25	To ±0.25%	10W[9]	0.98	(24.89)	−3 ppm/°C To +9 ppm/°C ±10ppm/°C			1.600 (40.64) x 1.700 (43.18) x 0.025 (0.635)
V3PR-300338	0.5								
V3PR-300571	1.0			0.658	(16.71)				1.750 (44.45) x 1.20 (28.45) x 0.025 (0.635)
V3PR-300572	2.0								
V3PR-300610	2.0 (4 R's)[10]			11.2	(284.48)				4.000 (101.6) x 5.000 (127.0) x 0.025 (0.635)

Precision Trimming Potentiometers

Model Number	Resistance (ohms)	Tolerance	Power	TCR (End-to-End)[11]	No. of Adj. Turns	Load-Life Stability (Max. Δ R)[3]	Nominal Dimensions (Excluding Leads) H x L x W Inch (mm) and Termination Styles
1¼" rectilinear Model 1202							
1202 (RJ12 Style)	2, 5, 10	±10%, ±20%	0.50W @ 85°C		25 ±2	1% 2000 Hrs. @ 85°C	0.325 (8.255) x 1.250 (31.750) x 0.195 (4.953) Type P: In-line pins Type Y: Staggered pins Type L: Flexible leads Type LB: Panel-mount with flexible leads
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±5%, ±10%					
¼ " square Models 1240, 1242							
1240 (RJR26 Style)	5, 10	±10%	0.25W @ 85°C	+10 ppm/°C (−55°C To +25°C) −10 ppm/°C (+25°C To +150°C)	21 ±2	1% 10000 Hrs. @ 85°C	0.250 (6.350) x 0.250 (6.350) x 0.175 (4.445) Type X: Edge-mount, side-adjust Type W: Edge-mount, top-adjust
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k,	±5%					
1242 RJ26	50, 100, 200, 500, 1k, 2k 5k	±10%				2% 1000 Hrs. @ 85°C	0.175 (4.445) x 0.250 (6.350) x 0.250 (6.350) Type P: Flat-mount, side adjust
¾ " Rectilinear Models 1280, 1285							
1280	10, 20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±10%	0.75W @ 25°C	+15 ppm/°C (−55°C To +25°C) −15 ppm/°C (+25°C To +125°C)	26 ±2	0.5% 2000 Hrs. @25°C	0.270 (6.86) x 0.750 (19.05) x 0.190 (4.83)
1285	10	±10%					(Panel mount available)
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±5%		+5 ppm/°C (−55°C To +25°C) −5 ppm/°C (+25°C To +125°C)			

Precision Resistive Miniature Voltage Dividers

	Model Number[12]	No. of Resistors	R Value of Each Individual Resistor[13]	Tol. Ratio Between Resistors at 25°C		TCR Ratio Between Resistors 0° to +60°C (Ref. @ 25°C)	TCR Ratio Between Resistors −55°C to +125°C (Ref. @ 25°C)	Maximum Dimensions (Excluding Leads) H x L x W x Inch (mm)
Voltage Dividers Attenuators BCD Decades	**300190, 1**	2	100Ω-100kΩ					0.160 (4.06) x 0.575 (14.61) x 0.530 (13.46)
	300192, 3, 4	3	100Ω-100kΩ					0.160 (4.06) x 0.820 (20.83) x 0.530 (13.46)
	300195, 6, 7, 8, 9	4	100Ω-100kΩ			Standard Spread: ±1.5 ppm/°C	±2.0 ppm/°C	**0.260 (6.60) x 1.190 (30.23) x** 0.530 (13.46)
Parallel Config.	**300210**	3	100Ω-100kΩ	1.0%, 0.1%, 0.02%, 0.005%	0.5%, 0.05%, 0.01%,	Maximum Spread: ±2.5 ppm/°C	±2.3 ppm/°C	0.160 (4.06) x 0.820 (20.83) x 0.530 (13.46)
	300211, 12	4	100Ω-100kΩ			Available to: 0.5 ppm/°C	0.5 ppm/°C	**0.260 (6.60) x 1.190 (30.23) x** 0.530 (13.46)
Mini Volt. Dividers	**3G0144C***	2(1 chip)	100Ω-40kΩ[14]			(−55°C to +125°C) Maximum Spread: 1.0 ppm/°C Available to: 0.1 ppm/°C		0.320 (8.128) x 0.295 (7.493) x 0.100 (2.540) (Nominal)
	300145C	4(2 chips)	100Ω-40kΩ[14]					0.375 (9.525) x 0.375 (9.525) x 0.200 (5.080) (Nominal)

*(Hermetically sealed model available)

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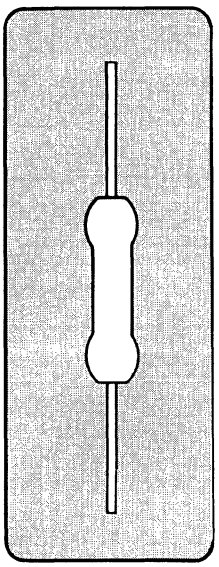
Ward Leonard Axial Lead Resistors



Application

These miniaturized, space-saving axial lead resistors find wide-spread application in computers, instruments, communication, and other electronic equipment. Axiohm® resistors meet the exacting requirements of printed circuit board and other automated equipment in addition to terminal board, point-to-point wiring, and mechanical connections.

Construction

Precision dimensioned ceramic cores are equipped with end caps and tinned axial leads for fast, easy soldering. Low TC alloy resistance wire is spot welded to end caps insuring a permanent low resistance bond. The cement, silicone, or vitreous enamel coating seals and protects the resistance wire.

Temperature Coefficient

Standard T.C. is ±180ppm/°C.

Resistance Tolerance

Standard ±5%. Closer tolerances on special order.

Optional Features

Non-Inductive Resistors — Specially designed axial lead resistors can be supplied for high frequency circuits. These resistors utilize the Ayrton-Perry method of winding in which two single layer windings run in opposite directions and cross at points 180° apart providing minimum inductance and distributed capacitance.

Controlled or Limited Inductance — Resistors are available with special single windings in which the winding is controlled not to exceed a specified inductance.

Reel Packs — Single or double adhesive tape for bulk packing resistors for automatic feeding in automated assembly line can be supplied.

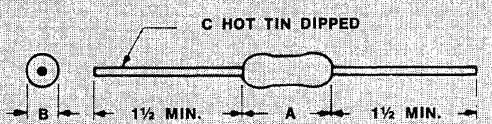
Ordering Information

1. Quantity
2. State watt rating, type coating (C = Cement, SX = Silicone, X = Vitreous enamel) and ohms. Example: A five watt cement coated axial lead resistor of 1,000 ohms would be ordered as 5C1000.
3. Resistance tolerance if other than standard ±5%.
4. Optional features
5. T.C. Other Than Standard

Axial Lead Resistors — Ratings and Sizes

Watt Rating at 325° C Temperature Rise, 25° C Ambient	Resistance Range in Ohms† Min.	Resistance Range in Ohms† Max.	Standard Resistance Tolerance	Dielectric Withstanding Voltage	Maximum Voltage Rating††	Dimensions (in inches) A ±1/16	B ±1/32	C B & S Gauge
1	0.1	7,500	±5%	500	100	13/32ⓘ	3/32	#24 (.020" dia.)
2	0.1	10,000	±5%	500	300	3/8	3/16	#20 (.032" dia.)
3	0.1	20,000	±5%	500	450	1/2	3/16	#20 (.032" dia.)
4	0.1	30,000	±5%	500	600	11/16	3/16	#20 (.032" dia.)
5	0.1	40,000	±5%	500	800	15/16	3/16	#20 (.032" dia.)
7	0.1	50,000	±5%	500	875	1	5/16	#20 (.032" dia.)
10	0.1	125,000	±5%	500	1600	1-3/4	5/16	#20 (.032" dia.)
12.5	0.1	175,000	±5%	500	1600	1-3/4	3/8	#20 (.032" dia.)

†Other resistance values on order.
††Voltage not to exceed $\sqrt{R \times P}$
ⓘ±1/32.



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WARD LEONARD, 31 South St., Mount Vernon, N.Y. 10550 • Phone 914-664-1000 • Telex 13-7427 • TWX 710-562-0144

Fixed Tubular Resistors

Application

Fixed resistors introduce only one pre-determined amount of resistance into a circuit.

Construction

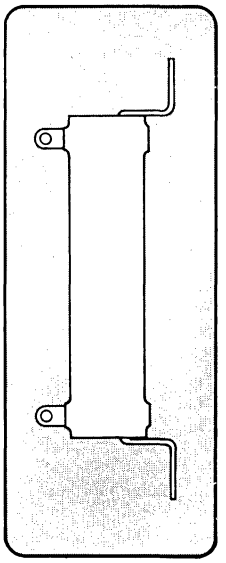
Standard fixed tubular resistors are single layer wound and furnished with two lug terminals that are pre-tinned for fast, easy soldering. They can be supplied with cement, silicone or vitreous enamel coatings.

Resistance Tolerance

±5% standard. Below one ohm ±10%.

Ordering Information

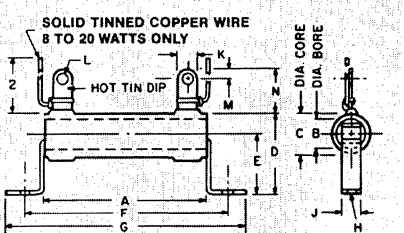
1. Quantity required.
2. Watt rating.
3. Type coating (FC = cement, FS = silicone, F = vitreous enamel).
4. Resistance value (in ohms).
   Example: A 10-watt cement coated fixed resistor of 500 ohms would be ordered as 10FC500.



Fixed Tubular Resistors — Lug Terminals

Watt Rating at 300° C Temperature Rise, 40° C Ambient	Resistance Range in Ohms† Min.	Max.	Standard Resistance Tolerance	Std. Lug Terminal Type No.	Mounting Bracket†† Type No.
8	0.5	12,000	±5%	225	829
10	0.5	28,000	±5%	225	829
12	0.5	36,000	±5%	225	829
15	0.5	40,000	±5%	225	835
20	0.5	62,000	±5%	225	835
25	0.5	70,000	±5%	219	813
30	0.5	77,000	±5%	219	826
35	0.5	115,000	±5%	219	813
50	0.5	185,000	±5%	219	813
70	0.5	275,000	±5%	219	814
100	0.5	450,000	±5%	219	814
130	0.5	500,000	±5%	252	815
160	0.5	650,000	±5%	252	815
180	0.5	750,000	±5%	252	815
225	0.5	900,000	±5%	252	815

†Other resistance values on order.
††Spring clip push-in type mounting brackets furnished only when specified on order.
Note: Maximum Voltage Ratings based on 495 R.M.S. (700 peak) volts per linear inch of core length. Voltage must not exceed $\sqrt{R \times P}$

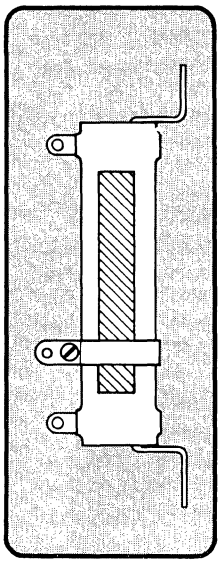


Dimensions — In Inches (Approximate)

Watt Rating	A	B	C	D	E	F	G	H dia.	J	K	L dia.	M	N
8	1	7/32	5/16	—	—	—	—	—	—	3/16	.089	1/8	7/16
10	1-1/2	7/32	5/16	—	—	—	—	—	—	3/16	.089	1/8	7/16
12	1-3/4	7/32	5/16	—	—	—	—	—	—	3/16	.089	1/8	7/16
15	1-1/2	5/16	7/16	—	—	—	—	—	—	3/16	.089	1/8	7/16
20	2	5/16	7/16	—	—	—	—	—	—	3/16	.089	1/8	7/16
25	2	25/64	9/16	1	21/32	2-5/8	3	.156	1/4	1/4	.144	5/32	9/16
30	2	29/64	5/8	1-1/16	11/16	2-5/8	3	.156	1/4	1/4	.144	5/32	9/16
35	3	25/64	9/16	1	21/32	3-5/8	4	.156	1/4	1/4	.144	5/32	9/16
50	4	25/64	9/16	1	21/32	4-5/8	5	.156	1/4	1/4	.144	5/32	9/16
70	4-1/2	17/32	3/4	1-5/8	13/16	5-1/4	6	.187	3/8	1/4	.144	5/32	9/16
100	6-1/2	17/32	3/4	1-5/8	13/16	7-1/4	8	.187	3/8	1/4	.144	5/32	9/16
130	6-1/2	3/4	1-1/8	1-15/16	1-5/16	7-1/4	8	.187	1/2	5/16	.169	5/32	5/8
160	7-1/2	3/4	1-1/8	1-15/16	1-5/16	8-1/4	9	.187	1/2	5/16	.169	5/32	5/8
180	8-1/2	3/4	1-1/8	1-15/16	1-5/16	9-1/4	10	.187	1/2	5/16	.169	5/32	5/8
225	10-1/2	3/4	1-1/8	1-15/16	1-5/16	11-1/4	12	.187	1/2	5/16	.169	5/32	5/8

Ward Leonard

Adjustable Tubular Resistors



Application

Ward Leonard Adjustohm® resistors are designed for use in electronic and other circuitry where resistance values must be adjusted from time to time or where intermediate resistance values are required.

Construction

Adjustable tubular resistors are manufactured to the same precise specifications as fixed tubular resistors. Each wire-wound resistor has a bare side, two lug terminals and one adjustable band.

Ordering Information

1. Quantity required 2. Watt rating
3. Type coating (AC=cement, AS=silicone, A=vitreous enamel)
4. Resistance value (in ohms)

Example: A 12 watt cement coated adjustable resistor of 1,000 ohms would be ordered as 12AC1000.

Adjustable Bands

Resistor Size (in Watts)	Band Cat. No.
12	609
30	612
50	612
70	612
130	615
180	615
225	615

NOTE: When adjustable contact band is positioned to obtain resistance required, the power rating must be lowered in proportion to the adjusted resistance to nominal. To determine power rating, use the following equation:

$$P_M = \frac{R_A}{R_N}$$

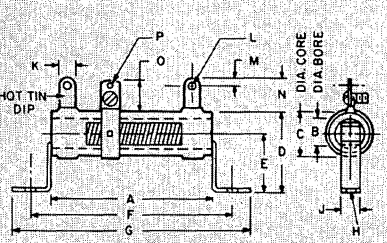
Where: P_M=Max. Power Rating (in Watts)
R_A=Resistance in Ohms (Adjusted)
R_N=Resistance in Ohms (Nominal)

Adjustable Tubular Resistors — Lug Terminals

Watt Rating at 300° C Temperature Rise	Resistance Range in Ohms† Min.	Max.	Standard Resistance Tolerance	Maximum Voltage Rating	Core and Length	Std. Lug Terminal Type No.	Adjustable Band Type No.	Mounting Bracket†† Type No.
12	1	8,000	+10%,-5%	Ratings based on 495 R.M.S. (700 peak) volts per linear inch of core length. Voltage must not exceed $\sqrt{RxP}$	Z1¾"	211	609Z	829
30	1	20,000	+10%,-5%		A2"	219	612A	826
50	1	40,000	+10%,-5%		T4"	219	612T	813
70	1	63,000	+10%,-5%		B4½"	219	612B	814
130	1	150,000	+10%,-5%		D6½"	252	615D	815
180	1	200,000	+10%,-5%		D8½"	252	615D	815
225	1	200,000	+10%,-5%		D10½"	252	615D	815

†Other resistance values on order. ††Spring clip push-in mounting brackets furnished only when specified on order.

Watt Rating	A	B	C	D	E	F	G	H dia.	J	K	L	M	N	O	P
12	1-3/4	7/32	5/16	7/16	9/32	2-1/8	2-7/16	144	1/4	3/16	089	1/8	7/16	9/16	116
30	2	29/64	5/8	1-1/16	11/16	2-5/8	3	156	1/4	1/4	144	5/32	9/16	3/4	144
50	4	25/64	9/16	1	21/32	4-5/8	5	156	1/4	1/4	144	5/32	9/16	3/4	144
70	4-1/2	17/32	3/4	1-5/8	13/16	5-1/4	6	187	3/8	1/4	144	5/32	9/16	3/4	144
130	6-1/2	3/4	1-1/8	1-15/16	1-5/16	7-1/4	8	187	1/2	5/16	169	5/32	5/8	25/32	169
180	8-1/2	3/4	1-1/8	1-15/16	1-5/16	9-1/4	10	187	1/2	5/16	169	5/32	5/8	25/32	169
225	10-1/2	3/4	1-1/8	1-15/16	1-5/16	11-1/4	12	187	1/2	5/16	169	5/32	5/8	25/32	169



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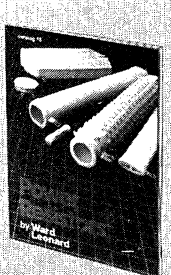

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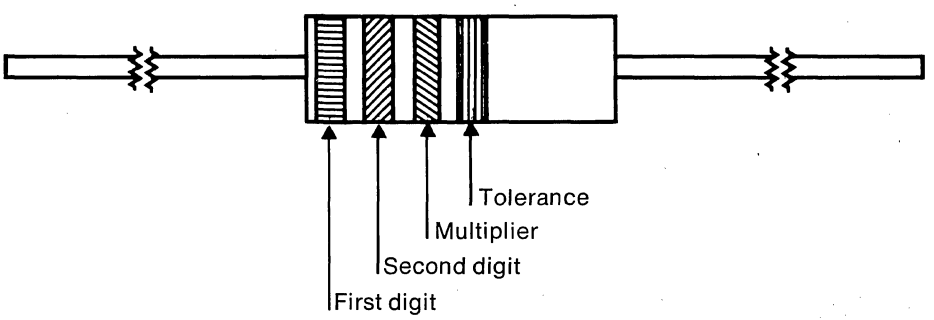
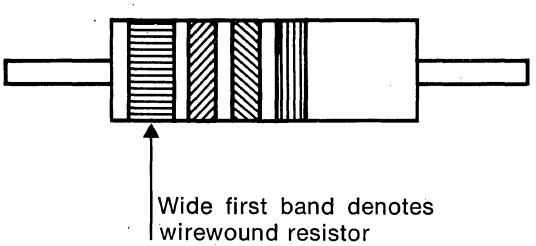
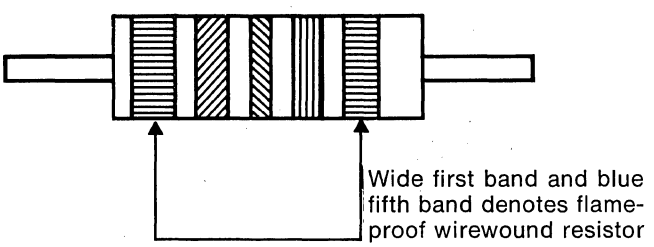
MINIGLOSSARY
RESISTOR COLOR CODES

EIA/MIL Resistor Color Codes



Color code for general-purpose industrial resistors

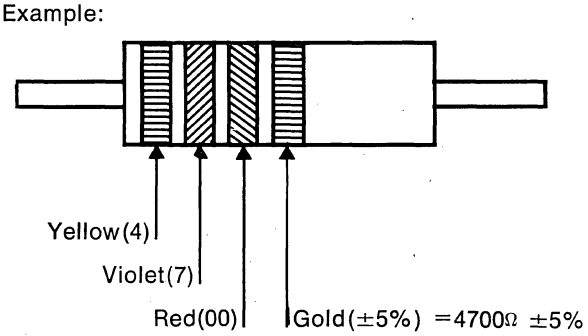




Color code for general-purpose wirewound resistors

Color	Significant digit	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	± 1%
Red	2	100	± 2%
Orange	3	1000	± 3%
Yellow	4	10,000	± 4%
Green	5	100,000	—
Blue	6	1,000,000	—
Violet	7	10,000,000	—
Gray	8	—	—
White	9	—	—
Gold	—	0.1	± 5%
Silver	—	0.01	±10%
No color	—	—	±20%

Example:



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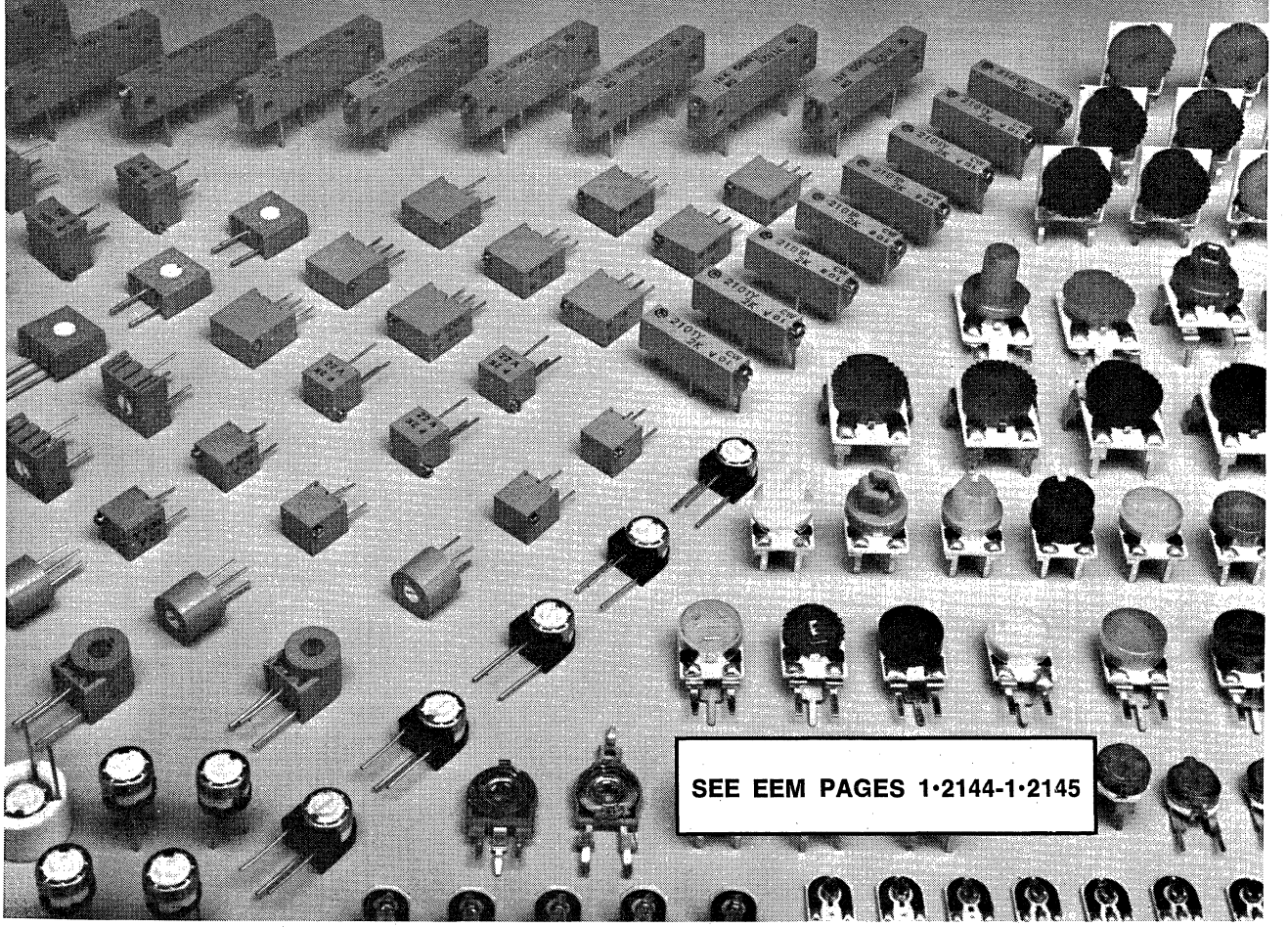


SEE EEM PAGES 1•2144-1•2145

POTENTIOMETERS

Manufacturer	Carbon Film	Carbon Comp	Cermet	Conductive Plastic	Hybrid	Wirewound	Rheostat	Single Turn	Multiturn	Precision	Linear	Servo Mount	Motorized	MIL
Allen-Bradley		1•2115	1•2115	1•2115										
Bourns			1•2128	1•2128, 1•2130		1•2129		1•2130	1•2129	1•2130	1•2128	1•2130		
CTS			1•5703					1•5703						
Duncan/Systron Donner				1•2132, 1•2135	1•2132	1•2132		1•2132	1•2132		1•2133	1•2132		1•2132
E-Systems/Memcor Div.						1•2134	1•2134							
ETI				1•2135	1•2135	1•2135			1•2135	1•2135	1•2135		1•2135	1•2135
Iskra	1•2136		1•2136											
Maurey Instrument				1•2137-1•2140		1•2137-1•2139					1•2138	1•2137, 1•2140		1•2137, 1•2140
Mura		1•2143						1•2143						
Ohmite		1•2147				1•2146, 1•2147	1•2146, 1•2147							1•2147
Samarius				1•2148		1•2148		1•2148	1•2148	1•2148	1•2148	1•2148		
Shogyo											1•2149			
Spectrol			1•2151, 1•2154	1•2151, 1•2154		1•2153, 1•2155, 1•2156		1•2152, 1•2154	1•2152, 1•2153, 1•2155	1•2152, 1•2153, 1•2155	1•2152, 1•2153	1•2152-1•2155		
Vernitech				1•2159				1•2159	1•2159	1•2159	1•2159	1•2159		
VRN Intl.			1•2162			1•2161, 1•1265 1•2168-1•2170, 1•2174				1•2177				
Weston						1•2185								

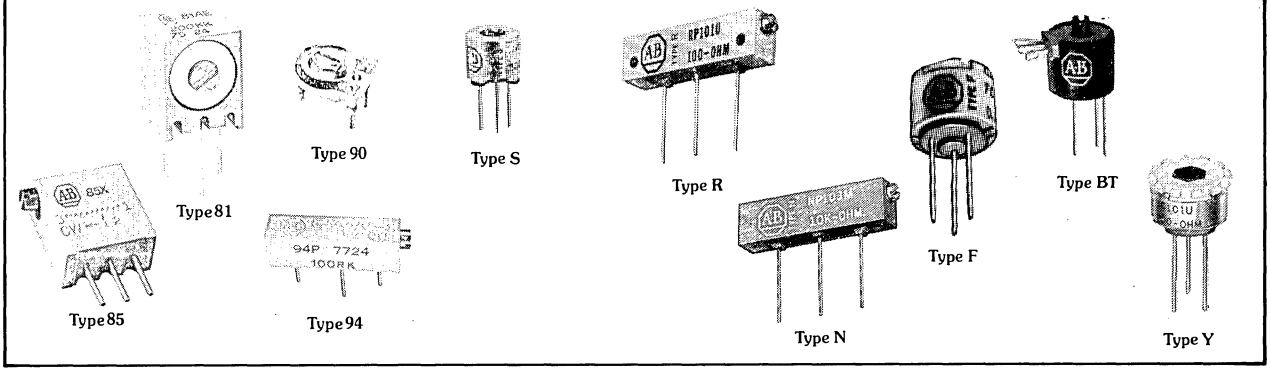
TRIMMERS

Manufacturer	Carbon Film	Carbon Comp	Cermet	Conductive Plastic	Metal Film	Wirewound	Single Turn	Multiturn	Precision	Rectilinear	MIL
Allen Bradley		1•2113	1•2113	1•2114			1•2113	1•2113		1•2113	
Bourns			1•2117-1•2121, 1•2123			1•2118-1•2220	1•2117	1•2118-1•2121-		1•2118, 1•2119	1•2118-1•2120
CTS			1•2131				1•2131				
Iskra										1•2136	
Mepco/Electra			1•2141				1•2141	1•2141			1•2141
Mura		1•2143					1•2143				
Murata/Erie		1•2110	1•2110	1•2110			1•2110, 1•2144	1•2144			
Spectrol			1•2150			1•2151	1•2151	1•2150, 1•2151		1•2150, 1•2151,	
Vishay								1•2157	1•2157	1•2157	1•2157
VRN Intl.			1•2162-1•2167, 1•2171-1•2173, 1•2175			1•2161, 1•2165, 1•2168-1•2170, 1•2174			1•2177		
Weston			1•2184, 1•2186-1•2190			1•2185-1•2190					

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.

Types 81,85,90,94, S,N,R,F,BT,Y Trimming Potentiometers



SPECIFICATIONS

Type	Publication Number	Resistance Element and Adjustment Turns	Resistance Range and Tolerance	Power	Voltage Rating (RMS or DC)	Operating Temperature Range	Terminal Types	Case Dimensions in Inches (millimeters)	Enclosure
81	EC5731-2.1	Cermet Single Turn	10 Ohms to 1 Megohm ±10%, ±20%	0.5 Watt at 70°C	300V	−55°C to +125°C	Pin	0.25 (6,35) Diameter by 0.25 (6,35)	Immersion Sealed
85	EC5735-2.1	Cermet Multi-Turn	10 Ohms to 2 Megohms ±10%, ±20%	0.5 Watt at 70°C	300V	−55°C to +125°C		L 0.4 (10) H 0.42 (10,7) W 0.21 (5,3)	
90	EC5770-2.1	Cermet Single Turn	100 Ohms to 2 Megohms ±20%	0.5 Watt at 70°C 1.0 Watt at 40°C	200V	−55°C +125°C		L 0.466 (11,9) W 0.393 (10,0) D 0.228 (5,8)	Open Frame
94	EC5774-2.1	Cermet Multi-Turn	10 Ohms to 2 Megohms ±10%, ±20%	0.5 Watt at 70°C 0.75 Watt at 25°C	300V	−55°C +125°C		L 0.76 (19,3) H 0.45 (11,55) W 0.2 (5,08)	Immersion Sealed
S	EC5720-2.1	Cermet Single Turn	50 Ohms to 1 Megohm ±10%	0.5 Watt at 85°C		−65°C +150°C		0.375 (9,52) Diameter by 0.375 (9,52)	
N	EC5815-2.1	Composition Multi-Turn	100 Ohms to 2.5 Megohms ±10%, ±20%	0.33 Watt at 50°C		−55°C to +100°C		L 1.250 (31,75) H 0.359 (9,13) W 0.250 (6,35)	
R	EC5820-2.1			0.25 Watt at 70°C		−55°C to +125°C	Pin or Solder Lug		
F	EC5806-2.1	Composition Single Turn	100 Ohms to 5 Megohms ±10%, ±20%	0.25 Watt at 70°C	350V	−55°C to +120°C	Pin or Solder Lug	0.500 (12,70) Diameter by 0.531 (13,49)	
BT	EC5920-2.1			Consult Factory		−40°C to +120°C	Front: 3 Lugs Rear: 3 Pins or Front: 2 Pins Rear: 2 Pins	0.500 (12,70) Diameter by 0.535 (13,59)	Dust and Splash Resistant
Y	EC5828-2.1			0.25 Watt at 50°C	350V	−55°C to +100°C	Pin or Solder Lug	0.500 (12,70) Diameter by 0.359 (9,13)	Dust and Splash Resistant

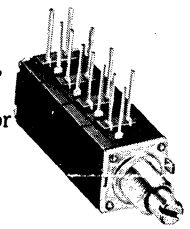
Conductive Plastic, Cermet and Hot-Molded Carbon Composition Panel Potentiometers

SPECIFICATIONS

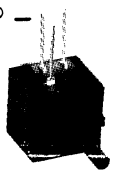
Type	Publication Number	Resistance Element	Resistance Range and Tolerance	Power Rating (Linear Taper)	Voltage Rating (RMS or DC)	Operating Temperature Range	Number of Sections Available	Case Dimensions in Inches (millimeters)	Enclosure
Series 70	EC5670-2.1	Cermet	100 Ohms to 5 Megohms ±10%	2.0 Watts @ 70° C	350V	−55° C to +150° C	1, 2, 3 or 4	0.625 (15,88) Square Lug terminals: 0.594 (15,08) Deep Pin terminals: 0.625 (15,88) Deep (Single Section)	Dust and Splash Resistant
		Hot-Molded Composition	50 Ohms to 10 Megohms ±10%, ±20%	1.0 Watt @ 70° C		−55° C to +120° C			
		Conductive Plastic	100 Ohms to 1 Megohm ±10%, ±20%	0.5 Watt @ 70° C					
Series 72	EC5670-2.1	Cermet	100 Ohms to 5 Megohms ±10%	1.0 Watt @ 70° C		−55° C to +100° C	1 or 2		
		Hot-Molded Composition	50 Ohms to 10 Megohms ±10%, ±20%	0.5 Watt @ 70° C					
		Conductive Plastic	100 Ohms to 1 Megohm ±10%, ±20%	0.25 Watt @ 70° C					
Series 73	EC5670-2.1	Cermet	100 Ohms to 5 Megohms ±10%	2.0 Watts @ 70° C		−55° C to +120° C			
		Hot-Molded Composition	50 Ohms to 10 Megohms ±10%, ±20%	0.75 Watt @ 70° C 1.0 Watt @ 40° C					
		Conductive Plastic	100 Ohms to 1 Megohm ±10%, ±20%	0.5 Watt @ 70° C					
J(RV4)	EC5607-2.1	Hot-Molded Composition	50 Ohms to 5 Megohms ±10%, ±20%	2.25 Watts @ 70° C	500V	−55° C to +120° C	1, 2 or 3	0.625 (15,88) Deep by 1.156 (29,36) Diameter (Single Section) [1]	
EJ	EC5620-2.1			2.25 Watts @ 70° C			1 or 2		
G(RV6)	EC5605-2.1		100 Ohms to 5 Megohms ±10%, ±20%	0.5 Watt @ 70° C	350V	−55° C to +120° C	1	For G and W: 0.469 (11,91) Deep For WR: 0.422 (10,72) Deep by 0.500 (12,70) Diameter Above dimensions for types G and WR do not include the available switch option [1]	Immersion Sealed
W(RV6) WP	EC5612-2.1			0.5 Watt @ 70° C		−55° C to +120° C	1		
WR	EC5650-2.1			0.5 Watt @ 70° C					Dust and Splash Resistant
SP	EC5640-2.1	Cermet	50 Ohms to 1 Megohm ±10% (5% available)	1.0 Watt @ 70° C	300V	−65° C to +150° C		0.438 (11,11) Deep by 0.375 (9,52) Diameter	Immersion Sealed
M	EC5610-2.1	Conductive Plastic	100 Ohms to 1 Megohm ±20%	0.1 Watt @ 40° C	90V	−25° C to +100° C	1 or 2	0.394 (10,0) Cubed All Versions	Dust and Splash Resistant
2000	EC5680-2.1		250 Ohms to 1 Megohm ±20%	0.5 Watt @ 70° C	350V	−55° C to +125° C	1	0.625 (15,88) Square	Sealed for Board Washing

[1] All depth dimensions are maximum.

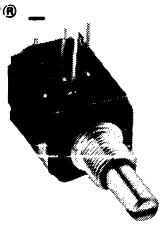
Series 70 MOD POT® – Modular design innovated by Allen-Bradley offers almost unlimited combinations: single, dual, triple or quadruple sections. Options include PC or solder lug terminals, variety of switches, vernier drives, concentric shafts, hot-molded composition, cermet or conductive plastic resistance elements.



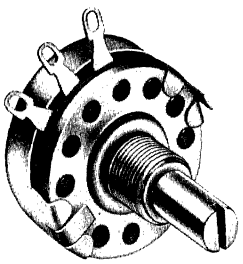
Series 72 MOD POT® – Similar to Series 70, except the bushing and shaft are non-metallic. Available in single or dual combination only.



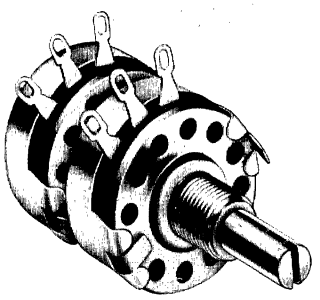
Series 73 MOD POT® – Similar to Series 70, except the bushing is of a more economical design.



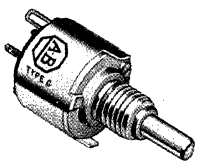
Type J (RV4) — Standard of the industry for quality. Hot-molded composition, 50 ohms to 5 megs, ±10% and ±20% (special values to 1000 megs available), 2.25W at 70° C, single, dual, triple sections available. Switch for single or dual sections.



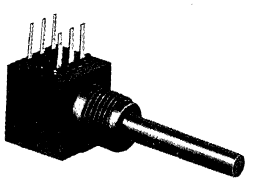
Type EJ — Extra long life version of the Type J with rotational life exceeding one million rotations, single or dual configurations. Slip clutch available.



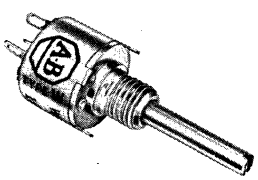
Type G (RV6) – Hot-molded composition, 100 ohms to 5 megs, ±10% and ±20%, 0.5W at 70° C, single section available with or without SPST switch.



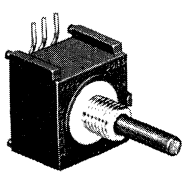
Type M — Miniature conductive plastic. 100 ohms to 1 meg., ±20%, 0.1W at 40° C, single and dual sections available. Switches optional. 5 terminal options. Non-metallic case, bushing and shaft.



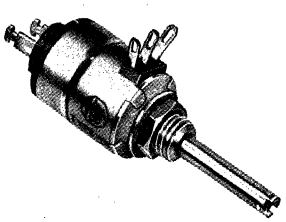
Type W (RV6) – Hot-molded composition, 100 ohms to 5 megs, ±10% and ±20%, 0.5W at 70° C, single section.



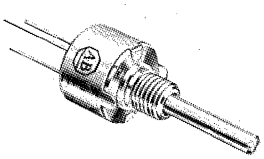
Type 2000 — Designed cost-effective in conductive plastic. 250 ohms to 1 meg, ±20%, 0.5W at 70°C single section. Terminal options available. Non-metallic case and shaft. Choice of bushing.



Type WR — Radial-lead version of Type W. Available with or without switch. Switch versions offer contacts that close at start of clockwise rotation (TYPE WRS) or with switch with contacts that close at start of counter-clockwise rotation (TYPE WRH).



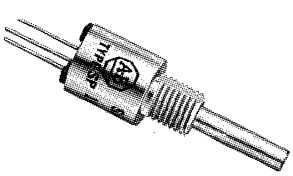
Type WP — Pin-terminal version of Type W. Suited for printed circuit board mounting.

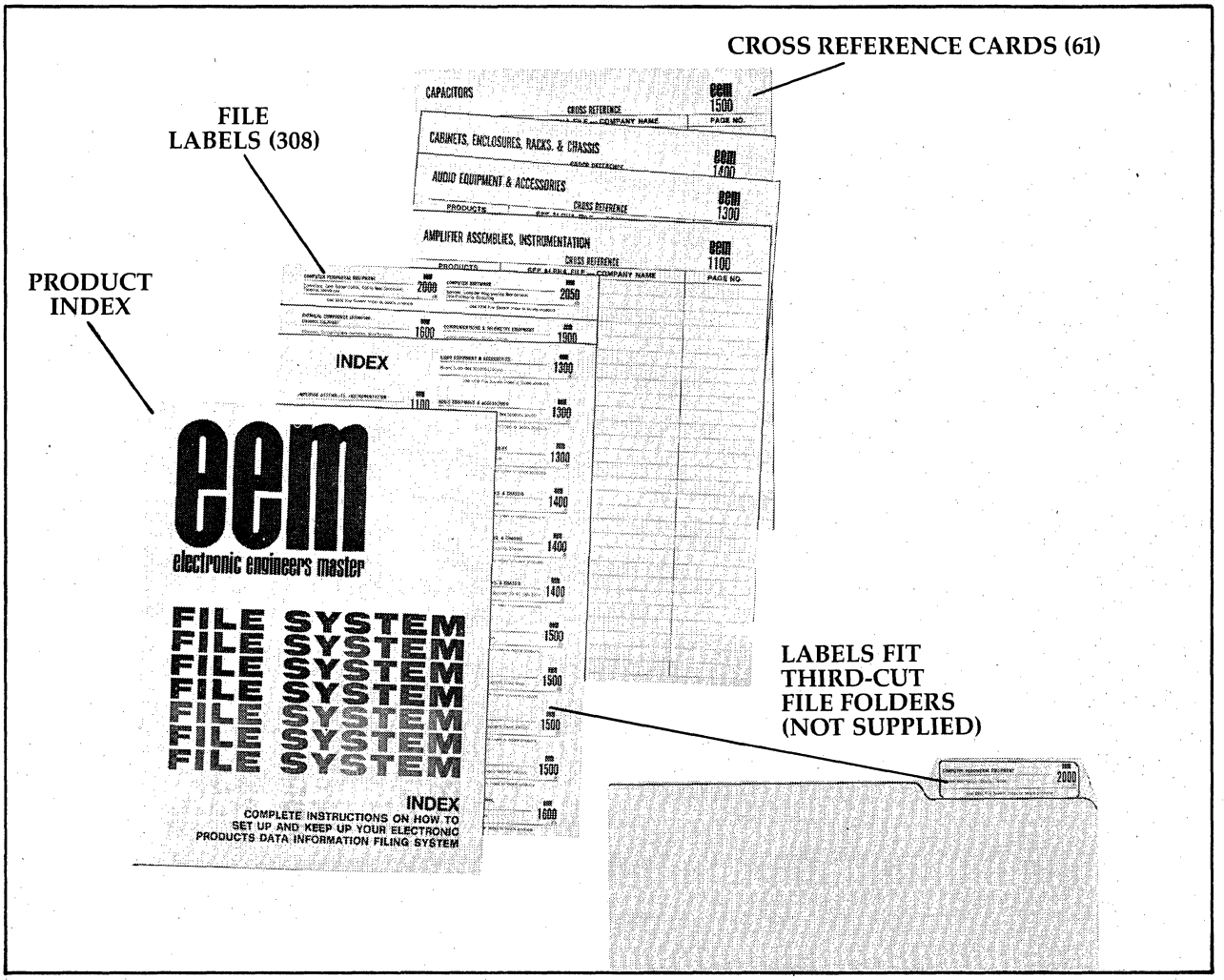


Standard options for most types include linear and non-linear tapers, a variety of shafts, bushings, shaft endings, shaft lengths, and hardware.

Types J and the multi-section MOD POT® with composition tracks are well suited for attenuator applications.

Type SP — Cermet, 50 ohms to 1 meg, ±10%, 1.0W at 70° C, single section. Only 3/8 inch diameter.





WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
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MFT® THE FUTURE IN TRIMMER/RESISTOR TECHNOLOGY

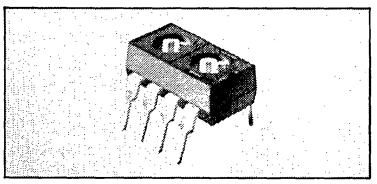
Bourns has combined the worlds best technologies used in producing cermet trimmers and cermet fixed resistor networks.

This innovative packaging concept results in improved circuit performance, reduced design time, increased reliability, and better temperature tracking than discrete equivalents.

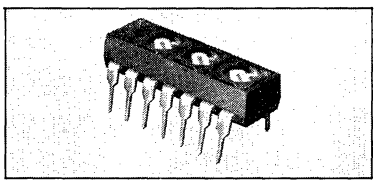
MFT trimmers/resistors are compatible with automatic test and insertion equipment, and their sealed construction enables them to be mounted prior to board washing.

Standard Models Available

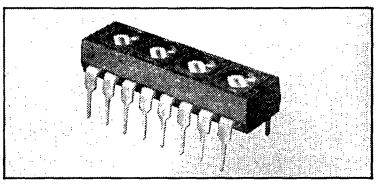
7102B
two single turn trimmers



7103C
three single turn trimmers



7104D
four single turn trimmers



Part Numbers Available From Bourns Distributors

Part Numbers	Detail R1	R2
7102B-210-101	101	101
-210-102	102	102
-210-103	103	103
-210-104	104	104

Part Numbers	Detail R1	R2	R3
7103C-310-103	103	103	103
-310-104	104	104	104

Part Numbers	Detail R1	R2	R3	R4
7104D-410-101	101	101	101	101
-410-102	102	102	102	102
-410-103	103	103	103	103
-410-104	104	104	104	104

SPECIFICATIONS

GENERAL Ref. model 7102B

ELECTRICAL

Rated Voltage.....V.P.R.P=Resistance; Up to 115V Absolute Max.
Total Package Power @ 85°C....0.50 Watt (Max.)
Total Package Power @ 125°C.....0.20 Watt (Max.)
Dielectric Withstanding Voltage.....900 VRMS (Max.)
Insulation Resistance.....1,000MΩ (Min.)

ENVIRONMENTAL

Temperature Range,
Operational.....−55°C to + 125°C
Storage.....−55°C to + 150°C
Temperature Coefficient, R1 or R2.....100 ppm/°C (Max.)
Terminal Strength, Pull.....4.5 lbs./30 sec.
Bend.....8 ounces
Short Time Overload (TRS), 2.5 x RATED Voltage for 5 Seconds.....0.25% (Max.)
Moisture Resistance.....1000MΩ (Min.)

POTENTIOMETER

ELECTRICAL

Range of R1 & R2 (Std.).....100, 1KΩ 10KΩ 100KΩ
Actual Electrical Travel (Nom.).....230°
End Resistance.....2 or 0.1% (Max.)

PHYSICAL

Adjustment Torque.....0.1 to 2 oz.-in. (Max.)
Mechanical Stops.....Solid, 3 oz.-in. (Min.)

ENVIRONMENTAL

Rotational Life.....200 Cycles (Min.)
Vibration, 30Gs, 45 Hz to 2 Hz, Contact Bounce.....0.1 ms (Max.)
(±) TRS.....1%
Shock, 100G's, Contact Bounce....0.1 ms (Max.)
(±) VRS.....1%
Low Temperature Exposure (TRS), 24 hours @ −55°C.....2.0% (Max.)
High Temperature Exposure (TRS), 24 hours @ +125°C.....3.0%
Humidity (TRS).....2.0%

MECHANICAL

8 Pin, 14 Pin, & 16 Pin Dual In Line (DIP) Packages per JEDEC Standards

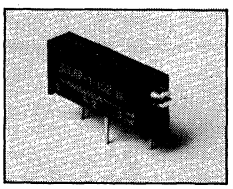
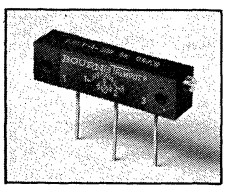
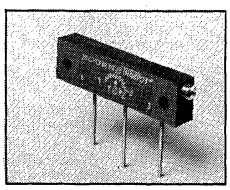
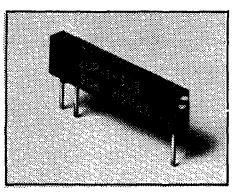
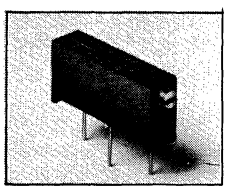
Specifications subject to change without notice.

BOURNS INC

BOURNS® RECTANGULAR MULTI-TURN TRIMMERS

TRIMPOT®, TRIMIT®, and E-Z-TRIM® TRIMMING POTENTIOMETERS

3005P	**3010**	**3057**	**20**	**3006**
¾″ long, industrial	1¼″ long, industrial	1¼″ long, industrial and military RT12, RTR12	.785″ long, Trimpot® Industrial SIP	¾″ long, industrial

	Wirewound			Cermet	
Resistance Range	10-50,000Ω	10-50,000Ω	10-100,000Ω	10-5,000,000Ω	10-2,000,000Ω
Resistance Tolerance*	±10% Std.	±5% Std.	±5% Std.	±10% Std.	±10% Std.
Contact Resistance Variation	N/A	N/A	N/A	1.0% or 1 ohm (whichever is greater)	1.0% or 1 ohm (whichever is greater)
Adjustability	Within Resolution	Within Resolution	Within Resolution	±0.01%	±0.01%
Insulation Resistance 500 VDC	100 MegΩ (Min.)	1000 MegΩ Min.	1000 MegΩ Min.	100 MegΩ Min.	100 MegΩ Min.
Power Rating	1.0 Watt @ 40°C	1.0 Watt @ 70°C	1.0 Watt @ 70°C	0.25 Watt @ 70°C (250 Volt Max.)	0.75 Watt @ 70°C (400 Volt Max.)
Temperature Range	−65°C to +125°C	−65°C to +150°	−55°C to +150°C	−55°C to +125°C	−55°C to +125°C
Temperature Coefficient	±50 ppm/°C max.	±50 ppm/°C max.	±50 ppm/°C max	±100 ppm/°C max.	±100 ppm/°C max.
Seal	MIL-R-27208 Immersion	MIL-R-27208 Immersion	MIL-R-27208 Immersion	MIL-R-22097 Immersion	MIL-R-22097 Immersion
Load Life (1000 hrs.)	1.0 watt @ 40°C	1.0 watt @ 70°C	1.0 watt @ 70°C	0.25 watt @70°C	0.75 watt @70°C
Mechanical Life	200 Cycles	200 Cycles	200 Cycles	200 Cycles	200 Cycles
Mechanical Adjustment	20 Turns	22 Turns	22 Turns	15 Turns	15 Turns
Mech. Stops	Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles

*Closer Tolerances Available.

Specifications subject to change without notice.

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TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
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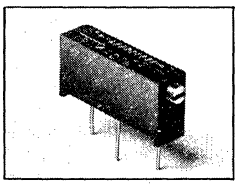
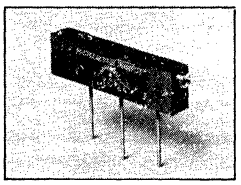
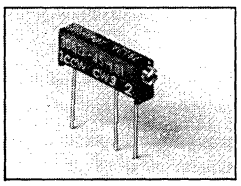
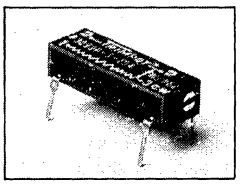
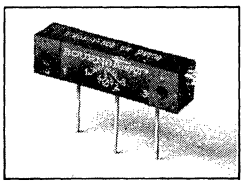
3009	**3059**	**3082**	**3099**	**3012**
¾″ long, industrial	1¼″ long, industrial and military RJ12, RJR12	½″ long, industrial and military RJR28	¾″ long, DIP industrial and military RJR32	1¼″ long, industrial
				
Cermet				
10-2,000,000Ω	10-2,000,000Ω	10-2,000,000Ω	10-2,000,000Ω	10-5,000,000Ω
±10% Std.	±10% Std.	±10% Std.	±10% Std.	±10% Std.
1.0% or 1 ohm (whichever is greater)	1.0% or 1 ohm (whichever is greater)	3.0% or 3 ohms (whichever is greater)	1.0% or 1 ohm (whichever is greater)	1.0% or 1 ohm (whichever is greater)
± 0.01%	± 0.01%	±0.03%	±0.01%	±0.01%
100 MegΩ min.	1000 MegΩ min.	1000 MegΩ min.	100 MegΩ min.	1000 MegΩ (min.)
0.75 Watt @ 70°C (400 Volt Max.)	1.0 Watt @ 70°C (400 Volt Max.)	0.6 Watt @ 25°C (400 Volt Max.)	1.0 Watt @ 70°C (400 Volt Max.)	1.0 Watt @ 70°C (500 Volt Max.)
−55°C to +125°C	−55°C to +150°C	−65°C to +150°C	−55°C to −150°C	−65°C to +150°C
±100 ppm/°C max.	±100 ppm/°C max.	±100 ppm/°C max.	±100 ppm/°C max.	±100 ppm/°C max.
MIL-R-22097 Immersion	MIL-R-22097 Immersion	MIL-R-39035 Immersion	MIL-R-39035 Immersion	MIL-R-22097 Immersion
0.75 Watt 70°C	1.0 Watt 70°C	0.6 Watt 25°C	1.0 Watt 70°C	1.0 Watt 70°C
200 Cycles	200 Cycles	200 Cycles	200 Cycles	200 Cycles
15 Turns	22 Turns	10 Turns	20 Turns	22 Turns
Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles

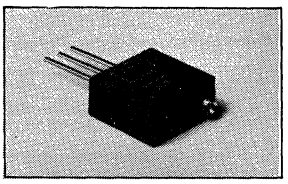
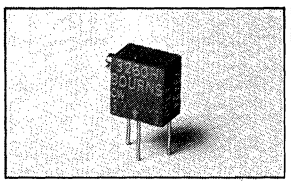
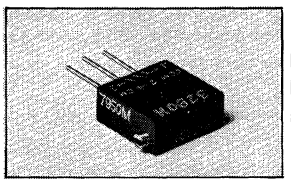
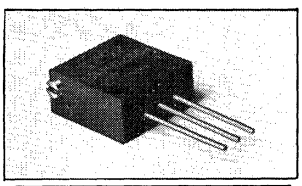
*Closer Tolerances Available.

Specifications subject to change without notice.

TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
TWX 910-332-1252, CBL BOURNSINC, TLX 676-423 • TEL 714 781-5050

BOURNS® SQUARE MULTI-TURN TRIMMERS

3250	**3260**	**3290**	**3252**
½" square, industrial and military RT22, RTR22	¼" square, industrial and military RT26	⅜" square, industrial and military RT24, RTR24	½" square, industrial and military RJ22

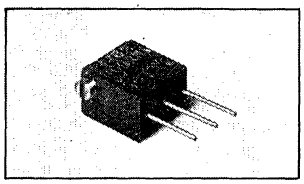
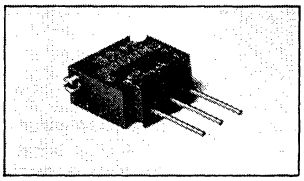
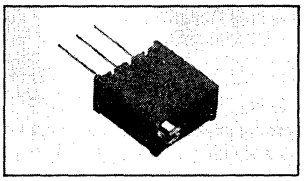
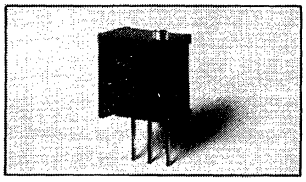





	Wirewound			Cermet
Resistance Range	10-50,000Ω	10-25,000Ω	10-50,000Ω	10-2,000,000Ω
Resistance Tolerance	±5% Std.	±5% Std.	±5% Std.	±10% Std.
Contact Resistance Variance	N/A	N/A	N/A	3.0% or 3 ohms (whichever is greater)
Adjustability	Within Resolution	Within Resolution	Within Resolution	±0.01%
Insulation Resistance 500 VDC	1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.
Power Rating	1.0 Watt @ 70°C	0.25 Watt at 85°C	1.0 Watt @ 70°C	1.0 Watt @ 70°C (400 Volt Max.)
Temperature Range	−65°C to +150°C	−65°C to +150°C	−65°C to +150°C	−65°C to +150°C
Temperature Coefficient	±50 ppm/°C max.	±50 ppm/°C max.	±50 ppm//°C max.	±100 ppm/°C max.
Seal	MIL-R-27208 Immersion	MIL-R-27208 Immersion	MIL-R-27208 Immersion	MIL-R-22097 Immersion
Load Life (1000 hrs.)	1.0 Watt at 70°C	0.25 Watt at 85°C	1.0 Watt at 70°C	1.0 Watt at 70°C
Mechanical Life	200 Cycles	200 Cycles	200 Cycles	200 Cycles
Mechanical Adjustment	25 Turns	11 Turns	25 Turns	22 Turns
Mechanical Stop	Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles

*Closer Tolerances Available.

Specifications subject to change without notice.

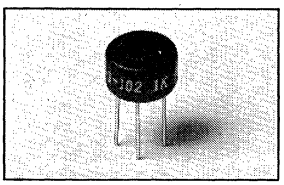
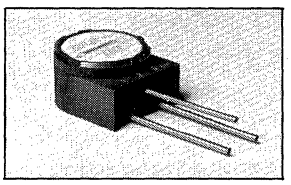
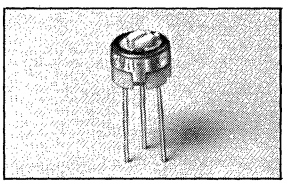
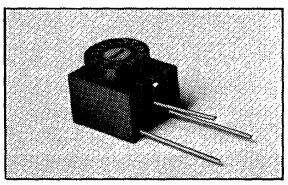
TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
TWX 910-332-1252, CBL BOURNSINC, TLX 676-423 • TEL 714 781-5050

3262	**3292**	**3296**	**3299**
¼″ square, industrial and military RJ26, RJR26	⅜″ square, industrial and military RJ24, RJR24	⅜″ square industrial	⅜″ square industrial
			
Cermet			
10-1,000,000Ω	10-1,000,000Ω	10-5,000,000 Ω	10-5,000,000Ω
±10% Std.	10% Std.	10% Std.	10% Std.
3.0% or 3 ohms (whichever is greater)	3.0% or 3 ohms (whichever is greater)	3.0% or 3 ohms (whichever is greater)	3.0% or 3 ohms (whichever is greater)
±0.02%	±0.01%	±0.01%	±0.01%
1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.
0.25 Watt @ 85°C (300 Volt Max.)	0.5 Watt @ 85°C (400 Volt Max.)	0.5 Watt @ 70°C (300 Volt Max.)	0.5 Watt @ 70°C (300 Volt Max.)
−65°C to +150°C	−65°C to +150°C	−55°C to +125°C	−55°C to +125°C
±100 ppm/°C Max.	±100 ppm/°C Max.	± 100 ppm/°C Max.	±100 ppm/°C Max.
MIL-R-22097 Immersion	MIL-R-22097 Immersion	MIL-R-22097 Immersion	MIL-R-22097 Immersion
0.25 Watt at 85°C	0.5 Watt at 85°C	0.5 Watt at 70°C	0.5 Watt at 70°C
200 Cycles	200 Cycles	200 Cycles	200 Cycles
12 Turns	22 Turns	25 Turns	25 Turns
Wiper Idles	Wiper Idles	Wiper Idles	Wiper Idles

Specifications subject to change without notice.

BOURNS INC
TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
TWX 910-332-1252, CBL BOURNSINC, TLX 676-423 • TEL 714 781-5050

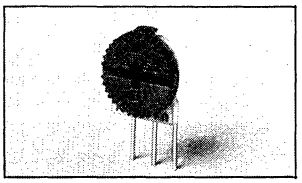
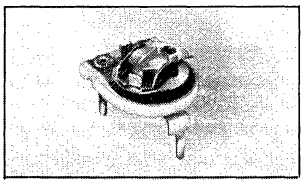
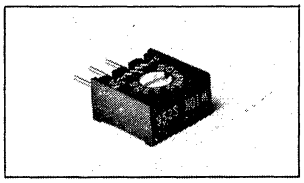
BOURNS® SINGLE TURN TRIMMERS

	3305 5/16" diameter industrial	**3345** 1/2" diameter industrial	**3329** 1/4" diameter industrial	**3339** 5/16" diameter industrial
				
	Wirewound		**Cermet**	
Resistance Range	10-25,000Ω	10-50,000Ω	10Ω to 1,000,000Ω	10-1,000,000Ω
Resistance Tolerance*	5% Std.	±5% Std.	±10% Std.	±10% Std.
Contact Resistance	N/A	N/A	3.0% or 3 ohms (whichever is greater)	3.0% or 3 ohms (whichever is greater)
Adjustability	Within Resolution	Within Resolution	±0.05%	±0.05%
Insulation Resistance 500 VDC	1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.	1000 MegΩ Min.
Power Rating	0.5 Watt @ 70°C	1.0 Watt @ 70°C	0.5 at 85°C (300 Volt Max.)	0.5 Watt @ 85°C (300 Volt Max.)
Temperature Range	−65°C to +150°C	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C
Temperature Coefficient	±70 ppm/°C Max.	±70 ppm/°C Max.	±100 ppm/°C Max.	±100 ppm/°C Max.
Seal	MIL-R-27208 Immersion	MIL-R-27208 Immersion	MIL-R-22097 Immersion	MIL-R-22097 Immersion
Load Life (1000 hrs.)	0.5 Watt at 70°C	1.0 Watt at 70°C	0.5 Watt at 85°C	0.5 Watt at 85°C
Mechanical Life	200 Cycles	200 Cycles	200 Cycles	200 Cycles
Adjustment Angle	280° (Nom.)	300° (Nom.)	240° (Nom.)	4 Turns
Mechanical Angle	300° (Nom.)	310° (Nom.)	260° (Nom.)	Wiper Idles

***Closer Tolerances Available.**

Specifications subject to change without notice.

BOURNS **TRIMPOT DIVISION,** 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
TWX 910-332-1252, CBL BOURNSINC, TLX 676-423 • TEL 714 781-5050

3352	**3359**	**3386**
⅜″ diameter industrial	⅜″ diameter industrial	⅜″ square, industrial
		
Cermet		
10-5 MegΩ	100-2,000,000Ω	10-2,000,000Ω
20% Std.	20% Std.	±10% Std.
1.0% or 1 ohm (whichever is greater)	2.0% or 3 ohms (whichever is greater)	1.0% or 1 ohm (whichever is greater)
±0.01%	±0.05%	±0.03%
10 MegΩ Min.	10 MegΩ Min.	1000 MegΩ Min.
0.75 Watt @ 40°C (250 Volt Max.)	75 Watt at 40°C (250 Volt Max)	0.5 Watt @ 85°C (300 Volt Max.)
−55°C to +125°C	−65°C to +125°C	−55°C to +125°C
±100 ppm/°C Max.	±100 ppm/°C Max.	±100 ppm/°C Max.
No	No	MIL-R-22097 Immersion
0.5 Watt at 85°C	0.75 Watt at 40°C	0.5 Watt at 85°C
200 Cycles	500 Cycles	200 Cycles
205° (Nom.)	230° (Nom.)	280° (Nom.)
225° (Nom.)	270° (Nom.)	310° (Nom.)

Specifications subject to change without notice.

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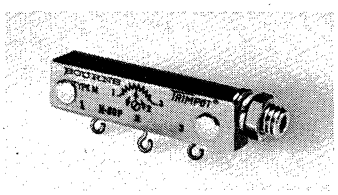
TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
TWX 910-332-1252, CBL BOURNSINC, TLX 676-423 • TEL 714 781-5050

PANEL MOUNTING DETAILS

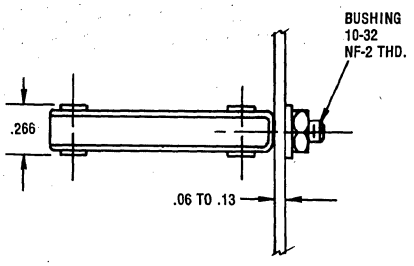
Many Bourns models are available for panel mount application (see following details for models). To order units with the hardware attached, simply select the part number you want from the standard part number table on the individual catalog sheet and add M after the part number. For the model 3006 a Z should be used instead of an M.

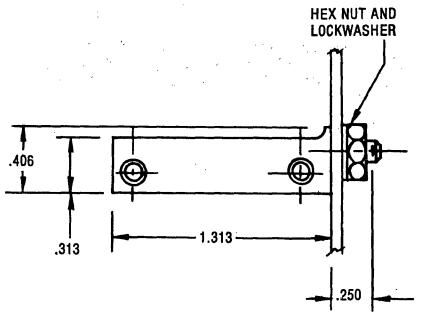
EXAMPLES 3057L-1-102M
3059J-1-503M
3292L-1-105M
3006P-1-502Z

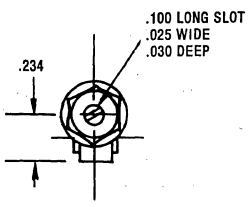


3059J-1-(RC)M

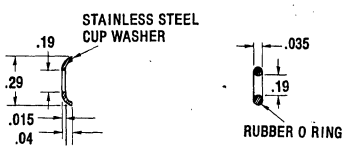
MODEL 3057 AND 3059







FOR PANEL SEAL ORDER H-82 AND POSITION ON BUSHING BEHIND PANEL



NOTES:
1. Provided with lockwasher and mounting nut.
2. Recommended panel hole. #10 drill (.194).

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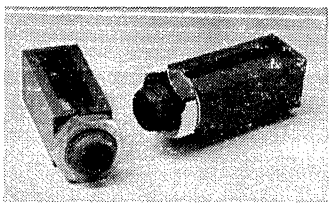
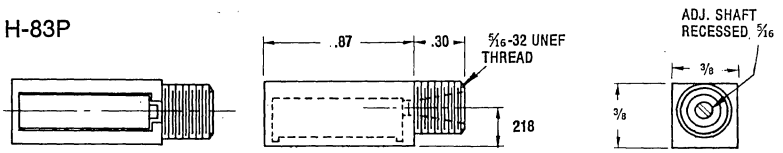
PANEL MOUNTING DETAILS



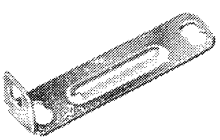
You can provide your own panel mount assembly by using a standard Model 3005 or 3006 with the H-83P Adaptor — simply select the part number you want and snap fit the unit in the plastic case. The H-83P with lockwasher and mounting nut is available in 50-piece lots.

H-83P

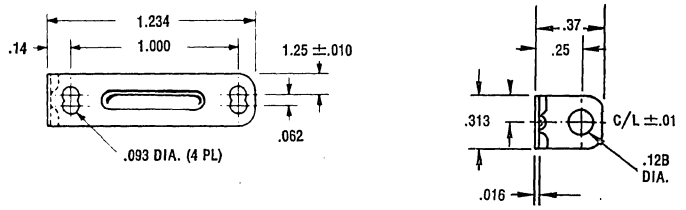


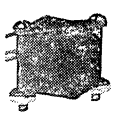
MOUNTING HARDWARE

The following hardware is available for special mounting applications.

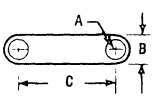


H-11E END BRACKET FOR MODELS 3057 AND 3059

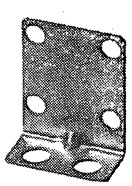




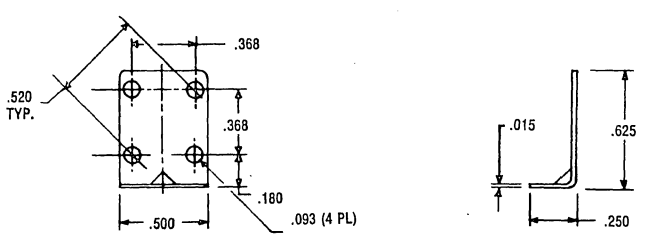
STACKING STRAPS
H-25 FOR MODELS 3250 AND 3252
H-28 FOR MODELS 3290 AND 3292

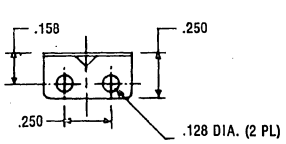


DIM.	H-25	H-28
A	.093	.070
B	.143	.125
C	.520	.419



H-26 SIDE BRACKET FOR MODELS 3250 AND 3252





NOTE: All mounting hardware is stainless steel.

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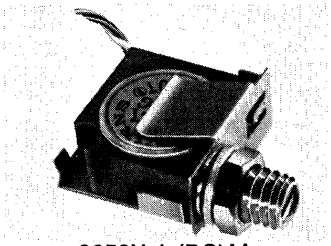
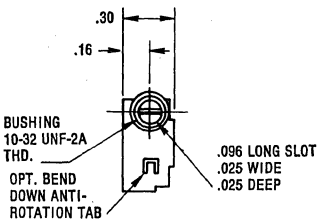
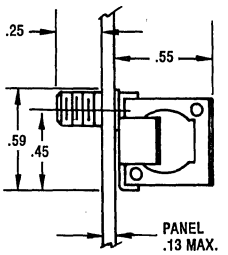
PANEL MOUNTING DETAILS



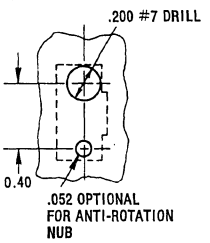
3252X-1-(RC)M

MODELS 3250 AND 3252

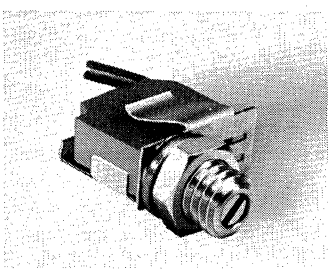




PANEL LAYOUT

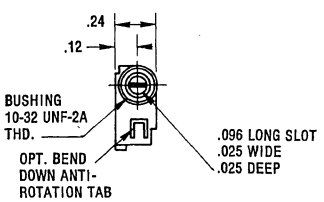


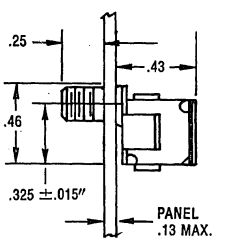
NOTE: Provided with lockwasher and mounting nut.



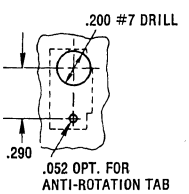
3290L-1-(RC)M

MODELS 3290 AND 3292

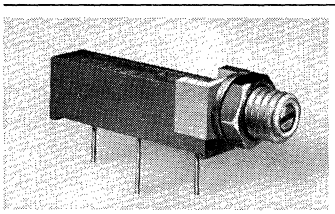




PANEL LAYOUT

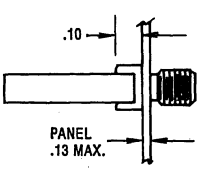


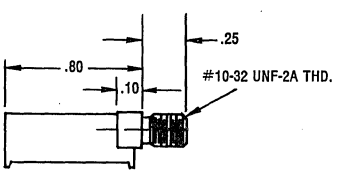
NOTE: Provided with lockwasher and mounting nut.

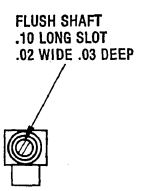


3006P-1-(RC)Z

MODEL 3005, 3006 AND 3009







NOTES:
1. Provided with lockwasher and mounting nut.
2. Recommend panel hole size .200 #7 Drill.

TRIMPOT DIVISION, 1200 COLUMBIA AVENUE, RIVERSIDE, CA 92507
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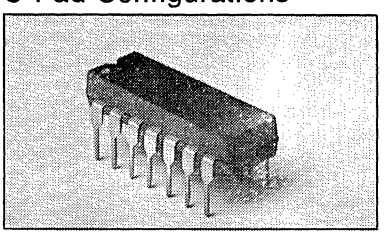
BOURNS® ATTENUATORS

Bourns offers an extensive line of fixed, variable and switchable attenuators. All Bourns attenuators are available in both standard and custom configurations. Our Engineering Departments can custom design special attenuators for your specified applications.

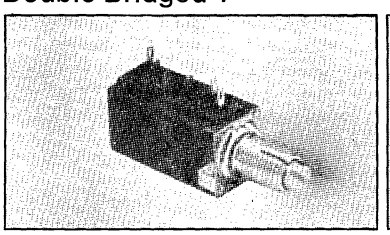
Fixed Attenuators

Models
4114R-033
4114R-033-001
4114R-033-002
O-Pad Configurations



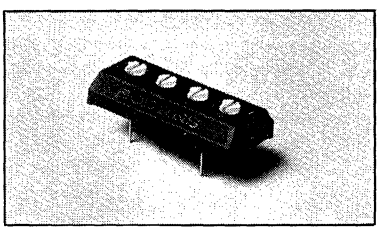
Variable Attenuators

Models 81/82
Straight T-Pad
Bridged T
Bridged H or
Double Bridged T



Switchable Attenuators

Model
3100
T and O-Pad
Configurations



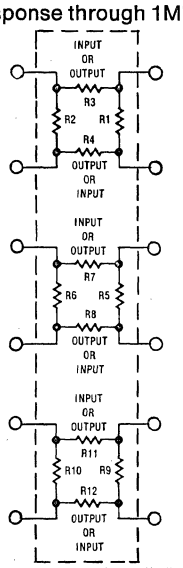
NETWORKS DIVISION

Pre-assembled 14 pin DIP'S contain balanced or unbalanced attenuator pads. Available in 1/2 dB steps to 36 dB

Features include temperature coefficient of ±100 ppm/°C operating temperature −65°C to 125°C

Attenuation tolerance (dB) of ±1%

Flat response through 1MHz



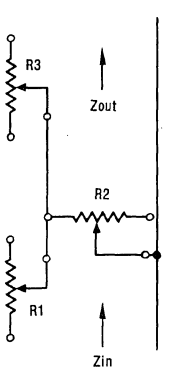
O-Pad

PRECISIONS CONTROLS DIVISION

Thick film cermet elements achieve infinite resolutions and setting stability

Straight T, bridged T and double bridged T-Pad are available with 10% or 20% impedance tolerances

Minimum attenuation loss 0.2 dB all models with flat response through complete audio range



Straight T-Pad

TRIMPOT DIVISION

Bourns Model 3100 switchable attenuators incorporate both switching and attenuator network functions in a single integrated package resulting in reduced component count, assembly costs and PC board space

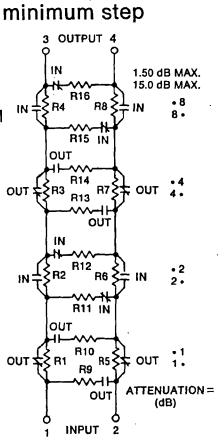
Input impedance 600Ω ±2% or 75Ω ±5.0%
Balanced and Unbalanced

Power rating + 15dBm (Max.)

Attenuator Range: 0-1.5, 0-15, and 0-24 dB

Binary Weighted Switching, 0.1 dB minimum step

Consult factory for additional types and values



O-Pad

Specifications subject to change without notice.

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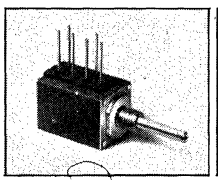
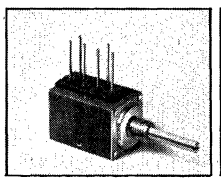
BOURNS® PANEL CONTROL POTENTIOMETERS

81/82



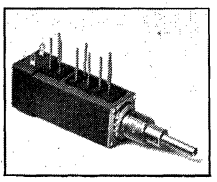
- 5/8 Inch Square
- Modular Construction
- Single or Multiple Sections
- Linear or Audio Tapers
- Single or Concentric Shafts
- Cermet
- Conductive Plastic

87/88



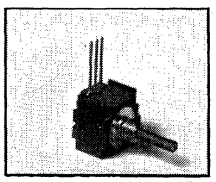
- 5/8 Inch Square
- Modular Construction
- Single or Multiple Sections
- Semi-Precision Linear Tapers
- Single or Concentric Shafts
- Cermet
- Conductive Plastic

85/86*



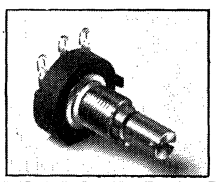
- 5/8 Inch Square
- Modular Construction
- Multiple Sections
- DPST and DPDT Rotary Switches*
- Single or Concentric Shafts
- Cermet
- Conductive Plastic

91/92



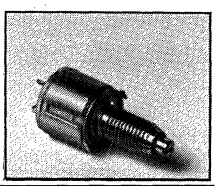
- 5/8 Inch Square
- Modular Construction
- Single or Dual Sections
- Linear or Audio Tapers
- Plastic Shaft
- Cermet
- Conductive Plastic
- Single Shaft

3851/3852



- 3/4 Inch Diameter
- 1/4 Inch Depth
- Single Section
- Linear or Audio Tapers
- Cermet
- Conductive Plastic
- Single Shaft

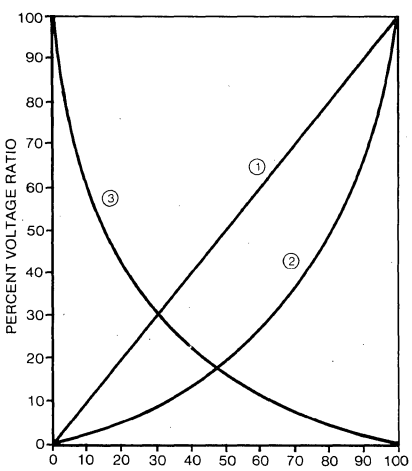
3862



- 1/2 Inch Diameter
- Rear Terminals
- Single Section
- Linear Taper
- 1/8 Inch Diameter Shaft Only
- Cermet
- Single Shaft

RESISTANCE RANGE

50†
75† △
100†
150△
200△
250
500
750△
1K
1.5△
2K△
2.5K
5K
7.5K△
10K
15K△
20K△
25K
50K
75K△
100K
150K△
200K△
250K
500K
750K△
1 Meg
2.5 Meg
5.0 Meg



Audio tapers available from 1K to 2.5 megohm only.

SWITCH TYPE

Type	Detent	Contacts
DPST	CW	Open/Closed
		Open/Open
		Closed/Closed
	CCW	Open/Closed
		Open/Open
		Closed/Closed
DPDT	CW	Open/Closed
	CCW	Open/Closed

Taper Code	Description	Linearity	Tol.	Fig. Ref.
A	Linear-Cermet	±5% Ind.	±10%	1
B	Linear-Cond. Plastic	±5% Ind.	±20%	1
C	CW Audio-Cermet	N/A	±10%	2
D	CW Audio-Cond. Plastic	N/A	±20%	2
E	Linear-Cond. Plastic	±5% Ind.	±10%	1
F	CCW Audio-Cermet	N/A	±10%	3
G	CCW Audio-Cond. Plastic	N/A	±20%	3
H	Linear-Cermet	±5% Ind.	±5%	1
L	Linear-Cond. Plastic	±2%Z.B.	±5%	1
M	Linear-Cermet	±2.5% Z.B.	±3%	1
N	Linear-Cond. Plastic	±1%Z.B.	±5%	1
P	Linear-Cermet	±1.5% Z.B.	±3%	1
S	CW Audio-Cond. Plastic	N/A	±10%	2
T	CCW Audio-Cond. Plastic	N/A	±10%	3

* Switch/potentiometer combinations only.
† Cermet only.
△ Non-standard resistance values.

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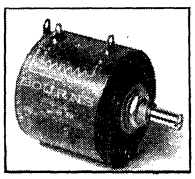
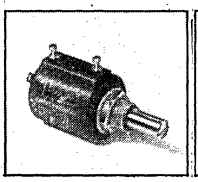
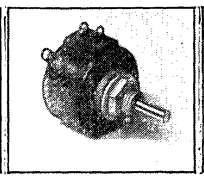
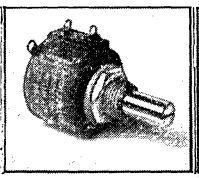
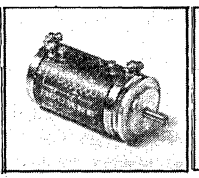
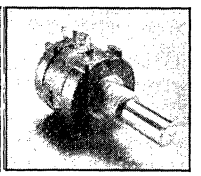
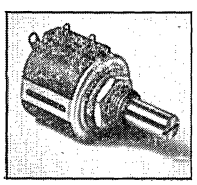
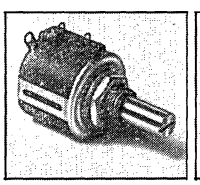
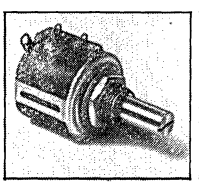
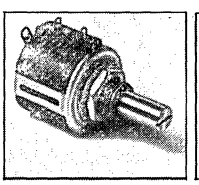
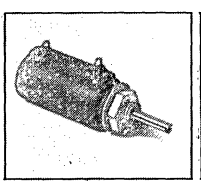
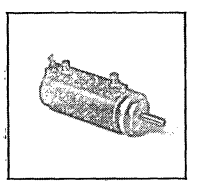
BOURNS® MULTI-TURN PRECISION POTENTIOMETERS

	3400 10 Turns	3500/3501* 10 Turns	3510/3511* 3 Turns	3520/3521* 5 Turns	3550 10 Turns	3590 10 Turns
						
Wirewound						
Resistance	100-250K	50-100K	50-50K	20-75K	100-100K	100-200K
Power Rating @ 70°C	5.0W	2.0W	1.0W	1.5W	2.5W	2.0W @ 40°C
Independent Linearity	±0.15%	±0.2%	±0.3%	±0.3%	±0.2%	±0.25%
Rotational Life	2x10⁶ Rev.	2x10⁶ Rev.	0.6x10⁶	1x10⁶ Rev.	2x10⁶ Rev.	1x10⁶ Rev.
Size	1-13/16" dia. x 1-3/4"	7/8" dia. x 1"	7/8" dia. x 9/16"	7/8" dia. x 11/16"	7/8" dia. x 1-9/16"	7/8" dia. x 3/4"

	3540 10 Turns	3543 3 Turns	3545 5 Turns	3541* 10 Turns	3700 10 Turns	3750 10 Turns
						
Wirewound						
Resistance	100-100K	20-50K	50-50K	1K-100K	100-100K	100-100K
Power Rating @ 70°C	2.0W	1.0W	1.5W	2.0W	1.0W	1.0W
Independent Linearity	±0.25%	±0.25%	±0.25%	±0.25%	±0.25%	±0.25%
Rotational Life	1x10⁶ Rev.	0.3x10⁶ Rev.	0.5x10⁶ Rev.	5x10⁶ Rev.	1x10⁶ Rev.	1x10⁶ Rev.
Size	7/8" dia. x 3/4"	7/8" dia. x 3/4"	7/8" dia. x 3/4"	7/8" dia. x 3/4"	1/2" dia. x 1"	1/2" dia. x 1"

*Hybritron® Element

Specifications subject to change without notice.

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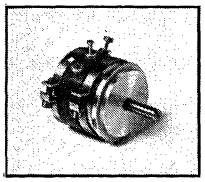
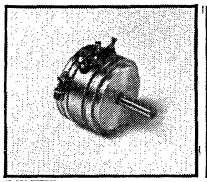
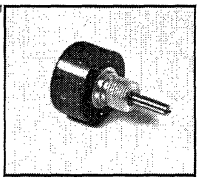
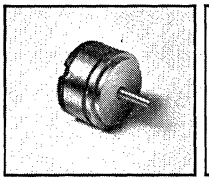
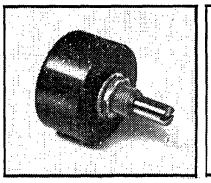
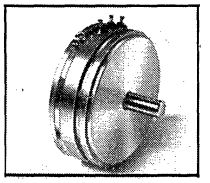
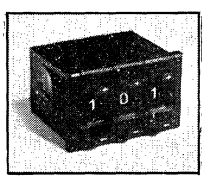
BOURNS® SINGLE-TURN PRECISION POTENTIOMETERS

Servo Mount	3585	6534		6538		6574
Bushing Mount	3535	6634	6637	6638	6657	6674
						
	Wirewound	Conductive Plastic				
Resistance	25-50K	1K-100K	1K-100K	1K-100K	1K-100K	1K-100K
Power Rating @ 70°C	1.0W	1.0W	1.0W	1.0W	1.5W	2.0W
Independent Linearity	±0.5%	±0.5%	±1.0%	±1.0%	±1.0%	±.25%
Rotational Life	1x10⁶ Rev.	25x10⁶ Rev.	10x10⁶ Rev.	20x10⁶ Rev.	10x10⁶ Rev.	25x10⁶ Rev.
Size	7/8" dia. x 11/16	7/8" dia. x 15/32	7/8" dia. x 7/16	7/8" dia. x 15/32 (servo) 17/32 (bushing)	1-5/16" dia. x 5/8	2" x 3/5"

BOURNS® DIALS, KNOBPOTS®, AND PUSH-BUTTON POTENTIOMETERS

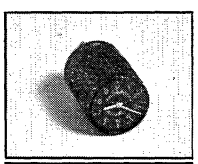
PUSH-BUTTON POTENTIOMETERS



DECADES	RESISTANCE	RESOLUTION
1	10 to 10K	10%
2	100 to 100K	1.0%
3	1K to 1 Meg	0.1%
4	10K to 1 Meg	0.01%
5	100K to 1 Meg	0.001%

KNOBPOTS®

3600



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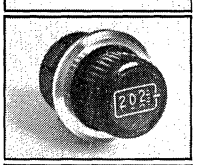

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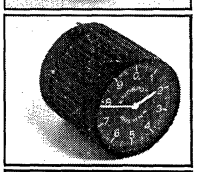

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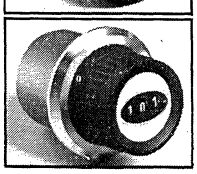
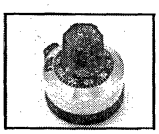


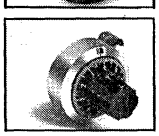
Resistance	Power Rating	Diameter
100 to 100K	1.5W @ 25°C	3/4"
100 to 100K	1.5W @ 25°C	7/8"
100 to 250K	2.5W @ 25°C	1-1/4"
100 to 250K	2.5W @ 25°C	1-1/4"

DIALS

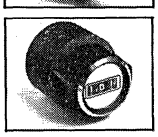
H-507-6
7/8" diameter



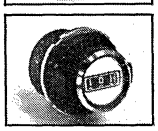
H-490
1" diameter



CT23
1-1/16" diameter



CT26
1-1/4" diameter

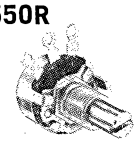
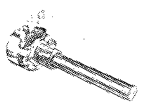
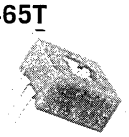
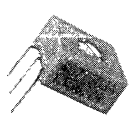
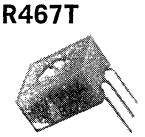
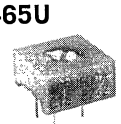
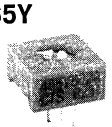


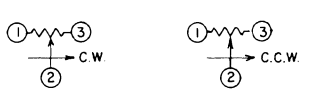
CTS OF BERNE, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

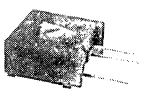
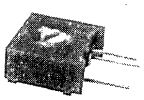
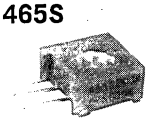
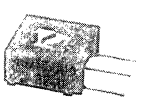
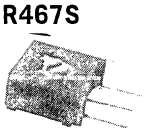
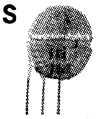
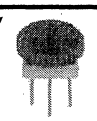
WORLD LEADER IN CERMET RESISTOR TECHNOLOGY

INDUSTRIAL CERMET POTS & TRIMMERS

CTS Series	Description	Data Sheet	Resistance Range
550R 	Power: 2 @ 70°C Max. Temp: 175°C Resist. Tol: ±10% Dim.: ¾″ dia. Bushing: ⅜″ FMS Shaft: ⅞″ FMS x .250″ dia., slotted	3550 E	50 Ω- 1 MEG Ω
550S 	Power: 2 @ 70°C Max. Temp: 175°C Resist. Tol: ±10% Dim.: ¾″ Dia. Bushing: ⅜″ FMS Shaft: 2″ FMS x .250″ dia.	3550 E	50 Ω- 1 MEG Ω
550LT	Power: 2 @ 70°C Max. Temp: 175°C Resist. Tol: ±10% Dim.: ¾″ dia. Bushing: ½″ FMS, locking Shaft: ⅝″ FMS x .250″ dia., slotted	3550 E	50 Ω- 1 MEG Ω
465T 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .100″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
467T 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .150″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
R465T	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .100″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
R467T 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .150″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
465U 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .200″ grid	3465	100 Ω- 1 MEG Ω
465Y 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 TO-5 lead spacing	3465	100 Ω- 1 MEG Ω



STANDARD ROTATION REVERSE ROTATION

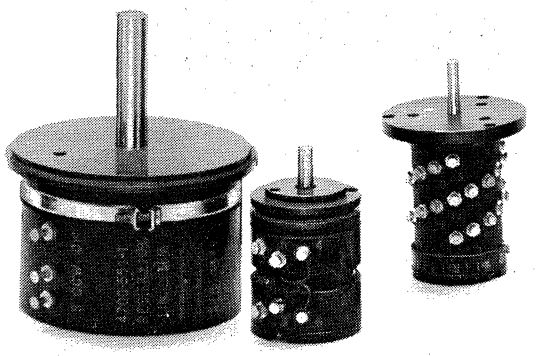
CTS Series	Description	Data Sheet	Resistance Range
465X 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 TO-5 lead spacing	3465	100 Ω- 1 MEG Ω
R465X 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 TO-5 lead spacing	3465	100 Ω- 1 MEG Ω
465S 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .100″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
467S 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±10% Dim.: .374″ x .385″ x .212″ No. of turns: 1 .150″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
R467S 	Power: 1 @ 25°C ½ @ 70°C Max. Temp: ±10% Resist. Tol: 125°C Dim.: .374″ x .385″ x .212″ No. of turns: 1 .150″ in-line lead spacing	3465	100 Ω- 1 MEG Ω
375E	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ Dia. x .150″ .100″ lead spacing Cent. Term.: .400″	3375	50 Ω- 1 MEG Ω
375V	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ dia. x .150″ .172″ lead spacing Cent. Term.: .156″	3375	50 Ω- 1 MEG Ω
375S 	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ dia. x .150″ .100″ lead spacing	3375	50 Ω- 1 MEG Ω
375T	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ dia. x .150″ .100″ lead spacing	3375	50 Ω- 1 MEG Ω
375X	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ dia. x .150″ .100″ lead spacing TO-5 lead spacing	3375	50 Ω- 1 MEG Ω
375Y 	Power: ½ @ 70°C Max. Temp: 125°C Resist. Tol: ±20% Dim.: .370″ dia. x .150″ .100″ lead spacing TO-5 lead spacing	3375	50 Ω- 1 MEG Ω

ORDERING INFORMATION: Place orders using following address: CTS OF BERNE, INC., 406 Parr Rd., Berne, Ind. 46711 • (219) 589-8220 • TWX 810-323-1580

SYSTRON DONNER
A THORN EMI company

DUNCAN ELECTRONICS DIVISION

A complete selection of standard products is available for cost-effective solutions to a wide variety of potentiometric functions. DUNCAN ELECTRONICS is also prepared to respond to special requirements, and offers a host of new, innovative alternatives to position sensing applications.



PRECISION POTENTIOMETERS

A COMPLETE SELECTION OF WIREWOUND, HYBRID, AND CONDUCTIVE PLASTIC UNITS, INCLUDING COMMERCIAL AND INDUSTRIAL MODELS AND SPECIAL CAPABILITIES.

COMPARISON OF RESISTIVE CHARACTERISTICS

PARAMETER	RESISTIVE TECHNOLOGY		
	Wirewound	Hybrid	Conductive Plastic
Resistance Range	Full Range	Limited Range	Full Range
Std. Resistance Tolerance	± 3%	± 5%	± 10%
Effective Travel Range	Up To 10-Turns	Up To 10-Turns	360° Maximum
Temp. Coefficient of Resistance	± 20 PPM/°C	± 70 PPM/°C	– 300 PPM/°C
Power Dissipation	High	High	Moderate
Resolution	Finite	Infinite	Infinite
Adjustability/Setability	Fair	Good	Excellent
Linearity/Conformity	Very Good	Good	Excellent
Contact Resistance	Low	High	Moderately High
Rotational Life (Rev.)	2×10^8	10×10^6	50×10^6
Moisture Stability	Excellent	Good	Fair
Non-Linear Functions	Excellent	Good	Excellent
Rheostat Applications	Excellent	Poor	Fair
AC Circuit Applications	Poor	Fair	Excellent
Relative Cost	Low	Medium	High

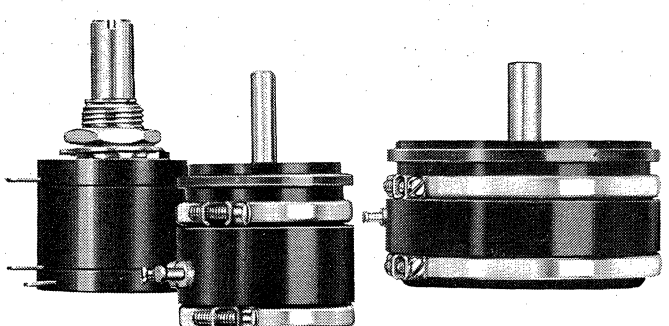
SINGLE TURN

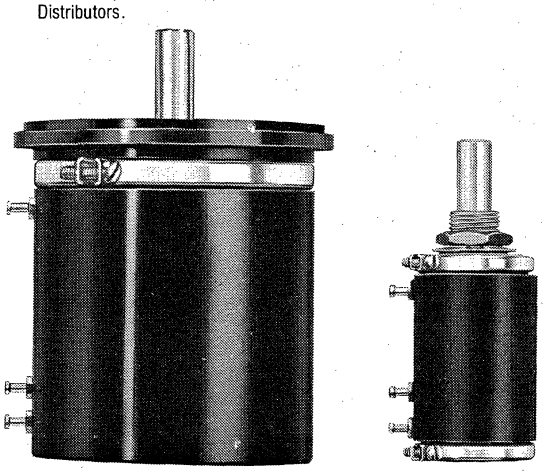
Element Type/ Series No.	Dia.	Resistance Range (Ω)	Linearity (%) Standard	Linearity (%) Best Practical	Max. Power @ 70°C (Watts)	Mounting Style
WIREWOUND						
1200	7/8"	15-75K	±0.5	±0.2	1.25	Servo/Bushing
(1230)[3]	7/8"	15-50K	±0.5	±0.25	1.25	(Bushing)
1300	1 1/16"	25-100K	±0.4	±0.15	2.0	Servo/Bushing
1500	1 7/16"	25-125K	±0.3	±0.12	3.0	Servo/Bushing
1600	1 3/4"	25-150K	±0.25	±0.09	4.0	Servo/Bushing
(1630)	1 3/4"	25-100K	±0.3	±0.15	4.0	(Bushing)
1700	2"	25-200K	±0.2	±0.08	5.0	Servo/Bushing
1800	3"	25-250K	±0.15	±0.05	7.0	Servo/Bushing
CONDUCTIVE						
1220	7/8"	400-75K	±0.5	±0.2	0.5	Servo/Bushing
1320	1 1/16"	500-100K	±0.4	±0.15	0.75	Servo/Bushing
1520	1 7/16"	500-125K	±0.3	±0.10	1.0	Servo/Bushing
1620	1 3/4"	500-150K	±0.25	±0.075	1.5	Servo/Bushing
1720	2"	600-200K	±0.2	±0.06	2.0	Servo/Bushing
1820	3"	750-300K	±0.15	±0.04	3.0	Servo/Bushing
HYBRID						
2200	7/8"	200-10K	±0.5	±0.25	1.25	Servo/Bushing
2230	7/8"	500-7K	±0.5	±0.3	1.25	(Bushing)
2300	1 1/16"	200-15K	±0.4	±0.2	2.0	Servo/Bushing
2500	1 7/16"	500-20K	±0.3	±0.15	3.0	Servo/Bushing
2600	1 3/4"	500-25K	±0.25	±0.12	4.0	Servo/Bushing
2630	1 3/4"	1K-17.5K	±0.5	±0.2	4.0	(Bushing)
2700	2"	500-30K	±0.2	±0.1	5.0	Servo/Bushing
2800	3"	750-50K	±0.15	±0.07	7.0	Servo/Bushing

MULTI-TURN

Element Type/ Series No.	Dia.	Resistance Range (Ω)	# of Turns	Linearity (%) Standard	Linearity (%) Best Practical	Max. Power @ 70°C (Watts)	Mounting Style
WIREWOUND							
3200	7/8"	3-250K	3/5/10	±0.5/ 0.35/0.25	±0.1/ 0.07/0.05	1.5/2.0/2.5	Servo/Bushing
(3233)	7/8"	10-200K	10	±0.25	±0.1	2.5	Bushing
(3250/M3250)	7/8"	10-150K	3/5/10	±0.5/ 0.5/0.25	±0.3/ 0.2/0.1	1.0/1.5/2.0	Bushing
3500	1 7/16"	5-500K	3/5/10	±0.25/ 0.2/0.15	±0.5/ 0.04/0.03	3.0/4.0/5.0	Servo
3600		5-600K	3/10	±0.35/0.25	±0.1/0.05	5.0/7.0	Bushing
3700	2"	5-830K	3/10	±0.2/0.1	±0.04/0.02	5.0/7.0	Servo/Bushing
HYBRID							
4200	7/8"	500-100K	3/5/10	±0.5/ 0.35/0.25	±0.15/ 0.1/0.075	1.5/2.0/2.5	Servo/Bushing
(4250/M4250)	7/8"	500-100K	10	±0.25	±0.15	2.0	Bushing
4500	1 7/16"	500-200K	3/5/10	±0.25/ 0.2/0.15	±0.075/ 0.06/0.05	3.0/4.0/5.0	Servo
4600	1 3/4"	1K-250K	3/10	±0.35/0.25	±0.15/0.08	5.0/7.0	Bushing
4700	2"	1K-250K	3/10	±0.2/0.1	±0.06/0.03	5.0/7.0	Servo/Bushing

NOTES: 1. All Wirewound models are manufactured to meet or exceed applicable characteristics of MIL-R-12934.
2. All Conductive Plastic and Hybrid models are manufactured to meet or exceed applicable characteristics of MIL-R-39023.
3. Models in parenthesis ( ) are available through authorized Duncan Distributors.





SYSTRON DONNER
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DUNCAN ELECTRONICS DIVISION
2865 Fairview Road, Costa Mesa, CA 92626
(714) 545-8261 TWX 910-595-1128

POSITION SENSING PRODUCTS

SLIDELINE® CONTROLS

FOR INSTRUMENTATION AND AUDIO/BROADCAST APPLICATIONS:

Duncan 400 Slideline® Potentiometers provide an ideal, human-factored solution for instrumentation and audio/broadcast controls, combining unusually accurate electrical characteristics with a wide variety of output options, fingertip controls, and faceplate alternatives to meet exacting customer applications requirements.

Ideally suited for medical and process control equipment, or test/measurement apparatus, the 400 is capable of providing specific packaging or electrical characteristics without the special costs you might expect. The 400 can change its face and provide excellent accuracy in single or dual element configurations for the type of control you seek. Units are available with two individual wipers generating independent outputs for establishing high/low limits in monitoring instruments. For specs, infinite resolution, virtually noise-free operation and a reputation for failure-free performance (rated for 5 million traverses without degradation), is coupled with a 600Ω to 250KΩ resistance range (±20%; ±10% available) and linearities from ±2% to ±0.1%. Stroke is 2¾" or 4¼".

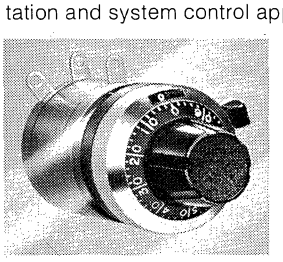
A normally open SPST or DPST "cue" switch function is available closing at the end of travel. As a result, valuable instrument panel space is saved and multiple functions provided.

TURNS-COUNTING DIALS

Duncan Turns-Counting Dials are especially designed to provide accurate, highly visible position readouts of multi-turn devices.

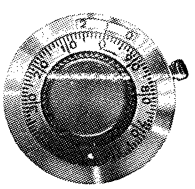
PERFECTLY DESIGNED FOR COMBINATIONS

Duncan Turns-Counting Dials are ideal for use with any Duncan Multi-turn Potentiometer, particularly the ⅞" dia., 10-turn 3250 series. Such combinations are suited for cost-effective instrumentation and system control applications.

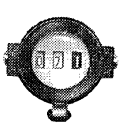


3250 10-turn/Model 62 Dial Combination

Model 62, 15-turn



Model 82, 20-turn



Model 71, Digital 10-turn

Model 76, Clockface 10-turn

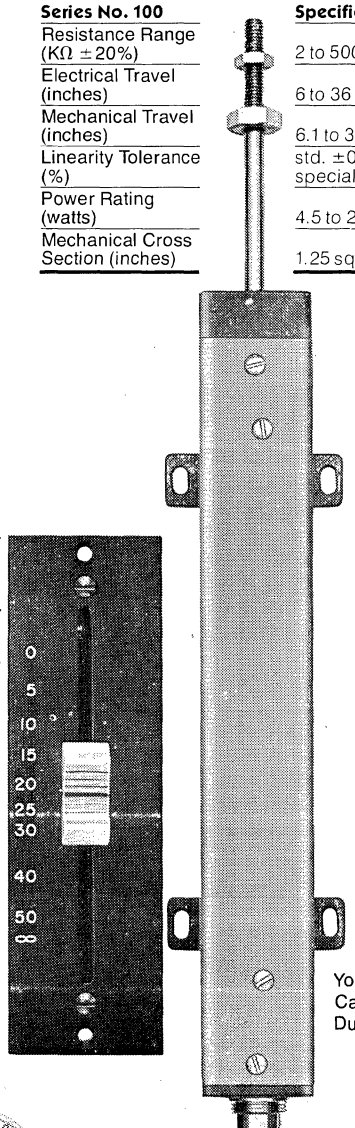
RECTILINEAR/*SERIES 100*

ACCURATE FEEDBACK AND INTERFACING CAPABILITIES IN A NEW SERIES

The new Duncan Series 100 Rectilinear Control is available in 7 different sizes.

Completely enclosed, the 100 offers an impressive array of linear motion/rectilinear capabilities and gives you a choice of 3 different interface connectors, linear and non-linear taper, and switch functions at the end of mechanical travel. They're perfect for use under unusual industrial or environmental conditions.

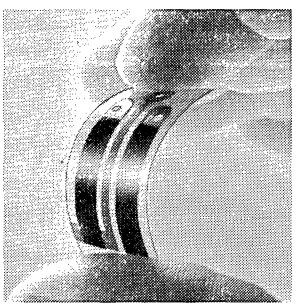
Series No. 100	Specifications
Resistance Range (KΩ ±20%)	2 to 500
Electrical Travel (inches)	6 to 36
Mechanical Travel (inches)	6.1 to 36.1
Linearity Tolerance (%)	std. ±0.5% special ±0.1%
Power Rating (watts)	4.5 to 27
Mechanical Cross Section (inches)	1.25 sq.



RESISTIVE ELEMENTS

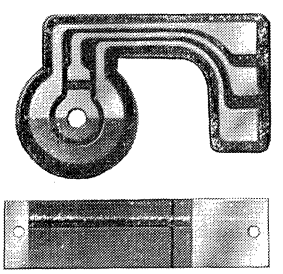
A STANDARD PRODUCT APPROACH TO LOW-COST POSITION SENSING

Series 98E Elements are currently operating in hundreds of different systems. You'll find them in everything from airborne applications and instrumentation, to consumer appliances and automotive electronics.



If you want to design your own element, we'll help you. Before your first production quantity is required, you will have the satisfaction of testing and approving a design in ample time to meet your planned requirements.

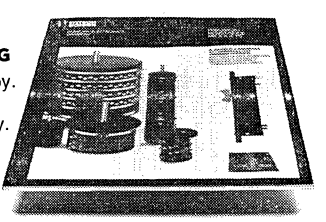
TYPICAL SPECIFICATION RANGES	
Electrical Travel	up to 36" (900mm)
Resistance Range (Ω per square)	50 to 20K ±20%/±10%
Linearity	to ±0.05%
Power Rating	3 watts/square



Although the 98E Element is priced right for use in commercial products or industrial controls, it meets high standards of reliability, anti-shock and low noise.

48-PAGE DESIGN HANDBOOK/CATALOG

You can receive your own copy. Call or write your nearest Duncan sales office or factory.

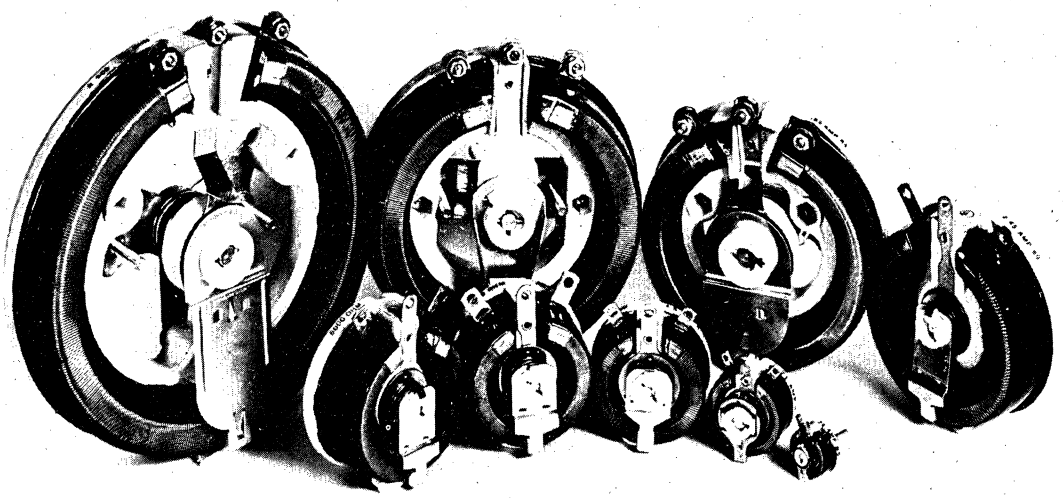


SYSTRON DONNER
A THORN EMI company
DUNCAN ELECTRONICS DIVISION
2865 Fairview Road, Costa Mesa, CA 92626
(714) 545-8261 TWX 910-595-1128

E-SYSTEMS
Memcor Division

POWER RHEOSTATS

MEET THE MEMCOR FAMILY OF HIGH QUALITY WIRE-WOUND POWER RHEOSTATS



All MEMCOR Power Rheostats are vitreous enamel coated. The core and base are bonded together with vitreous enamel, thereby contributing markedly to the heat dissipation.

Standard tolerance: ±10%, ±5% available as a special.

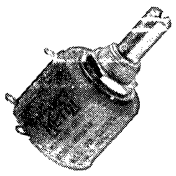
TYPE	POWER (Watts)	RESISTANCE RANGE	DIAMETER	WEIGHT
R12½	12½ Watt	1 - 5000 Ohms	⅞"	.035 Lbs.
R25	25 Watt	1 - 5000 Ohms	1 9/16"	0.23 Lbs.
R50	50 Watt	0.5 - 10,000 Ohms	2 15/16"	0.45 Lbs.
R75	75 Watt	0.5 - 10,000 Ohms	2¾"	0.60 Lbs.
R100	100 Watt	0.5 - 10,000 Ohms	3⅛"	0.72 Lbs.
R150	150 Watt	0.5 - 10,000 Ohms	4"	1.50 Lbs.
R225	225 Watt	1 - 2500 Ohms	5"	2.18 Lbs.
R300	300 Watt	1 - 2500 Ohms	6"	3.0 Lbs.
R500	500 Watt	1 - 2500 Ohms	8"	3.75 Lbs.
R1000	1000 Watt	1 - 2000 Ohms	12"	10.0 Lbs.

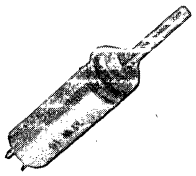
Special Rheostats with Tapered Sections, Locking Devices, Off Positions, Tandem Mountings, Special Shafts on Bushing, and many other variations can be supplied.

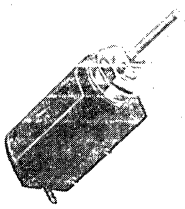
Write for FREE Catalog.

E-SYSTEMS
Memcor Division
DEPT. EM
1320 FLAXMILL ROAD
HUNTINGTON, INDIANA 46750
Telephone: (219) 356-4300
TWX: 810-333-1530

MULTI-TURN POTENTIOMETERS TURNS COUNTING DIALS


MR22


MW10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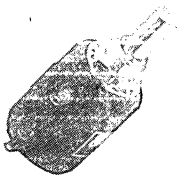
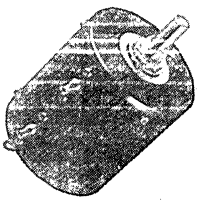
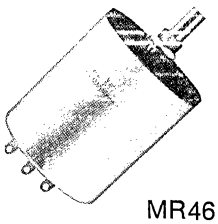
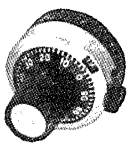
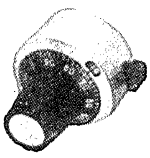

MW20

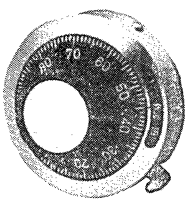

MW46

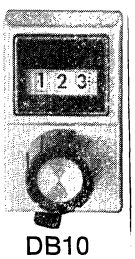

MR46


MG22
7/8" DIA.

MB25
1" DIA.


CA20
7/8" DIA.


MF46
1 13/16" DIA.



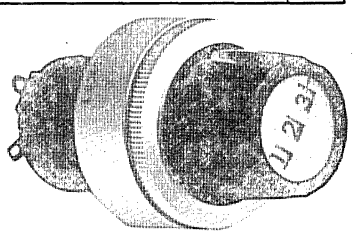
DB10
1" x 1.75"

DB100
1" x 1.75"

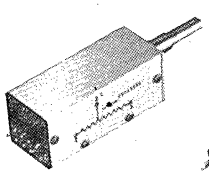
Model	No. of Turns	Size Dia.x Length	Resistance Range	Resistance Tolerance	Linearity, Independent	Power Rating	Mechanical Life (Rev.)	Shaft Dia. †
MR22	10	.875x.750	10Ω-100KΩ	±5%	±.25%	2 watts	500,000	1/4"
MW10-10	10	.400x1.00	20Ω-100KΩ	±5%	<5K = ±.4% >5K = ±.25%	1.5 watts	200,000	1/8"
MW12-10	10	.500x1.00	20Ω-150KΩ	±3%	<5K = ±.3% >5K = ±.25%	1 watt	1,000,000	1/8"
MW22-10	10	.875x.750	100Ω-100KΩ	±5%	±.25%	2 watts	500,000	1/4"
MW20-10	10	.790x1.00	20Ω-200KΩ	±3%	±.25%	5 watts	2,000,000	1/4"
MW25-10	10	.980x1.476	20Ω-200KΩ	±3%	±.25%	5 watts	2,000,000	1/8"
MW46-10	10	1.812x2.00	5Ω-500KΩ	±3%	±.25%	10 watts	2,000,000	1/4"
MW46-20	20	1.812x3.13	10Ω-1 Meg.	±3%	±.25%	20 watts	2,000,000	1/4"
MR46-10	10	1.812x2.20	0.5Ω-500KΩ	±5%	±.25%	10 watts	2,000,000	1/4"
MR46-20	20	1.812x3.74	10Ω-1 Meg.	±3%	±.25%	20 watts	2,000,000	1/4"
SMR46	10	Same as MR46-10 except with limit switches at ends. (Snap action)						
M046-10	10	2.500x3.187	Same specs as MR46-10 except oil-filled.					

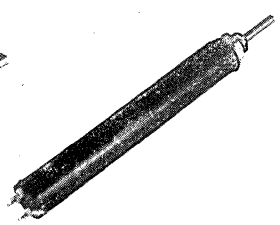
COMBO® 3

Pre-assembled and phased to ±.25% absolute readout accuracy. Mounts in a 1.187" dia. panel hole. Available with seven potentiometers above.



LINEAR MOTION

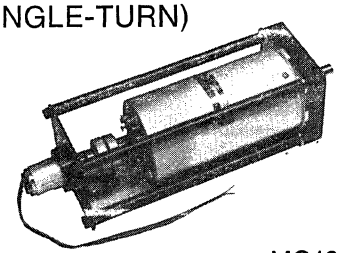




- Full line of precision linear motion potentiometers. Strokes from 0.433" to 40". Available in wirewound, conductive plastic or hybrid elements. Please contact ETI for complete specifications.

MOTOR CONTROLLED POTENTIOMETERS

(MULTI-TURN AND SINGLE-TURN)


MC46-2

ETI offers for the first time a complete line of motor-controlled potentiometers with motor operating currents low enough to respond accurately from operational amplifier outputs.

All ETI rotary potentiometers may be motorized for your applications.

PRECISION POTENTIOMETER, 2,000,000 TURNS LIFE.

GEAR RATIOS: 41:1 TO 235,000:1 WITH DUAL ADJUSTABLE CLUTCHING COUPLER.

PRECISION FRACTIONAL H/P MOTORS IN 6 OR 12 VDC, RPM'S FROM 6,000 to 20,000. A.C. MOTORPOTS NOW AVAILABLE.

See Section 3500, Motors and Drives for full information.

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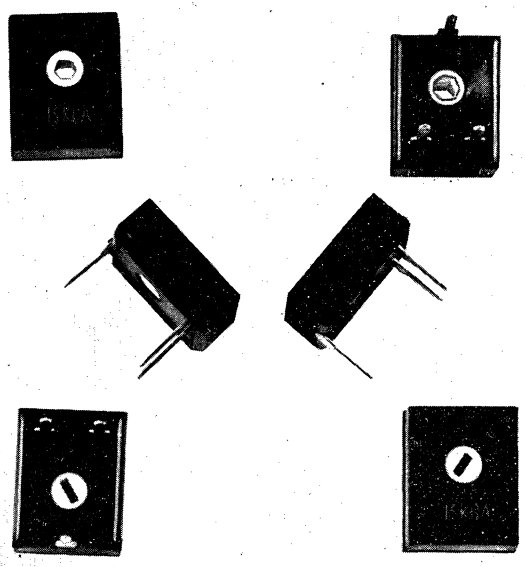
DIV: POLARIS ENTERPRISES, INC.

ISKRA

• Ceramic Caps, Discs, Feed Thru • Ferrites • Meters • Motors, fractional H.P. • Semiconductors • Switches • Speakers • Trimmer Pots

POTENTIOMETERS



Color of protecting housing
PNZ type — black
PNKZ type — green
PNCZ type — red

For the requirements of modern electronic equipment ISKRA has designed a new series of trimmer potentiometers PNZ 10, which feature a number of improvements.
Some of them are:

△ Miniature rectangular design
△ Horizontal and vertical mounting
△ Three types of resistive layers:
carbon layer on phenolic
carbon layer on ceramic
cermet layer on ceramic
△ With hex slot suitable for automatic adjustment
△ Dual wiper design reduces contact resistance and electrical noise
△ Enclosed body protects against dust and short circuits
△ Non-inflammable plastic according to UL-94-VO

'POTS'

PNZ Series	Wattage	Resistance	T.C.
(Miniature and enclosed trimmer potentiometers)	.2W, .5W	25 ohms - 5 meg ohms	100 ppm/°C 2000 ppm/°C

PNZ Series available in Carbon on Phenolic, Carbon on Ceramic and Cermet Horizontal and vertical mount configurations (standard industry spacing) available with Screw Driver Slot, Hex Slot, Thumbwheel and Spindle Shift.

Open construction trimmers, from 8mm thru 18mm diameters available on order. Custom controls, slider and focus potentiometers also available.

Rated resistance range

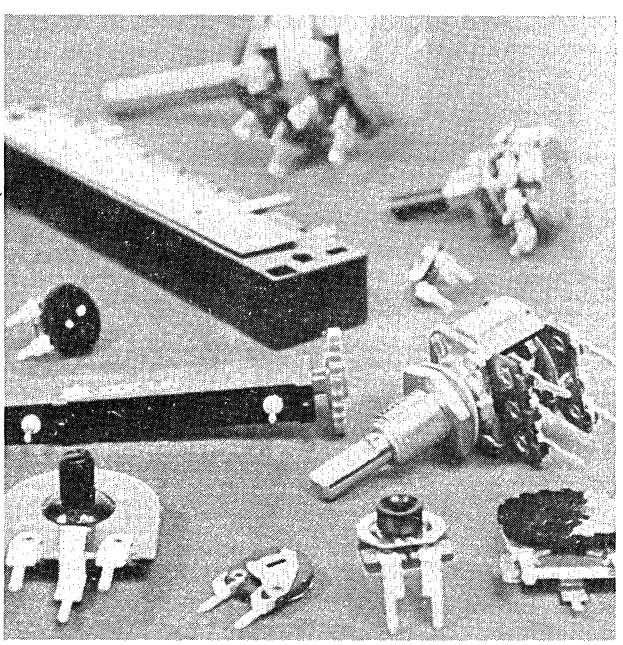
—	1 kΩ	100 kΩ	10 MΩ
25 Ω	2.5 kΩ	250 kΩ	—
50 Ω	5 kΩ	500 kΩ	—
100 Ω	10 kΩ	1 MΩ	—
250 Ω	25 kΩ	2.5 MΩ	—
500 Ω	50 kΩ	5 MΩ	—

CERAMIC BASED PRE-SET POTENTIOMETERS

With the development of modern electronics and miniaturization the technical needs have also increased and consequently pre-set potentiometrs have to be adapted accordingly. The main requirements are:

△ High electrical loading
△ Higher operating temperature
△ Climatic influences
△ Requirements according to long term stability

Pre-set potentiometers have been developed on alumina ceramics, open version. Several potentiometers are available with dust-proof casing.



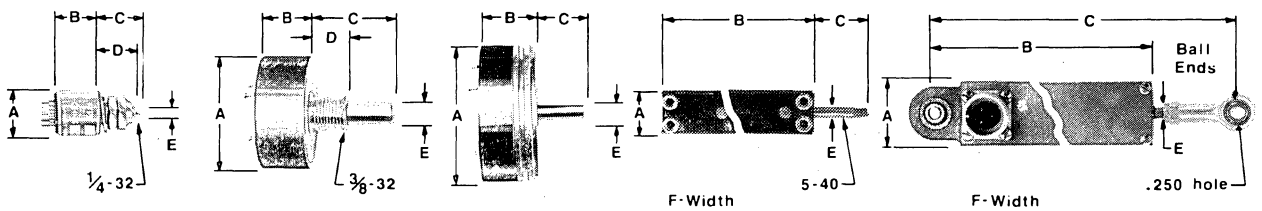
ISKRA ELECTRONICS INC.
8 GREENFIELD RD., SYOSSET, NY 11791 • (516) 364-2616

MAUREY INSTRUMENT CORP. Potentiometers

Rotary and Linear Motion Transducers

WIREWOUND These precision potentiometers were developed for military use over a period of 27 years. They are widely used in instrumentation and automation where precise electrical and mechanical requirements are specified. Low resistance tolerance and TCR; close electrical angle tolerance. Custom designs are available.

CONDUCTIVE PLASTIC Our raised molded track will withstand 200,000,000 cycles of high dynamic velocities (10″ per second). The infinite resolution and low noise make these units particularly suitable for servo feedback applications. 100 g shock, 100—20,000 Hz at 50 g. Impervious to most gases and oils.



	TRIMMER	BUSHING				SERVO**			LINEAR MOTION (LMA)			LINEAR MOTION (LMB)			
	Part No.	Type	A	B	C	D	E	F	OHMS Range	OHMS ± %	Lin. ± %	Elect. Travel	Mech. Travel	Watts @ 40°C	Torque OZ-IN
Wirewound	50-M123	TRIMMER	.50	.50	.50	.44	.125	—	50Ω-50K	5	3.0	325°	325°	2	1-8
	50-M125	BUSH'G	.50	.50	.62	.25	.125	—	50Ω-25K	5	1.0-0.5	325°	325°	2	0.5
	87-M44	SERVO**	.87	.68	.50	—	.125	—	100Ω-25K	5	1.0-0.2	353°	360°	2	0.1
	131-M3	BUSH'G	1.31	.50	.87	.38	.250	—	100Ω-50K	5	1.0-0.3	320°	330°	3	0.1
	200-M167	SERVO**	2.00	.80	.75	—	.250	—	100Ω-50K	5	1.0-0.1	356°	360°	5	0.5
	200-M493	BUSH'G	2.00	1.00	.87	.38	.250	—	100Ω-100K	5	1.0-0.4	320°	360°	4	0.6
	300-M74	SERVO**	3.00	.80	.75	—	.250	—	500Ω-100K	5	0.2-0.05	358°	360°	7	0.6
	M1326-1	LMA ‡	.50	2.00	.75	—	.125	.38	50Ω-20K	5	3.0-0.3	1.00″ ‡	1.10″	1	4*
	M1326-4	LMA ‡	.50	.500	.75	—	.125	.38	250Ω-50K	5	0.3-0.1	4.00″ ‡	4.10″	4	4*
	M1326-12	LMA ‡	.50	13.00	.75	—	.125	.38	5K-100K	5	0.1-0.05	12.0″ ‡	12.10″	12	4*
	M2028-5	LMB ‡	1.25	10.50	12.70	—	.250	.76	1K-100K	5	0.2-0.03	5.0″ ‡	5.25″	5	4*
	M2028-10	LMB ‡	1.25	15.80	18.00	—	.250	.76	2K-200K	5	0.1-0.02	10.0″ ‡	10.25″	10	4*
	M2028-15	LMB ‡	1.25	21.00	23.20	—	.250	.76	5K-200K	5	0.1-0.01	15.0″ ‡	15.25″	15	4*
Conductive Plastic	87-P82	BUSH'G	.87	.53	.87	.38	.250	—	500Ω-50K	20	2.0	340°	360°	1	1
	87-P83	SERVO**	.87	.59	.50	—	.125	—	500Ω-50K	10	0.5	340°	360°	1	0.5
	106-P249	SERVO**	1.06	.65	.50	—	.125	—	500Ω-100K	10	0.5	340°	360°	1.5	0.5
	112-P16	BUSH'G	1.12	.53	.87	.38	.250	—	500Ω-100K	20	2.0	340°	360°	1.5	1
	112-P19	SERVO**	1.12	.65	.50	—	.125	—	500Ω-100K	10	0.5	340°	360°	1.5	0.5
	200-P445	BUSH'G	2.00	.53	.87	.38	.250	—	1K-100K	20	1.0	340°	360°	3	1
	200-P446	SERVO**	2.00	.80	.75	—	.250	—	1K-100K	10	0.5	340°	360°	3	0.5
	P1613-1	LMA ‡	.50	2.00	.75	—	.125	.38	1K-5K	20	2.0	1.0″ ‡	1.1″	0.5	4*
	P1613-4	LMA ‡	.50	5.00	.75	—	.125	.38	4K-10K	20	0.5	4.0″ ‡	4.1″	2	4*
	P1991-5	LMB ‡	1.25	10.50	12.70	—	.250	.76	5K-20K	20	0.5	5.0″ ‡	5.25″	2.5	4*
	P1991-10	LMB ‡	1.25	15.80	18.00	—	.250	.76	10K-25K	20	0.5	10.0″ ‡	10.25″	5	4*
	P1991-15	LMB ‡	1.25	21.00	23.20	—	.250	.76	15K-50K	20	0.5	15.0″ ‡	15.25″	7	4*

* Frictional force in ounces shown for linear motion units.
** Servo dimensions to MIL-R12934C and MIL-R39023A. Custom deviations to the above units are available.
‡ Available travel in one inch increments.

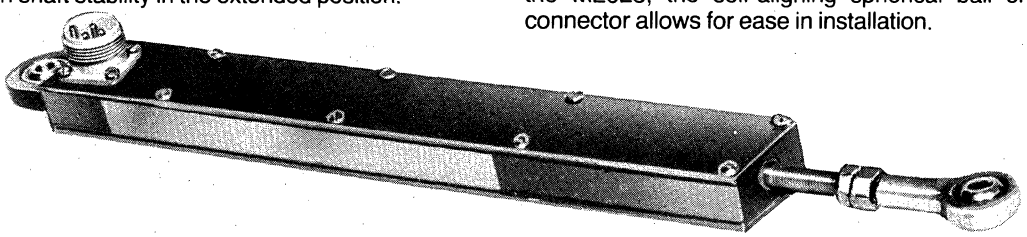
MAUREY INSTRUMENT CORPORATION
4557 West 60th Street, Chicago, IL 60629 · PHONE (312) 581-4555 · TWX 910-221-6025

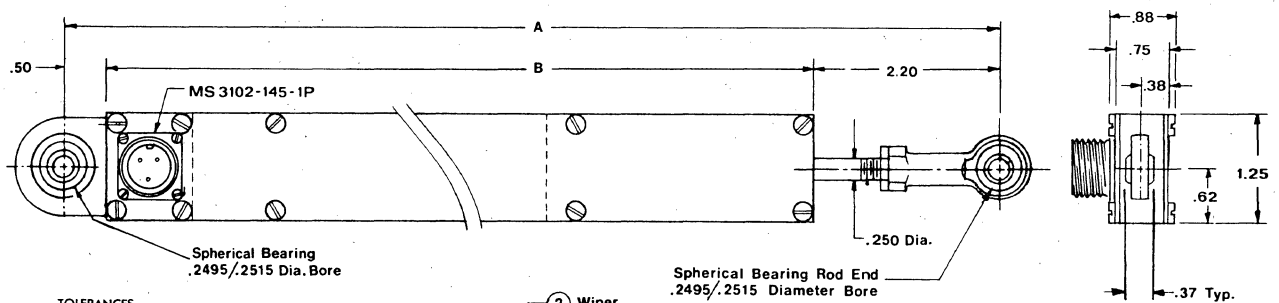
MAUREY INSTRUMENT CORP.

HEAVY DUTY LINEAR MOTION POTENTIOMETERS WIREWOUND AND CONDUCTIVE PLASTIC HDL

WIREWOUND M2028 This transducer combines the inherent accuracy and reliability of a wirewound potentiometer with the physical ruggedness required in industrial applications. They are used with hydraulic and mechanical actuators to measure and control linear motion. The self-aligning spherical ball ends and MS connector simplifies installation. High duty bearings give the ¼ inch shaft stability in the extended position.

CONDUCTIVE PLASTIC P1991 Where severe environmental conditions exist as in mills, factories and power generating plants, this linear motion transducer is practically indestructible. The unit is impervious to dust, oil and moisture. The molded, raised conductive track and graphite composition contacts provide for years of maintenance free service. As with the M2028, the self-aligning spherical ball ends and MS connector allows for ease in installation.





ELECTRICAL AND MECHANICAL CHARACTERISTICS

	M2028 WIREWOUND	P1991 CONDUCTIVE PLASTIC
Total Resistance (Ohms)	See Charts II & III	See Note 5
Total Resistance Tolerance	±5%	±20%
Theoretical Resolution	See Chart III	.001 inch
Independent Linearity	See Note 6	±0.5%
Theoretical Elect. Travel (inches)	See Chart I	See Chart I
Theoretical Elect. Travel Tolerance (inches)	± .010	± .025
Total Mechanical Travel (inches)	See Chart I	See Chart I
Temperature Coefficient	50 PPM/°C	500 PPM/°C
Operating Temperature Range	−55 to 125°C	−55° to 105°C
Power Rating (Watts at 40°C)	1 watt/inch	0.5 watt/inch
Dielectric Strength (Volts, RMS for 60 Sec)	750 volts, RMS	750 volts, RMS
Terminals	3	3
Taps	1/2 inch spacing	1/2 inch spacing
Tap Tolerance (inches)	± .010	± .030
Life Expectancy (Cycles at 60 in./min.)	500,000	50,000,000
Shaft Frictional Force	4 ounces	4 ounces
Weight (ounces)	See Chart I	See Chart I
Bearings	Nylon	Nylon

Notes:
1. Mating connector supplied.
2. Stainless steel shaft.
3. Anodized aluminum housing.
4. Terminals available on special request.
5. Ohms per inch for P1991: 500, 1K, 2K, 5K, 10K.
7. Independent linearity for M2028: (100% ÷ Total Turns x 2)
6. With modification, this type is available in strokes greater than 15 inches.

CHART I

Dash No.	Elect. Travel	Mech. Travel	A	B	Wt. Ozs.
−1	1.00	1.25	12.70	10.50	10
−2	2.00	2.25	12.70	10.50	10
−3	3.00	3.25	12.70	10.50	10
−4	4.00	4.25	12.70	10.50	10
−5	5.00	5.25	12.70	10.50	10
−6	6.00	6.25	18.00	15.80	15
−7	7.00	7.25	18.00	15.80	15
−8	8.00	8.25	18.00	15.80	15
−9	9.00	9.25	18.00	15.80	15
−10	10.00	10.25	18.00	15.80	15
−11	11.00	11.25	23.20	21.00	20
−12	12.00	12.25	23.20	21.00	20
−13	13.00	13.25	23.20	21.00	20
−14	14.00	14.25	23.20	21.00	20
−15	15.00	15.25	23.20	21.00	20

CHART II

DASH NO.	TOTAL RESISTANCE
102	1,000
202	2,000
502	5,000
103	10,000
203	20,000
503	50,000
104	100,000

CHART III

OHMS PER INCH	NUMBER OF TURNS PER INCH
500	270
1,000	370
2,000	415
2,500	450
5,000	550
10,000	660
20,000	1000

PART NUMBER DESIGNATION (EXAMPLE)
M2028-5-502
- BASIC TYPE
- ELECTRICAL TRAVEL (5.00 INCHES)
- TOTAL RESISTANCE (5000 Ω)

4555 West 60th Street, Chicago, IL 60629
MAUREY INSTRUMENT CORPORATION
PHONE (312) 581-4555
TWX 910-221-6025

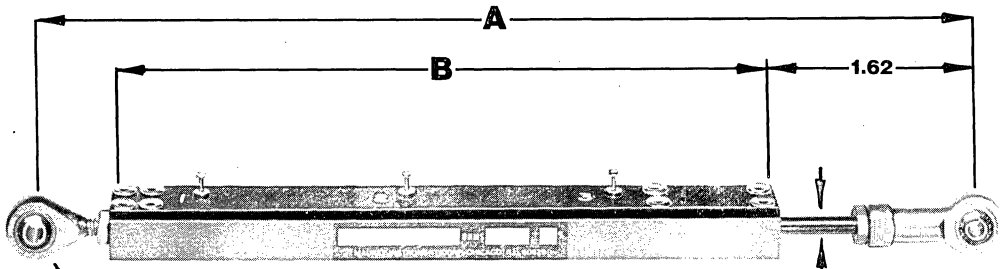
MAUREY INSTRUMENT CORP.

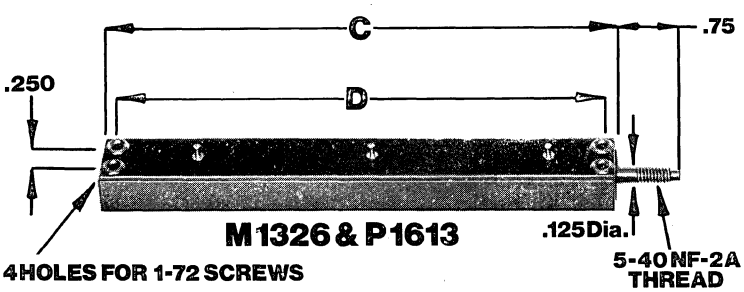
LIGHT DUTY LINEAR MOTION POTENTIOMETERS WIREWOUND AND CONDUCTIVE PLASTIC

LDL

WIREWOUND (M-Series) These miniature transducers combine the best electrical characteristics in the smallest size at the lowest cost. The units were designed for use in laboratory test equipment, light industrial applications and automation where great accuracy of electrical output is essential. The spherical ball ends add flexibility to mounting. These wirewound, linear motion potentiometers will meet the requirement in the majority of applications.

CONDUCTIVE PLASTIC (P-Series) Where long life in a hostile environment is required, these linear motion transducers with molded, raised tracks and graphite composition contacts have no equal. They are practically impervious to dust, water and oil. The high contact pressure resists the effects of severe vibration and shock. The units are being used in factories and mills where maintenance-free operation is essential.





Stroke (Inches)	M1326/P1613		M2078/P2080	
	A	B	C	D
1	2.00	1.800	5.12	3.00
2	3.00	2.800	6.12	4.00
3	4.00	3.800	7.12	5.00
4	5.00	4.800	8.12	6.00
5	6.00	5.800	9.12	7.00
6	7.00	6.800	10.12	8.00
7	8.00	7.800		
8	9.00	8.800		
9	10.00	9.800		
10	11.00	10.800		
11	12.00	11.800		
12	13.00	12.800		

Shaft shown in fully retracted position
Shaft is free to rotate. .
Body: ½ wide on terminal side x 3/8 deep.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

	M1326 WIREWOUND	P1613 CONDUCTIVE PLASTIC	M2078 WIREWOUND	P2080 CONDUCTIVE PLASTIC
Total Resistance (Ohms)	25Ω to 20K/inch	250Ω to 10K/inch	25Ω to 20K/inch	250Ω to 10K/inch
Total Resistance Tolerance	±5%	±20%	±5%	±20%
Theoretical Resolution (inch)	006 to .001	.001	006 to .001	.001
Independent Linearity	±1.2% to ±0.1%	±2% to ±0.5%	±1.2% to ±0.1%	±2% to ±0.5%
Theoretical Electrical Travel (inches)	1.000 to 12.000	1.00 to 5.00	1.000 to 6.000	1.00 to 5.00
Theoretical Elect. Travel Tolerance (inches)	±.010	±.050	±.010	±.050
Total Mechanical Travel (inches)	1.10 to 12.10	1.10 to 5.10	1.10 to 6.11	1.10 to 5.10
Temperature Coefficient (PPM/°C)	50	500	50	500
Operating Temperature Range	−55°to125°C	−55°to105°C	−55°to125°C	−55°to105°C
Power Rating (Watts at 40°C)	1 watt/inch	0.5 watt/inch	1 watt/inch	0.5 watt/inch
Dielectric Strength (Volts, RMS for 60 Sec)	750	750	750	750
Terminals	3	3	3	3
Taps	4 taps/inch	4 taps/inch	4 taps/inch	4 taps/inch
Tap Tolerance (inches)	±.010	±.050	±.010	±.050
Life Expectancy (cycles at 60 in./min.)	500,000	50,000,000	500,000	50,000,000
Shaft Frictional Force (ounces, max.)	4 oz.	4 oz.	4 oz.	4 oz.
Bearings	Nylon	Nylon	Nylon	Nylon

Standard Resistance Values, Ohms / inch: 250Ω, 500Ω, 1K, 2K, 2.5K, 10K, 20K

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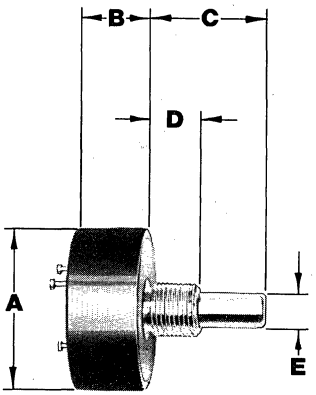
MAUREY INSTRUMENT CORP.

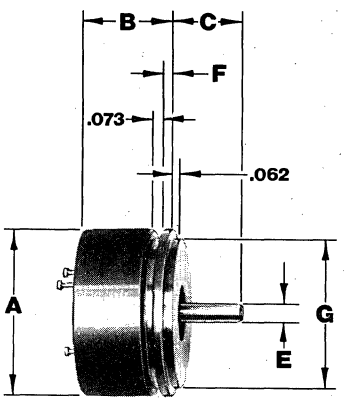
PRECISION CONDUCTIVE-PLASTIC SINGLE TURN POTENTIOMETERS

PST

These conductive plastic potentiometers have been specially designed for severe environmental conditions in mill-factory operations as well as in critical military applications. The molded, raised track maintains itself free from contamination of foreign particles, oil or water. The high gram pressure of the graphite composition contact on the raised track gives excellent resistance to contact bounce under punishing vibration or shock, as well as an exceptional rotational life. Such units are particularly suited for applications where trouble-free maintenance is required.



BUSHING



SERVO

	TYPE	A	B	C	D	E	F	G
87-P82	BUSHING	.87	.53	.87	.38	.250	—	—
87-P83	SERVO	.87	.59	.50	—	.125	.062	.750
106-P249	SERVO	1.06	.57	.50	—	.125	.062	.968
112-P16	BUSHING	1.12	.50	.87	.38	.250	—	—
112-P19	SERVO	1.12	.57	.50	—	.125	.062	1.000
143-P93	SERVO	1.43	.63	.75	—	.250	.093	1.312
200-P445	BUSHING	2.00	.50	.87	.38	.250	—	—
200-P446	SERVO	2.00	.75	.75	—	.250	.093	1.875

ELECTRICAL AND MECHANICAL CHARACTERISTICS

	87-P82 BUSHING	87-P83 SERVO	106-P249 SERVO	112-P16 BUSHING	112-P19 SERVO	143-P SERVO	200-P445 BUSHING	200-P446 SERVO
Total Resistance (Ohms)	500 Ω - 50K	500 Ω - 50K	500 Ω - 100K	500 Ω - 100K	500 Ω - 100K	1K - 100K	1K - 100K	1K - 100K
Total Resistance Tolerance	±20%	±10%	±10%	±20%	±10%	±10%	±20%	±10%
Theoretical Resolution	.001%	.001%	.001%	.001%	.001%	.001%	.001%	.001%
Independent Linearity	±2%	±0.5%	±0.5%	±2%	±0.5%	±0.5%	±2%	±0.5%
Theoretical Electrical Travel (Degrees)	340°	340°	340°	340°	340°	340°	340°	340°
Theoretical Elect. Travel Tolerance (Degrees)	±5°	±3°	±2°	±5°	±2°	±2°	±5°	±2°
Total Mechanical Travel (Degrees)	360°	360°	360°	360°	360°	360°	360°	360°
Temperature Coefficient (PPM/°C)	400	400	400	400	400	400	400	400
Operating Temperature Range (°C)	−55°to105°C	−55°to105°C	−55°to105°C	−55°to105°C	−55°to105°C	−55°to105°C	−55°to105°C	−55°to105°C
Power Rating (Watts at 40°C)	1	1	1.5	1.5	1.5	2	3	3
Dielectric Strength (Volts, RMS for 60 Sec)	1000	1000	1000	1000	1000	1000	1000	1000
Terminals, Standard	3	3	3	3	3	3	3	3
Taps, Maximum Available	4	4	6	6	6	9	9	9
Tap Tolerance	±5°	±3°	±2°	±5°	±2°	±2°	±5°	±2°
Life Expectancy (Revolutions at 500RPM)	20,000,000	100,000,000	100,000,000	20,000,000	100,000,000	100,000,000	20,000,000	100,000,000
Moment of Inertia (gm-cm^2)	0.2	0.2	0.2	0.2	0.2	1.5	1.5	1.5
Starting Torque (ounce-inches)	*0.6	0.5	0.5	*0.6	0.5	0.3	*0.6	0.3
Running Torque (ounce-inches)	*0.5	0.4	0.4	*0.5	0.4	0.2	*0.5	0.2
Weight (ounces)	0.5 oz.	0.6 oz.	0.6 oz.	0.6 oz.	0.6 oz.	1.7 oz.	2 oz.	4 oz.
*Stop Strength (pound-inches)	**2 lb.-in.	—	—	*2 lb.-in.	—	—	*3 lb.-in.	—
Bearings	Bronze	SS Ball B.	SS Ball B.	Bronze	SS Ball B.	SS Ball B.	Bronze	SS Ball B.

* Add one ounce-inch for O-ring seal

** For units with mechanical stops. Conforms to MIL - R - 39023 A

Standard Resistance Values Within Range Indicated.
500 Ω , 1K, 2K, 5K, 10K, 20K, 50K, 100K

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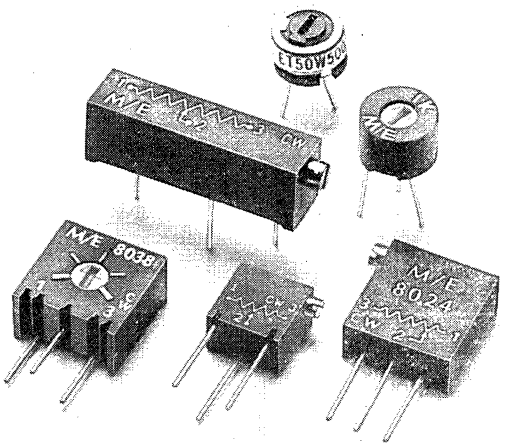
Mepco//Electra

A NORTH AMERICAN PHILIPS COMPANY

Your resistor/capacitor company with tomorrow's technology today.



CERMET TRIMMER SPECIFICATIONS

Temperature Coefficient: ±100 ppm/°C, standard
Contact Resistance Variation (CRV): 3%
End Resistance: 1% maximum or 2Ω, whichever is greater.
Resolution: Essentially infinite.
Operating Range:
−25°C to +125°C for Models 8014, 8035, 8038.
−65°C to +150°C for Models 8024, 8026, 8050.
Torque: 3.8 inch-ounces maximum, depending on model.
Sealed to allow wave solder and immersion cleaning.
Stops: Clutch at both ends for multiturn; positive at both ends for single turn models.

STANDARD RESISTANCE VALUES AND CODES			
OHMS	**CODE**	**OHMS**	**CODE**
10	100	10K	103
20	200	20K	203
50	500	50K	503
100	101	100K	104
200	201	200K	204
500	501	500K	504
1K	102	1MEG	105
2K	202	2MEG	205
5K	502	5MEG	505

TRIMMERS

11468 Sorrento Valley Rd., San Diego, CA 92121 (619) 453-0332 TWX: 910-337-1120

INDUSTRIAL CERMET TRIMMERS

	8014	**8024**	**8026**	**8035**	**8038**
Description	¼" Round Single Turn	⅜" Square Multiturn	¼" Square Multiturn	¾" Rectangular Multiturn	⅜" Square Single Turn
Standard Resistances	100Ω to 1 MΩ	10Ω-1 MΩ	10Ω-1 MΩ	10Ω-1 MΩ	100Ω-1 MΩ
Resistance Tolerance (%)	±20% ±10%	±10%	±10%	±10%	±10%
Dimensions H x W x L (In.)	.250 dia. x .175 (Pin styles W, P) .320 x .250 x .225 (Pin style X)	.375 x .375 x .150	.250 x .250 x .165	.250 x .195 x .750	.375 x .375 x .200
Power Rating (Watts)	0.5 @ 25°C	0.5 @ 85°C	0.25 @ 85°C	0.75 @ 25°C	0.5 @ 85°C
Adjustment	1 Turn	25 Turns	12 Turns	15 Turns	1 Turn
Pin Styles	Side/Top Adjust	Side/Top Adjust	Side/Top Adjust	Side Adjust	Side/Top Adjust

MILITARY CERMET TRIMMERS

MIL-R-22097	**RJ24**	**RJ26**	**RJ50**
Pin Styles	P, W, X	P, W, X	P
Characteristic*	C, F	C, F	F
Resistance Range	10Ω-1 MΩ	10Ω-1 MΩ	10Ω-1 MΩ
MIL-R-39035	**RJR24**	**RJR26**	**RJR50**
Pin Styles	P, W, X	P, W, X	P
Characteristic*	F, H	F, H	F
Resistance Range	10Ω-1 MΩ 20KΩ-1 MΩ for "H" Char.	10Ω-1 MΩ 20KΩ-1 MΩ for "H" Char.	10Ω-1 MΩ

* "F" or "H" Characteristic provides "C" level approval.

For information on Mepco/Electra's CAPACITORS/RESISTORS/MILITARY COMPONENTS, see pages 1•1142, 1•1998 and 1•1674.

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

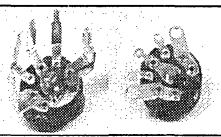
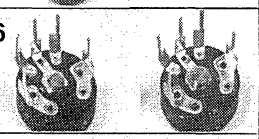
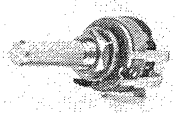
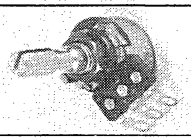
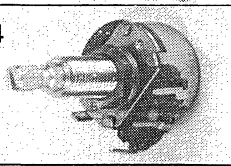
Y

YIG yttrium iron garnet

MURA®

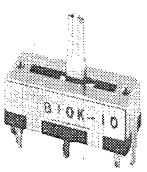
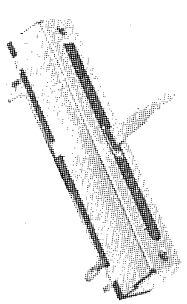
CORPORATION
177 CANTIAGUE ROCK ROAD, WESTBURY, N.Y. 11590 / (516) 935-3640 Telex: 967 879

ROTARY
SLIDE
TRIMMING
CARBON COMPOSITION

SERIES	DIAMETER IN/MM	RESISTANCE RANGE (KΩ)(+/−20%)	POWER RATING (WATTS)	SHAFT TYPE	SWITCH TYPE	SWITCH RATING	TERMINAL TYPE P-PCB, S-SOLDER	ANGLE OF ROTATION (+/−10%)
12 	½/12	.5-500	0.1	N/A	ROTARY SPST	12VDC/1A	P/S	230°
16 	5/8/16	.5-1000	0.1	N/A	ROTARY SPST	12VDC/1A	P/S	260°
17 	43/64/17	.5-1000	0.1	S,R,F,H,E	ROTARY SPST	12VDC/1A	P/S	260°
18 	21/32/16.8	.5-1000 AVAILABLE WITH DUAL ELEMENT	0.2	S,F,R,M,H	ROTARY SPST SPST	12VDC/1A 125 VAC/1A	P/S	300°
24 	15/16/24	.1-3000 AVAILABLE WITH DUAL ELEMENT AND DUAL ELEMENT WITH SWITCH.	0.5	S,F,R,M,H	ROTARY SPST SPST SPDT DPST DPDT PUSH-PULL	125VAC/1A 125VAC/3A 125VAC/1A 125VAC/3A 125VAC/1A 250VAC/3A	P/S	300°

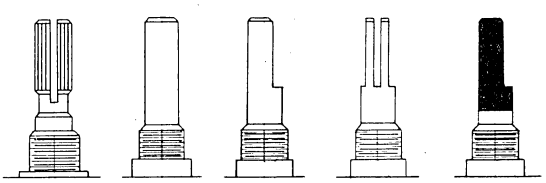
ROTARY POTS:
DETENTS–SERIES 18 AND 24
CENTER,11, 41

SLIDE POTS:
CENTER DETENT-10, 15, 30, 45
11 DETENTS-60

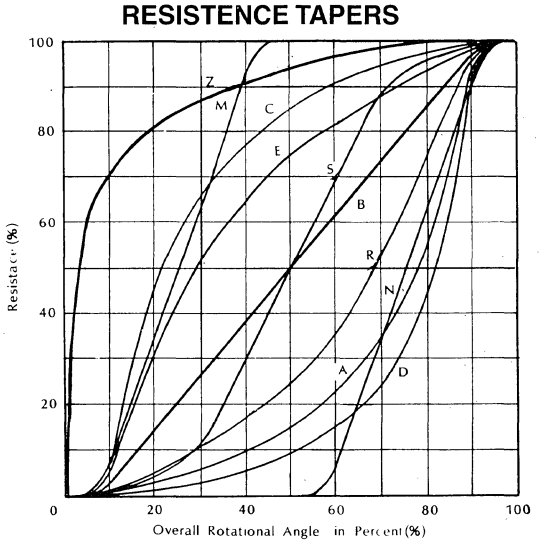
SLIDE POTS	TRAVEL (MM)	TERMINAL TYPE P-PCB, S-SOLDER	DUAL AVAIL.
SV10	10	P	YES
SV15 	15	S	YES
SV20	20	S	YES
SV30 	30	P	YES
		S	YES
SV45	45	P	YES
		S	YES
SV60	60	P	NO
		S	

RESISTANCE RANGE: 500Ω-2MΩ

SHAFT TYPES

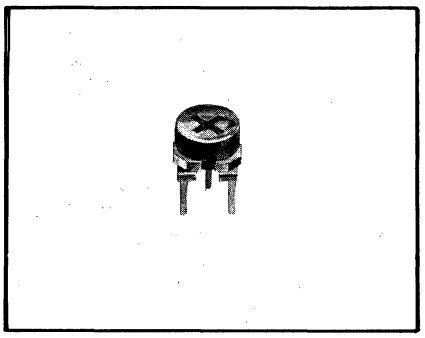


RESISTENCE TAPERS



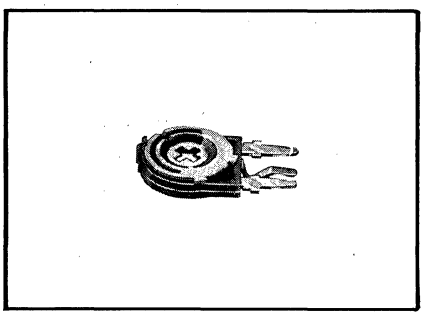
single turn, low cost trimming potentiometers

MURATA ERIE NORTH AMERICA, INC.



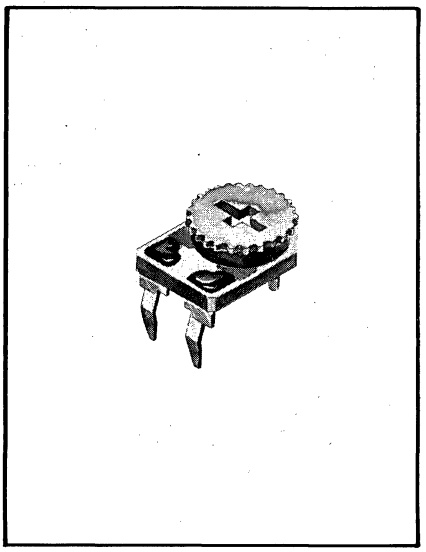
1/10 Watt, Carbon—RVA0607

Resistance Range:	200 ohms to 2 Megohms
Tolerance:	±30%
Residual Resistance:	200 to 500 ohms — 5 ohms max. Over 500 ohms — 1% max.
Taper:	Linear
Power Rating:	0.1W (at 70°C) Derated to 0 watts at 125°C
Max. Working Voltage:	50 VDC
Torque:	.27 to 2.8 oz. in. (20 to 200 g cm)
Terminal Strength:	35.27 oz. (1.0 kg) when the force is applied in the direction of the axes of the terminal
Effective Rotation:	Approx. 220°



1/10 Watt, Carbon—RVF

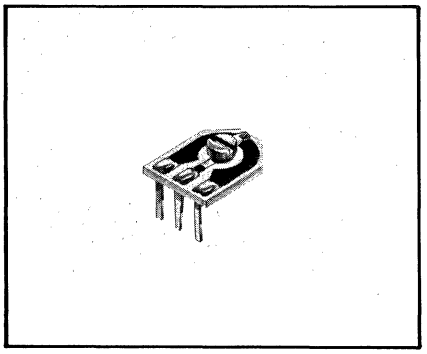
Resistance Range:	200 ohms to 1 Megohm
Tolerance:	±25%
Residual Resistance:	Less than 5% of nominal rated resistance
Taper:	Linear
Power Rating:	0.1W (at 70°C) Derated to 0 watts at 100°C
Max. Working Voltage:	150 VDC
Torque:	.42 to 4.2 oz. in. (2.9-29.4 mNm)
Terminal Strength:	35.27 oz. (98 mNm) when the force is applied in the direction of the axes of the terminal
Effective Rotation:	270° ±10°



1/5 to 3/4 Watt, Carbon, Cond. Plastic & Cermet—0911/1214

Characteristic	RVA (Carbon) RVX (Cond. Plastic)		RVG (Cermet)	
	0911	1214	0911	1214
Resistance Range:	200 — 5 Megohms*		200 — 1 Megohm	
Tolerance:	±20%			
Residual Resistance:	Less than 500Ω. 5Ω maximum 500Ω and up, less than 1% of nominal rated resistance			
Taper:	Linear			
Power Rating**:	1/5W (70°C)	1/3W (70°C)	1/2W (70°C)	3/4W (70°C)
Max. Working Voltage***:	250 VDC	350 VDC	350 VDC	500 VDC
Torque:	0.56-4.86 in. oz.	0.83-6.0 in. oz.	0.56-4.86 in. oz.	0.83-6.0 in. oz.
Terminal Strength:	35.27 oz.			
Effective Rotation: Elec.	240°	250°	240°	250°
Mech.	260° ±10°	280° ±10°	260° ±10°	280° ±10°
Stop Strength:	13.9 oz.			

* 100 ohms available in RVA ** Derated to 0 watts at 125°C
*** Max working V varies with resistance value. Vmax = √ Resistance x Power



1/3 Watt, Cermet—RVS0707

Resistance Range:	100 ohms to 1 Megohm
Tolerance:	±20%
Temperature Coefficient:	100ppm/°C
Residual Resistance:	100 to 500 ohms — 5 ohms max. Over 500 ohms — 1% max.
Taper:	Linear
Power Rating:	1/3W (at 70°C) Derated to 0 Watts at 125°C
Max. Working Voltage:	100 VDC
Torque:	.27 to 2.8 oz. in. (20 to 200 g cm)
Terminal Strength:	12.35 oz. (350 gr) when the force is applied in the direction of the axes of the terminal
Effective Rotation:	200° ±10°

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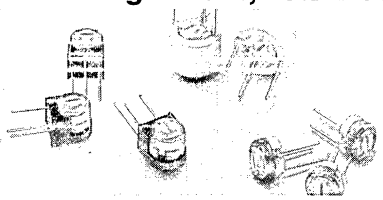
sealed precision cermet trimming potentiometers—±100 ppm/°C

MURATA ERIE NORTH AMERICA, INC.

3321 Single Turn, 1/2 Watt



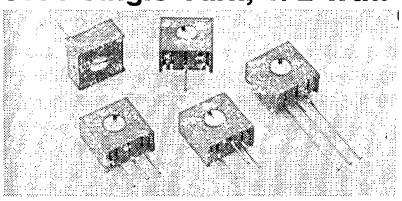
FEATURES

- Flame retardant rotor meets UL94V-0 requirements
- Extremely small size — .260″D. x .181″
- Sealed to withstand wave soldering and immersion cleaning processes

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±20%
Residual Resistance	1% or 2 ohms max. whichever is greater
Power Rating	0.5W at 70°C. Derated to 0W at +150°C
Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +150°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

3104 Single Turn, 1/2 Watt



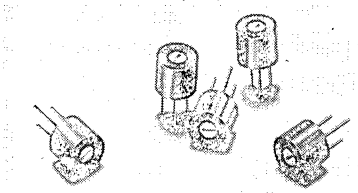
FEATURES

- Low cost
- ⅜″ square

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±10%
Residual Resistance	2 ohms max.
Power Rating	0.5W at 70°C. Derated to 0W at +125°C
Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +125°C
Contact Resistance Variation	1% or 1 ohm max. whichever is greater

1102, 4-Turn, 1/2 Watt



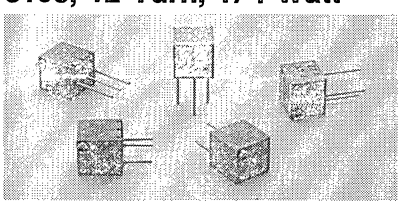
FEATURES

- Unique planetary drive provides the precise setting capability of a multi-turn unit in a small single-turn package
- Just .299″D x .260″
- Sealed to withstand wave soldering and immersion cleaning process

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±10%
Residual Resistance	1% or 2 ohms max. whichever is greater
Power Rating	0.5W at 70°C. Derated to 0W at +125°C
Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +125°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

3103, 12-Turn, 1/4 Watt



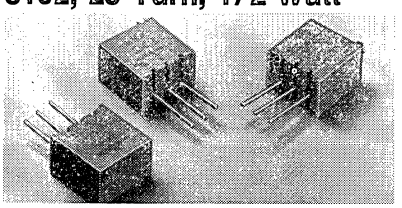
FEATURES

- ¼″ square
- Sealed to MIL-R-22097 standards

SPECIFICATIONS

Resistance Range	10 ohms to 1 Megohm
Tolerance	±10%
Residual Resistance	1% or 2 ohms max. whichever is greater
Power Rating	0.25W at 70°C. Derated to 0W at +125°C
Working Voltage	200 VDC max.
Operating Temperature Range	−55°C to +125°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

3102, 25-Turn, 1/2 Watt



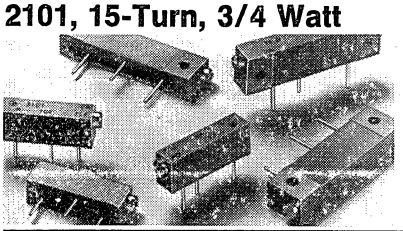
FEATURES

- Small size — .374″ x .394″ x .240″
- Sealed to MIL-R-22097 standards. Will withstand industrial cleaning processes

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±10%
Residual Resistance	1% or 2 ohms max. whichever is greater
Power Rating	0.5W at 70°C. Derated to 0W at +125°C
Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +125°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

2101, 15-Turn, 3/4 Watt



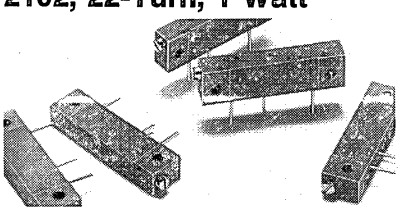
FEATURES

- Small size — .181″ x .252″ x .752″ for close board spacing
- Sealed to MIL-R-22097 standards. Will withstand industrial cleaning processes

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±10%
Residual Resistance	3% or 1 ohm max. whichever is greater
Power Rating	0.75W at 70°C. Derated to 0W at +125°C
Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +125°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

2102, 22-Turn, 1 Watt



FEATURES

- 22 turn mechanism provides extremely fine adjustment capability
- High power dissipation: 1.0W at 70°C
- Sealed to withstand wave soldering and immersion cleaning processes

SPECIFICATIONS

Resistance Range	10 ohms to 2 Megohms
Tolerance	±10%
Residual Resistance	1% or 2 ohms max. whichever is greater
Power Rating	1W at 70°C. Derated to 0W at +150°C
Max. Working Voltage	300 VDC max.
Operating Temperature Range	−55°C to +150°C
Contact Resistance Variation	3% or 3 ohms max. whichever is greater

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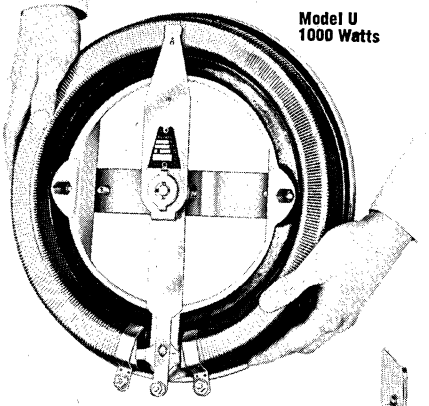
OHMITE® vitreous enameled rheostats (potentiometers)

Now, Ohmite offers TWELVE sizes in its line of famous rheostats.

In all Ohmite rheostats, the resistance wire is wound on a solid ceramic core. The turns are locked in place with tough, protective vitreous enamel or Ohmicone® silicone ceramic. Pivoted, universal action mounting of the brush, assures perfect contact. Metal-graphite contact brushes, varied to fit current and resistance, insure good contact with negligible wear of the wire. Terminals at each end of the winding permit connection of the unit as a potentiometer.

NOW, FOR ITS RATING, INDUSTRY'S SMALLEST RHEOSTAT!

Model C
7½ Watts



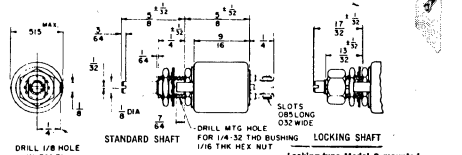
Model U
1000 Watts

Dimensions and Other Parameters	Mod. C Encl.	Model E Unencl.	Model E Encl.	Model H	Model J	Model G	Model K	Model L	Model P	Model N	Model R	Model T	Model U
Rated Watts	7½	12½		25	50	75	100	150	225	300	500	750	1000
Resistance Range - Ohms	10 to 5,000	1 to 15,000		1 to 25,000	0.5 to 50,000	0.5 to 50,000	0.5 to 50,000	0.5 to 50,000	1 to 30,000	1 to 50,000	1 to 20,000	1 to 15,000	1 to 20,000
Overall Diameter	.515	⅞	1¾	1 1/16	2 5/16	2¾	3⅛	4	5	6	8	10	12
Overall Deptn Behind Panel	⅞	1 1/16	1 5/32	1⅜	1⅜	1¾	1¾	2	2⅛	2⅜	2⅛	3	3
Weight - Lbs.	.017	.037	.053	0.19	0.32	0.52	0.64	1.1	2	2.6	4	7.6	10
Mtg. Centers (Dimension "M")	(Single-Hole Mounting)								⅞	1 3/16	1½	1⅞	3

MODEL "C" — 7½ WATT* — STANDARD & LOCKING SHAFT

Ohms	Amps	Standard Shaft Catalog No.[1]	Locking Shaft Catalog No.[1]
10	.86	4908	4948
15	.71	4909	(4949)
25	.55	4910	(4950)
35	.46	(4911)	(4951)
50	.39	4912	(4952)
75	.32	(4913)	(4953)
100	.27	4914	4954
150	.22	(4915)	(4955)
200	.19	4916	(4956)
250	.17	4917	(4957)
350	.15	4918	4958
500	.12	4919	(4959)
750	.10	(4920)	(4960)
1000	.086	4921	4961
1500	.071	(4922)	(4962)
2500	.055	(4923)	4963
3500	.046	(4924)	(4964)
5000	.039	4925	4965

*Rating on metal panel — unit is silicone-ceramic coated.



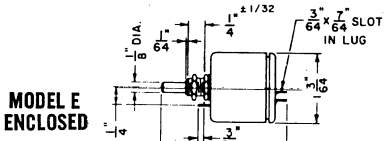
Locking-type Model C mounted in socket on panel. Solder terminals fit transistor socket.

MODEL C ENCLOSED

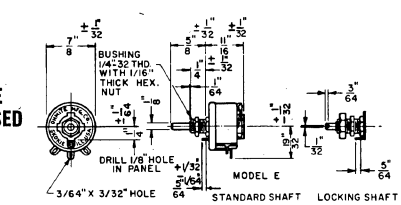
MODEL "E" — 12½ WATT* — UNENCLOSED & ENCLOSED

Total Ohms	Max. Amps	Steps Appr.	Unenclosed Standard Shaft Cat. No.[1]	Unenclosed Locking Shaft Cat. No.[1]	Enclosed Std. Shaft Cat. No.	Total Ohms	Max. Amps	Steps Appr.	Unenclosed Standard Shaft Cat. No.[1]	Unenclosed Locking Shaft Cat. No.[1]	Enclosed Std. Shaft Cat. No.
1	3.53	32	**0101**	L0101	(W0101)	175	.27	146	**0114**	L0114	(W0114)
2	2.50	28	**0102**	L0102	(W0102	200	.25	132	0114A	L0114A	(W0114A)
2.5	2.24	31	(0102A)	(L0102A)	(W0102A)	250	.22	128	**0115**	L0115	(W0115)
3	2.04	33	0103	L0103	(W0103)	350	.19	149	**0116**	L0116	(W0116)
5	1.58	61	0103A	L0103A	(W0103A)	500	.16	213	**0117**	L0117	(W0117)
6	1.44	58	**0104**	L0104	(W0104)	750	.13	193	**0118**	L0118	(W0118)
8	1.25	61	**0105**	L0105	(W0105)	1,000	.11	257	**0119**	L0119	(W0119)
10	1.12	76	**0106**	L0106	(W0106)	1,500	.091	255	**0120**	L0120	(W0120)
15	.91	64	0107	L0107	(W0107)	2,500	.071	277	**0121**	L0121	(W0121)
25	.71	67	**0108**	L0108	(W0108)	3,500	.060	313	**0122**†	L0122†	(W0122)†
35	.60	73	**0109**	L0109	(W0109)	5,000	.050	355	**0123**†	L0123†	(W0123)†
50	.50	83	**0110**	L0110	(W0110)	7,500	.041‡	299	4190†	L4190†	(W4190)†
75	.41	101	**0111**	L0111	(W0111)	10,000	.035‡	398	**4191**†	L4191†	(W4191)†
100	.35	106	**0112**	L0112	(W0112)	12,500	.031‡	434	(4192)†	(L4192)†	(W4192)†
125	.32	132	**0113**	L0113	(W0113)	15,000	.029‡	521	4193†	L4193†	(W4193)†
150	.29	125	0113A	L0113A	(W0113A)						

*Rating on metal panel. †Silicone-ceramic coating. ‡7.5KΩ = 305V. max; 10KΩ, 12.5KΩ, and 15KΩ = 350V. max.

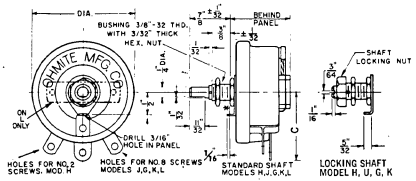


MODEL E ENCLOSED



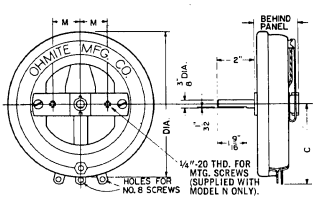
MODEL E UNENCLOSED

MODELS H, J, G, K, L*



* NO NON-TURN ON MODEL L

MODELS P, N, R, T, U



25 WATT MODEL "H" — UL Listed

Locking Shaft	Std. Shaft	Total Ohms	Max. Amps	Steps Approx.
L0140	**0140**	1	5.000	30
L0141	**0141**	2	3.540	30
L0142	**0142**	3	2.880	31
L0143	**0143**	6	2.040	50
L0144	**0144**	8	1.770	53
L0145	**0145**	10	1.580	52
L0146	**0146**	15	1.290	67
L0147	**0147**	25	1.000	89
L0148	**0148**	35	.845	98
L0149	**0149**	50	.707	80
L0150	**0150**	75	.575	107
L0151	**0151**	100	.500	142

50 WATT MODEL "J" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0308	0.5	10.000	24
0309	1	7.070	44
0310	2	5.000	43
0311	4	3.530	42
0312	6	2.880	45
0313	8	2.500	43
0314	12	2.040	86
0315	16	1.760	91
0316	22	1.500	100
0317	35	1.190	125
0318	50	1.000	112
0319	80	.790	143
0320	125	.630	176

75 WATT MODEL "G" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
1100	0.5	12.300	27
(1101)	1	8.660	27
1102	2	6.120	30
1103	3	5.000	28
1104	5	3.880	53
1105	7.5	3.160	50
1106	10	2.740	53
1107	16	2.170	91
1108	25	1.730	113
1109	50	1.230	142

100 WATT MODEL "K" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0440	0.5	14.100	33
0441	1	10.000	33
0442	2	7.070	32
0443	3	5.750	39
0444	5	4.470	57
0445	7.5	3.650	60
0446	10	3.160	57
0447	16	2.500	88
0448	25	2.000	109
0449	50	1.410	137

150 WATT MODEL "L" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0524	0.5	17.300	29
0525	1	12.300	41
0526	2	8.650	40
0527	3	7.070	42
0528	5	5.480	44
0529	7.5	4.470	75
0530	10	3.880	79
0531	15	3.163	75
0532	25	2.450	120
0533	35	2.070	133
0534	50	1.735	151

Continued on next page

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OHMITE® vitreous enameled rheostats (potentiometers)

25 WATT MODEL "H" — UL Listed

Locking Shaft	Std. Shaft	Total Ohms	Max. Amps	Steps Approx.
L0152	**0152**	125	.445	139
L0153	**0153**	175	.373	154
L0154	**0154**	250	.316	177
L0155	**0155**	350	.267	197
L0156	**0156**	500	.222	220
L0157	**0157**	750	.182	261
L0158	**0158**	1,000	.155	278
L0159	**0159**	1,500	.129	267
L0160	**0160**	2,500	.100	341
L0161	**0161**	3,500	.084	315
L0162	**0162**	5,000	.070	355
L4200	4200†	7,500	.058	439
L4201†	**4201†**	10,000	.050	476
L4202†	4202†	15,000	.041	431
L4203†	**4203†**	20,000	.035	422
L4204†	**4204†**	25,000	.032	527

†Silicone-ceramic coating, 500V max. for 10KΩ and above. Not UL listed.

50 WATT MODEL "J" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0321	150	.575	170
0322	225	.470	199
0323	300	.408	211
0324	500	.316	284
0325	800	.250	282
0326	1,000	.224	352
0327	1,600	.176	355
0328	2,500	.141	449
0329	3,500	.119	496
0330	5,000	.100	459
0331	8,000	.079	576
0332	10,000	.070	565
4210†	15,000	.058	568
4211†	20,000	.050	599
4212†	25,000	.045	573
4213†	30,000	.041	688
(4214†)	40,000	.035	673
4215†	50,000	.032	842

†Silicone-ceramic coating. 750V max. for 15KΩ and above. Not UL listed.

75 WATT MODEL "G" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
1110	75	1.000	134
1111	100	.866	178
1112	200	.612	180
1113	300	.500	211
1114	400	.433	223
1115	500	.388	279
(1116)	750	.316	338
1117	1,000	.274	356
(1118)	1,500	.224	420
1119	2,000	.194	443
(1120)	2,500	.173	441
(1121)	5,000	.123	564
(1122)	7,500	.100	547
1123	10,000	.087	572

100 WATT MODEL "K" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0450	75	1.150	163
0451	100	1.000	172
0452	200	.707	216
0453	300	.575	261
0454	400	.500	272
0455	500	.447	269
0456	750	.365	326
0457	1,000	.316	343
0458	1,500	.258	404
0459	2,000	.224	426
0460	2,500	.200	426
0461	5,000	.141	543
0462	7,500	.115	528
0463	10,000	.100	704

150 WATT MODEL "L" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0535	75	1.415	179
0536	100	1.225	190
0537	150	1.000	225
0538	200	.865	239
0539	250	.775	236
0540	350	.655	265
0541	500	.548	296
0542	750	.447	352
0543	1,250	.346	473
0544	1,800	.288	537
0545	2,250	.259	529
0546	3,000	.224	558
0547	4,500	.182	667
0548	7,500	.141	714
0549	10,000	.122	952

225 WATT MODEL "P" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
(1250)	1.0	15.000	42
1251	2.0	10.600	41
1252	3.0	8.660	61
(1253)	4.0	7.500	58
1254	5.0	6.710	57
(1255)	7.5	5.490	60
1256	10.0	4.740	115
1257	15.0	3.870	108
1258	25.0	3.000	114
1259	50.0	2.120	218
1260	75.0	1.730	206
1261	100	1.500	275
1262	150	1.220	259
1263	200	1.060	345
1264	300	.866	326
1265	400	.750	342
1266	700	.567	483
1267	900	.500	484
1268	1,200	.433	513
1269	1,500	.387	641
(1270)	1,750	.358	603
(1270A)	2,000	.336	690
1271	2,500	.300	679

300 WATT MODEL "N" — UL Listed

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0650	1.0	17.320	56
0651	2.0	12.240	51
0652	3.0	10.000	51
0653	4.0	8.660	77
0654	5.0	7.750	76
0655	7.5	6.320	72
0656	10.0	5.480	76
0657	15.0	4.470	144
0658	25.0	3.460	134
0659	50.0	2.450	230
0660	75.0	2.000	275
0661	100	1.730	288
0662	150	1.410	345
0663	200	1.220	364
0664	300	1.000	433
0665	400	.866	456
0666	700	.655	500
0667	900	.578	517
0668	1,200	.500	541
0669	1,500	.447	676
(0670)	1,750	.414	625
(0670A)	2,000	.387	714
0671	2,500	.346	720

500 WATT MODEL "R"

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
0849	1.0	22.300	56
0850	1.5	18.200	71
(0851)	2.0	15.800	75
(0852)	2.5	14.100	78
0853	3.0	12.900	79
0854	4.0	11.200	74
0855	5.0	10.000	104
0856	8.0	7.900	104
0857	12.5	6.300	115
0858	16.0	5.600	186
0859	25.0	4.470	205
0860	40.0	3.540	206
0872	50.0	3.160	205
0861	80.0	2.520	316
0862	125	2.000	388
0863	175	1.690	434
0864	250	1.410	490
0865	325	1.240	505
0866	500	1.000	614
0867	750	.817	735
0868	1,000	.707	769
0869	1,500	.577	932
(0870)	2,000	.500	971
0871	2,500	.447	962

750 WATT MODEL "T"

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
(1300)	1.0	27.400	72
(1301)	1.5	22.300	72
(1302)	2.0	19.400	96
(1303)	2.5	17.300	101
(1304)	3.0	15.800	96
(1305)	4.0	13.600	94
(1306)	5.0	12.200	104
(1307)	8.0	9.650	100
(1308)	10.0	8.650	139
(1309)	12.5	7.750	138
(1310)	16.0	6.820	139
(1311)	25.0	5.470	137
(1312)	50.0	3.870	246
(1313)	80.0	3.060	381
(1314)	100	2.740	376
(1315)	160	2.170	476
(1316)	200	1.940	469
(1317)	300	1.580	562
(1318)	400	1.370	593
(1319)	600	1.117	705
(1320)	750	1.000	694
(1321)	1,200	.791	889
(1322)	1,800	.646	1,050
(1322A)	2,000	.610	935
(1323)	2,500	.547	1,170

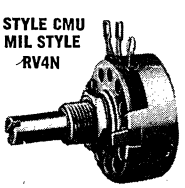
1000 WATT MODEL "U"

Catalog No.[1]	Total Ohms	Max. Amps	Steps Approx.
1450	1.0	31.600	91
1451	1.5	25.800	90
1452	2.0	22.400	90
1453	2.5	20.000	127
1454	3.0	18.300	114
1455	4.0	15.800	120
1456	5.0	14.100	124
1457	8.0	11.200	118
1458	10.0	10.000	117
(1459)	12.5	8.950	163
1460	16.0	7.900	166
1461	25.0	6.330	162
1462	50.0	4.470	327
1463	75.0	3.650	307
1464	100	3.160	446
1465	175	2.390	490
1466	225	2.110	630
1467	300	1.830	661
1468	400	1.580	704
1469	500	1.410	695
1470	750	1.150	828
1471	1,000	1.000	870
1472	1,500	.816	1,040
1473	2,500	.633	1,100

[1] **Popular items appear in BOLD print and are usually in stock at authorized Ohmite stocking distributors. Items in LIGHT FACE print are available from stocking distributors but are not normally stocked in depth. Parentheses indicate non-stock standard items subject to a minimum handling charge per item.**

OHMITE® molded composition potentiometers

STYLE CMU
MIL STYLE RV4N



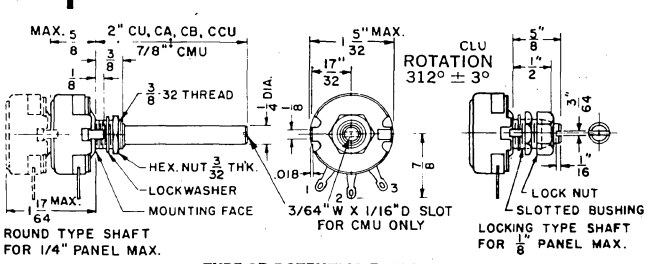
Ohmite molded composition potentiometers (Type AB) provide high quality and dependable performance.

Because the resistance element is a thick, solid-molded ring, longer life and smoother operation are obtained. This is due also to the molded composition contact. Units are dust and splash proof, fungus and corrosion resistant and meet the requirements of military specification MIL-R-94.

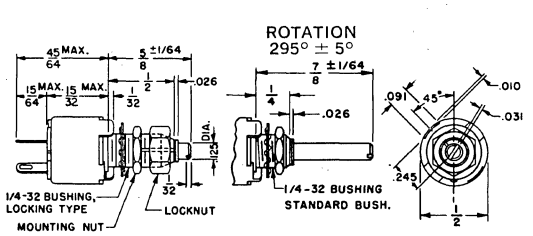
STOCK "POTS" — MIL Units are stamped with MIL and Commercial Designations.

	Type AB (1⅝2" Dia.) Rated 2 Watts						Type AS (½" Dia.) Rated ½ Watt	
	Single Unit ⅞" Shaft	Single Unit 2" Shaft			Locking	Dual	Miniature Locking	Miniature ⅞" Shaft
Resist.	Style CMU (Linear) Comm. & MIL	Style CU (Linear)	Style CA (CW log)	Style CB (CCW log)	Style CLU (Linear) Comm. & MIL	Style CCU (Linear)	Style AS (Linear) Comm. & MIL	Style ASM (Linear) Comm. & MIL
Range or Limited Ohmic Values	50 to 5.0 Meg.	50 to 5.0 Meg.	0.1 Meg. .25 Meg. .5 Meg. 1.0 Meg. 2.5 Meg.	10,000 25,000 50,000	50 to 5.0 Meg.	10,000 25,000 50,000 1.0 Meg. .25 Meg. .5 Meg. 1.0 Meg.	50 to 5.0 Meg.	50 to 5.0 Meg.
Weight	.064 lb.	.084 lb.			.070 lb.	.123 lb.	.017 lb.	.017 lb.

FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX



TYPE AB POTENTIOMETERS



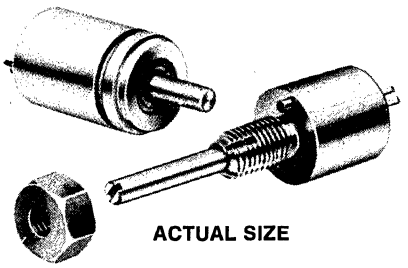
TYPE AS POTENTIOMETERS

SAMARIUS INC.

300 SEYMOUR AVENUE, DERBY, CONN. 06418 (203) 735-7405 • TWX: 710-451-2495

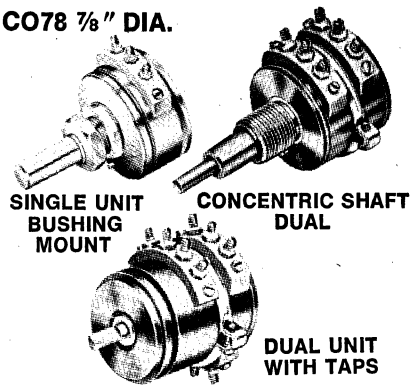
PRECISION POTENTIOMETERS

C-050 ½" DIA.

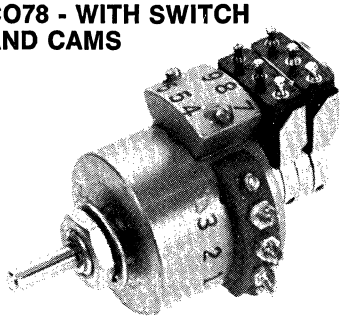


Available in resistance values to 500K. Dual Gang Units available both Bushing & Servo Mt.

CO78 ⅞" DIA.

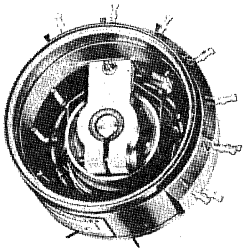


CO78 - WITH SWITCH AND CAMS



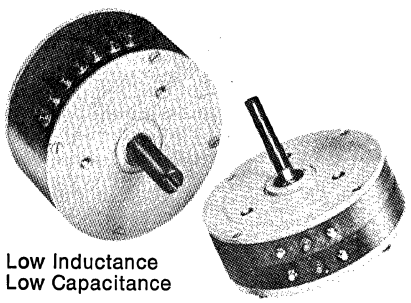
Designed for aircraft and commercial applications.

BC200 - C200P 2" DIA.



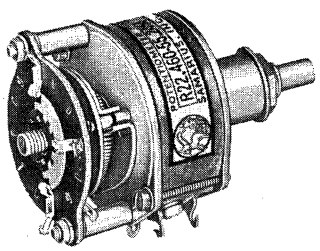
Most versatile unit- all resistance values. Taps economically supplied. Gangable and available in both Bushing & Servo Mount.

M300, M301, M400 INSTRUMENT POTENTIOMETERS



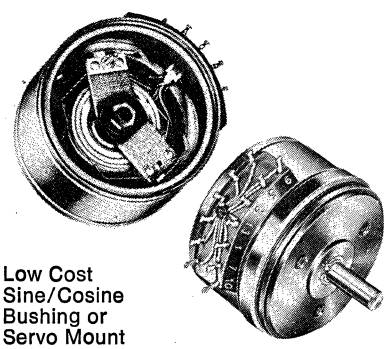
Low Inductance
Low Capacitance

MODEL L140 LOOP CONTROL



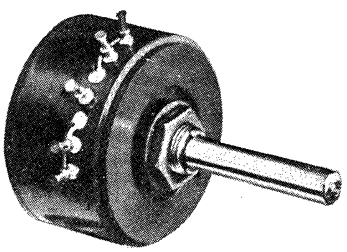
Spring return to center with or without switch and center tap. Used in Satellite and Radar Antennas. Also Medical, Robot and Comparators.

BC200 - C200P SINE/COSINE



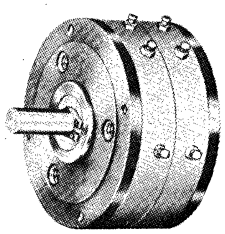
Low Cost
Sine/Cosine
Bushing or
Servo Mount

M158 - CP158 1⅝"



Low Cost Industrial Wirewound & Conductive Plastic Units

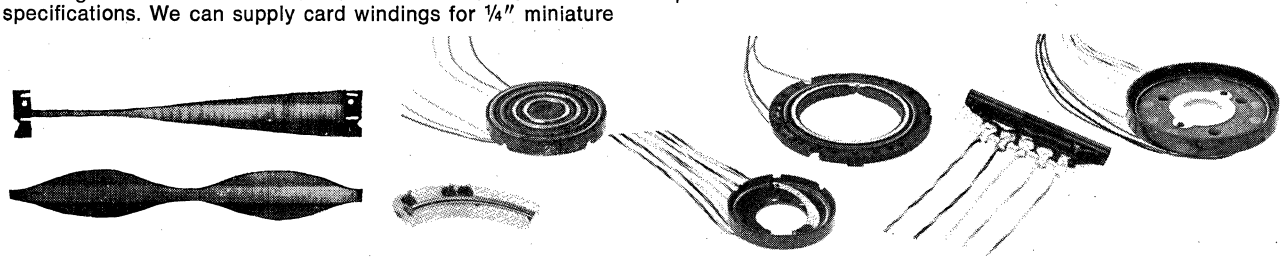
SERIES HP-200, HP-300, HP-500 2", 3", 5" HIGH RESOLUTION



Ideal for Tight Linearity Long Elect Angles

HIGH PRECISION POTENTIOMETER AND RESISTOR ASSEMBLY

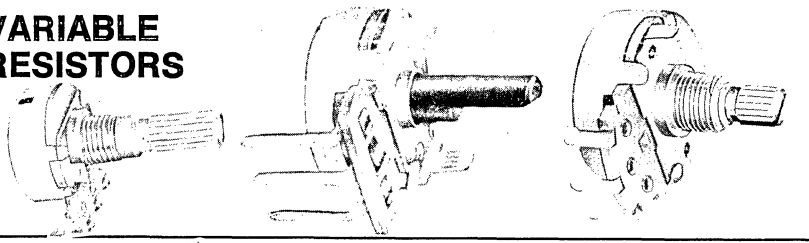
Samarius, Inc. furnish their clients with a custom winding service for wire wound potentiometer elements in card and mandrel types. Linear or functional requirements are achieved through cooperative R & D with customers. Card profiles are ground with exact duplication from master templates on our own engineered and built machines to tolerances to meet all specifications. We can supply card windings for ¼" miniature potentiometers to cards 12 feet long and 4 inches wide. Mandrel windings are available up to 16 feet long in any type of wire needed. Over 30 years' experience in supplying high precision potentiometer windings to the field. Call on our engineering staff for their help in solving your winding or potentiometer problems.



DEPT. EM, 287 NORTHERN BOULEVARD
GREAT NECK, NEW YORK, 11021
(516) 466-0911
CABLE: "SHOGYO NEWYORK"
TELEX: 12218 + 4758024

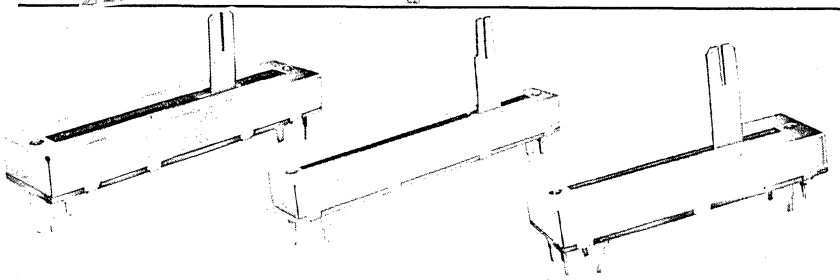
SHOGYO INTERNATIONAL CORPORATION

VARIABLE RESISTORS



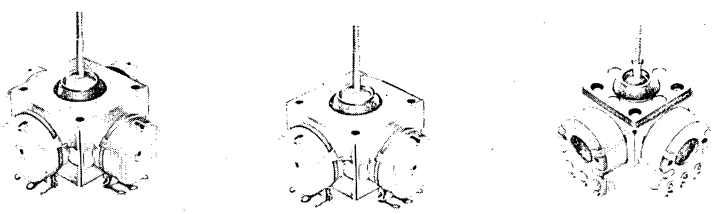
ROTARY

Angle of Rotation Ranges: 260° ±5° through 300° ±5°
Resistance Range: 500Ω through 2MΩ
Power Rating: .05W through .25W
Voltage Rating: 150V through 500V
Torque: 200 through 350g—cm
For Switch, Gang Error and Electrical Tap Specifications please consult Shogyo directly.



SLIDE

Travel: 20 ±0.5(mm) through 60 ±0.5(mm)
Mounting Pitch: 65(mm) — 31 ±0.3(mm) through 85(mm)
Resistance Range: 500Ω — 1MΩ, 5KΩ through 1MΩ
Power Rating: 0.1W through 0.5W
Voltage Rating: 150V through 500V
Sliding Force: 50 — 350g
Single and Double Types available.



SEMI-FIXED

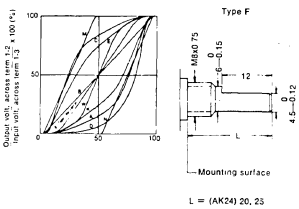
Resistance Range: 100Ω through 2KΩ
Resistance Tolerance: ±20%
Taper: Linear
Rated Power: 0.1W
Maximum Operating Voltage: 100V
Rotating Angle: 260 ±15%
Rotating Torque: 40 — 250g—cm
Rotating Life: Maximum 10% resistance change @ 50 rotations
Temperature Characteristic: +5 — 20% resistance change after 5 hours at 70°C
Load Characteristic: ±5% resistance change after 5 hours @ normal temperature
Moisture Characteristic: 7 — 15% resistance change after 5 hours at 95% humidity, 40°C

RESISTANCE CHARACTERISTICS

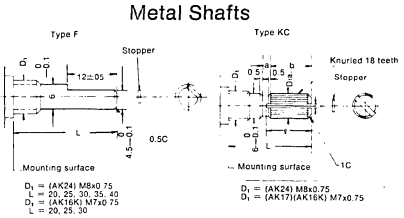
TAPER	CHECK POINT	$\frac{V1\text{-}2}{V1\text{-}3}$ x 100 (%)	$\frac{V2\text{-}3}{V1\text{-}3}$ x 100 (%)
A	60%	15 ~ 30%	
B	50%	40 ~ 60%	
C	60%		15 ~ 30%
D	50%	2 ~ 15%	
E	50%		15 ~ 35%
M	25% 50%	40 ~ 60% 98 ~ 100%	
N	50% 75%	0 ~ 2% 40 ~ 60%	
W	30% 50% 70%	5 ~ 15% 40 ~ 60% 85 ~ 95%	

ILLUSTRATION OF SHAFT

Insulated Shafts



Metal Shafts

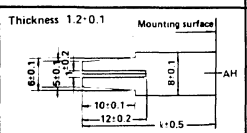
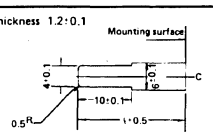
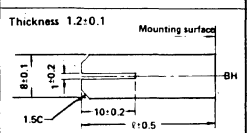
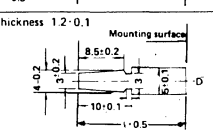
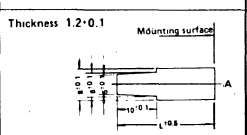
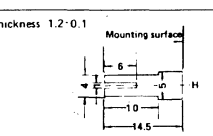


L	15	20	25	30	35	40	60
a	1.5	2	4	4	4	4	4.5
b	6	10	12	12	12	12	21
L	7	11	14	14	14	14	14

△ AK24 only

Any special taper as customers required available on request

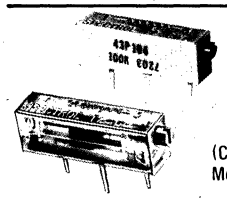
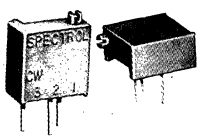
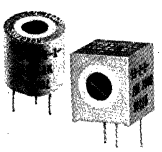
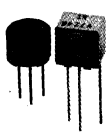
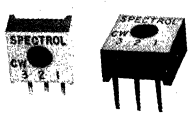
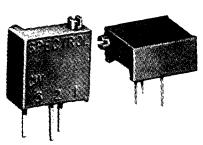
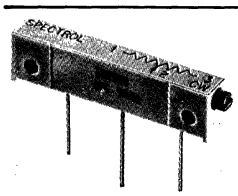
STANDARD LEVERS FOR SLIDE VARIABLE RESISTOR

LEVER DESIGNATION	LEVER SHAPE	LENGTH	APPLICABLE TYPES	LEVER DESIGNATION	LEVER SHAPE	LENGTH	APPLICABLE TYPES
AH		L = 20, 25, 30mm	AK-451 AK-452 AK-601 AK-602 AK-701 AK-702	C		L = 15, 20, 25mm	AK-305 AK-306 AK-451 AK-452 AK-601 AK-602
BH		L = 20, 25, 30mm	AK-451 AK-452 AK-601 AK-602 AK-701 AK-702	D		L = 15, 20, 25mm	AK-305 AK-306 AK-451 AK-452 AK-601 AK-602
A		L = 20, 25, 30mm	AK-451 AK-452 AK-601 AK-602 AK-701 AK-702	H		L = 15, 20, 25mm	AK-201 AK-202 AK-301 AK-302 AK-305 AK-306

SEE OUR OTHER CATALOG PAGES IN EEM SECTIONS 1300/2100/2450/2950/5600

Spectrol

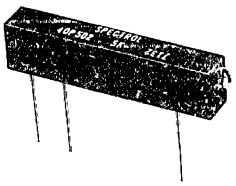
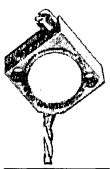
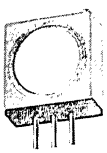
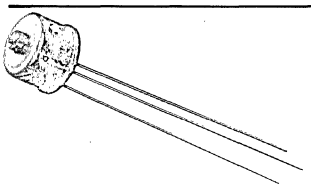
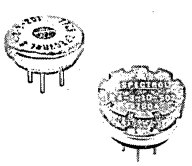
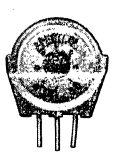
CERMET TRIMMING POTENTIOMETERS

Actual size	MODEL NO.	NOMINAL SIZE (INCHES)	NOM. ADJ. TURNS	TERMINAL[1] STYLE	RESISTANCE TOLERANCE	MAXIMUM POWER RATING (WATTS)	TEMPCO (PPM/° C)	STANDARD RESISTANCE RANGE (OHMS)
	▶ 43 (Clear Lid & Panel Mount Available)	0.75 Long	20	PC	±10%	0.75 @ 70° C	±100 (100 Ω–2 Meg) +200 −100 (10, 20 & 50 Ω)	10 Ω–2 Meg.
	52	0.38 Square	25	PC	±5%	0.5 @ 85° C	±100 (100 Ω–2 Meg) 0 to +250 (10, 20, 50 Ω)	10 Ω–2 Meg.
	▶ 53	0.34 Dia. Top Adjust 0.31 x 0.36 Side Adjust	240°	PC	±20% (±10% Available)	0.5 @ 85° C	±100 (100 Ω – 1 Meg) 0 to +400 (10, 20 & 50 Ω)	10 Ω – 1 Meg.
	▶ 62	0.25 Dia. Top Adjust .025 Square Side Adjust	215°	PC	±20% (±10% Available)	0.5 @ 70° C	±100 (100 Ω – 1 Meg) 0 to +450 (10, 20 & 50 Ω)	10 Ω – 1 Meg.
	▶ 63	0.38 Square	270°	PC	±20% (± 10% Available)	0.5 @ 70° C	±100 (100 Ω –2 Meg) 0 to +250 (10, 20, 50 Ω)	10 Ω–2 Meg.
	▶ 64	0.38 Square	25	PC	± 10%	0.5 @ 85° C	± 100 (100Ω–2 Meg) 0 to +250 (10, 20, 50Ω)	10 Ω–2 Meg.
	▶ 70	1.25 Long	20	L, PC, SH	±10%	1.0 @ 85° C	±100 (100Ω –2 Meg) − 100 to +200 (10, 20 & 50 Ω)	10 Ω-2 Meg.

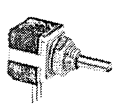
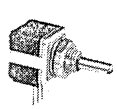
▶ DISTRIBUTOR AUTHORIZED STOCKING ITEM

Spectrol

WIREWOUND TRIMMING POTENTIOMETERS

Actual size	MODEL NO.	NOMINAL SIZE (INCHES)	NOM. ADJ. TURNS	TERMINAL[1] STYLE	RESISTANCE TOLERANCE	MAXIMUM POWER RATING (WATTS)	TEMPCO (PPM/° C)	STANDARD RESISTANCE RANGE (OHMS)
	40 (RT 12 Available)	1.25 Long	22	L,PC,SH	±5%	1.0 @ 70° C	±50	10Ω–10K 20K 50K 100K
	▷ 50 (RT 24 Available)	0.38 Square	23	L,PC	±5%	0.75 @ 85° C	±50	10Ω–10K 20K 50K
	▷ 55 (RT 22 Available)	0.50 Square	23	L,PC	±5%	1.5 @ 70° C	±50	10Ω–10K 20K 50K
	80	0.35 Dia.	310°	PC	5%	1.0 @ 50° C	±50	10Ω–10K 20K 50K
	▷ 84	0.50 Dia. (Base)	300°	PC,SH	±5%	1.5 @ 70° C	±50	Screw Driver 10Ω–10K 20K Knob 10Ω–10K 20K Panel Mt. 10Ω–10K 20K
	85	0.55 x 0.54 Side Adjust	300°	PC	±5%	1.5 @ 70° C	±50	Screw Driver 10Ω–10K 20K

PANEL CONTROL POTENTIOMETERS

Units shown 1/2 actual size	MODEL NO.	SIZE	RESISTANCE RANGE (OHMS)	STANDARD RESISTANCE TOLERANCE	LINEARITY TOLERANCE	MAXIMUM POWER RATING (WATTS)	MOUNTING AVAILABLE
	▷ 148 (Conductive Plastic)	0.500 Square	100 to 1 Meg.	±20%	±5%	0.5 @ 70°C	Bushing
	▷ 149 (Cermet)	0.500 Square	100 to 2 Meg.	±10%	±5%	1.0 @ 85°C	Bushing

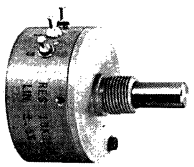
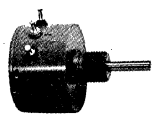
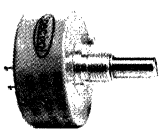
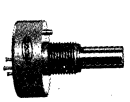
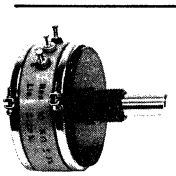
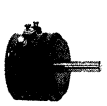
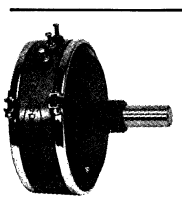
[1]TERMINATIONS: L – COLOR CODED LEAD WIRES, SH – SOLDER HOOKS, PC – PRINTED CIRCUIT PINS.

▷ DISTRIBUTOR AUTHORIZED STOCKING ITEM

Spectrol

SINGLE-TURN WIREWOUND PRECISION POTENTIOMETERS

All units shown ½ actual size

	MODEL NO.	NOMINAL DIA.[2] (INCHES)	RESISTANCE RANGE (OHMS)	STANDARD RESISTANCE TOLERANCE	LINEARITY TOLERANCE STANDARD	LINEARITY TOLERANCE BEST PRACTICAL[1]	MAXIMUM POWER RATING (WATTS)	MOUNTING AVAILABLE
	**100**	1.312	5 to 35K	± 3% (± 5% below 50Ω)	5Ω to 100Ω ±1.0% 100Ω to 35KΩ ± 0.5%	±.15%	2.75 @ 40° C	Bushing Servo
	**122** (Style RR 1100 Available)	1.062	5 to 20K	± 3% (±5% below 20Ω)	5Ω to 200Ω ± 1.0% 200Ω to 20KΩ ± 0.5%	±.20%	1.5 @ 70° C	Bushing Servo
	▶ **132**	1.312	5 to 35K	± 3% (± 5% below 50Ω)	5Ω to 200Ω ± 1.0% 200Ω to 35KΩ ± 0.5%	±.25%	2.75 @ 40° C	Bushing
	▶ **140**	.500	50 to 50K	± 5%	± 1.0%	±.50%	2.0 @ 40° C	Bushing
	142	.500	50 to 50K	±5%	±1.0%	±.50%	2.0 @ 40°C	Servo
	**152**	.875	5 to 40K	± 3% (±5% below 50Ω)	5Ω to 500Ω ±1.0% 500Ω and above ±0.5%	±.35%	2.0 @ 40° C	Bushing Servo
	**172** (Style RR1300 Available)	1.438	5 to 40K	±3% (±5% below 50Ω)	5Ω to 200Ω ±1.00% 200Ω to 2KΩ ± 0.5% 2K to 50KΩ ±.25%	±.15%	2.0 @ 70°C	Bushing Servo
	**182**	.750	5 to 30K	±3% (±5% below 20Ω)	5Ω to 2KΩ ±1.0% 2KΩ to 30KΩ ±0.5%	±.25%	1.5 @ 70°C	Servo
	**202**	1.750	5 to 65K	± 3% (± 5% below 50Ω)	5Ω to 50Ω ± 1.0% 50Ω to 500Ω ±0.5% 500Ω to 65KΩ ±.25%	±.15%	3.5 @ 70° C	Bushing Servo

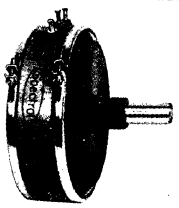
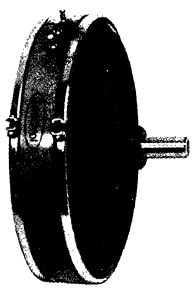
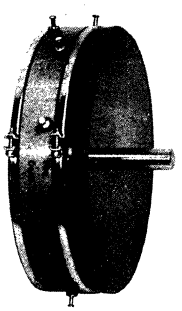
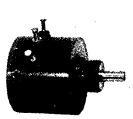
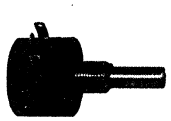
[1] BEST PRACTICAL LINEARITY FIGURES SHOWN FOR THE VARIOUS MODELS APPLY TO HIGHER RESISTANCE UNITS. CONSULT FACTORY WITH SPECIFIC REQUIREMENTS.

▶ DISTRIBUTOR AUTHORIZED STOCKING ITEM

[2] SIZES SHOWN ARE FOR THE BUSHING MOUNT VERSIONS. SHAFT DIA. .125" FOR MODELS 122, 140, 142, 502, 552, 702, AND CW05; .094" FOR MODELS 162 AND 164; .250" FOR ALL OTHER MODELS.

Spectrol

SINGLE-TURN WIREWOUND PRECISION POTENTIOMETERS

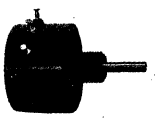
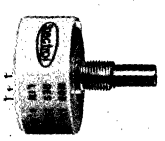
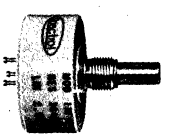
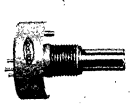
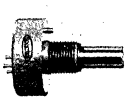
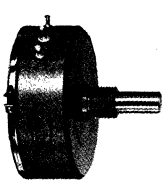
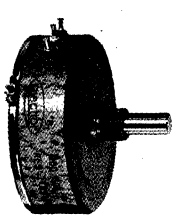
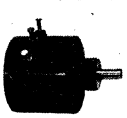
All units shown ½ actual size	MODEL NO.	NOMINAL DIA.[2] (INCHES)	RESISTANCE RANGE (OHMS)	STANDARD RESISTANCE TOLERANCE	LINEARITY TOLERANCE STANDARD	LINEARITY TOLERANCE BEST PRACTICAL[1]	MAXIMUM POWER RATING (WATTS)	MOUNTING AVAILABLE
	**302** (Style RR 2000 Available)	2.000	5 to 85K	±3% (±5% below 50Ω)	5Ω to 50Ω ±1.0% 50Ω to 200Ω ±0.5% 200Ω to 85KΩ ±.25%	±.10%	4.0 @ 70° C	Bushing Servo
	**402** (Style RR 3000 Available)	3.000	10 to 150K	±3% (±5% below 100Ω)	10Ω to 200Ω ±0.5% 200Ω to 150KΩ ±.25%	±.075%	6.0 @ 70° C	Bushing Servo
	**452** SIN/COS	3.000	250 to 25K per quad	±3%	250Ω to 2.5KΩ ±0.5% (PK To PK) 2.5KΩ and above ±0.3% (PK To PK)		6.0 @ 70°C	Servo
	**702** (Style RR 2100 Available)	.875	5 to 100K	±3% (±5% below 20Ω)	5Ω to 500Ω ±1.0% 500Ω to 20KΩ ±0.5%	±.25%	1.25 @ 70° C	Bushing Servo
	**MW**	.906	5 to 50K	±10%	±5%	±2%	1 @ 20°C	Bushing

[1] BEST PRACTICAL LINEARITY FIGURES SHOWN FOR THE VARIOUS MODELS APPLY TO HIGHER RESISTANCE UNITS. CONSULT FACTORY WITH SPECIFIC REQUIREMENTS.

[2] SIZES SHOWN ARE FOR THE BUSHING MOUNT VERSIONS. SHAFT DIA. .125" FOR MODELS 122, 140, 142, 502, 552, 702, AND CW05; .094" FOR MODELS 162 AND 164; .250" FOR ALL OTHER MODELS.

Spectrol

SINGLE-TURN CONDUCTIVE PLASTIC AND CERMET POTENTIOMETERS

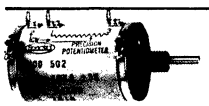
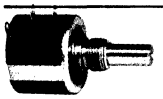
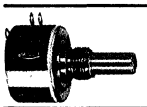
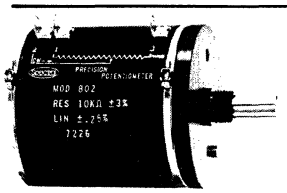
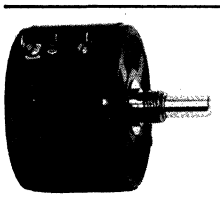
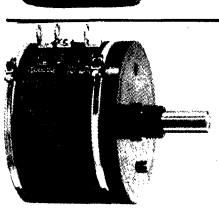
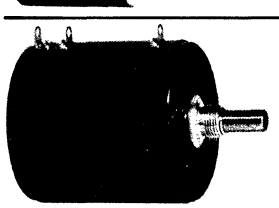
All units shown ½ actual size — MODEL NO.	NOMINAL DIA. (INCHES)	RESISTANCE RANGE (OHMS)	RESISTANCE TOLERANCE	LINEARITY	MAXIMUM POWER RATING (WATTS)	OUTPUT SMOOTHNESS	TEMPCO (PPM/° C)	MOUNTING AVAILABLE
126 (Conductive Plastic)	1.062	500 to 50K	±10% (Special to ±5%)	±0.5% (Special to ±.15%)	0.6 @ 70° C	0.1% Max.	±400	Servo
 **128** (Conductive Plastic)	1.062	500 to 50K	±10% (Special to ±5%)	±0.5% (Special to ±.15%)	1.25 @ 70° C	0.1% Max.	±400	Bushing Servo
 **138** (Conductive Plastic)	1.312	1K to 50K	±10% (Special to ±5%)	±0.5% (Special to ±.25%)	2.0 @ 40° C	0.1% Max.	±500	Bushing
 **139** (Cermet)	1.312	500 to 2 Meg.	±20% (Special to ±5%)	±0.5% (Special to ±0.25%)	5.0 @ 40° C	0.1% Max.	±100	Bushing
 **158** (Conductive Plastic)	.875	500 to 50K	±10% (Special to ±5%)	±0.5% (Special to ±0.25%)	1.0 @ 40° C	0.1% Max.	±400	Bushing* Servo
 **159** (Cermet)	.875	500 to 2 Meg.	±20% (Special to ±5%)	±0.2% (Special to ±0.5%)	3.5 @ 40° C	0.1% Max.	±100	Bushing Servo
 **208** (Conductive Plastic)	1.750	500 to 50K	±10% (Special to ±5%)	±0.3% (Special to ±0.1%)	1.75 @ 70° C	0.1% Max.	±400	Bushing Servo
 **308** (Conductive Plastic)	2.000	500 to 100K	±10% (Special to ±5%)	±.25% (Special to ±.05%)	2.0 @ 70° C	0.1% Max.	±400	Bushing Servo
 **708** (Conductive Plastic)	.875	500 to 50K	±10% (Special to ±5%)	±0.5% (Special to ±0.2%)	1.0 @ 70° C	0.1% Max.	±400	Bushing Servo

*CONSULT FACTORY FOR NEW LOW-COST VERSION

Spectrol

MULTI-TURN WIREWOUND PRECISION POTENTIOMETERS

All units shown ½ actual size

MODEL NO.	NOMINAL DIA.[2] (INCHES)	RESISTANCE RANGE (OHMS)	STANDARD RESISTANCE TOLERANCE	LINEARITY TOLERANCE STANDARD	LINEARITY TOLERANCE BEST PRACTICAL[1]	MAXIMUM POWER RATING (WATTS)	MOUNTING AVAILABLE
(10 Turn) ▶ **162/164**	.500	100 to 115K	±5%	±.30%	±.1%	2.0 @ 40° C	162 Bushing 164 Servo
 (Style RR 1000 Available) **502** (10 Turn)	.875	15 to 150K	±3% (±5% below 100Ω)	±.25%	±.05%	2.0 @ 70° C	Bushing Servo
 **533** (3 Turn)	.875	5 to 60K	±5%	±.25%	±.15%	1.0 @ 70° C	Bushing Servo
▶ **534** (10 Turn)	.875	10 to 200K	±5%	±.25%	±.075%	2.0 @ 70° C	Bushing Servo
535 (5 Turn)	.875	5 to 100K	±5%	±.25%	±.10%	1.5 @ 70° C	Bushing Servo
 **537** (3 Turn)	.875 (.590 Length)	5 to 60K	±5%	±.25%	±.10%	1.0 @ 70° C	Bushing Servo
552 (3 Turn)	.875	5 to 45K	±3% (±5% below 50Ω)	±.25%	±.125%	1.0 @ 70° C	Bushing Servo
 **802** (10 Turn) (Style RR 2100 Available)	1.812	20 to 500K	±3% (±5% below 200Ω)	±.25%	±.025%	5.0 @ 70° C	Bushing Servo
 ▶ **830** (3 Turn)	1.812	15 to 150K	±3% (±5% below 100Ω)	±.25%	±.05%	3.0 @ 40° C	Bushing
 **852** (3 Turn)	1.812	15 to 150K	±3% (±5% below 100Ω)	±.25%	±.05%	2.0 @ 70° C	Bushing Servo
 ▶ **860** (10 Turn)	1.812	20 to 500K	±3% (±5% below 200Ω)	±.25%	±.025%	8.0 @ 40° C	Bushing
HEL 05 (10 Turn)	.500	100 to 50K	±5% (±10% below 100Ω)	±1.0%	±.25%	1.5 @ 40° C	Bushing

▶ DISTRIBUTOR AUTHORIZED STOCKING ITEM

Spectrol

SWITCHES AND MULTIDIALS

SUBMINIATURE SWITCHES

All units shown actual size

	MODEL NO.	NOMINAL DIA. (INCHES)	SWITCH ACTION	CONTACT CURRENT RATING	LIFE AT RATED CURRENT	CONTACT RESISTANCE (OHMS)	DESCRIPTION
	▶ 87-11-XX†	.500	Positive Detent, 36° Indexing, Stops	250MA @ 28VDC	4,000 Switching Operations, Per Position	.05 Maximum	Screwdriver Adjust
	▶ 87-21-XX†	.550	Positive Detent, 36° Indexing, Stops	250MA @ 28VDC	4,000 Switching Operations, Per Position	.05 Maximum	Knob Adjust
	▶ 87-31-XX†	.500	Positive Detent, 36° Indexing, Stops	250MA @ 28 VDC	4,000 Switching Operations, Per Position	.05 Maximum	Bushing Panel Mounting

NUMBER OF POLES AND ACTIVE POSITIONS

NUMBER OF POLES	ACTIVE POSITIONS	ACTIVE TERMINAL PIN NUMBERS	BASIC PART NUMBER
SINGLE POLE	1	1 (ON–OFF)	87-XX-11
	2	1 and 2	87-XX-12
	3	1 thru 3	87-XX-13
	4	1 thru 4	87-XX-14
	5	1 thru 5	87-XX-15
	6	1 thru 6	87-XX-16
	7	1 thru 7	87-XX-17
	8	1 thru 8	87-XX-18
	9	1 thru 9	87-XX-19
	10	1 thru 10	87-XX-10

NUMBER OF POLES	ACTIVE POSITIONS	ACTIVE TERMINAL PIN NUMBERS	BASIC PART NUMBER
TWO-POLE	1	3 and 8 (ON–OFF)	87-XX-21
	2	2, 3, 7, and 8	87-XX-22
	3	2, 3, 4, 7, 8, and 9	87-XX-23
	4	1 thru 4, 6 thru 9	87-XX-24
	5	1 thru 10	87-XX-25
THREE POLE	1	1, 4, and 8 (ON–OFF)	87-XX-31
	2	1, 2, 4, 5, 8, and 9	87-XX-32
	3	1 thru 6, 8 thru 10	87-XX-33

TYPICAL SWITCH APPLICATIONS

● Logic switching. ● Internal switching device for optional equipment add-ons. ● Test point switching. ● Adapting main-frame computers to peripheral equipment. ● Standardizing printed circuit boards. ● Selecting operational voltages. ● Selecting calibration resistors.

MULTIDIALS

All units shown 1/3 actual size.

	MODEL NO.	NOMINAL DIA. (INCHES)	NUMBER OF TURNS	MINOR SCALE DIVISION	SHAFT BORE ■ (INCHES)	FINISH ■	
	▶ 11-1-11	1.000	11	1/50 Turn	.250	Satin Chrome	
	▶ 15-1-11 ▶ 18-1-11	H 1.750 W 1.000	10 (3 Digit)	1/500 Turn	.250	Satin Chrome	
	▶ 15-2-11	H 1.750 W 1.000	100 (4 Digit)	1/500 Turn	.250	Satin Chrome	
	▶ 16-1-11	.875	15	1/50 Turn	.250	Clear Anodized	
	21-1-11	1.812	15	1/100 Turn	.250	Satin Chrome	7.05

TRIMMER ADJUSTMENT TOOL

½ actual size

▶ 8 — 5.0 Long

This Adjustment Tool is designed to adjust trimmers of all sizes and has an extended as well as recessed blade for critical adjustments.

†LAST TWO DIGITS DENOTE POLE/POSITION, E.G., SINGLE POLE UP TO 10 POSITIONS, 2 POLE UP TO 5 POSITIONS, AND 3 POLE UP TO 3 POSITIONS.

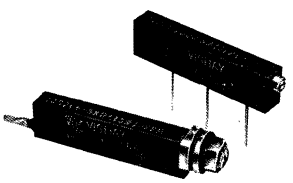
*PRICES SHOWN FOR SINGLE POLE VERSIONS ONLY.

■ OTHER SHAFT BORE SIZES AND FINISHES AVAILABLE

▶ DISTRIBUTOR AUTHORIZED STOCKING ITEM

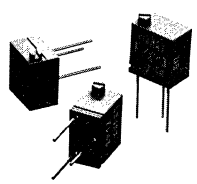
VISHAY® PRECISION TRIMMING POTENTIOMETERS

Precision Trimming Potentiometers



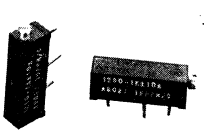
1¼" rectilinear
Model 1202

Model Number	Resistance (ohms)	Tolerance	Power	TCR (End-to-End)[1]	No. of Adj. Turns	Load-Life Stability (Max. Δ R)[3]	Nominal Dimensions (Excluding Leads) H x L x W Inch (mm) and Termination Styles
1202 (RJ12 Style)	2, 5, 10	±10%, ±20%,	0.50W @ 85°C		25 ±2	1% 2000 Hrs. @ 85°C	0.325 (8.255) x 1.250 (31.750) x 0.195 (4.953) Type P: In-line pins Type Y: Staggered pins Type L: Flexible leads Type LB: Panel-mount with flexible leads
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±5%, ±10%					



¼" square
Models 1240, 1242

Model Number	Resistance (ohms)	Tolerance	Power	TCR (End-to-End)[1]	No. of Adj. Turns	Load-Life Stability (Max. Δ R)[3]	Nominal Dimensions (Excluding Leads) H x L x W Inch (mm) and Termination Styles
1240 (RJR26 Style)	5, 10	±10%	0.25W @ 85°C	+10 ppm/°C (−55°C To +25°C) −10 ppm/°C (+25°C To +150°C)	21 ±2	1% 10000 Hrs. @ 85°C	0.250 (6.350) x 0.250 (6.350) x 0.175 (4.445) Type X: Edge-mount, side-adjust Type W: Edge-mount, top-adjust 0.175 (4.445) x 0.250 (6.350) x 0.250 (6.350) Type P: Flat-mount, side adjust
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k,	±5%					
1242 (RJ26)	50, 100, 200, 500, 1k, 2k 5k	±10%				2% 1000 Hrs. @ 85°C	



¾" Rectilinear
Models 1280, 1285

Model Number	Resistance (ohms)	Tolerance	Power	TCR (End-to-End)[1]	No. of Adj. Turns	Load-Life Stability (Max. Δ R)[3]	Nominal Dimensions (Excluding Leads) H x L x W Inch (mm) and Termination Styles
1280	10, 20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±10%	0.75W @ 25°C	+15 ppm/°C (−55°C To +25°C) −15 ppm/°C (+25°C To +125°C)	26 ±2	0.5% 2000 Hrs. @25°C	0.270 (6.86) x 0.750 (19.05) x 0.190 (4.83) (Panel mount available)
1285	10	±10%		+5 ppm/°C (−55°C To +25°C) −5 ppm/°C (+25°C To +125°C)			
	20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 20k	±5%					

VISHAY ...to be precise®

VISHAY RESISTIVE SYSTEMS GROUP of Vishay Intertechnology, Inc.
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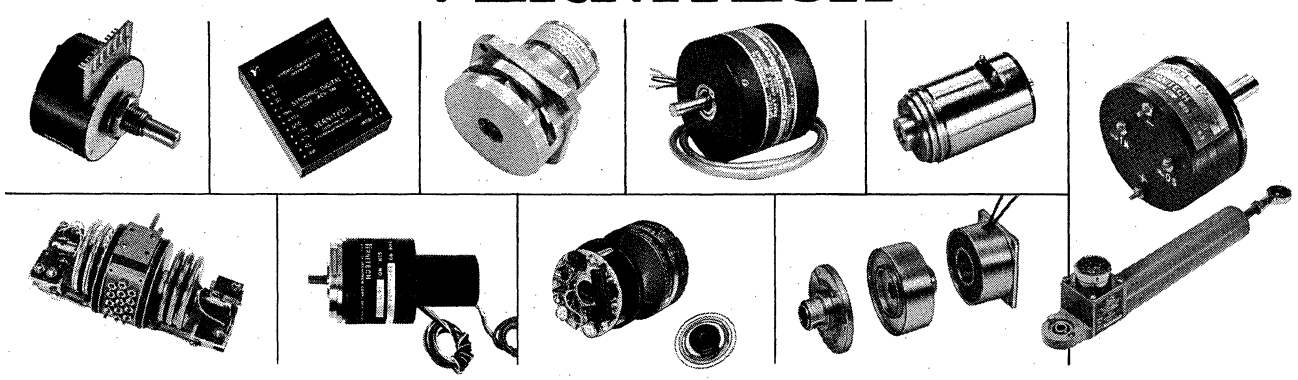
If you want to move it, control it, sense it, stop it, or scan it, call Vernitech.

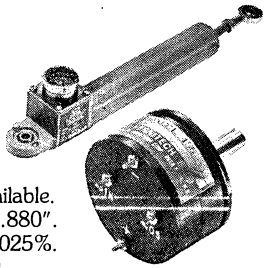
That is, if you're looking for instrument motors, optical and contacting shaft angle encoders, rotary and linear potentiometers, potentiometric pressure transducers, industrial precision brakes or clutches, or laser scanning motors, we'll probably have just what you're looking for. Just look on the opposite page. And if you *don't* find what you want, call Vernitech, give us the particulars, and we'll make it for you.

VERNITECH



VERNITECH, a division of Vernitron Corp., 300 Marcus Blvd., Deer Park, NY 11729 • 516-586-5100 • TWX 510-227-6089

POTENTIOMETERS



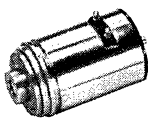
employing Vernitech's unique conductive film and precious metal wipers...respond to wiper motions as small as .000005".

Rotary Single Turn
Linear, non-linear, sine/cosine available.
Sizes 0.5", L 0.5" to Dia 5.0", L 1.880".
Linearity or conformity ±2% to 0.025%.
Resistance range 1KΩ to −250KΩ.

Rotary Multi-Turn
10 to 100 turns available.
Sizes Dia 0.5", L 1.5" to Dia 2.0", L 2.625".
Linearity or conformity ±0.5% to 0.015%.
Resistance range 1KΩ to 500KΩ.

Linear Motion
Electrical stroke lengths 1" to 60".
Linearity or conformity ±0.2% to 0.01%.
Resistance range 250Ω/in to 250KΩ/in.

CLUTCHES AND BRAKES (electromagnetic)



hundreds of models and sizes available from stock.

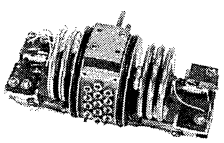
Precision Instrument Type
Sizes 5, 8, 11, 13, 15, and 18.
Standard length and wafer types. Spring and magnetic.
Meet MIL-E-5272C. Zero backlash.
Torque 5 to 150 oz. in. Response time 5 to 142 ms.

Industrial Types — open frame
Sizes 8, 12, 17, 22, 26. Torque to 75 in. lb.
Response time 6-30 ms at rated voltage.

Industrial Types — enclosed frame
Hybrid or special units designed for particular applications when MIL-SPECS and close tolerances are not essential, but where having a complete "self-contained" unit is desirable: cassette tape decks, analog devices actuators, etc.

Fail Safe
Braking action occurs 10 ms after coil is de-energized or power fails. Sizes 8, 17, 30, and 45.
Torque up to 50 in. lb. Zero backlash. Adjustable to compensate for wear.

PRESSURE TRANSDUCERS potentiometer type,



featuring infinite resolution, long life, and high reliability through the use of conductive film resistance elements, multiple wipers, and direct coupling of pressure sensing element to potentiometer wipers.

Pressure ranges from 0.1 to 10,000 psi in gage, absolute and differential types. Also available with high overpressure capability.

Linearity to ±0.3%. Air speed, altitude and low cost types available.

VERNITECH

MOTORS

Over 1500 Standard Designs or Custom Designed to your requirements.

Synchronous — for laser scanning
Sizes 5, 8, 11, 15, 18, 20, 25, 35.
Speeds 100 to 48,000 rpm.
5 through 1600 Hz. 2, 4, 8, 12 poles.

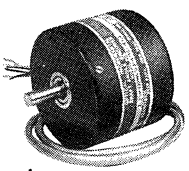
Servo
Viscous damped — sizes 8, 10, 11, 15, 18.
Speeds 3000 to 10,000 rpm.
Inertially damped — sizes 8, 11, 15, 18.
Speeds 3000 to 9500 rpm.

Stepper
Sizes 5, 8, 11, 15. Stepping angles 7.5°, 15°, 45°, 90°.
Stepping rates 100, 110, 125, 130, 175, 180, 225, 240, 260, 400, 725, 800, 1000 pps.

Precision Motor Generators Sizes 8, 10, 11, 15, 18, 23.

Integrating and Computer Motor Tachometers
Sizes 8, 10, 11, 15, 18, 23.

SHAFT ANGLE ENCODERS



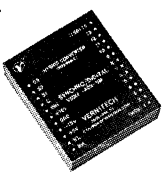
featuring precision chrome on glass discs for highest accuracy.

Optical Incremental
VOE 11 — Dia. 1.062", L. 1.80". To 1024 pulses
VOE 015 — Dia. 1.510", L. 0.88". To 1024 pulses (modular)
VOE M15 "Dial Coder" — panel mounted, 1.500" dia., L. 1.08" 127-256 pulses
VOE 023 — Dia. 2.25", L. 80". To 1250 pulses (modular)
VOE 23 — Dia. 2.250", L. 1.875". To 1250 pulses (available sealed)
VOE L23 "Thrift-Line" Dia. 2.250" L. 1.875". To 600 pulses
VOE 25 — Dia. 2.500", L. 2.500". To 3000 pulses (available sealed)

Optical Absolute
VOE 23: Binary, Gray or BCD to 512 counts per turn. Counting speed: 3000 rpm.
VOE 30: Single or multi-turn; Binary, Gray or BCD. To 1024 counts per turn. Max count (2^{19}) in 512 turns. Counting Speed: 30KHz.

Contacting Absolute
Sizes 11, 18, 23, & 31. Binary, Gray, and BCD. Single or multi-turn. Max count (2^{19}) in 2048 turns. 64 to 1024 counts per turn. Operating speed 200 rpm max.

SYNCHRO CONVERTER MODULES



Tracking Synchro-to-Digital and Resolver-to-Digital Converters
Economy Series VSD/VRD. Precision Series VSDH/VRDH
Compact, solid state, high performance converters employing type 11 servo loops for lag free tracking at rates to 3600°/sec. Resolution 10 bits, 12 bits, or 14 bits.

Digital-to-Synchro and Digital-to-Resolver Converters Series VDS/VDR:Accept shaft angle data in digital form for conversion to analog at accuracies up to ±4′.

Tracking Synchro-to-Linear DC Converter Module
Series VSDCH/VRDCH:Accept 3-wire synchro or 4-wire resolver input data, convert it to DC analog voltage proportional to synchro angle of input. Accuracy ±6′ (typ.).

Tracking Angle Position Indicator
VNST-104: Tracking Synchro-to-Digital Converter, can also be used as a control element. Four decade 0.8" red LED display. Display accuracy ±6′ arc (typical). Tracking rate 3600°/sec max. Parallel binary or BDC output. Self contained line operated power supply.

Custom designs available to your specifications.

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VRN

TABLE OF CONTENTS

Quick Reference Chart

CERMET

SIZE	SERIES	NO TURNS	STD RES. (Ω)	TOL.	POWER RATING	TC	PAGE
¼" ROUND	170	1	10-2M	±10%	.5W	±100	6
¼" SQUARE	180	1	10-2M	±10%	.5W	±100	7
¼" SQUARE	260	16	20-2M	±10%	.5W	±100	10
⅜" SQUARE	780	1	10-2M	±10%	.5W	±100	15-16
⅜" SQUARE	752	24	20-2M	±10%	.5W	±100	14
½" ROUND	150	1	50-2M	±10%	.75W	±100	5
½" SQUARE	255	24	20-2M	±10%	1.0W	±100	9
¾" RECT.	960	20	10-2M	±10%	.75W	±100	18-19
1¼" RECT.	450	22	10-2M	±10%	1.0W	±100	12

WIREWOUND

5/16" SQUARE	800	15	10-20K	±5%	.6W	±50	17
⅜" SQUARE	700	23	10-20K	±5%	1.0W	±50	13
½" ROUND	100	1	20-20K	±5%	1.0W	±50	4
½" SQUARE	205	24	10-20K	±5%	1.0W	±50	8
1¼" RECT.	400	22	10-20K	±5%	1.0W	±50	11

ATTENUATORS

¾" RECT.	9950/55	5	N/A	±20%	.25W	N/A	21
½" ROUND	9958/59	1	N/A	±20%	.25W	N/A	21

VRN

100 SERIES

1/2" Round Wirewound Single-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 1W @ 70°C

Standard resistance range: 20Ω to 20KΩ

Resistance tolerance: ±5% std.

Temperature coefficient: ±50ppm/°C max.

Noise during adjustment: 100Ω max.

End resistance: 1Ω or 2% (W.I.G.)

Dielectric strength: 1500VAC

Insulation resistance: 1000MΩ

Absolute minimum resistance: .25% or 1Ω (W.I.G.)

MECHANICAL

Operating temperature range: −55°C to +150°C

Total adjustment turns: 1

Operating torque: 0.25 to 7.5 oz.—in. max.

Mechanical stops: 30 oz.—in. min.

Electrical travel: 315° Nominal

ENVIRONMENTAL

Models 100, 101-5, 102-5, 103-6, 104-6, 106-2, 110 and 118-7 meet, or exceed, all of the environmental and life requirements of MIL-R-27208, Characteristic C.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

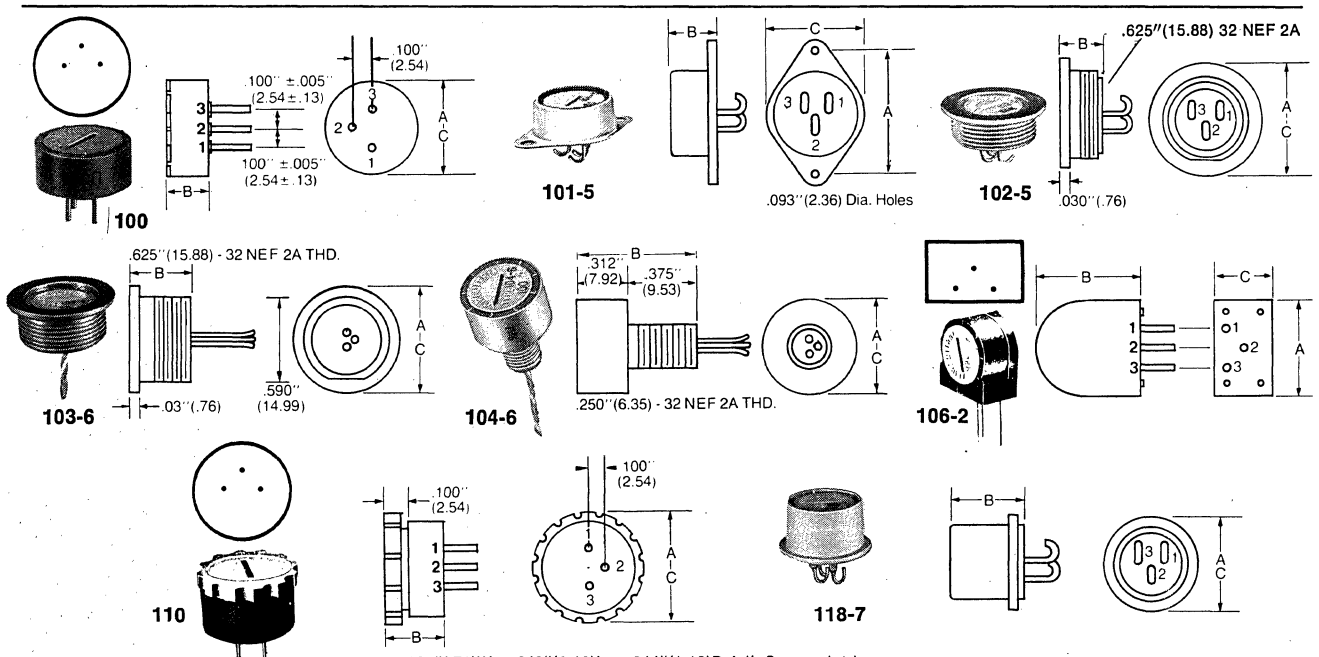
*	1K
20	2K
50	5K
100	10K
200	20K
500	

*Lower values available—consult factory.

ORDERING INFORMATION

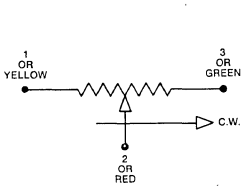
106 — 2 — 5K

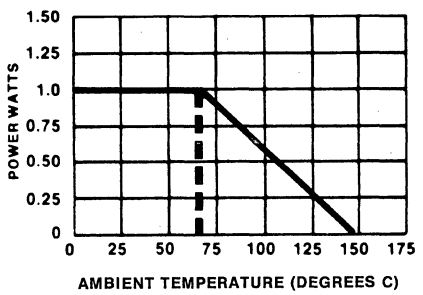
Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value



Dimensions					
Case				Leads	
Model	A	B	C	Diameter	Length
100	.500"(12.70)	.235"(5.97)	.500"(12.70)	.028"(.71)	.187"(4.75) min.
101-5	.750"(19.05)	.265"(6.73)	.625"(15.88)	Hooked	.187"(4.75) min.
102-5	.750"(19.05)	.250"(6.35)	.750"(19.05)	Hooked	.205"(5.21) min.
103-6	.750"(19.05)	.312"(7.92)	.750"(19.05)	Flex	10"(254.0) min.
104-6	.546"(13.87)	.687"(17.45)	.546" (13.87)	Flex	10"(254.0) min.
106-2	.500"(12.70)	.563"(14.30)	.312"(7.93)	.020"(.51)	.187"(4.75) min.
110	.563"(14.30)	.325"(8.26)	.563"(14.30)	.028"(.71)	.187"(4.75) min.
118-7	.656"(16.66)	.375"(9.53)	.656"(16.66)	Hooked	.250"(6.35) min.

NOTE: Metric conversion in mm in brackets





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

150 SERIES

CIRCUITRIM®

1/2" Round Cermet Single-Turn Trimmer Potentiometers

SPECIFICATIONS

ELECTRICAL

Power rating:
0.75W @ 85°C (300V max.)

Standard resistance range: 50Ω to 2MΩ

Resistance tolerance: ± 10% std.

Temperature coefficient:
±100ppm/°C max.
(±50 ppm/°C available—consult factory)

Contact resistance variation:
20Ω or 3% (W.I.G.)

End resistance: 5Ω max. or 2% (W.I.G.)

Dielectric strength: 1500VAC

Insulation resistance: 1000MΩ

Absolute minimum resistance:
1Ω or .25% (W.I.G.)

MECHANICAL

Operating temperature range:
−55° to +150°C

Total adjustment turns: 1

Operating torque:
0.25 to 7.5 oz.—in. max.

Mechanical stops: 30 oz.—in. min.

ENVIRONMENTAL

Models 150, 151-5, 152-5, 153-6, 154-6, 156-2, 158-2 and 160 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristic F.

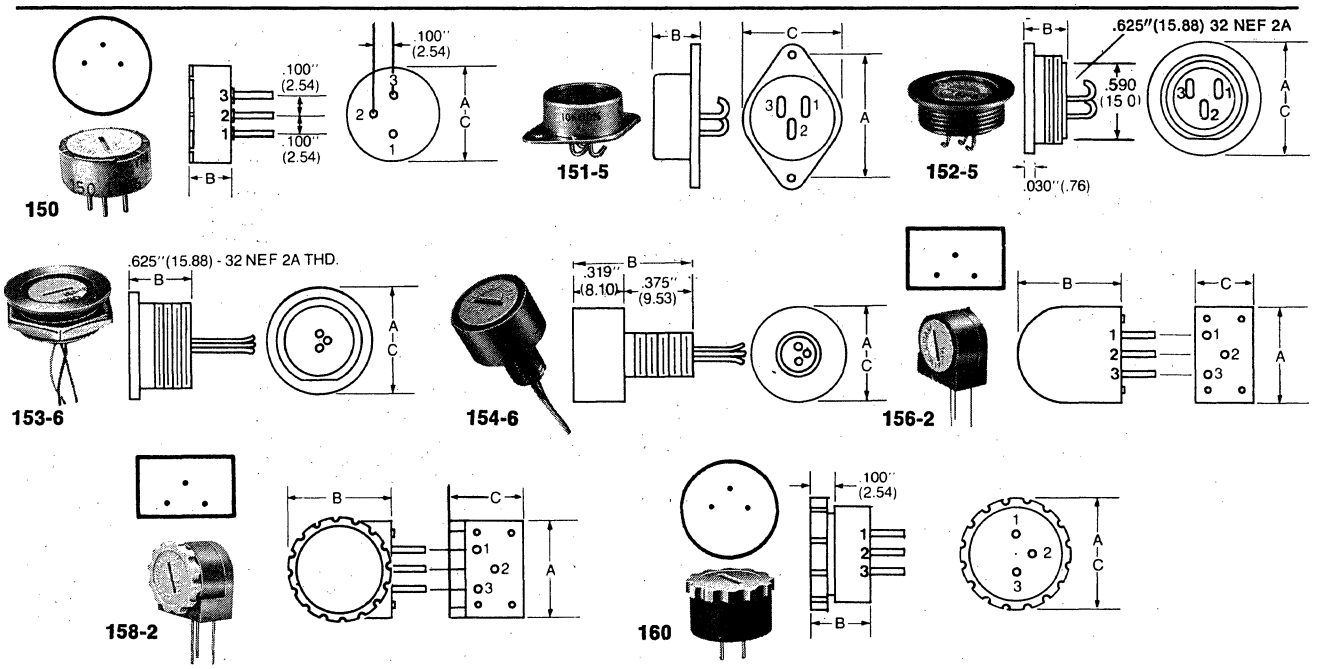
STANDARD RESISTANCE VALUES AVAILABLE (Ω)

50	2K	100K
100	5K	200K
200	10K	500K
500	20K	1M
1K	50K	2M

ORDERING INFORMATION

156 — 2 — 5K

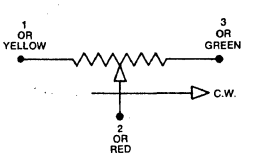
Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value

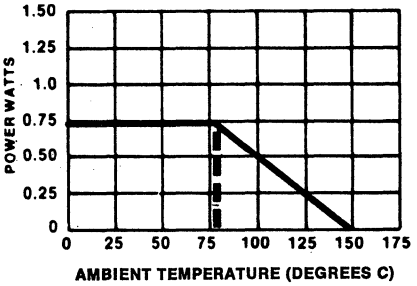


.028"(.71)W x .240"(6.10)L x .044"(1.12)D Adj. Screw slot in cover
Unless otherwise stated, tolerances are ±.015"(.37)

Model	Dimensions: Case A	Case B	Case C	Leads: Diameter	Leads: Length
150	.500"(12.70)	.235"(5.97)	.500"(12.70)	.028"(.71)	.187"(4.75) min.
151-5	.750"(19.05)	.265"(6.73)	.625"(15.88)	Hooked	.187"(4.75) min.
152-5	.750"(19.05)	.250"(6.35)	.750"(19.05)	Hooked	.205"(5.21) min.
153-6	.750"(19.05)	.312"(7.92)	.750"(19.05)	Flex	10"(254.00) min.
154-6	.534"(13.56)	.687"(17.45)	.534"(13.56)	Flex	10"(254.00) min.
156-2	.500"(12.70)	.563"(14.30)	.412"(10.46)	.020"(.51)	.187"(4.75) min.
158-2	.500"(12.70)	.563"(14.30)	.412"(10.46)	.020"(.51)	.187"(4.75) min.
160	.563"(14.30)	.325"(8.26)	.563"(14.30)	.028"(.71)	.187"(4.75) min.

NOTE: Metric conversion in mm in brackets





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

170 SERIES

1/4" Round Cermet
Single-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.5W @ 85°C (300V max.)

Standard resistance range: 10Ω to 2 MΩ

Resistance tolerance: ±10% 100Ω to 2MΩ (±20% below 100Ω)

Temperature coefficient: ±100ppm/°C max. (±50ppm/°C available—consult factory)

Contact resistance variation: 3Ω or 3% (W.I.G.)

End resistance: 2Ω max. or 2% (W.I.G.)

Dielectric strength: 400VAC

Insulation resistance: 100MΩ

Absolute minimum resistance: 2Ω or 1% (W.I.G.)

MECHANICAL

Operating temperature range: −55° to +150°C

Total adjustment: 280° nominal

Operating torque: 5.0 oz.—in. max.

Mechanical stops: Solid

ENVIRONMENTAL

Models 170 and 171 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristic F.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

10	1K	100K
20	2K	200K
50	5K	500K
100	10K	1M
200	20K	2M
500	50K	

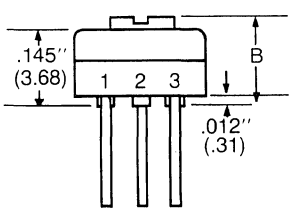
ORDERING INFORMATION

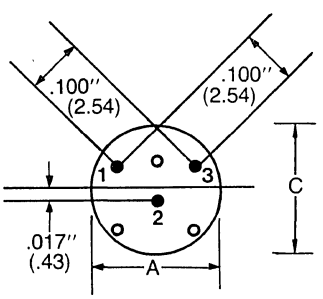
170 — 20K

Indicate Type Number — Indicate Resistance Value

170

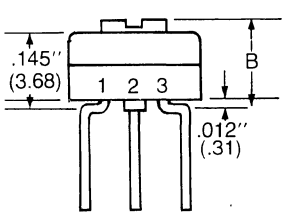
.125"(3.18) Dia. Adj. Screw with .025"(.64)W x .020"(.51)D Slot

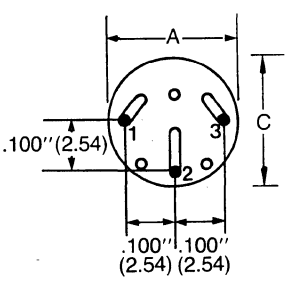




171

.125"(3.18) Dia. Adj. Screw with .025"(.64)W x .020"(.51)D Slot

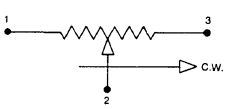


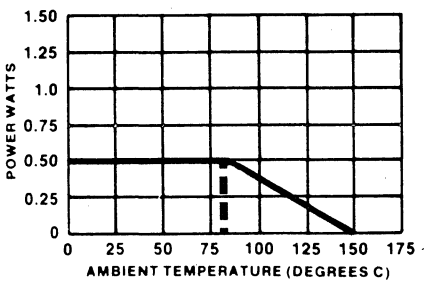


Unless otherwise stated, tolerances are ±.010"(.25)

Dimensions					
	Case			Leads	
Model	A	B	C	Diameter	Length
170	.250"(6.35)	.170"(4.32)	.250"(6.35)	.016" ±.001"(.41 ±.02)	.187"(4.75)min.
171	.250"(6.35)	.170"(4.32)	.250"(6.35)	.016" ±.001"(.41 ±.02)	.187"(4.75)min.

NOTE: Metric conversion in mm in brackets





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

180/181/182/183/RJ50/RJR50

1/4" Square Cermet Single-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.5W @ 85°C (300V max.)
Standard resistance range: 10Ω to 2MΩ
Resistance tolerance: ±10% 100Ω to 2MΩ (±20% below 100Ω)
Temperature coefficient: ±100ppm/°C max. (±50ppm/°C available—consult factory)
Contact resistance variation: 3Ω or 3% (W.I.G.)
End resistance: 2Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 2Ω or 1% (W.I.G.)

MECHANICAL

Operating temperature range: −55° to +150°C
Total adjustment: 280° nominal
Operating torque: 5.0 oz.—in. max.
Mechanical stops: Solid

ENVIRONMENTAL

Models 180, 181, 182 and 183 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristic F.

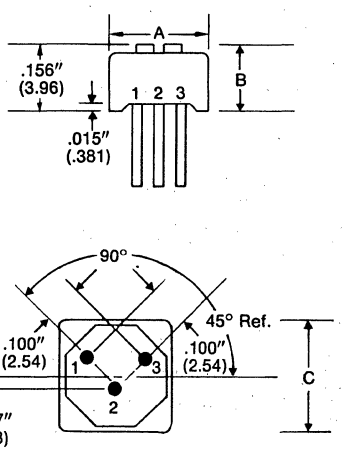
STANDARD RESISTANCE VALUES AVAILABLE (Ω)

10 (not mil)	1K	100K
20 (not mil)	2K	200K
50 (not mil)	5K	500K
100	10K	1M (not mil)
200	20K	2M (not mil)
500	50K	

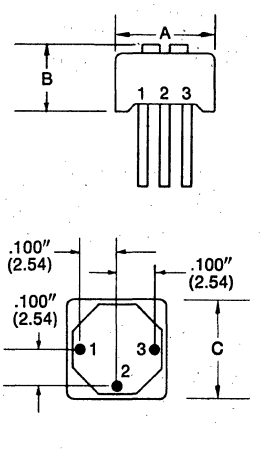
ORDERING INFORMATION

182 — 50K

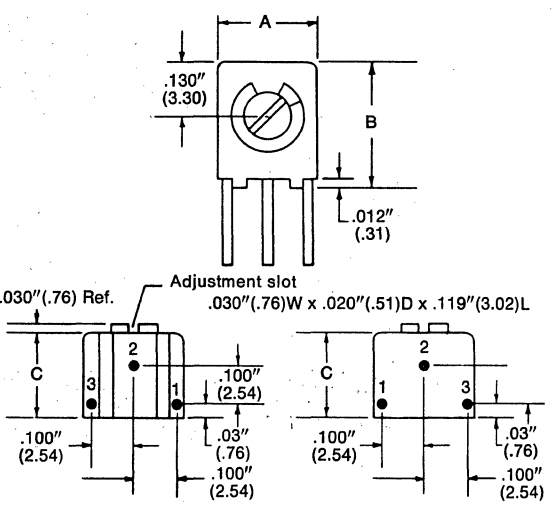
Indicate Type Number — Indicate Resistance Value



180



181
RJ50P
RJR50P



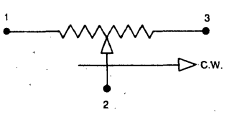
182 183

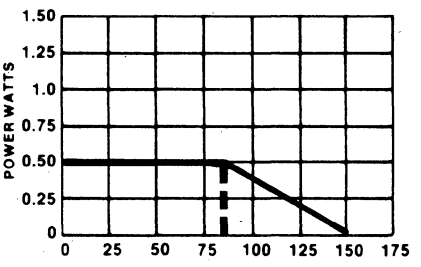
182/183

Unless otherwise stated, tolerances are ±.010"(.25)

Dimensions					
	Case			Leads	
Model	A	B	C	Diameter	Length
180	.267"(6.78)	.180"(4.57)	.267"(6.78)	.018"(.45)	.187"(4.75) min.
181 RJ/RJR50	.267"(6.78)	.180"(4.57)	.267"(6.78)	.018"(.45)	.187"(4.75) min.
182	.267"(6.78)	.312"(7.92)	.192"(4.87)	.018"(.45)	.187"(4.75) min.
183	.267"(6.78)	.312"(7.92)	.192"(4.87)	.018"(.45)	.187"(4.75) min.

NOTE: Metric conversion in mm in brackets





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

205/RT22

1/2" Square Wirewound Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 1W @ 70°C
Standard resistance range: 10Ω to 20KΩ
Resistance tolerance: ±5% std.
Temperature coefficient: ±50ppm/°C max.
Noise during adjustment: 100Ω max.
End resistance: 2Ω to 2% (W.I.G.)
Dielectric strength: 1000VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 1% or 1Ω (W.I.G.)

MECHANICAL

Operating temperature range: −55° to +150°C
Total adjustment turns: 24 ±2
Operating torque: 5.0 oz.—in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 205-00, 205-10, 205-207 and 205-208 meet, or exceed, all of the environmental and life requirements of MIL-R-27208, Characteristic C.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

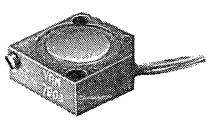
10 (not mil)	1K
20 (not mil)	2K
50	5K
100	10K
200	20K
500	

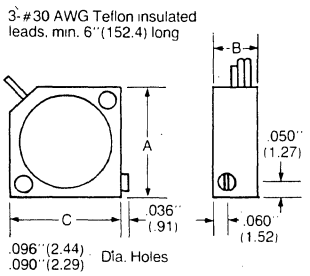
ORDERING INFORMATION

205 — 00 — 10K

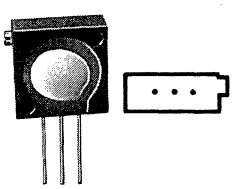
- 205 — Indicate Type Number
- 00 — Indicate Package Configuration
- 10K — Indicate Resistance Value

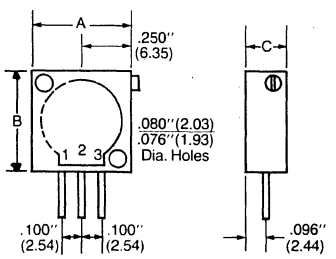
205-00L*
RT22L



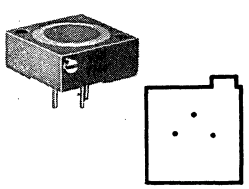


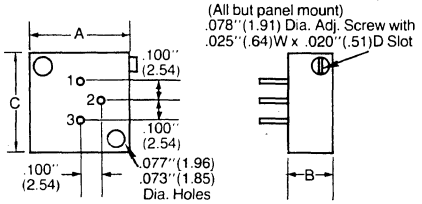
205-207X
RT22X



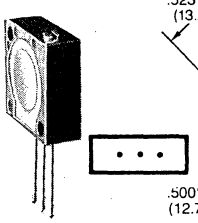


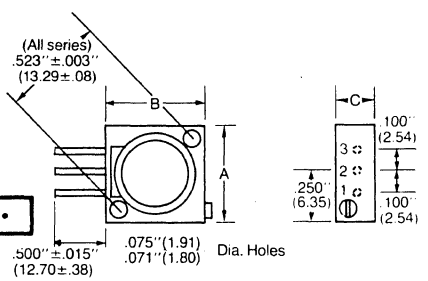
205-10P
RT22P





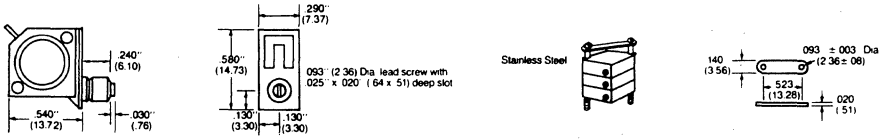
205-208W
RT22W





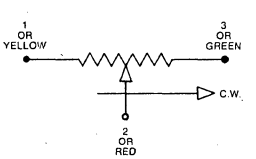
Unless otherwise stated, tolerances are ±.010"(.25)

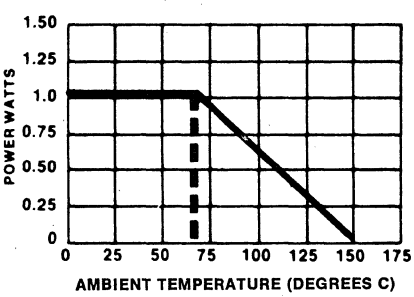
*PANEL MOUNTING BRACKET MODEL 205-60



Dimensions					
Case				Leads	
Model	A	B	C	Diameter	Length
205-00L	.500"(12.70)	.192"(4.88)	.500"(12.70)	Flex	6"(152.4) min.
205-10P	.500"(12.70)	.215"(5.46)	.500"(12.70)	.028"(.71)	.187"(4.75) min.
205-207X	.500"(12.70)	.500"(12.70)	.192"(4.88)	.028"(.71)	.187"(4.75) min.
205-208W	.500"(12.70)	.500"(12.70)	.192"(4.88)	.028"(.71)	.187"(4.75) min.

NOTE: Metric conversion in mm in brackets





NOTE
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.

VRN

255/RJ22

CIRCUITRIM®

1/2" Square Cermet Multi-Turn Trimmer Potentiometers

SPECIFICATIONS

ELECTRICAL

Power rating: 1.0W @ 70°C

Standard resistance range: 20Ω to 2MΩ

Resistance tolerance: ±10% std.

Temperature coefficient:
±100ppm/°C max.
(±50ppm/°C available—consult factory)

Contact resistance variation:
3Ω or 3% (W.I.G.)

End resistance: 2Ω or 2% (W.I.G.)

Dielectric strength: 900VAC

Insulation resistance: 1000MΩ

Absolute minimum resistance:
1Ω or 3% (W.I.G.)

MECHANICAL

Operating temperature range:
−55° to +150°C

Total adjustment turns: 24 ±2

Operating torque: 5.0 oz.—in. max.

Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 255-00, 255-10, 255-207 and 255-208 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristic F. RJ22 meets or exceeds all environmental and life requirements of MIL-R-22097.

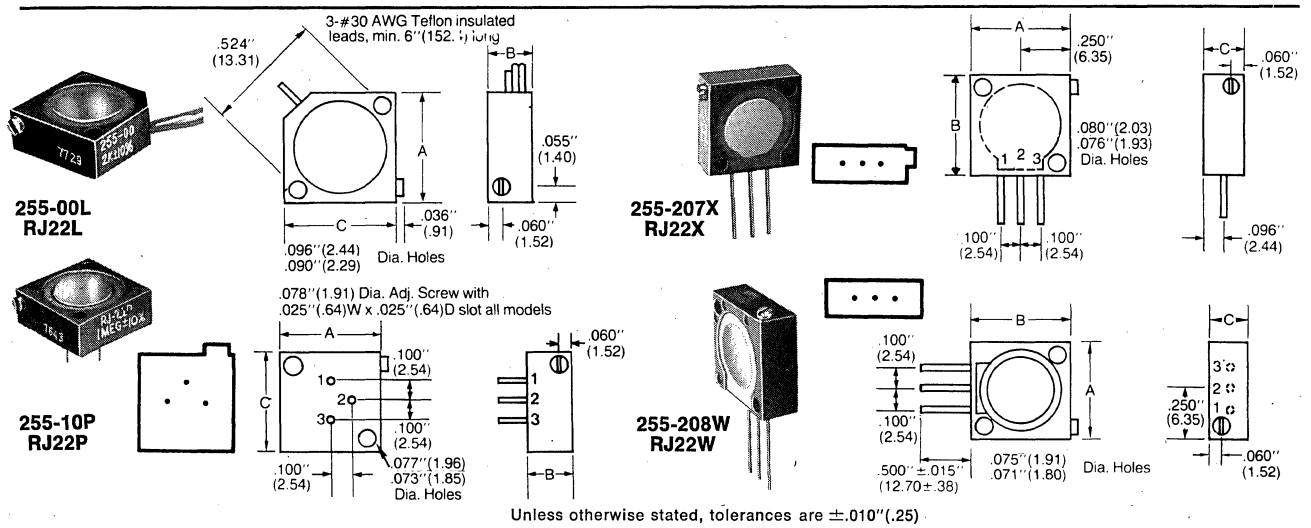
STANDARD RESISTANCE VALUES AVAILABLE (Ω)

20	10K
50	20K (255 only)
100	25K (mil only)
200	100K
500	200K (255 only)
1K	250K (mil only)
2K	500K
5K	1M
	2M (255 only)

ORDERING INFORMATION

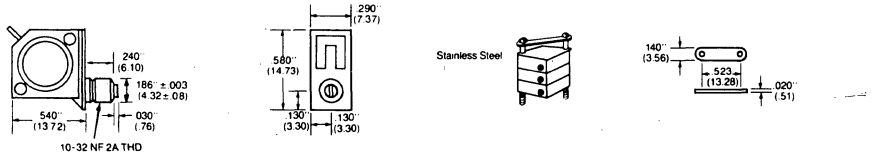
255 — 00 — 10K

Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value



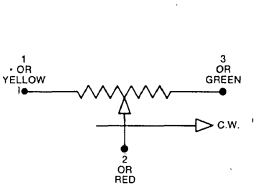
Unless otherwise stated, tolerances are ±.010"(.25)

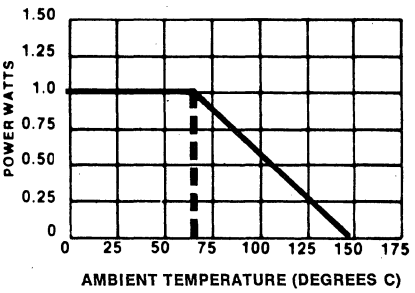
*PANEL MOUNTING BRACKET MODEL 255-60



Dimensions					
Case				Leads	
Model	A	B	C	Diameter	Length
255-00L	.500"(12.70)	.192"(4.88)	.500"(12.70)	Flex	6" flex (152.4) min.
255-10P	.500"(12.70)	.215"(5.46)	.500"(12.70)	.028"(.71)	.187"(4.75) min.
255-207X	.500"(12.70)	.500"(12.70)	.192"(4.88)	.028"(.71)	.187"(4.75) min.
255-208W	.500"(12.70)	.500"(12.70)	.192"(4.88)	.028"(.71)	.187"(4.75) min.

NOTE: Metric conversion in mm in brackets





NOTE:
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.

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VRN

260/RJ26/RJR26 SERIES

1/4" Square Cermet Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating:
¼ W at 70°C derate to zero at 125°C
Standard resistance range:
10Ω to 1MΩ
Resistance tolerance:
±10% Standard
Temperature coefficient of resistances of Potentiometer:
±100 PPM/°C (±50 PPM/°C Available Consult Factory)
Contact resistance variation:
3 ohms, or 3% whichever is greater
Insulation resistance:
1000 meg ohms at 500VDC
Dielectric strength: 900VAC
End resistance (max.):
2Ω or 2% whichever is greater
Resolution: Essentially infinite

MECHANICAL

Operating temperature range:
−55° to +150°C
Total adjustment turns: 16 ± 3 turns
Operating torque: 3 oz.—in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

The potentiometers listed under this specification will meet all of the environmental and life requirements of MIL-R-22097 for Models 26X-XXX and RJ26; MIL-R-39035 for Models RJR26.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

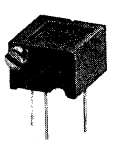
20	20K (not for mil)
50	25K (mil only)
100	50K
200	100K
500	200K (not for mil)
1K	250K (mil only)
2K	500K
5K	1M
10K	2M (not for mil)

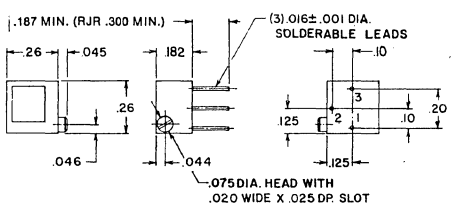
ORDERING INFORMATION

260 — 207 — 10K

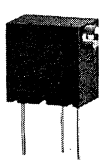
Indicate Type | Indicate Style | Indicate Value

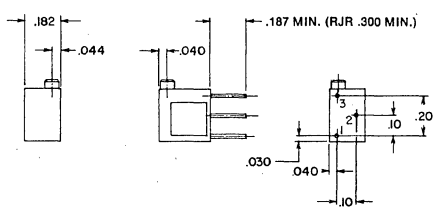
MODEL 260-10
RJ26P
RJR26P



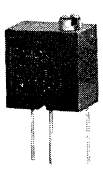


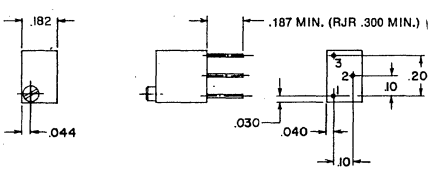
MODEL 260-207
RJ26X
RJR26X



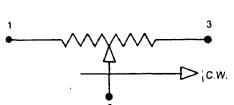


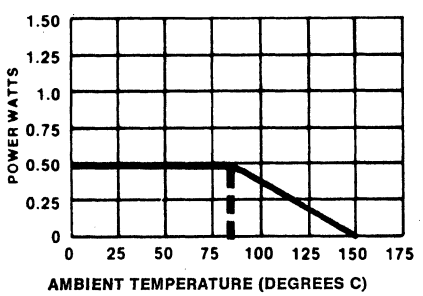
MODEL 260-208
RJ26W
RJR26W





NOTE: Dimensions common to all styles are not repeated.





VRN

400/RT12

1¼" Rectangular Wirewound Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 1W @ 70°C
Standard resistance range: 10Ω to 20KΩ
Resistance tolerance: ±5% std.
Temperature coefficient: ±50ppm/°C max.
Noise during adjustment: 100Ω max.
End resistance: 1Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 1Ω or .25% (W.I.G.)

MECHANICAL

Operating temperature range: −55° to +150°C
Total adjustment turns: 22±5
Operating torque: 0.1 to 8.0 oz.-in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 400-00, 400-10 and 400-20 meet, or exceed, all of the environmental and life requirements of MIL-R-27208, Characteristic C.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

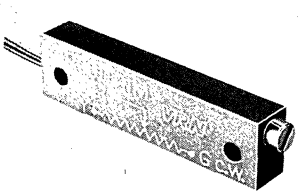
10	not for mil	1K
20		2K
50		5K
100		10K
200		20K
500		

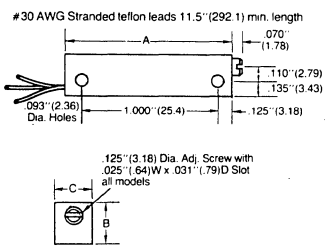
ORDERING INFORMATION

400 — 10 — 20K

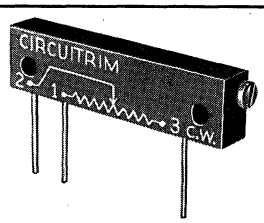
- 400 — Indicate Type Number
- 10 — Indicate Package Configuration
- 20K — Indicate Resistance Value

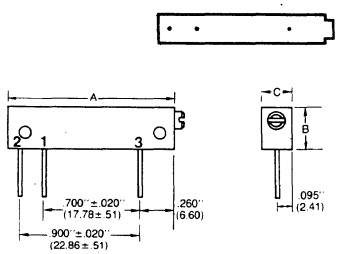
400-00L *
RT12L



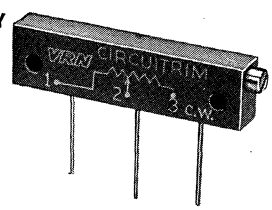


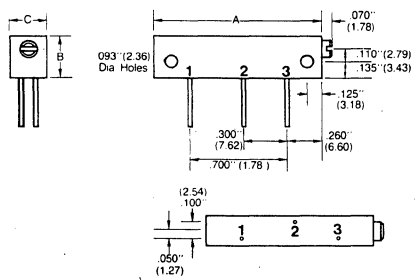
400-10P
RT12P





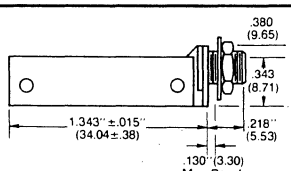
400-20Y
RT12Y

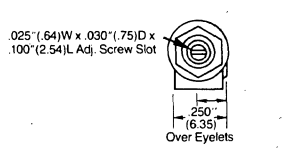




Unless otherwise stated, tolerances are ±.010"(.25)

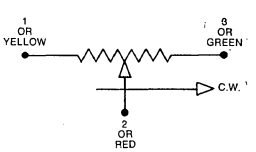
*PANEL MOUNTING BRACKET MODEL 400-60

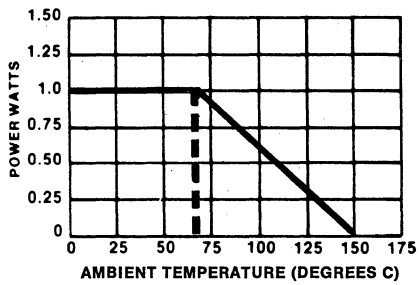




Dimensions					
Case				Leads	
Model	A	B	C	Diameter	Length
400-00L	1.250"(31.75)	.315"(8.00)	.190"(4.83)	Flex	11.5"(292.10) min.
400-10P	1.250"(31.75)	.315"(8.00)	.190"(4.83)	.028"(.71)	.187"(4.75) min.
400-20Y	1.250"(31.75)	.315"(8.00)	.190"(4.83)	.028"(.71)	.187"(4.75) min.

NOTE: Metric conversion in mm in brackets





NOTE:
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.

VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

450/RJ12/RJR12

1¼" Rectangular Cermet Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 1W @ 70°C (300V max.)
Standard resistance range: 10Ω to 2MΩ
Resistance tolerance: ±10% std.
Temperature coefficient: ±100ppm/°C max. (±50ppm/°C available—consult factory)
Contact resistance variation: 3Ω or 3% (W.I.G.)
End resistance: 2Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 2Ω max.

MECHANICAL

Operating temperature range: −55° to +150°C
Total adjustment turns: 22 ±5
Operating torque: 8.0 oz.—in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 450-00, 450-10 and 450-20 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristic F. RJ12 22097 RJR12 39035

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

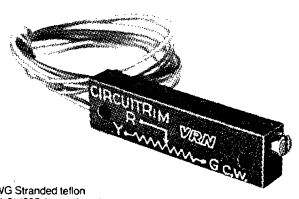
10 (not mil)	10K
20 (not mil)	20K
50 (not mil)	50K
100	100K
200	200K (not for mil)
500	250K (mil only)
1K	500K
2K	1M
5K	2M (not for mil)

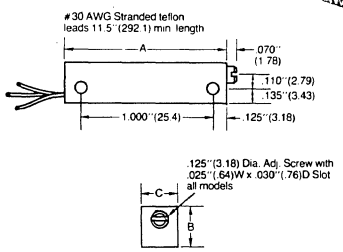
ORDERING INFORMATION

450 — 10 — 50K

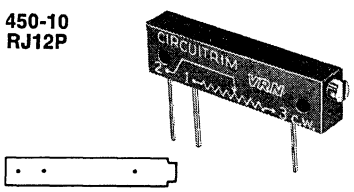
- 450 — Indicate Type Number
- 10 — Indicate Package Configuration
- 50K — Indicate Resistance Value

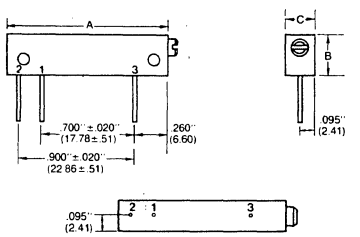
450-00L*
RJ12L
RJR12L



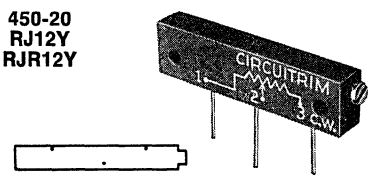


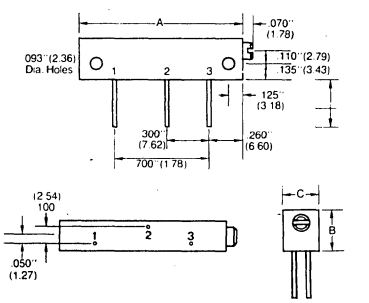
450-10
RJ12P





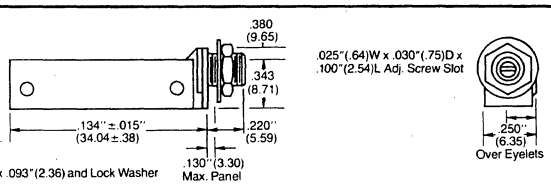
450-20
RJ12Y
RJR12Y





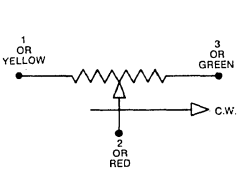
Unless otherwise stated, tolerances are ±.010"(.25)

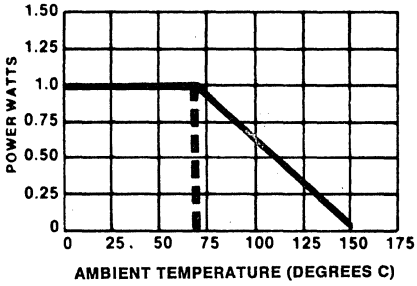
*PANEL MOUNTING BRACKET MODEL 450-60



Dimensions					
	Case			Leads	
Model	A	B	C	Diameter	Length
450-00L	1.250" (31.75)	.315" (8.00)	.190" (4.83)	Flex	11.5" (292.1) min.
450-10P	1.250" (31.75)	.315" (8.00)	.190" (4.83)	.028" (.71)	.500" (12.70) min.
450-20Y	1.250" (31.75)	.315" (8.00)	.190" (4.83)	.028" (.71)	.500" (12.70) min.

NOTE: Metric conversion in mm in brackets





NOTE:
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.

VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

700/RT24/RTR24

3/8" Square Wirewound Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: .75W @ 70°C

Standard resistance range: 10Ω to 20KΩ

Resistance tolerance: ±5% std.

Temperature coefficient: ±50ppm/°C max.

Noise during adjustment: 100Ω max.

End resistance: 1Ω or 2% (W.I.G.)

Dielectric strength: 1000VAC

Insulation resistance: 1000MΩ

Absolute minimum resistance: 1Ω or 0.25% (W.I.G.)

MECHANICAL

Operating temperature range: −65° to +150°C

Total adjustment turns: 23 ±2

Operating torque: 5.0 oz.—in. max.

Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 700-00, 700-10, 700-207 and 700-208 meet, or exceed, all of the environmental and life requirements of MIL-R-27208, Characteristic C.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

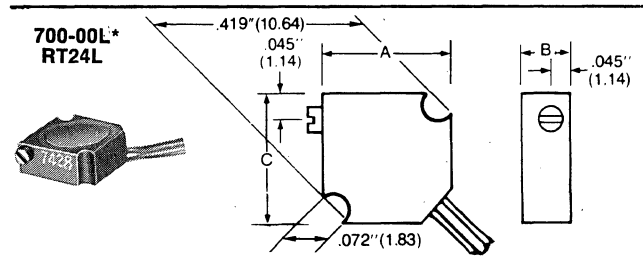
10	1K
20	2K
50	5K
100	10K
200	20K (not mil)
500	

ORDERING INFORMATION

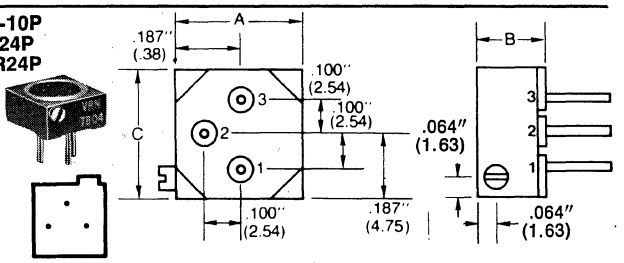
700 — 207 — 20K

Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value

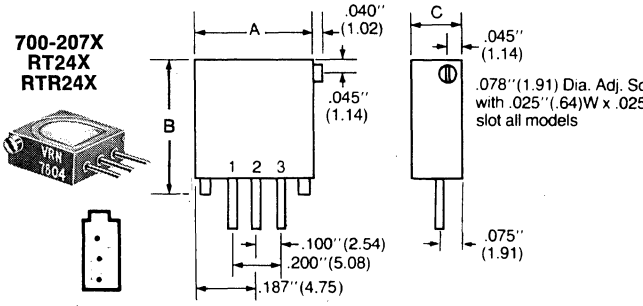
700-00L*
RT24L



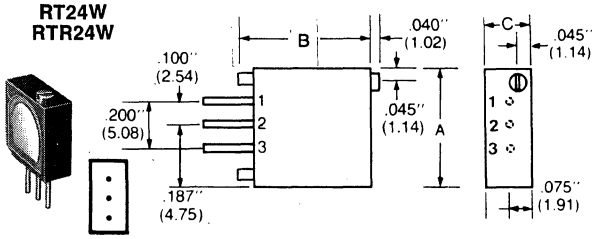
700-10P
RT24P
RTR24P



700-207X
RT24X
RTR24X

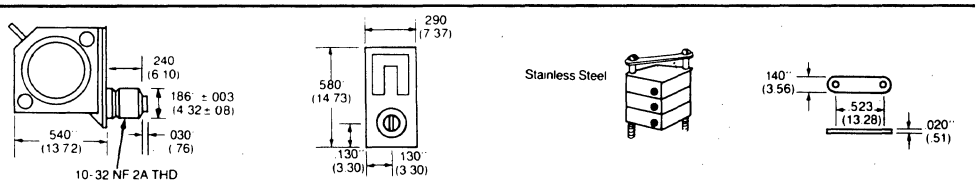


700-208W
RT24W
RTR24W



Unless otherwise stated, tolerances are ±.010"(.25)

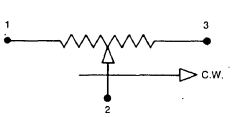
*PANEL MOUNTING BRACKET—MODEL 700-60

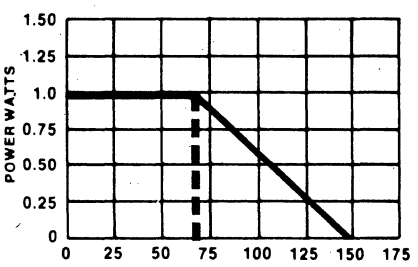


Model	Dimensions				
	Case			Leads	
	A	B	C	Diameter	Length
700-00L	.375"(9.53)	.145"(3.68)	.375"(9.53)	Flex	6"(152.4) min.
700-10P RTR24P	.380"(9.65) .380"(9.65)	.205"(5.21) .205"(5.21)	.380"(9.65) .380"(9.65)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.
700-207X RTR24X	.380"(9.65) .380"(9.65)	.410"(10.41) .410"(10.41)	.170"(4.32) .170"(4.32)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.
700-208W RTR24W	.380"(9.65) .380"(9.65)	.410"(10.41) .410"(10.41)	.170"(4.32) .170"(4.32)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.

NOTE: Metric conversion in mm in brackets

NOTE:
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.





AMBIENT TEMPERATURE (DEGREES C)

VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

752/RJ24/RJR24

3/8" Square Cermet Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.5W @ 85°C (300V max.)
Standard resistance range: 20Ω to 2MΩ
Resistance tolerance:
±10% 100Ω to 2MΩ
±20% below 100Ω
Temperature coefficient:
±100ppm/°C max.
Contact resistance variation:
3Ω or 3% (W.I.G.)
End resistance: 2Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ min.
Absolute minimum resistance: 1Ω

MECHANICAL

Operating temperature range:
−55°C to +150°C
Total adjustment turns: 24 ±3
Operating torque: 5 in.-oz max.
Stop: Wiper idles

ENVIRONMENTAL

752 meets or exceeds all environmental and life requirements of MIL-R-22097 & MIL-R-39035. RJ24 meets or exceeds all environmental and life requirements of MIL-R-22097. RJR24 meets or exceeds all environmental and life requirements of MIL-R-39035.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

20 (not for mil)	20K (not for mil)
50 (not for mil)	25K (mil only)
100	50K
200	100K
500	200K (not for mil)
1K	250K (mil only)
2K	500K
5K	1M
10K	2M (not for mil)

ORDERING INFORMATION

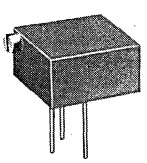
752 — 207 — 10K

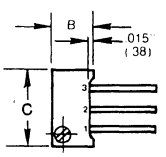
Indicate Type	Indicate Style	Indicate Value

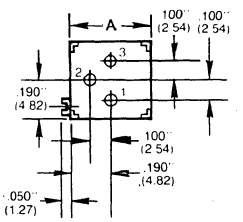
RJ24 — F — P —10K

Indicate Style	Indicate Character	Indicate Style	Indicate Value

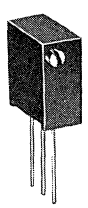
752-10P
RJ24P
RJR24P

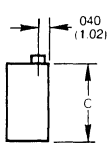


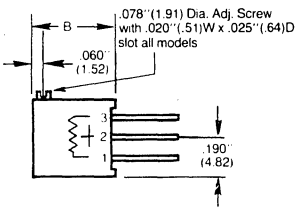


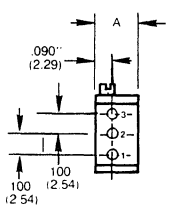


752-207X
RJ24X
RJR24X

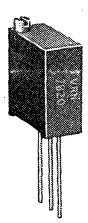


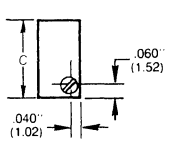


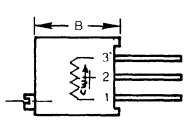


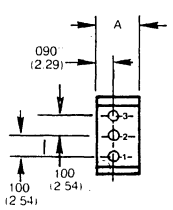


752-208W
RJ24W
RJR24W







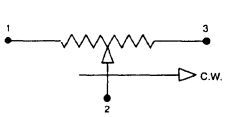


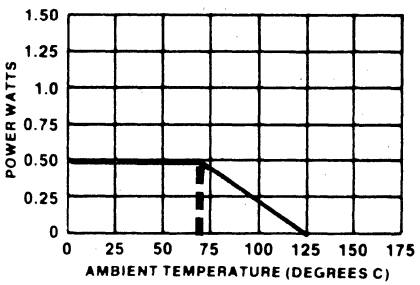
Unless otherwise stated, tolerances are ±.010"(.25)

Model	Dimensions				
	Case			Leads	
	A	B	C	Diameter	Length
752-10P RJR24P	.388"(9.86) .388"(9.86)	.225"(5.72) .195" max.	.380"(9.65) .380"(9.65)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.
752-207X RJR24X	.200"(5.08) .195" max.	.410"(10.40) .410"(10.40)	.380"(9.65) .380"(9.65)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.
752-208W RJR24W	.200"(5.08) .195" max.	.410"(10.40) .410"(10.40)	.380"(9.65) .380"(9.65)	.020"(.51) .020"(.51)	.187"(4.75) min. .300"(7.62) min.

NOTE: Metric conversion in mm in brackets

NOTE: The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

780 SERIES

3/8" Square Cermet Single-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.5W @ 85°C (300V max.)
Standard resistance range: 10Ω to 2MΩ
Resistance tolerance:
±10% 100Ω to 2MΩ ±20% below 100Ω
Temperature coefficient:
±100ppm/°C max. std.
(±50ppm/°C available)
Contact resistance variation:
3Ω or 3% (W.I.G.)
End resistance: 2Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 2Ω max.

MECHANICAL

Operating temperature range:
−55° to +150°C
Total adjustment: 280° nominal
Operating torque: 4.0 oz.—in. max.
Mechanical stops: Solid

ENVIRONMENTAL

Meets or exceeds all of the environmental and life requirements of MIL-R-22097, Characteristic F.

STANDARD RESISTANCE VALUES AVAILABLE (Ω)

10	2K	200K
20	5K	250K
50	10K	500K
100	20K	1M
200	25K	2M
500	50K	
1K	100K	

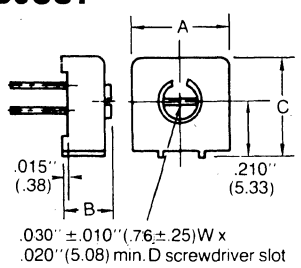
ORDERING INFORMATION

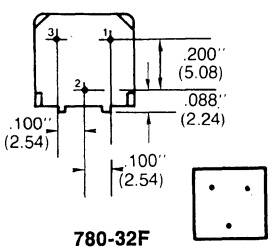
780 — 10A* — 50K

Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value

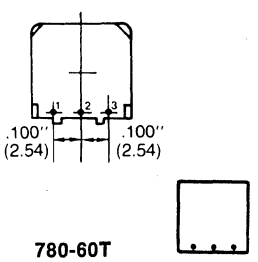
*NOTE: On the 780 series, the letter suffix shown on the VRN P/N should be used when ordering.

TOP ADJUST

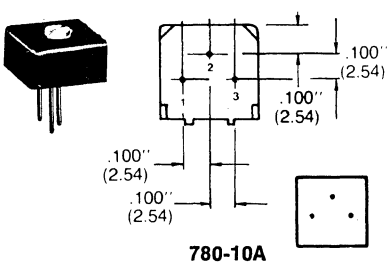




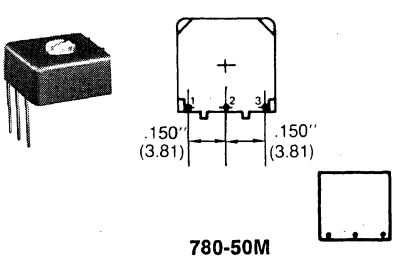
780-32F



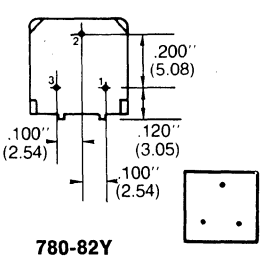
780-60T



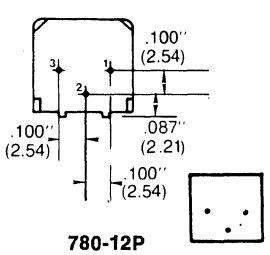
780-10A



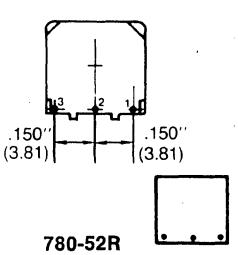
780-50M



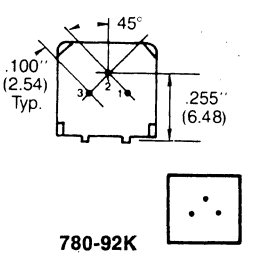
780-82Y



780-12P



780-52R



780-92K

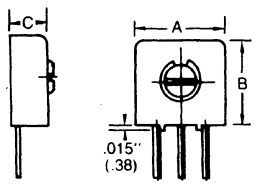
VRN

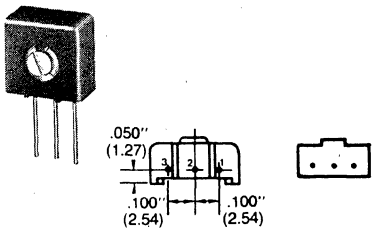
780 SERIES

3/8" Square Cermet Single-Turn Trimmer Potentiometers

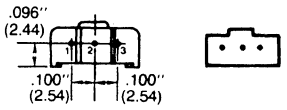
CIRCUITRIM®

SIDE ADJUST

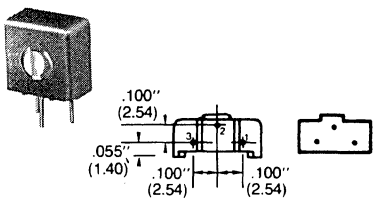




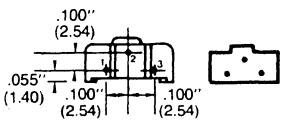
780-20C



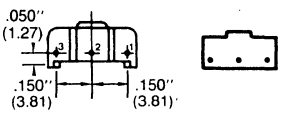
780-22W



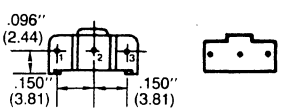
780-40X



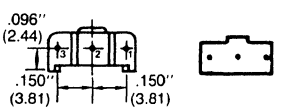
780-42H



780-70B

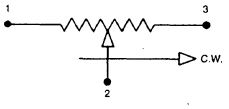


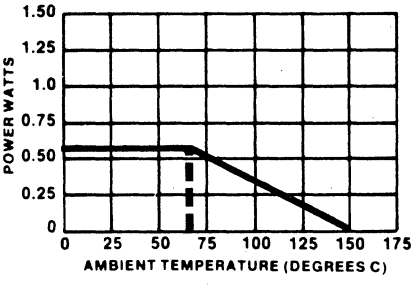
780-72S



780-73J

Dimensions					
	Case			Leads	
Model	A	B	C	Diameter	Length/min.
780-10A	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-12P	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-20C	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-22W	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-32F	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-40X	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-42H	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-50M	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-52R	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-60T	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-70B	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-72S	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-73J	.375"(9.53)	.370"(9.40)	.191"(4.85)	.020"(.508)	.187"(4.75)
780-82Y	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)
780-92K	.375"(9.53)	.191"(4.85)	.370"(9.40)	.020"(.508)	.187"(4.75)





NOTE:
On the 780 series, the letter suffix shown on the VRN P/N should be used when ordering. Unless otherwise stated, tolerances are ±.010"(.25).
Metric conversion in mm in brackets.

VRN

800 SERIES

5/16" Square Wirewound Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.6W @ 70°C
Standard resistance range: 10Ω to 20KΩ
Resistance tolerance: ±5% std.
Temperature coefficient: ±50ppm/°C max.
Noise during adjustment: 100Ω max.
End resistance: 1Ω or 2% (W.I.G.)
Dielectric strength: 900VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance: 1Ω or 0.25% (W.I.G.)

MECHANICAL

Operating temperature range: −55° to +150°C
Total adjustment turns: 15 ±2
Operating torque: 3.0 oz.—in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 800-20 and 800-208 meet, or exceed, all of the environmental and life requirements of MIL-R-27208, Characteristic C.

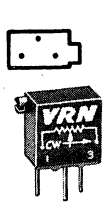
STANDARD RESISTANCE VALUES AVAILABLE (Ω)

10	1K
20	2K
50	5K
100	10K
200	20K
500	

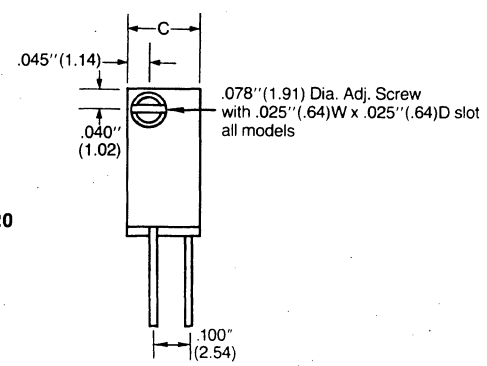
ORDERING INFORMATION

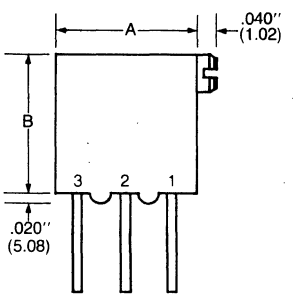
800 — 20 — 5K

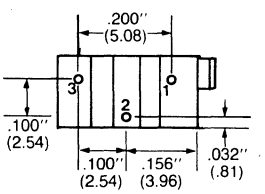
Indicate Type Number	Indicate Package Configuration	Indicate Resistance Value

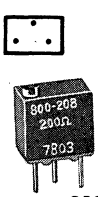


800-20

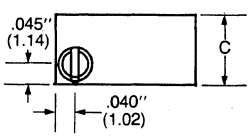


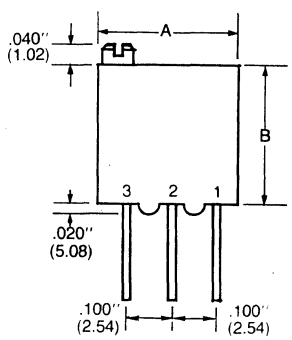


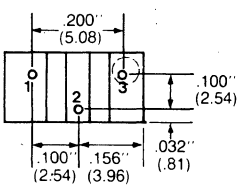




800-208

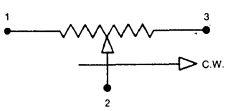


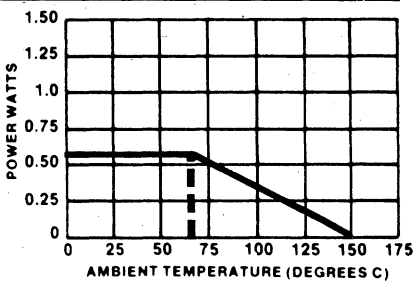




Pin-out templates are actual size—pierce with pencil point for pin locations.
Unless otherwise stated, tolerances are ±.010"(.25)

Dimensions					
	Case			Leads	
Model	A	B	C	Diameter	Length
800-20	.312"(7.92)	.312"(7.92)	.190"(4.82)	.016"±.002"(.41±.05)	.187"(4.75)min.
800-208	.312"(7.92)	.312"(7.92)	.190"(4.82)	.016"±.002"(.41±.05)	.187"(4.75)min.





VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

960 SERIES

3/4" Rectangular Cermet Multi-Turn Trimmer Potentiometers

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: 0.75W @ 70°C (300V max.)
Standard resistance range: 10Ω to 2MΩ
Resistance tolerance: ±10% std.
Temperature coefficient:
±100ppm/°C max.
(±50ppm/°C available—consult factory)
Contact resistance variation:
3Ω max. or 3% (W.I.G.)
End resistance: 2Ω or 2% (W.I.G.)
Dielectric strength: 1000VAC
Insulation resistance: 1000MΩ
Absolute minimum resistance:
1Ω or 3% (W.I.G.)

MECHANICAL

Operating temperature range:
−55° to +125°C;
(962-20: −55° to +100°C)
(963-20: −55° to +100°C)
Total adjustment turns: 20 nominal
Operating torque: 5.0 oz.—in. max.
Mechanical stops: Wiper assembly idles

ENVIRONMENTAL

Models 960-20, 961-20, 970-20, 971-20, 980-20, 988-20 and 989-20 meet, or exceed, all of the environmental and life requirements of MIL-R-22097, Characteristics F.

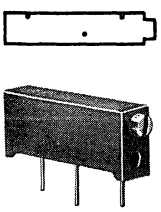
STANDARD RESISTANCE VALUES AVAILABLE (Ω)

10	1K	100K
20	2K	200K
50	5K	500K
100	10K	1M
200	20K	2M
500	50K	

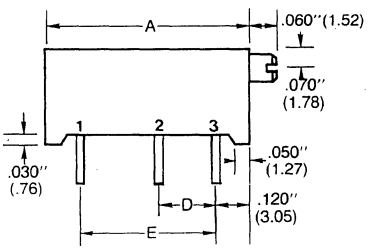
ORDERING INFORMATION

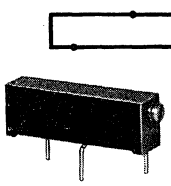
960 — 20 — 500

Indicate Type Number	Indicate Package Configuration	Resistance Indicate Value

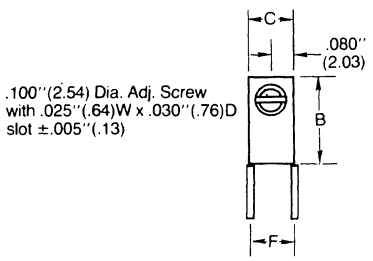


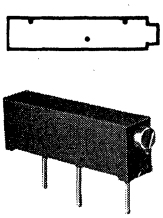
960-20P



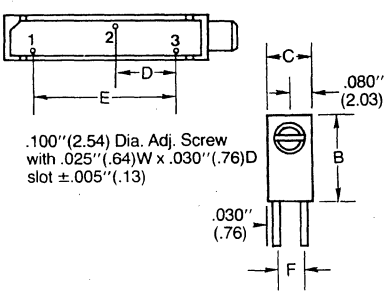


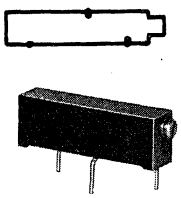
970-20



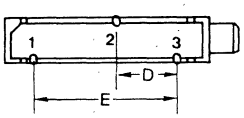


961-20P





971-20Y

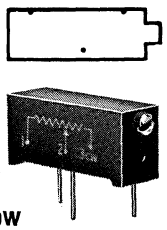


VRN

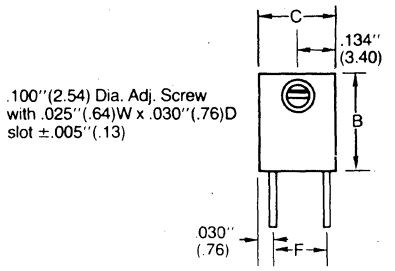
960 SERIES

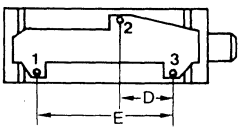
CIRCUITRIM®

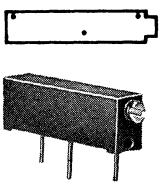
3/4" Rectangular Cermet Multi-Turn Trimmer Potentiometers



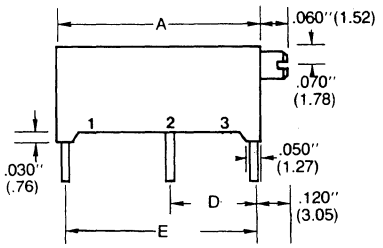
980-20W

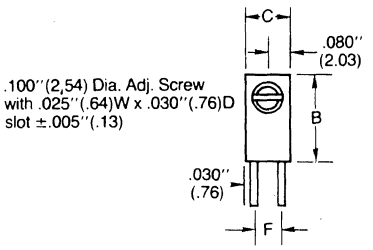


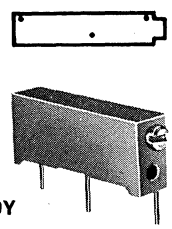




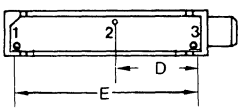
988-20





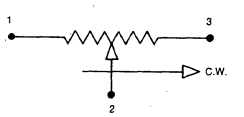


989-20Y



Unless otherwise stated, tolerances are ±.010"(.25)

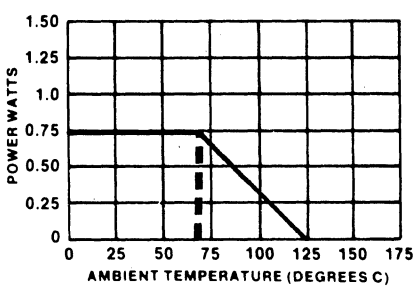
Dimensions								
Case				Pin Spacing			Leads	
Model	A	B	C	D	E	F	Diameter	Length
960-20P*	.750"(19.05)	.310"(7.87)	.160"(4.06)	.200"(5.08)	.500"(12.75)	.100"(2.54)	.018"(.46)	.187"(4.75) min.
961-20P**	.750"(19.05)	.250"(6.35)	.160"(4.06)	.200"(5.08)	.500"(12.75)	.100"(2.54)		
970-20	.750"(19.05)	.310"(7.87)	.160"(4.06)	.200"(5.08)	.500"(12.75)	.200"(5.08)		
971-20Y	.750"(19.05)	.250"(6.35)	.160"(4.06)	.200"(5.08)	.500"(12.75)	.200"(5.08)		
980-20W	.750"(19.05)	.350"(8.89)	.270"(6.86)	.200"(5.08)	.500"(12.75)	.200"(5.08)		
988-20	.750"(19.05)	.250"(6.35)	.160"(4.06)	.300"(7.62)	.700"(14.78)	.100"(2.54)		
989-20Y	.750"(19.05)	.310"(7.87)	.160"(4.06)	.300"(7.62)	.700"(14.78)	.100"(2.54)		



NOTE: Metric conversion in mm in brackets

*Clear housing available—order Model 962-20 **Clear housing available—order Model 963-20

NOTE:
The letter suffix as shown on the VRN P/N is for reference only and is not included in part marking, and should not be used when ordering.



VRN

Precision Potentiometers

More than 30 years of experience have gone into the design and manufacture of VRN precision potentiometers. Our continued research and development into material technology and stringent quality control standards enable us to produce a superior product at lowest cost.

The wide selection of standard units offered will enable design engineers to select a precision potentiometer to meet specific application needs, as well as tight-tolerance packaging requirements.

Shaft, bushing and electrical tolerances are easily modified to meet non-standard specifications.

If, however, you are unable to find a standard precision potentiometer that meets your exact needs, please contact the factory. VRN offers the widest choice of custom designs and turn packages available . . . chances are we already have a custom design to meet your needs.

CONTACT FACTORY FOR DETAILED DATA SHEETS

Diameter	Type	No. Turns	Resistance Element		Mounting		Resistance Range	Power Rating Watts	Linearity (±%)
			Wire	CP	Servo	Bushing			
½"	5001	1	X			X	10-50K	2.0	5.0
	5005	5	X			X	50-50K	1.0	0.5
	5000	10	X			X	100-100K	1.5	0.5
¾"	7501	1	X			X	50-50K	2.25	1.0
	7561-0001	1		X	X		200-1M	1.0	1.0
	7561-0002	1		X		X	200-1M	1.0	1.0
	7405	5	X			X	100-50K	2.0	0.5
	7400	10	X			X	100-100K	3.0	0.25
⅞"	0871-0001	1	X		X		100-10K	1.25	0.5
	0871-0002	1	X			X	100-10K	1.25	0.5
	8400	10	X			X	100-100K	3.0	0.25
	8403	3	X			X	50-50K	2.0	0.5
	8405	5	X			X	50-50K	2.0	0.5
	8500	10	X			X	100-100K	3.0	0.25
	8503	3	X			X	50-50K	2.0	0.5
	8505	5	X			X	50-50K	2.0	0.5
	7800	10	X			X	100-100K	2.0	0.25
1"	1005	5	X			X	250-100K	2.0	0.5
	1000	10	X			X	500-250K	3.0	0.5
	1215	15	X			X	500-450K	4.0	0.1
	1220	20	X			X	1K -600K	5.0	0.1
1 1/16"	1061-0001	1	X		X		50-50K	1.5	0.5
	1061-0002	1	X			X	50-50K	1.5	0.5
1 7/16"	1441-0001	1	X		X		100-40K	2.0	0.5
	1441-0002	1	X			X	100-40K	2.0	0.5
1½"	151	1	X			X	100-100K	3.5	0.5
	HD 153	3	X			X	200-250K	3.0	0.5
	HD 155	5	X			X	200-500K	4.0	0.5
	HD 150	10	X			X	500-500K	5.0	0.25
1¾"	1751-0001	1	X		X		50-50K	2.5	0.25
	1751-0002	1	X			X	50-50K	2.5	0.25
2"	2001-0001	1	X		X		100-100K	4.0	0.25
	2001-0002	1	X			X	100-100K	4.0	0.25
3"	3001-0001	1	X		X		100-100K	6.0	0.25
	3001-0002	1	X			X	100-100K	6.0	0.25

Most single turn models can be made available with Cermet or conductive plastic elements—consult factory.

VRN

9950/9955/9958/9959

Bridge-T Attenuators

CIRCUITRIM®

SPECIFICATIONS

ELECTRICAL

Power rating: .25W @ 50°C
0W @ 125°C
Impedance:
75Ω std. (50Ω and 600Ω available)
Tolerance: ±20%
Attenuation range:
.25dB max. CW to 20dB min. CCW
Attenuation vs. frequency:
1db max. variation 50-400 MHz
Insulation resistance:
100MΩ min. @ 500VDC
Dielectric strength: 1000VAC

MECHANICAL

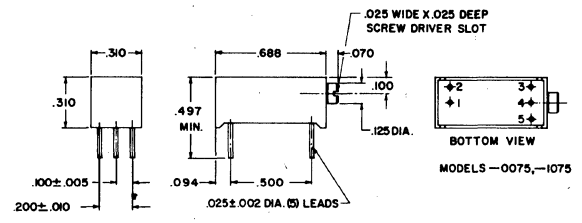
Rotation: 9958/59 295° ±5°
9950/55 1800° (clutches both ends)
Stop strength:
10 in.-oz. min. (9958/59 only)
Operating torque: 0.5 to 5.0 in.-oz.

ENVIRONMENTAL

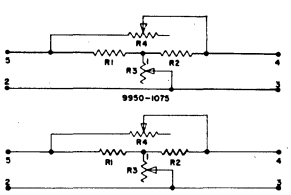
Operating temperature range:
−55°C to +125°C
Sealed to withstand wave soldering.

SHAFT LENGTH L ±.02"	HOW TO ORDER 9958 75Ω PLASTIC	9958 75Ω METAL	9959 75Ω PLASTIC	9959 75Ω METAL
.031	—1752	—	—1750	—
.125	—2752	—6752	—2750	—6750
.250	—3752	—7752	—3750	—7750
.375	—4752	—8752	—4750	—8750
.500	—5752	—9752	—5750	—9750

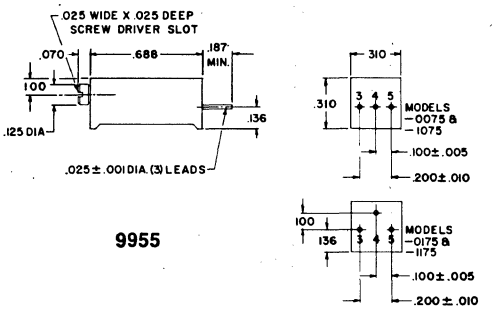
9950/55		
TYPE	DESCRIPTION	FIXED RESISTORS
9950-0075	Side Adj.—Horiz. Mt.	None
-1075	Side Adj.—Horiz. Mt.	Two (2) 75Ω
9955-0075	Top Adj.—Vert. Mt.	None
-1075	Top Adj.—Vert. Mt.	Two (2) 75Ω
-0175	Top Adj.—T05 Mt.	None
-1175	Top Adj.—T05 Mt.	Two (2) 75Ω



9950



9950-0075*



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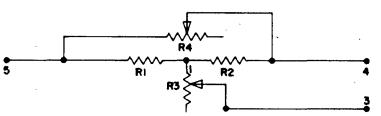
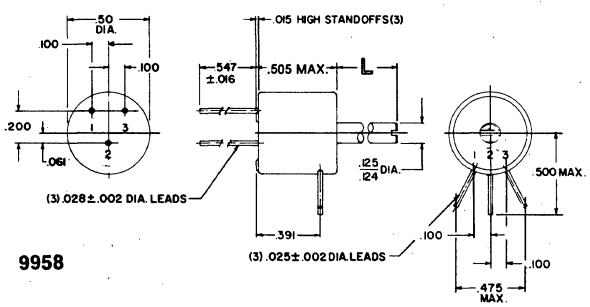


9955-1075, 1175



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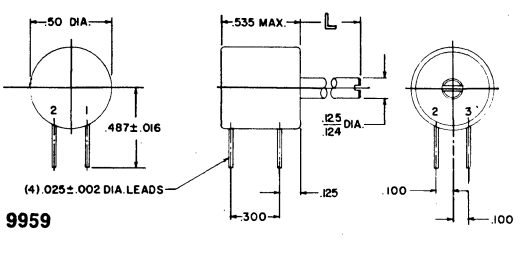

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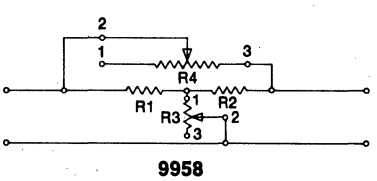

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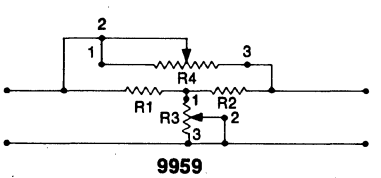

9959

VRN INTERNATIONAL P.O. Box 44000, St. Petersburg, FL 33743 Tel. 813-347-2181/TWX: 810-863-0357/TELEX: 523417

VRN

Cross-Reference Guide for Trimmer Potentiometers

This cross-reference information is provided as a guide only, because part-to-part compatibility between manufacturers is not always the same. If you do not find a direct cross-reference in this guide, contact the VRN Sales Department in St. Petersburg, Florida at 813-347-2181. Chances are, with our constantly expanding product lines, we still may be able to satisfy your immediate need.

ALLEN-BRADLEY	VRN
A2A	170
A2B	171
A2C	171 C.E.
A4B	182
A4C	183
A4D	182
D2A	760—10 C.E.
D2B	760—30 C.E.
D2C	760—52 C.E.
D4A	760—42 C.E.
D4D	760—22 C.E.
E2A	780—12P
E2B	780—32F
E2C	780—50M
E2F	780—52R
E2G	780—82Y
E4A	780—40X
E4C	780—70B
E4D	780—20C
E4F	780—72S
E4H	780—70B
E4J	780—22W
E4K	780—42H
FC	150 C.E.
FR	150 C.E.
MT2W	752—208 C.E.
MT2X	752—208
MT4P	752—10
MT4X	752—207 C.E.
MT4Y	752—207
RT 5L	961—20
RT 5H	960—20
RT 6L	971—20
RT 6H	970—20
RT 7L	988—20
RT 7H	989—20
SH	183
SV	171

BECKMAN	VRN
50	450—00
53	450—20
54	450—201
55L	450—00
55P	450—20
55S	450—201
56L	450—00
56P	450—10
57	450—629-C.E.
58P	450—20
58S	450—202
61M	171 C.E.
61P	170 C.E.
61PA	182
62M	171
62P	170
62PA	182
63P	752—10
63W	752—208
63X	752—207
66P	752—10
66W	752—208
66X	752—207
68P	752—10
68W	752—208
68X	752—207
72P	780—12P
72PL	780—60T
72PM	780—32F
72PX	780—50M
72RX	780—42H
72RPX	780—52R
72RXL	780—22W
72RXW	780—72S
72X	780—40X
72XL	780—20C
72XW	780—70B
76P	989—20
77P	980—20
78L	450—00
78P	450—20
78S	450—202
79P	960—20
82P	170
82PA	182
82PF	170 C.E.
89P	961—20
89PH	960—20
89W	971—20
89WH	970—20
89X	988—20
89XH	989—20
91	760 C.E.
93P	782-12

BOURNS	VRN
200L	600—00
200P	600—20
200S	600—201 C.E.
215L	450—00 C.E.
215P	450—20 C.E.
215S	450—201 C.E.
224L	400—00
224P	400—10
260L	600—00
260P	600—20
260S	600—202
271	600—00
272	450—00
273	600—202
274	450—202
275	600—20
276	450—20
3000P	910—20 C.E.
3005P	910—20
3006P	961—20
3006W	971—20
3006Y	988—20
3007P	910—20
3009P	960—20
3009Y	989—20
3010L	600—00
3010P	600—20
3012L	450—00
3012P	450—20
3052L	450—00
3052P	450—10
3052Y	450—20
3057J	400—202
3057L	400—00
3057P	400—10
3057Y	400—20
3059J	450—202
3059L	450—00
3059P	450—10
3059Y	450—20
3065P	930—20 C.E.
3066P	980—20
3067P	930—20 C.E.
3068P	980—20 C.E.
3069P	970—20
3250L	205—00
3250P	205—10
3250W	205—208
3250W—66	205—207
3252L	255—00
3252P	255—10
3252W	255—208
3252X	255—207
3255L	205—00
3255P	205—10
3255W	205—208
3255W—66	205—207
3260H	800—20 C.E.
3260W	800—208 C.E.

C.E.—CLOSEST EQUIVALENT

BOURNS	VRN
3262W	260—208
3262X	260—207
3279W	850—208
3279X	850—20
3280L	700—00
3280P	700—10
3280W	700—208
3280W—66	700—207
3281P	752—10 C.E.
3281W	752—208 C.E.
3281W—66	752—208 C.E.
3282P	752—10
3282W	752—208
3282W—66	752—207
3290H	700—207
3290L	700—00
3290P	700—10
3290W	700—208
3292P	752—10
3292W	752—208
3292X	752—207
3299P	752—10
3299W	752—208
3299X	752—207
3299Y	752—408
3299Z	752—407
3322P	171
3326P	171
3329H	170
3329P	171
3329W	182
3345P	100
3345P (THUMBWHEEL)	110
3345W	106—2
3345W (THUMBWHEEL)	108—2
3386B	780—70B
3386C	780—20C
3386F	780—32F
3386H	780—42H
3386J	780—73J
3386K	780—92K
3386M	780—50M
3386P	780—12P
3386R	780—52R
3386S	780—72S
3386T	780—60T
3386W	780—22W
3386X	780—40X
3386Y	780—82Y
3389F	760—30
3389H	760—42
3389P	760—10
3389R	760—52
3389S	760—72
3389T	760—82
3389W	760—22

DALE	VRN
100SX	780—20C
101SX	780—40X
101T	780—12P
102T	780—32F
150SX	780—70B
150TX	780—50M
781	988—20
783	971—20
784	961—20
785	961—20
1286	400—60
1287	400—20
1288	400—00
1680	400—10
1686	400—60
1697	400—00
2186	400—60
2187	400—20
2188	400—00
2417	910—20
2487	910—20
5050	205—00
5080	205—207
5091	205—10
5850	700—00
5851	700—10
5880	700—208
5887	700—207
8417	960—20
8487	960—20

MEPCO ELECTRA	VRN
8012EKJ	450—202
8012EKL	450—00
8012EKQ	450—10
8012EKR	450—20
8014EMB	171
8014EMF	170
8014EMU	182
8024EKA	752—208
8024EKN	752—207
8024EKX	752—10
8034EKO	980—20
8034EKP	960—20
8034EKR	989—20
8035EKP	961—20
8035EKR	988—20
8050EKB	171
8050EKF	170
8050EKU	182

SPECTROL	VRN
40L	400—00
40L—T601	400—60
40P	400—10
40Y	400—20
40Y—T602	400—202
40Y—T603	400—622
43P	961—20
43P—T601	960—690
43W	971—20
43Y	988—20 C.E.
47P	910—20
47P—T040	912—20
47W	930—20
50—1	700—00
50—1—P	700—60
50—2	700—207
50—3	700—208
50—4	700—10
52P	752—10
52W	752—208
52X	752—207
53—1	171 C.E.
53—2	182
55—1	205—00
55—1—P	205—60
55—2	205—207
55—3	205—208
55—4	205—10
62—1	170
62—2	183
62—3	171
63H	780—50M
63M	780—32F
63P	780—12P
63S	780—20C
63T	780—60T
63V	780—70B
63X	780—40X
64P	752—10
64W	752—208
64X	752—207
64Y	752—408
64Z	752—407
65P	171
65X	182
65Y	170
70L	450—00
70L—T601	450—60
70P	450—10
70Y	450—20
70Y—T602	450—202
70Y—T603	450—622
80—3	171
84—3—10	110 C.E.
84—3—6	100 C.E.
85—3—8	106—2 C.E.

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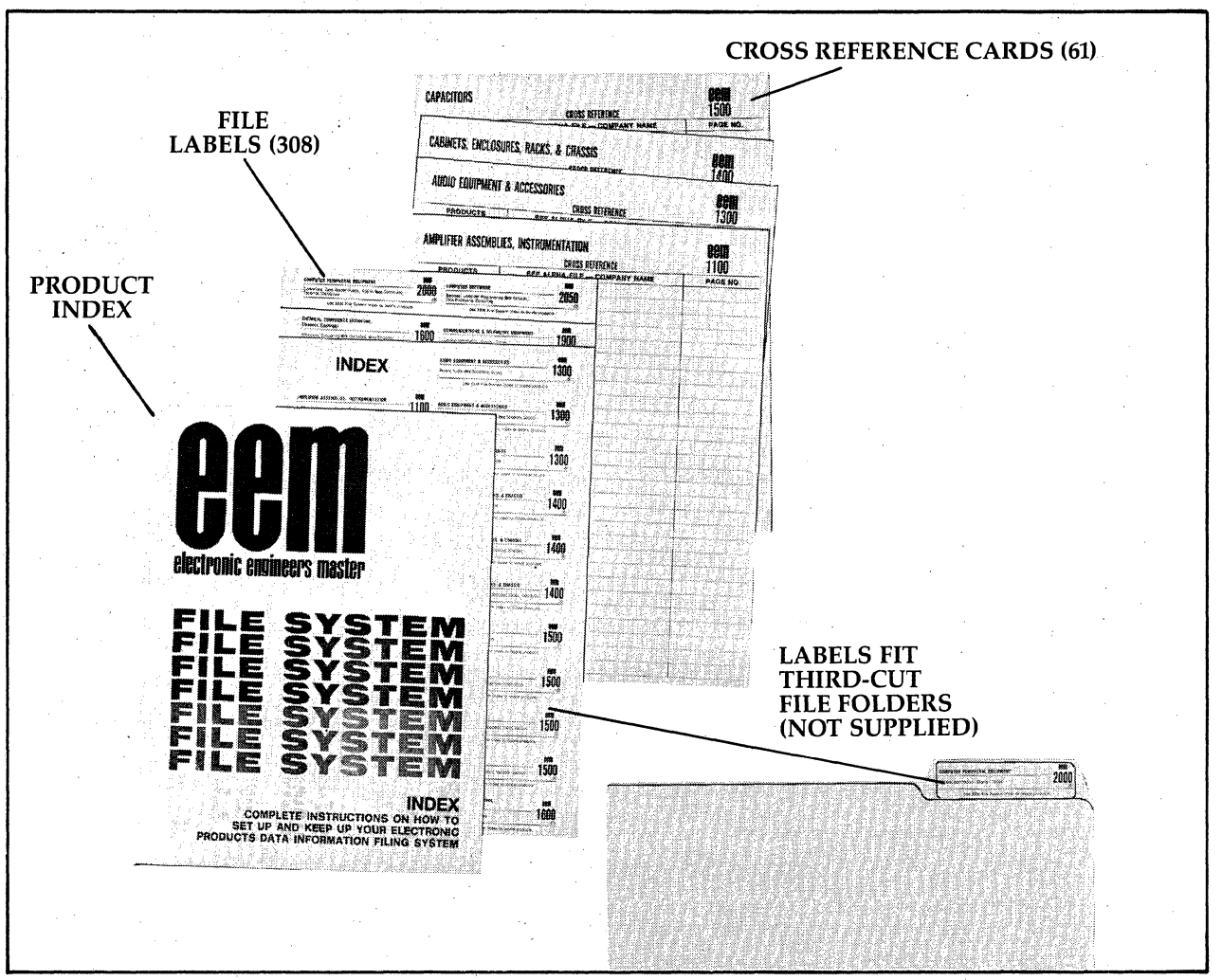

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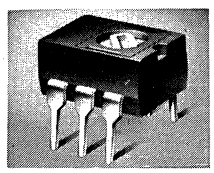
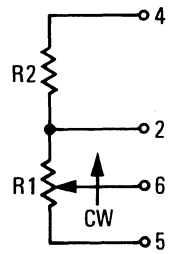
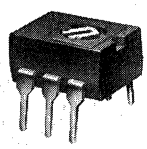
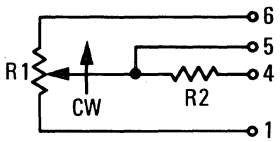


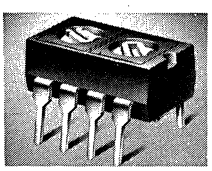


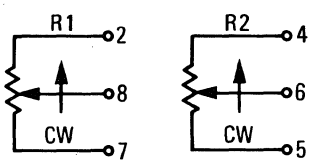
SERIES 0608A
6-PIN DIP



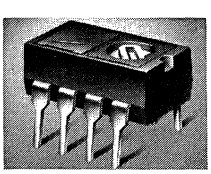


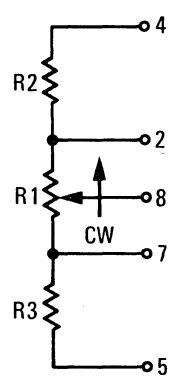
SERIES 0802B
8-PIN DIP



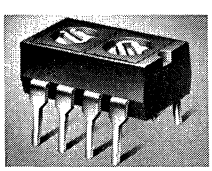


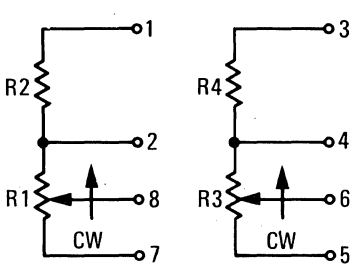
SERIES 0806B
8-PIN DIP





SERIES 0825B
8-PIN DIP





Model Numbers	Resistance Values (Ohms)			
	R1	R2	R3	R4
0605A-102-502	1K	4K	—	—
0605A-102-103	2K	8K	—	—
0605A-102-504	100K	400K	—	—
0605A-105-102	500	500	—	—
0605A-105-103	5K	5K	—	—
0605A-105-503	25K	25K	—	—
0605A-105-104	50K	50K	—	—
0605A-107-503	35K	15K	—	—
0605A-108-502	4K	1K	—	—
0605A-108-504	400K	100K	—	—
0605A-109-103	9K	1K	—	—
0605A-109-104	90K	10K	—	—
0608A-101-104	100K	100K	—	—
0608A-105-502	5K	25K	—	—
0608A-105-103	10K	50K	—	—
0802B-210-101	100	100	—	—
0802B-210-102	1K	1K	—	—
0802B-210-103	10K	10K	—	—
0802B-210-104	100K	100K	—	—
0802B-210-504	500K	500K	—	—
0802B-211-103	10K	20K	—	—
0802B-211-104	100K	200K	—	—
0802B-212-102	1K	10K	—	—
0802B-212-103	10K	100K	—	—
0806B-119-103	8K	1K	1K	—
0806B-127-503	25K	15K	10K	—
0806B-137-503	20K	15K	15K	—
0806B-137-504	200K	150K	150K	—
0806B-146-102	200	400	400	—
0806B-146-104	20K	40K	40K	—
0806B-145-103	1K	5K	4K	—
0806B-157-104	20K	30K	50K	—
0825B-201-502	500	4.5K	500	4.5K
0825B-201-503	5K	45K	5K	45K
0825B-203-503	15K	35K	15K	35K
0825B-207-502	3.5K	1.5K	3.5K	1.5K
0825B-207-103	7K	3K	7K	3K
0825B-207-503	35K	15K	35K	15K
0825B-209-104	90K	10K	90K	10K

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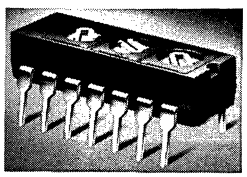
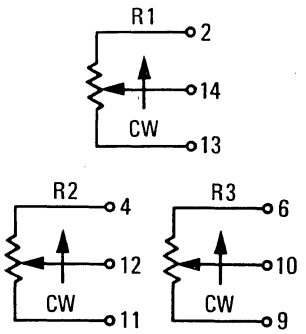
TRIMMER RESISTOR NETWORK

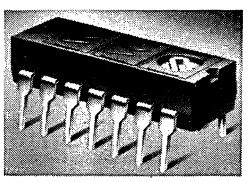
WESTON

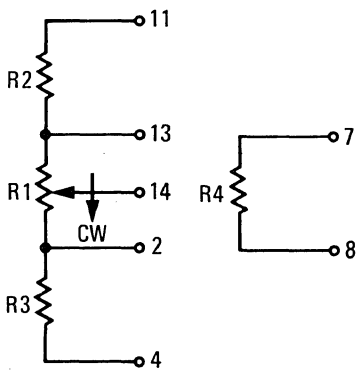
SERIES 1403C
14-PIN DIP





SERIES 1407C
14-PIN DIP





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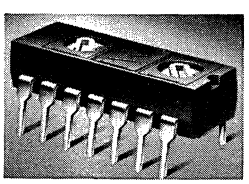
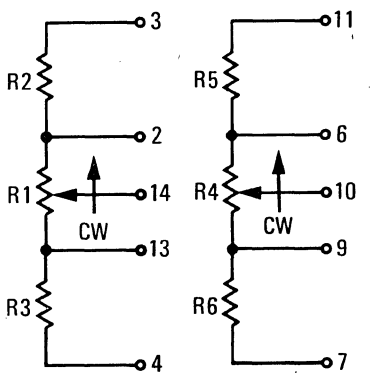
14-PIN DIP





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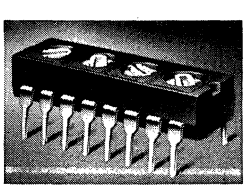
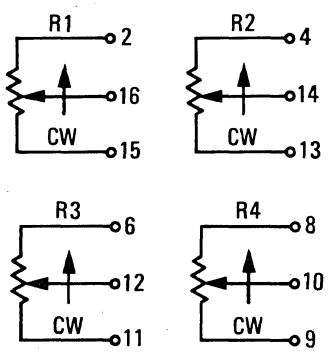
16-PIN DIP





Model Numbers	Resistance Values (Ohms)					
	R1	R2	R3	R4	R5	R6
1403C-310-102	1K	1K	1K	—	—	—
1403C-310-103	10K	10K	10K	—	—	—
1403C-310-104	100K	100K	100K	—	—	—
1403C-312-103	10K	20K	20K	—	—	—
1403C-314-102	1K	10K	2K	—	—	—
1403C-314-103	10K	100K	20K	—	—	—
1407C-111-104	1.7K	90K	8.3K	7.6K	—	—
1407C-112-104	200	90K	9.8K	8.8K	—	—
1426C-237-503	20K	15K	15K	20K	15K	15K
1426C-245-103	1K	5K	4K	1K	5K	4K
1604D-410-101	100	100	100	100	—	—
1604D-410-102	1K	1K	1K	1K	—	—
1604D-410-103	10K	10K	10K	10K	—	—
1604D-410-104	100K	100K	100K	100K	—	—
1604D-410-504	500K	500K	500K	500K	—	—
1604D-419-103	10K	20K	20K	20K	—	—
1604D-420-103	10K	100K	20K	20K	—	—
1604D-423-103	10K	100K	10K	100K	—	—

Consult factory for samples, pricing and resistance values not listed.

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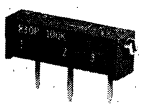
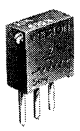
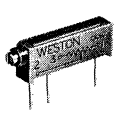
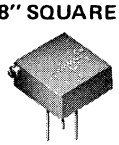
WESTON

GENERAL PURPOSE CERMET POTENTIOMETERS SQUARE, RECTANGULAR AND ROUND COMMERCIAL

FAIRCHILD WESTON
Schlumberger

	Model	Terminal Type	Turns	Size L W T	Stops	Power Rating (W)	Max. Oper. Temp.°C	T.C. ±PPM/°C	Res. Tol. %	Resistance Range
3/4" RECTANGULAR 	830P	P	12	.75 x .25 x .19	Wiper Idles	.75 @ 70°C	125	100	10% (*)	10Ω - 2 Meg.
	830W 830Y	W Y								10Ω - 2 Meg.
3/8" SQUARE	840P 840X	P X	1	.375 x .375 x .187	Solid	.50 @ 70°C	125	100	10% (*)	10Ω - 2 Meg.
	Other Models Available. Consult Factory.									
3/8" SQUARE 	850P 850W 850X	P W X	22	.375 x .375 x .187	Wiper Idles	1 @ 50°C	125	100	10% (*)	10Ω - 2 Meg.
	Other Models Available. Consult Factory.									
1/4" SQUARE	860W 860X	W X	16	.250 x .250 x .185	Wiper Idles	.5 @ 85°C	150	100	10% (*)	100Ω - 1 Meg
	Other Models Available. Consult Factory.									
3/8" SQUARE (NEW)	950P 950W 950X	P W X	22	.375 x .375 x .187	Wiper Idles	1 @ 50°C	125	100	10% (*)	100Ω - 2 Meg
1/2" RECTANGULAR 	522-00HS	P	10	.50 x .17 x .10	Wiper Idles	.30 @ 85°C	150	100	10% (*)	10Ω - 1 Meg.
3/8" SQUARE 	546-00HS	L	25	.375 x .375 x .150	Wiper Idles	.50 @ 85°C	150	100	10% (*)	10Ω - 1 Meg.
	547-00HS 548-00HS 548-72HS	P W X		.375 x .375 x .170 .417 x .375 x .165 .417 x .375 x .165						10Ω - 1 Meg.
1/4" ROUND	566-00HS 567-00HS	P P	1	.270 Dia. x .215	Solid	.50 @ 70°C	150	100	10% (*)	10Ω - 1 Meg.

Humidity: (All Models) MIL-STD-202, Method 106

Terminals: L, Insulated Flexible Leads; P, Printed Circuit Pins Base Mounted; W, Printed Circuit Pins Edge Mounted 180° from Screw; X, Printed Circuit Pins Edge Mounted 90° from Screw; Y, Printed Circuit Pins Base Mounted.

Specifications Subject to Change Without Notice.

*Note: Resistance Tolerance for 10Ω, 20Ω ±20%

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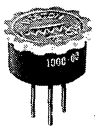
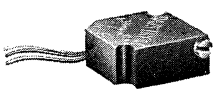
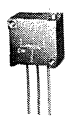
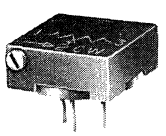
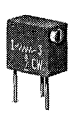
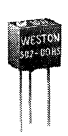
FAIRCHILD WESTON
Schlumberger

GENERAL PURPOSE WIREWOUND POTENTIOMETERS SQUARE, RECTANGULAR AND ROUND COMMERCIAL

WESTON

	Model	Terminal Type	Turns	Size L W T	Stops	Power Rating (W)	Max. Oper. Temp. °C	T.C. ±PPM/°C	Res. Tol. %	Resistance Range
1/2" ROUND 	1000-00HS	P	1	.500 Dia. x .315	Solid	1 @ 70°C	150	50	5%	10Ω - 50K
	1000-67HS	P		.500 Dia. x .250						10Ω - 50K
	1000-68HS	X		.562 x .500 x .312						10Ω - 50K
	Other Models Available. Consult Factory.									
1 1/4" RECTANGULAR	534-00HS	L	24	1.25 x .315 x .190	Wiper Idles	1 @ 70°C	150	50	5%	10Ω - 50K
	535-00HS	P		1.25 x .315 x .190						
	539-00HS	Y		1.25 x .325 x .195						
3/8" SQUARE 	543-00HS	L	25	.375 x .375 x .160	Wiper Idles	1 @ 70°C	150	50	5%	10Ω - 50K
	544-00HS	P		.375 x .375 x .170						10Ω - 50K
	545-00HS	W		.417 x .375 x .170						
	545-72HS	X		.417 x .375 x .170						
1/2" SQUARE 	553-00HS	L	35	.500 x .500 x .187	Wiper Idles	1 @ 70°C	150	50	5%	10Ω - 50K
	555-00HS	W		.535 x .500 x .220						10Ω - 50K
	555-72HS	X		.535 x .500 x .220						
1/2" SQUARE 	701-00HS	P	37	.500 x .500 x .230	Wiper Idles	1 @ 70°C	150	50	5%	10Ω - 50K
1/4" SQUARE 	561-00HS	P	13	.170 x .250 x .250	Wiper Idles	.25 @ 70°C	150	50	5%	10Ω - 25K
	562-00HS	W		.250 x .250 x .170						10Ω - 25K
	562-72HS	X		.250 x .250 x .170						
5/16" SQUARE 	501-00HS	P	15	.175 x .312 x .312	Wiper Idles	.6 @ 70°C	150	70	5%	10Ω - 20K
	502-00HS	W		.312 x .312 x .175						10Ω - 20K
	502-72HS	X		.312 x .312 x .175						

Humidity: (All Models) MIL-STD-202, Method 106

Terminals: L, Insulated Flexible Leads; P, Printed Circuit Pins Base Mounted; W, Printed Circuit Pins Edge Mounted 180° from Screw; X, Printed Circuit Pins Edge Mounted 90° from Screw; Y, Printed Circuit Pins Base Mounted.

Specifications Subject to Change Without Notice.

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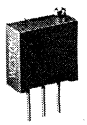
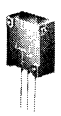
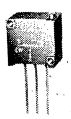
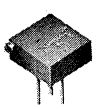
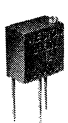
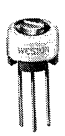
WESTON

MILITARY APPROVED
POTENTIOMETERS WIREWOUND - MIL-R-27208 NON-WIREWOUND - MIL-R-22097

FAIRCHILD WESTON
Schlumberger

	Model	Terminal Type	Military Designation	Turns	Size L W T	Stops	Power Rating (W)	Max. Oper. Temp. °C	T.C. ±PPM/°C	Res. Tol. %	Resistance Range
MIL-R-27208/8 1 1/4" RECTANGULAR	534-118HS	L	RT12C2L	24	1.25 x .315 x .190	Wiper Idles	.75 @ 85°C	150	50	5%	10Ω - 20K
	535-105HS	P	RT12C2P		1.25 x .315 x .190						
	539-105HS	Y	RT12C2Y		1.25 x .325 x .195						
MIL-R-27208/9  3/8" SQUARE	543-118HS	L	RT24C2L	25	.375 x .375 x .160	Wiper Idles	.75 @ 85°C	150	50	5%	10Ω - 10K
	544-105HS	P	RT24C2P		.375 x .375 x .170						10Ω - 10K
	545-101HS	W	RT24C2W		.417 x .375 x .170						
	545-102HS	X	RT24C2X		.417 x .375 x .170						
MIL-R-27208/4  1/2" SQUARE	553-118HS	L	RT22C2L	35	.500 x .500 x .187	Wiper Idles	.75 @ 85°C	150	50	5%	50Ω - 20K
	555-101HS	W	RT22C2W	35	.535 x .500 x .220						50Ω - 20K
	555-102HS	X	RT22C2X	35	.535 x .500 x .220						
	701-105HS	P	RT22C2P	37	.500 x .500 x .230						10Ω - 20K
MIL-R-27208/10  1/4" SQUARE	561-105HS	P	RT26C2P	13	.170 x .250 x .250	Wiper Idles	.25 @ 85°C	150	50	5%	10Ω - 5K
	562-101HS	W	RT26C2W		.250 x .250 x .170						10Ω - 5K
	562-102HS	X	RT26C2X		.250 x .250 x .170						
MIL-R-22097/4  3/8" SQUARE	546-118HS	L	RJ24FL	25	.375 x .375 x .160	Wiper Idles	.50 @ 85°C	150	100	5%	50Ω - 1 Meg.
	547-105HS	P	RJ24FP		.375 x .375 x .170						50Ω - 1 Meg.
	548-101HS	W	RJ24FW		.417 x .375 x .170						
	548-102HS	X	RJ24FX		.417 x .375 x .170						
	("C" Characteristic Also Available)										
MIL-R-22097/5  1/4" SQUARE	860-101HS	W	RJ26FW	16	.250 x .250 x .185	Wiper Idles	.25 @ 85°C	150	100	10%	100Ω - 1 Meg.
	860-102HS	X	RJ26FX								
	("C" Characteristic Also Available)										
MIL-R-22097/6  1/4" ROUND	567-105HS	P	RJ50CP	1	.270 Dia. x .215	Solid	.25 @ 85°C	150	250	10%	100Ω - 1 Meg

Humidity: (All Models) MIL-STD-202, Method 106

Terminals: L, Insulated Flexible Leads; P, Printed Circuit Pins Base Mounted; W, Printed Circuit Pins Edge Mounted 180° from Screw; X, Printed Circuit Pins Edge Mounted 90° from Screw; Y, Printed Circuit Pins Base Mounted.

Specifications Subject To Change Without Notice.

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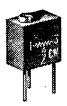
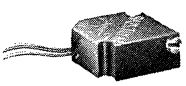
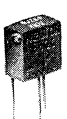
FAIRCHILD WESTON
Schlumberger

MILITARY APPROVED POTENTIOMETERS HI-RELIABILITY - WIREWOUND - MIL-R-39015 HI-RELIABILITY - NON-WIREWOUND - MIL-R-39035

WESTON

	Model	Terminal Type	Military Designation	Turns	Size L W T	Stops	Power Rating (W)	Max. Oper. Temp. °C	T.C. ±PPM/°C	Res. Tol. %	Resistance Range
MIL-R-39015/1 1 1/4" RECTANGULAR	534-160HS	L	RTR12DL		1.25 x .315 x .190						
	535-160HS	P	RTR12DP	24	1.25 x .315 x .190	Wiper Idles	.75 @ 85°C	150	50	5%	100Ω - 20K
	539-160HS	Y	RTR12DY		1.25 x .325 x .195						
	RTR12DL - "M" & "P" Failure Rate Level; RTR12DP and RTR12DY-"M" Failure Rate Level										
MIL-R-39015/2  1/2" SQUARE	553-160HS	L	RTR22DL	35	.500 x .500 x .187						100Ω - 20K
	555-160HS	W	RTR22DW	35	.535 x .500 x .220	Wiper Idles	.75 @ 85°C	150	50	5%	100Ω - 20K
	555-161HS	X	RTR22DX	35	.535 x .500 x .220						100Ω - 20K
	701-160HS	P	RTR22DP	37	.500 x .500 x .230						10Ω - 20K
	RTR22DL & RTR22DP - "M" & "P" Failure Level; RTR22DW & RTR22DX - "M" Failure Level										
MIL-R-39015/3  3/8" SQUARE	543-160HS	L	RTR24DL	25	.375 x .375 x .150	Wiper Idles	.75 @ 85°C	150	50	5%	200Ω - 10K
	"M" Failure Rate Level										
MIL-R-39035/3  1/4" SQUARE	860-160HS	W	RJR26FW	16	.250 x .250 x .185	Wiper Idles	.25 @ 85°C	150	100	10%	100Ω - 1 Meg.
	860-161HS	X	RJR26FX								
	"M" & "P" Failure Rate Level										

Humidity: (All Models) MIL-STD-202, Method 106

Terminals: L, Insulated Flexible Leads; P, Printed Circuit Pins Base Mounted; W, Printed Circuit Pins Edge Mounted 180° from Screw; X, Printed Circuit Pins Edge Mounted 90° from Screw; Y, Printed Circuit Pins Base Mounted.

Failure Rate Designation: In percent/1000 Hours M=1.0, P = 0.1, R = 0.01, S = 0.001

Specifications Subject to Change Without Notice.

Military Part Number: Consists of the document number and a dash number with letters which signify - Terminal Type and Failure Rate.

Example: M39015/1 - 001 L M

- M39015/1 - Document number
- 001 - Dash number from table
- L - Terminal type
- M - Failure rate level

RTR12 D L 101 M

- RTR12 - Style
- D - Characteristics
- L - Terminals
- 101 - Resistance Mil-Code
- M - Failure rate level

WESTON

TRIMMER POTENTIOMETER CROSS-REFERENCE GUIDE

FAIRCHILD WESTON
Schlumberger

THIS GUIDE PROVIDES A FAST CROSS-REFERENCE BETWEEN WESTON PRODUCTS AND COMPETITIVE UNITS OFFERED BY OTHER POTENTIOMETER COMPANIES. IT IS NOT MEANT TO INFER EXACT INTERCHANGEABILITY IN ALL INSTANCES. FOR FURTHER INFORMATION CONCERNING PRODUCT SUBSTITUTES CONTACT YOUR WESTON SALES REPRESENTATIVE OR DISTRIBUTOR.

NOTE 1: Where a Weston series number is followed by a Mil-Designation style (EG: RT22C2P) this type unit is listed on the Qualified Product List (QPL). The competitive unit would also appear on the QPL list unless otherwise noted.

MEPCO/ELECTRA ET 24 • P 103 •••
- ET = PRODUCT TYPE
- 24 = MODEL DESIGNATION
- P = QPL (IF REQUIRED)
- 103 = RESISTANCE VALUE CODE NO.
- ••• = MODIFICATION KEY NUMBER
- • = PIN OR LEAD DESIGNATION

OR 8014 E M F 103
- 8014 = SERIES
- E = INDUSTRIAL, J = RJ, R = RJR
- M = TOLERANCE (M = ±20%, K = ±10%, J = ±5%)
- F = PIN STYLE
- 103 = RESISTANCE VALUE

BECKMAN (HELIPOT) 77P R10K
- 77P = MODEL
- R10K = RESISTANCE VALUE

BOURNS 200 L 1 102 M
- 200 = MODEL NO.
- L = TERMINAL TYPE
- 1 = CATALOG ITEM (2 OR 3 DIGITS INDICATE A SPECIAL)
- 102 = RESISTANCE CODE
- M = PANEL MOUNT

WESTON 555 00HS P 10K
- 555 = SERIES
- 00HS = MODEL & SUFFIX
- P = PANEL MOUNT (IF APPLICABLE)
- 10K = RESISTANCE VALUE

VRN ST. PETERSBURG (FORMERLY IRC (TRW)) 205 00 1K
- 205 = TYPE NUMBER
- 00 = TERMINAL STYLE (WHERE APPLICABLE)
- 1K = RESISTANCE VALUE

BECKMAN (HELIPOT)	WESTON
61PN	566-00HS
61MN	567-00HS
62P	566-65HS
62PF	566-00HS
63L**	546-118HS (RJ24FL)
63P**	547-105HS (RJ24FP)
63W**	548-101HS (RJ24FW)
63X**	548-102HS (RJ24FX)
66P	547-00HS (or 850P)(or 950P)
66W	548-00HS (or 850W)(or 950W)
66X	548-72HS (or 850X)(or 950X)
67P	850P (or 950P)
67W	850W (or 950W)
67X	850X (or 950X)
67Y	850Y
68P	850P (or 950P)
68W	850W (or 950W)
68X	850X (or 950X)

NOTE:
Weston Models 830, 840 & 850 - Terminal Lead Dimension is .036±.002 x .010±.001 (Thickness)

BECKMAN (HELIPOT)	WESTON
72P	840P
72PL	840W
72PM	840M
72RPX*	840X
72RX*	840H
72RXL*	840W
72RXW***	840X
72PX	840R
72X*	840H
72XL*	840W
72XW	840X
76P	830Y
77P	830W
79P	830P
82P	566-00HS
82PF	566-65HS
89P	830P
89W	830W
89X	830Y

*Terminals are Reversed
**Not Listed on QPL
***Schematic is Reversed

BOURNS	WESTON
200L	534-00HS
200L-M (Panel Mount)	
200P	539-00HS
224L**	534-118HS (RT12C2L)
224L-M (Panel Mount)	
224P**	535-105HS (RT12C2P)
224Y**	539-105HS (RT12C2Y)
M224L**	534-118HS (RT12C2L)
M224P**	535-105HS (RT12C2P)
M224Y**	539-105HS (RT12C2Y)
224L-500**	534-160HS (RTR12DL)
224P-500**	535-160HS (RTR12DP)
236L	534-00HS
236L-M (Panel Mount)	
236P	539-00HS
260L	534-00HS
260L-M (Panel Mount)	
260P	539-00HS
271	534-00HS
271-M (Panel Mount)	
275	539-00HS
3005P (Wirewound)	830P (Cermet)
3006P	830P
3006W	830W
3006Y	830Y

BOURNS	WESTON
3007P (Wirewound)	830P (Cermet)
3009P	830P
3009Y	830Y
3010L**	534-118HS (RT12C2L)
3010L-M (Panel Mount)	
3010P**	539-105HS (RT12C2Y)
3057L	534-00HS
3057L-M (Panel Mount)	
3057P	535-00HS
3057Y	539-00HS
R3057L	534-118HS (RT12C2L)
R3057P	535-105HS (RT12C2P)
R3057Y	539-105HS (RT12C2Y)
R3057L	534-160HS (RTR12DL)
R3057P	535-160HS (RTR12DP)
R3057Y	539-160HS (RTR12DY)
3065P (Wirewound)	830W (Cermet)
3066P	830W
3067P (Wirewound)	830W (Cermet)
3068P	830W
3069P	830W
3082P	522-00HS

**Not Listed on QPL

FAIRCHILD WESTON
Schlumberger

TRIMMER POTENTIOMETER CROSS-REFERENCE GUIDE

WESTON

BOURNS	WESTON
3250L	553-118HS (RT22C2L)
3250L-M (Panel Mount)	
3250P	701-105HS (RT22C2P)
3250W	555-101HS (RT22C2W)
3250W-66	555-102HS (RT22C2X)
M3250L	553-118HS (RT22C2L)
M3250L-M (Panel Mount)	
M3250P	701-105HS (RT22C2P)
M3250W	555-101HS (RT22C2W)
M3250X	555-102HS (RT22C2X)
M3250L-501	553-160HS (RTR22DL)
M3250L-501M (Panel Mount)	
M3250P-501	701-160HS (RTR22DP)
M3250W-501	555-160HS (RTR22DW)
M3250W-66-501	555-161HS (RTR22DX)
3255L	553-00HS
3255L-M (Panel Mount)	
3255P	701-00HS
3255W	555-00HS
3255W-66	555-72HS
R3260W	562-101HS (RT26C2W)
R3260X	562-102HS (RT26C2X)
3260H	562-102HS (RT26C2X)
3260W	562-101HS (RT26C2W)
3262W	860W
3262X	860X
B3262W (3262W)	860-101HS (RJ26FW)
B3262X (3262X)	860-102HS (RJ26FX)
3262W	860-160HS (RJR26FW)
3262X	860-161HS (RJR26FX)
3279W	860W
3279X	860X
3280L	543-00HS
3280P	544-00HS
3280W	545-00HS
3280W-66	545-72HS
3281L	546-00HS
3281P	547-00HS (or 850P)(or 950P)
3281W	548-00HS (or 850W)(or 950W)
3281W-66	548-72HS (or 850X)(or 950X)
3282L	546-00HS
3282P	547-00HS (or 850P)(or 950P)
3282W	548-00HS (or 850W)(or 950W)
3282H	548-72HS (or 850X)(or 950X)
3290L	543-118HS (RT24C2L)
3290P	544-105HS (RT24C2P)
3290W	545-101HS (RT24C2W)
3290X (H)	545-102HS (RT24C2X)

Bourns model number with letter prefix indicates type unit listed on QPL (Example: M3251L)

NOTE: Weston Models 830, 840 & 850 - Terminal Lead Dimension is .036±.002 x .010±.001 (Thickness)

BOURNS	WESTON
A3290P	544-105HS (RT24C2P)
A3290W	545-101HS (RT24C2W)
A3290X	545-102HS (RT24C2X)
M3290P	544-160HS (RTR24DP)
M3290W	545-160HS (RTR24DW)
M3290X (H)	545-161HS (RTR24DX)
3292L (B3292L)	546-118HS (RJ24FL)
3292P (B3292P)	547-105HS (RJ24FP)
3292W (B3292W)	548-101HS (RJ24FW)
3292X (B3292X)	548-102HS (RJ24FX)
B3292P (RJR24FP)	
B3292W (RJR24FW)	
B3292X (RJR24FX)	
3299P	547-00HS (or 850P)(or 950P)
3299W	548-00HS (or 850W)(or 950W)
3299X	548-72HS (or 850X)(or 950X)
3299Y	850Y
3299Z	850Z
3322P**	567-105HS (RJ50CP)
3326P	567-00HS
3329H	566-00HS
3329P	567-00HS
3339P (4 turns)	860W (16 turns)
3345P	1000-67HS
3345P (TW)	100-00HS
3345W	1000-68HS
3345W (TW)	1000-75HS
(TW-Thumbwheel)	
3386B***	840X
3386C*	840W
3386F	840M
3386H	840H
3386J*****	840X
3386M***	840R
3386P	840P
3386R*	840R
3386S******	840X
3386T	840T
3386W****	840W
3386X*	840H
3389P	840P
3389W	840W
3389T	840T
3389H	840H
3389R*	840R
3389S*	840X

*Terminals are Reversed
**Not Listed on QPL
***Schematic is Reversed
****Terminals Located on Center Line
*****Schematic is Reversed; Terminals Located on Center Line
******Terminals & Schematic is Reversed; Terminals Located on Center Line

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WESTON

TRIMMER POTENTIOMETER CROSS-REFERENCE GUIDE

FAIRCHILD WESTON
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MEPCO/ELECTRA	WESTON
E24L	546-00HS
ET24P (8024EKX)	547-00HS (or 850P)(or 950P)
ET24W (8024EKA)	548-00HS (or 850W)(or 950W)
ET24X (8024EKN)	548-72HS (or 850X)(or 950X)
ET26W (8026EKB)	860W
ET26X (8026EKM)	860X
ET34P (8034EKP)	830P
ET34X (8034EKR)	830Y
ET34Y (8034EKO)	830W
(8038EKH)	840M
ET38P (8038EKP)	840P
ET38PT (8038EKA)	840T
ET38PW* (8038EKR)	840R
ET38X (8038EKX)	840H
ET38XL (8038EKW)	840W
ET50P (8014EKB)	567-00HS
ET50W (8014EKF)	566-00HS

MEPCO/ELECTRA	WESTON
RJ24L**	546-118HS (RJ24FL)
RJ24P	547-105HS (RJ24FP)
RJ24W	548-101HS (RJ24FW)
RJ24X	548-102HS (RJ24FX)
RJ26W	860-101HS (RJ26FW)
RJ26X	860-102HS (RJ26FX)
RJ50P (RF50)	567-105HS (RF50CP)
RJR24P RJR24W RJR24X	
RJR26W	860-160HS (RJR26FW)
RJR26X	860-161HS (RJR26FX)

*Terminals are Reversed
**Not Listed on QPL

NOTE: Weston Models 830, 840 & 850 - Terminal Lead Dimension is .036±.002 x .010±.001 (Thickness)

VRN St. Petersburg Formerly IRC (TRW)	WESTON
76-10	840P
76-20	840W
76-30	840M
76-40	840H
76-50	840R
76-70	840X
100	1000-69HS
106-2	1000-68HS
110	1000-00HS
170	566-00HS
171	567-00HS
181	567-105HS (RJ50CP)
205-00	553-118HS (RT22C2L)
205-10	701-105HS (RT22C2P)
205-60 (Panel Mount)	
205-207	555-102HS (RT22C2X)
205-208	555-101HS (RT22C2W)
400-00	534-118HS (RT12C2L)
400-10	535-105HS (RT12C2P)
400-20	539-105HS (RT12C2Y)
400-60 (Panel Mount)	
500	1000-00HS
501	1000-69HS
502	1000-67HS
506	1000-75HS
600-00	534-00HS
600-00M (Panel Mount)	
600-20	539-00HS

VRN St. Petersburg Formerly IRC (TRW)	WESTON
700-00	543-118HS (RT24C2L)
700-10	544-105HS (RT24C2P)
700-207	545-102HS (RT24C2X)
700-208	545-101HS (RT24C2W)
700-307	545-72HS
700-308	545-00HS
701-10	544-160HS (RTR24DP)
701-207	545-161HS (RTR24DX)
701-208	545-160HS (RTR24DW)
750-10	547-105HS (RJ24FP)
750-307 (750-207)	548-102HS (RJ24FX)
750-308 (750-208)	548-101HS (RJ24FW)
750-10 (RJR24FP) 750-307 (RJR24FX) 750-308 (RJR24FW)	
800-20	502-72HS
800-208	502-00HS
850-20	860X
850-208	860W
910-20 (Wirewound)	830P (Cermet)
910-30 (Wirewound)	830P (Cermet)
930-20 (Wirewound)	830W (Cermet)
960-20	830P
980-20	830W
989-20	830Y
961-20	830P
981-20	830W
988-20	830Y

NOTE: Weston Models 830, 840 & 850 - Terminal Lead Dimension is .036±.002 x .010±.001 (Thickness)

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Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

TRANSISTORS

Manufacturer	RF (Incl. Microwave)	Power		Switching	UJT	Darlington	Chip	Germanium
		Bipolar	FET					
American Microsemiconductor	1•2193	1•2193				1•2193		
General Electric		1•2195		1•2195		1•2195	1•2195	
Motorola Semiconductor	1•2199, 1•2130	1•2202	1•2202	1•2199				
Philips ECG/Sylvania	1•2206	1•2206	1•2206		1•2207	1•2296		1•2206

THYRISTORS, RECTIFIERS & DIODES

Manufacturer	Thyristors				Rectifiers & Diodes				
	SCRS	Triacs	Diacs	Silicon	Germanium	Selenium	Bridges & Assemblies	Zener	Varactor
American Microsemiconductor	1•2193	1•2193		1•2193					
General Electric	1•2194	1•2194	1•2194	1•2194					
Motorola Semiconductor	1•2203	1•2203		1•2204			1•2204	1•2198, 1•2201	1•2198
Philips ECG/Sylvania	1•2206	1•2206	1•2207	1•2206	1•2206		1•2206	1•2206	1•2206
Teccor	1•2210, 1•2211	1•2210	1•2210						
Iskra Electronics				1•2196			1•2196		
ISL				1•2197			1•2197		
Murata/Erie				1•2205					
Sanford-Miller				1•2209		1•2209	1•2209		
Varo				1•2212, 1•2213			1•2212, 1•2213		
Voltage Multipliers				1•2215			1•2215		

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- MAJOR BRAND
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- DAILY SHIPMENTS FROM STOCK
- OBSOLETE DEVICES

RECTIFIERS & DIODES

1N34A	1N1201	1N2450	1N3913	1N4446
1N60	1N1202	1N2469	1N4001	1N4454
1N91	1N1203	1N2786	1N4002	1N5400
1N92	1N1204	1N2787	1N4003	1N5401
1N93	1N1205	1N2788	1N4004	1N5402
1N100	1N1301	1N2789	1N4005	1N5403
1N270	1N1306	1N3064	1N4006	1N5404
1N283	1N2021	1N3600	1N4007	1N5405
1N643A	1N2025	1N3890	1N4148	1N5406
1N914	1N2250	1N3895	1N4149	1N5407
1N1183A	1N2282	1N3899	1N4154	1N5408
1N1194A	1N2285	1N3903	1N4372	1N5608
1N1200	1N2446	1N3909	1N4381	1N5609

TRANSISTORS

2N159	2N2102	2N2907	2N3638	2N4401
2N341	2N2219	2N2924	2N3702	2N4402
2N342	2N2221A	2N2925	2N3704	2N4403
2N404	2N2222A	2N2926	2N3715	2N4437
2N697	2N2344	2N3055	2N3721	2N5109
2N706	2N2369	2N3114	2N3904	2N5134
2N1132	2N2432	2N3250	2N3906	2N5139
2N1141	2N2559	2N3391	2N3994	2N5210
2N1305	2N2605	2N3415	2N4036	2N5226
2N1309	2N2714	2N3440	2N4059	2N5882
2N1595	2N2904	2N3553	2N4126	2N6076
2N1711	2N2905	2N3563	2N4256	2N6578
2N2060	2N2906	2N3566	2N4400	2N6579

ICS

7400	7475	74LS08	74LS241	74S280
7401	7480	74LS51	74LS243	LM306
7402	7490	74LS107	74LS259	LM307
7403	7495	74LS109	74LS273	UA723
7404	74105	74LS123	74LS374	UA741
7405	74145	74LS132	74LS377	MC1458
7408	74166	74LS151	74LS399	MOC3010
7410	74251	74LS153	74S00	2708
7411	74367	74LS155	74S03	2716
7420	74LS00	74LS161	74S08	2732
7430	74LS02	74LS175	74S11	2764
7432	74LS03	74LS191	74S64	4116
7474	74LS04	74LS240	74S182	4164

SCR'S & TRIACS

2N681	2N1504	2N3753	2N4993	2N6070
2N689	2N1771	2N3760	2N5060	2N6401
2N876	2N1778	2N4441	2N5064	2N6565
2N901	2N2324	2N4444	2N5204	ST-2
2N1595	2N2329	2N4983	2N5207	1N5760

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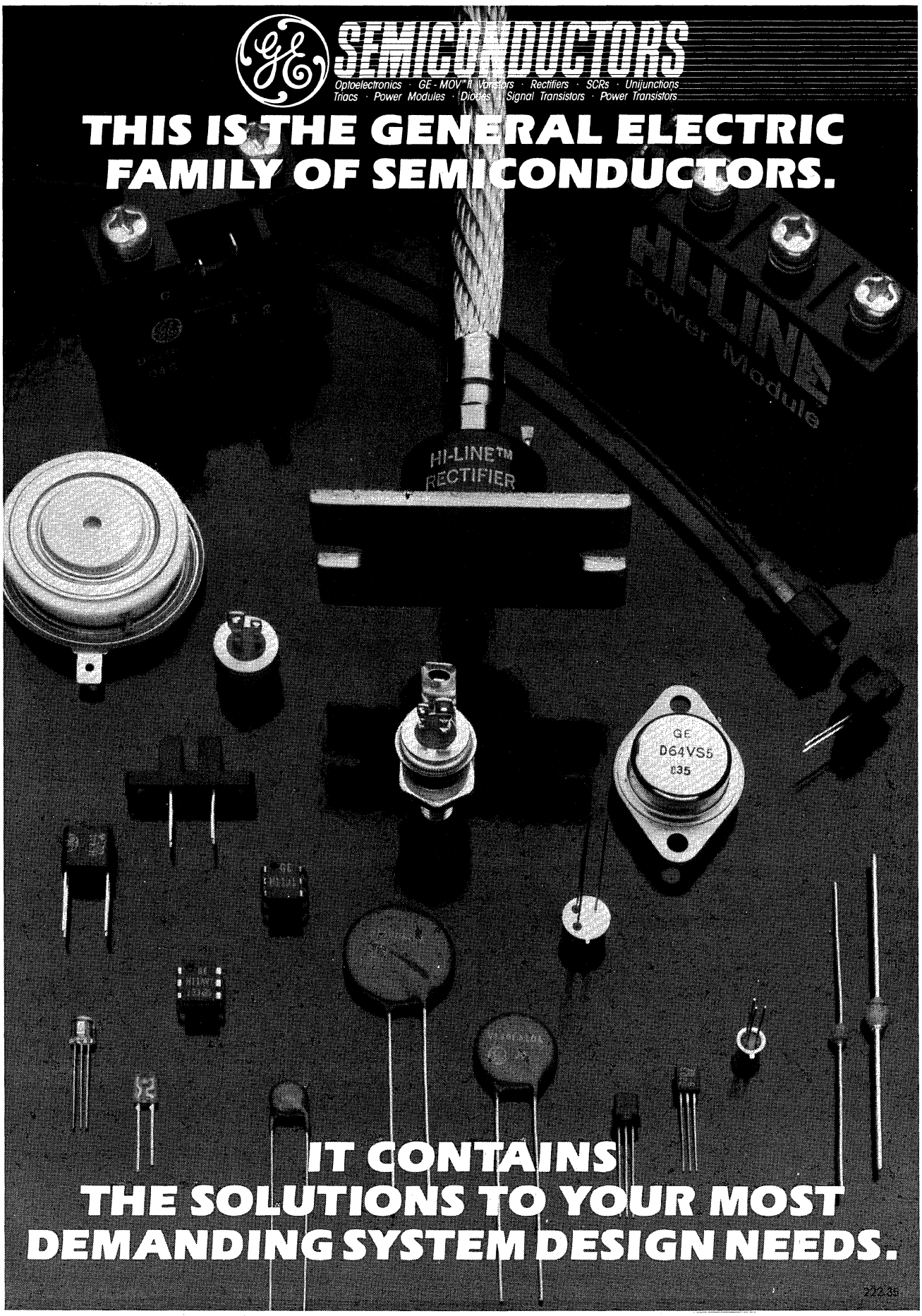
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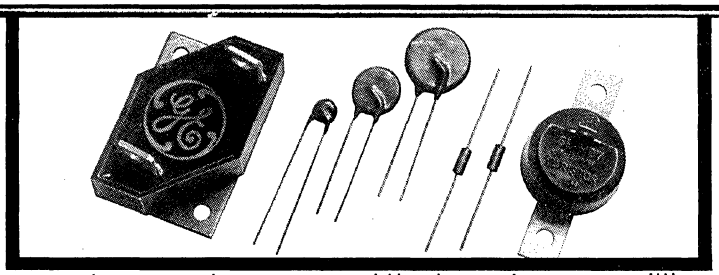

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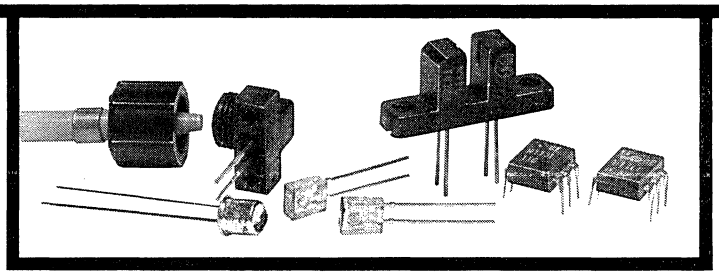

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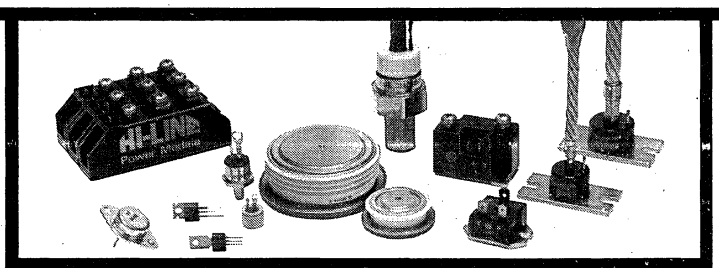

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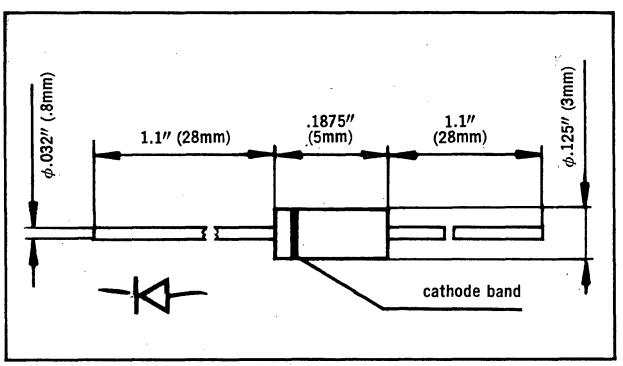
MAXIMUM RATINGS

Rating	Symbol	Unit	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	U_{RRM} U_{RM} U_R	V	50	100	200	400	600	800	1000
Non-Repetitive Peak Reverse Voltage 10 ms (Halfwave, Single Phase 50 Hz Peak)	U_{RSM}	V	(100)* 60	(150)* 120	(300)* 240	(600)* 480	(900)* 720	(1200)* 1000	(1500)* 1200
RMS Voltage	U_{RMS}	V	35	70	140	280	420	560	700
Average Rectified Forward Current (Single Phase, Resistive Load 50 Hz)	I_O	A	1.0						
Non-Repetitive Peak Current (Surge Current, 1 Cycle for 10 ms)	I_{FSM}	A	50						
Operating Temperature	T_{op}	°C	−65 to +175						
Storage Temperature	T_{STG}	°C	−65 to +175						

**Available on special request*

ELECTRICAL CHARACTERISTICS

Characteristics and Conditions	Symbol	Unit	Head
Max. Instantaneous Forward Voltage Drop (I_F = 1,0A T_j = 25°C)	U_{FWD}	V	1.1
Max. Reverse Current at U_{RRM} (T_j = 25°C)	I_R	μA	10
Max. Reverse Current at U_{RRM} (T_j = 100°C)	I_R	μA	50
Typical Thermal Resistance Junction to Ambient (Mounting Method A)	R_{TH}	°C/W	85



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SILICON DIODES AND BRIDGES

Silicon rectifier diodes 1A 50V to 1,000V, 1N4001 – 1N4007

Type	U_{RRM} (V)	U_{RSM} 10 ms (V)	I_{FAV} (A)	I_{FSM} 10 ms (A)	T_{op} (°C)	U_F I_F= 1.0A T_j= 25°C (V)	I_R at U_{RRM} T_j= 25°C (μA)
1N4001	50	60					
1N4002	100	120					
1N4003	200	240					
1N4004	400	480	1.0	50	−65 to +175	1.1	10
1N4005	600	720					
1N4006	800	1,000					
1N4007	1,000	1,200					

Silicon rectifier diodes 3A 100V to 1,200V, 1N5400 – 1N5408

Type	U_{RRM} (V)	U_{RSM} 10 ms (V)	I_{FAV} T_L= 45°C L= 10mm (A)	I_{FSM} 10 ms (A)	T_{op} (°C)	U_F I_F= 6A T_j= 25°C (V)	I_R at U_{RRM} T_j= 25°C (μA)	I_R at U_{RRM} T_j= 150°C (μA)
1N5400	50	60						
1N5401	100	120						
1N5402	200	240						
1N5403	300	360						
1N5404	400	480	3	150	−40 to +175	1.3	20	500
1N5405	500	600						
1N5406	600	720						
1N5407	800	1,000						
1N5408	1,000	1,200						

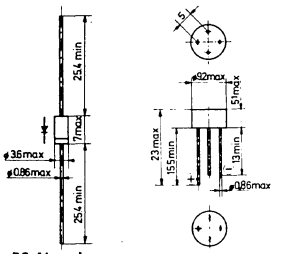
Silicon planar epitaxial signal diodes BA500 series

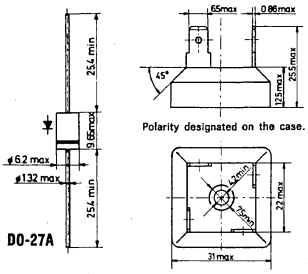
Type	U_{BR} 100 μA (V)	I_o (mA)	U_F at I_F at 25°C (V)	(mA)
BA511 (1N4148)	100	75	1.0	10
BA513 (1N4448)	100	75	1.0	100
BA517 (1N4150)	70 1 μA	200	1.0	200
BA518 (1N4151)	75 5 μA	75	1.0	50
BA519 (1N4152)	40 5 μA	75	0.88	20
BA520 (1N4153)	75 5 μA	75	0.88	20
BA521 (1N4154)	35 5 μA	75	1.0	30
BA523 (1N4444)	70 5 μA	200	1.0	100
BA531 (1N4727)	30 5 μA	75	0.85	10
BA533 (1N4864)	125	100	1.1	100
BA543 (BAY17)	15	200	1.0	100
BA544 (BAY18)	60	200	1.0	100
BA545 (BAY19)	120	200	1.0	100
BA546 (BAY20)	180	200	1.0	100
BA547 (BAY80)	150	100	1.0	100

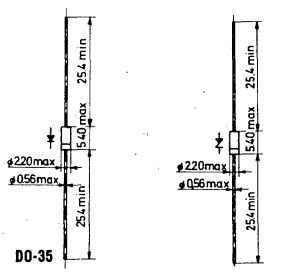
Type	I_R at 25°C (nA)	I_R at 150°C (μA)	at U_R (V)	C at 1 MHz U_R=0V (pF)	t_{rr} (ns)
BA511 (1N4148)	25	50	20	4	4[1]
BA513 (1N4448)	25	50	20	4	4[1]
BA517 (1N4150)	100	100	50	2.5	6[4]
BA518 (1N4151)	50	50	50	2	2[1]
BA519 (1N4152)	50	50	30	2	2[1]
BA520 (1N4153)	50	50	50	2	2[1]
BA521 (1N4154)	100	100	25	4	2[1]
BA523 (1N4444)	50	50	50	2	7[2]
BA531 (1N4727)	100	10 (100°C)	20	4	Q=40 pC
BA533 (1N4864)	100	100	80	1.3	4[1]
BA543 (BAY17)	100	15	12	1.5	50[3]
BA544 (BAY18)	100	15	50	1.5	50[3]
BA545 (BAY19)	100	15	100	1.5	50[3]
BA546 (BAY20)	100	15	150	1.5	50[3]
BA547 (BAY80)	100	100	120	6	50[3]

Reverse recovery time:

1. I_F=10 mA U_R=6V R_L=100Ω measured at I_R=1 mA
2. I_F=10 mA U_R=1V R_L=100Ω measured at I_R=1 mA
3. I_F=30 mA I_R=30 mA R_L=100Ω measured at I_R=3 mA
4. I_F=10 mA I_R=1 mA measured at I_R=0.1 mA







Index of symbols

- α — Conduction angle
- C — Capacitance
- I_F — Forward (DC) current
- I_{FAV} — Average forward current 40 to 1,000 Hz of one halfsine wave at T_{amb} or T_{case}
- I_{FSM} — Surge forward current, peak value 10 ms
- I_Z — Zener (reverse) current
- I_R — Reverse current, maximum value at T_j and U_{RRM}
- L — Distance from case
- P_{tot} — Total power dissipation
- R — Resistance
- t_{rr} — Reverse recovery time, typical value
- T_{amb} — Ambient temperature
- T_{case} — Case temperature
- T_j — Junction temperature
- T_L — Lead temperature
- T_{op} — Operating temperature
- T_{stg} — Storage temperature
- U_{BR} — Breakdown voltage
- U_F — Forward voltage drop, maximum value at rated I_F
- U_{RMS} — RMS voltage
- U_{RRM} — Repetitive Peak reverse voltage
- U_{RSM} — Peak reverse voltage, 10 ms
- U_Z — Zener (reverse) voltage

Single-phase bridge B . . . C800, B . . . C1000, B . . . C1500

Type	U_{RRM}[1] (V)	U_{RSM}[1] 10 ms (V)	I_{FAV} T_{amb} 45°C C load (A)	I_{FSM}[1] t= 10 ms T_j= 25°C (A)	T_{op} (°C)	U_F[1] I_F= 1.0A T_j= 25°C (V)	I_R[1] at U_{RRM} T_j= 25°C (μA)
B40C800	100	120					
B80C800	200	240					
B125C800	300	350	0.8	50	−40 to +175	1.3	10
B250C800	600	720					
B380C800	800	1,000					
B500C800	1,000	1,200					
B40C1000	100	120					
B80C1000	200	240					
B125C1000	300	350	1	50	−40 to +175	1.2	10
B250C1000	600	720					
B380C1000	800	1,000					
B500C1000	1,000	1,200					
B40C1500	100	120					
B80C1500	200	250					
B125C1500	300	350	1.5	50	−40 to +175	1.1	10
B250C1500	600	720					
B380C1500	800	1,000					
B500C1500	1,000	1,200					

Single-phase bridge B. . . C10, B . . . C25

T_j at 25°C Type	U_{RRM}[1] (V)	U_{RSM}[1] (V)	I_{FAV} T_C=80°C (A)	I_{FSM}[1] t=10 ms (A)	T_{op} (°C)
B40C10	100	120			
B80C10	200	240			
B125C10	300	350	10	250	−40 to +150
B250C10	600	720			
B500C10	800	1,000			
B40C25	100	120			
B80C25	200	240			
B125C25	300	350	25	350	−40 to +150
B250C25	600	720			
B500C25	800	1,000			

[1] Ratings and characteristics hold for every diode in the bridge structure.

Zener diodes 500 mW, 0.7V to 35V/±5%, BZX . . .

Type	Zener Voltage at I_Z=5 mA Min.	Max.	$I_{Z\,max}$ mA at 45°C amb	αU_Z 10^{-4}/K	R_Z typ. Ω at I_Z	U_R min. V at 100 nA
BZX3.3	3.1	3.5	109	−8 . . . − 3	80 (<90)	−
BZX3.6	3.4	3.8	101	−8 . . . − 3	80 (<90)	−
BZX3.9	3.7	4.1	92	−7 . . . − 3	80 (<90)	−
BZX4.3	4.0	4.6	85	−6 . . . + 1	80 (<90)	−
BZX4.7	4.4	5.0	76	−5 . . . + 2	70 (<78)	−
BZX5.1	4.8	5.4	67	−3 . . . + 4	30 (<60)	0.8
BZX5.6	5.2	6.0	59	−2 . . . + 6	10 (<40)	1
BZX6.2	5.8	6.6	54	−1 . . . + 7	4.8 (<10)	2
BZX6.8	6.4	7.2	49	+2 . . . + 7	4.5 (<8)	3
BZX7.5	7.0	7.9	44	+3 . . . + 7	4.0 (<7)	5
BZX8.2	7.7	8.7	40	+4 . . . + 7	4.5 (<7)	6
BZX9.1	8.5	9.6	36	+5 . . . + 8	4.8 (<10)	7
BZX10	9.4	10.6	33	+5 . . . + 8	5.2 (<15)	7.5
BZX11	10.4	11.6	30	+5 . . . + 9	6.0 (<20)	8.5
BZX12	11.4	12.7	28	+6 . . . + 9	7.0 (<20)	9
BZX13	12.4	14.1	25	+7 . . . + 9	9.0 (<25)	10
BZX15	13.8	15.6	23	+7 . . . + 9	11 (<30)	11
BZX16	15.3	17.1	20	+8 . . . + 9.5	13 (<40)	12
BZX18	16.8	19.1	18	+8 . . . +10	18 (<50)	14
BZX20	18.8	21.2	17	+8 . . . +10	20 (<50)	15
BZX22	20.8	23.3	16	+8 . . . +10	25 (<55)	17
BZX24	22.8	25.6	13	+8 . . . +10	28 (<80)	18
BZX27	25.1	28.9	12	+8 . . . +10	30 (<80)	20
BZX30	28.0	32.0	10	+8 . . . +10	35 (<80)	22.5
BZX33	31.0	35.0	9	+8 . . . +10	40 (<80)	25

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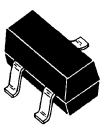
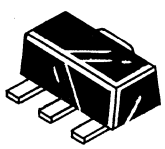
MICROMINIATURE SPACE-SAVING ALTERNATIVES FOR DISCRETE DEVICES

TO-236AA



SOT-23

CASE 345-1



SOT-89

Package (Body) Size:		
Length	0.12″ (max.)	0.181″ (max.)
Width	0.055″ (max.)	0.102″ (max.)
Maximum Die Size:	30 mils x 30 mils	60 mils x 60 mils
Maximum P_D*:	350 mW	1.0 W

*Mounted on alumina substrate

A wide variety of discrete components from Motorola's repertoire of reliability-proven semiconductor processes and geometries are available in the SOT (Small-Outline Transistor) packages. Products include Bipolar and Field-Effect Transistors (FETs); Switching, Zener and Varactor Diodes; and Silicon Controlled Rectifiers (SCRs). These surface-mounted SOT devices are currently being used by circuit designers on printed circuit boards as well as ceramic substrates.

Significant features of SOT devices include:

- Complete Pretest Capability — 100% electrically tested.
- Handling and Assembly Ease — devices can be positioned manually or by using automated placement equipment.
- Reliability — SOTs are subjected to the same rigid reliability tests performed on all Motorola plastic packages.
- Small Size/Less Weight — considerable size reduction and weight saving is achieved in circuit designs using "SO" surface mount technology.
- Broad Line — Motorola offers over 250 standard discrete devices in the SOT package (inquiries regarding customers special requirements are invited).
- Marking Capability — A multi-digit code is laser marked on all SOT devices.
- Multi-Sources — There are many U.S. and foreign sources of SOTs.
- Packaging — SOTs are shipped in vials or via the industry accepted 8 mm tape and reel format for automatic placement.
- Standard SOT-23 versus "Low Profile" SOT-23 — Motorola offers both the standard SOT-23 outline (TO-236AA) and the new "low profile" SOT-23 (TO-236AB). The only difference is the clearance from the bottom of the package to the surface of the substrate:
  Standard SOT-23: 0.004″ Min./0.0098″ Max.
  "Low Profile" SOT-23: 0.0005″ Min./0.004″ Max.
  The low profile package is primarily designed for customers using double-sided PCB with the SOT-23s mounted on the bottom side of the board and the non-surface mounted devices inserted in the top side of the board.
- Selector Guide — Send for your copy of Motorola's "Microminiature Products" brochure (BR-127) for additional information.

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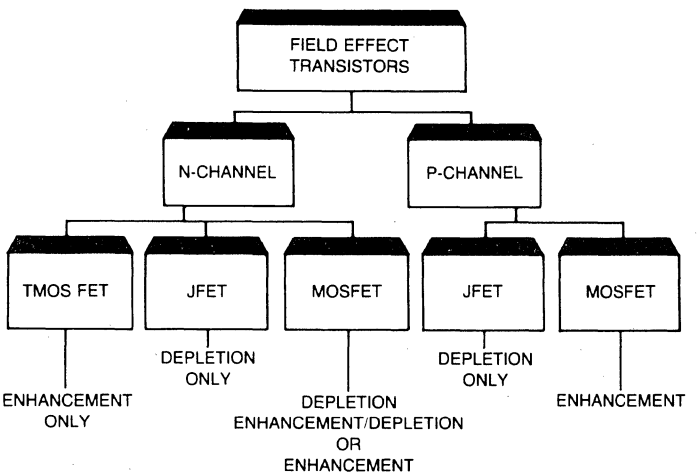
SMALL-SIGNAL FIELD-EFFECT TRANSISTORS

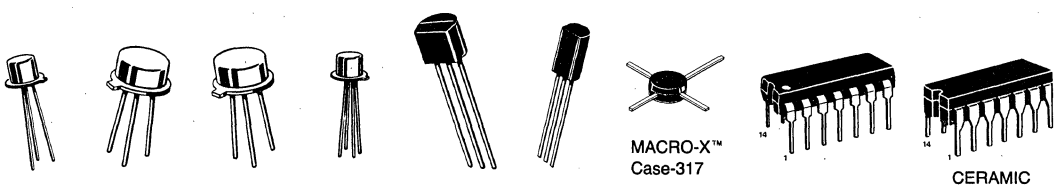
Motorola offers a broad line of Small-Signal Field-Effect Transistors that encompass the latest technology and covers the full range of FET applications.

Types of FETs



- JFETs — N- and P- channel which operate in the depletion mode are available in both metal and plastic packages. Applications include general-purpose amplifiers, switches and choppers, RF amplifiers and mixers.
- MOSFETs — are available in either depletion or enhancement mode. They are available in both N- and P- channel, single and dual gate construction. Applications include smoke detectors, RF amplifiers and mixers for TV tuners, radio, etc.
- TMOS™ FETs — have an oxide-insulated gate which controls vertical current flow. TMOS devices exhibit higher input impedance, faster switching, enhanced thermal stability and easier paralleling than bipolar transistors. Additionally, they have lower "ON" resistance and higher power handling capability than conventional horizontal MOSFETs or JFETs.

Our package line-up is the most comprehensive in the industry, from the low-cost plastic to the hermetic metal can packages:



For additional information, order: SG33R1 FET Selector Guide and Cross Reference. This selector guide/cross reference provides: Specs on over 250 standard FETs, design considerations, applications information, package information and a cross reference/interchangeability guide.

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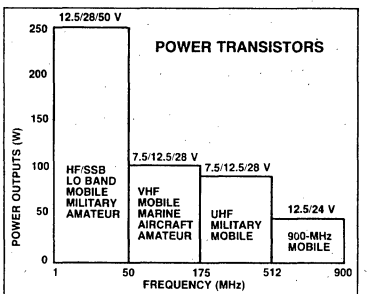
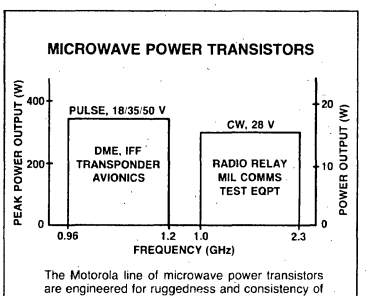
RF COMPONENTS

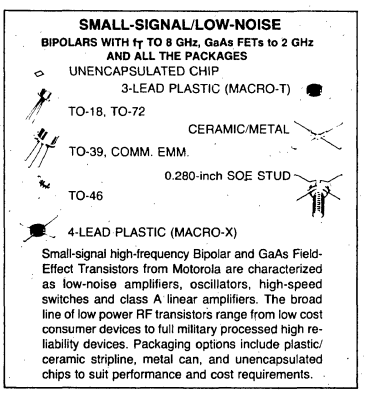
The Motorola broad line RF component portfolio encompasses low-power low-noise devices to high-power transmitter devices, unencapsulated chips to packaged transistors to hybrid modules. Device technology covers silicon bipolars, TMOS power FETs, and GaAs FETs. We have a complete engineering staff to help you with your application and extensive technical literature in application notes, engineering bulletins, selector guides, and the RF data manual. For RF components think Motorola RF.



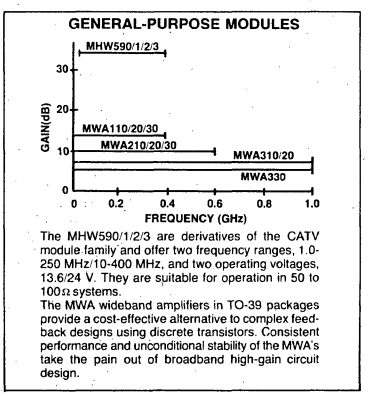
Motorola's RF Power Bipolar and TMOS Field-Effect Transistors are categorized according to the application and frequency band for which each type is optimized. Outputs up to 250 watts are available, suitable for commercial, military, ground, airborne, and marine use from 1.5 MHz to 1 GHz.



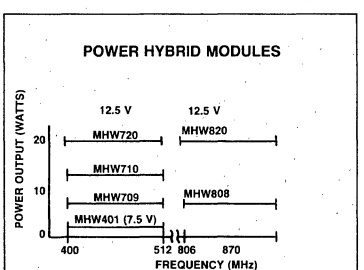
The Motorola line of microwave power transistors are engineered for ruggedness and consistency of performance from unit to unit, lot to lot. Gold metal systems and silicon nitride passivation ensure reliability. Both hermetic and organic sealed packages provide cost effective options to suit the end-use environment. Internal input/output impedance matching elements facilitate broadband designs.



Small-signal high-frequency Bipolar and GaAs Field-Effect Transistors from Motorola are characterized as low-noise amplifiers, oscillators, high-speed switches and class A linear amplifiers. The broad line of low power RF transistors range from low cost consumer devices to full military processed high reliability devices. Packaging options include plastic/ceramic stripline, metal can, and unencapsulated chips to suit performance and cost requirements.



The MHW590/1/2/3 are derivatives of the CATV module family and offer two frequency ranges, 1.0-250 MHz/10-400 MHz, and two operating voltages, 13.6/24 V. They are suitable for operation in 50 to 100Ω systems.
The MWA wideband amplifiers in TO-39 packages provide a cost-effective alternative to complex feedback designs using discrete transistors. Consistent performance and unconditional stability of the MWA's take the pain out of broadband high-gain circuit design.



Power Hybrid Modules are self-contained Power Amplifiers which provide a pre-engineered, functional performance-tested alternative to the use of individual power transistors. Producing VHF/UHF power outputs up to 20 W, these modules offer field-replaceable, consistent performance, and tolerance to load mismatch.

RF LITERATURE

SG-76 Microwave Transistors Selector Guide and Cross Reference

SG-46R1 RF Selector Guide and Cross Reference

For additional information, send requests for these selector guides to:

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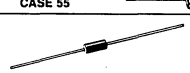
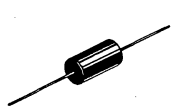
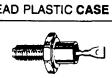
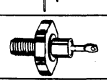
ZENER DIODES

POWER DISSIPATION	BASIC FUNCTION AND DEVICE		PACKAGE
250 mW	GENERAL PURPOSE	• 1N4678 Thru 1N4717 1.8 Volts Thru 43 Volts	
	LOW NOISE	• 1N4614 Thru 1N4627 1.8 Volts Thru 6.2 Volts • 1N4099 Thru 1N4135 6.8 Volts Thru 100 Volts	AXIAL LEAD GLASS **CASE 299-02**
400 mW/500 mW	GENERAL PURPOSE	• 1N4370 Thru 1N4372 2.4 Volts Thru 3.0 Volts • 1N746 Thru 1N759 3.3 Volts Thru 12 Volts • 1N957 Thru 1N986 6.8 Volts Thru 110 Volts • 1N5221 Thru 1N5272 2.4 Volts Thru 110 Volts • 1N5985 Thru 1N6025 2.4 Volts Thru 110 Volts	
	LOW NOISE	• 1N5518 Thru 1N5546 3.3 Volts Thru 33 Volts	
	TEMPERATURE COMPENSATED	• 1N821 Thru 1N829 6.2 Volts • 1N4565 Thru 1N4584 6.4 Volts	AXIAL LEAD GLASS **CASE 299-02**
	GENERAL PURPOSE	• 1N987 Thru 1N992 120 Volts Thru 200 Volts	
	TEMPERATURE COMPENSATED	• 1N821A Thru 1N829A 6.2 Volts • MZ605 Thru MZ640 6.2 Volts • 1N3154 Thru 1N3157 8.4 Volts • 1N4775 Thru 1N4784 8.5 Volts • 1N935 Thru 1N939 9.0 Volts • 1N941 Thru 1N945 11.7 Volts	AXIAL LEAD GLASS **CASE 51-02**
	GENERAL PURPOSE	• 1N5273 Thru 1N5281 120 Volts Thru 200 Volts	AXIAL LEAD PLASTIC **CASE 51-02**
600 mW	CURRENT REGULATOR	• 1N5283 Thru 1N5314 0.22 mA Thru 4.7 mA • MCL1300 Thru MCL1305 0.5 mA Thru 5.05 mA	AXIAL LEAD GLASS **CASE 51-02**
1 WATT	GENERAL PURPOSE	• 1N4728 Thru 1N4764 3.3 Volts Thru 100 Volts	AXIAL LEAD GLASS **CASE 59**
	GENERAL PURPOSE	• 1M110ZS10 Thru 1M200ZS10 110 Volts Thru 200 Volts	AXIAL LEAD PLASTIC **CASE 59**
	GENERAL PURPOSE	• 1N3821 Thru 1N3830 3.3 Volts Thru 7.5 Volts • 1N3016 Thru 1N3051 6.8 Volts Thru 200 Volts	AXIAL LEAD METAL **CASE 52**
1.5 WATT	GENERAL PURPOSE	• 1N5913 Thru 1N5956 3.3 Volts Thru 200 Volts	AXIAL LEAD PLASTIC **CASE 59**
	GENERAL PURPOSE	• 1N3785 Thru 1N3820 6.8 Volts Thru 200 Volts	SINGLE ENDED METAL **CASE 55**
5 WATT	GENERAL PURPOSE	• 1N5333 Thru 1N5388 3.3 Volts Thru 200 Volts	
	TRANSIENT SUPPRESSORS (Mosorbs)	• P6KE6.8 Thru P6KE200 6.8 Volts Thru 200 Volts 600 WATTS PEAK POWER	 AXIAL LEAD PLASTIC **CASE 17-02**
		• 1N6267 Thru 1N6303 6.8 Volts Thru 200 Volts 1500 WATTS PEAK POWER • 1.5KE6.8 Thru 1.5KE200 6.8 Volts Thru 200 Volts 1500 WATTS PEAK POWER • 1N5908 5 Volts 1500 WATTS PEAK POWER • ICTE-5 Thru ICTE-45 • MPTE-5 Thru MPTE-45 5 Volts Thru 45 Volts 1500 WATTS PEAK POWER • 1N6373 Thru 1N6389 5 Volts Thru 45 Volts	 AXIAL LEAD PLASTIC **CASE 41-11**
10 WATTS	GENERAL PURPOSE	• 1N3993 Thru 1N4000 3.9 Volts Thru 7.5 Volts • 1N2970 Thru 1N3015 6.8 Volts Thru 200 Volts	STUD **CASE 56** 
50 WATTS	GENERAL PURPOSE	• 1N4557 Thru 1N4564 3.9 Volts Thru 7.5 Volts • 1N2804 Thru 1N2846 6.8 Volts Thru 200 Volts	**CASE 54** TO-3
	GENERAL PURPOSE	• 1N4549 Thru 1N4556 3.9 Volts Thru 7.5 Volts • 1N3305 Thru 1N3350 6.8 Volts Thru 200 Volts	STUD **CASE 58** 

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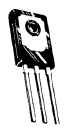
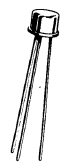
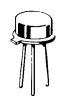
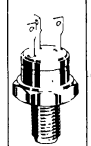
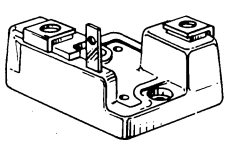
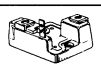
Silicon Power Transistor Package Types

Package	Case 152	TO-202AC Case 306	TO-126 Case 77	 TO-127 Case 90	TO-220AB Case 221A	TO-218 Case 340	 TO-5 Case 31	 TO-39 Case 79	 TO-59 Case 160	TO-66 Case 80	TO-204AA Case 1 Case 11	TO-204AE Case 197
I_C Range (Amps)	0.5-2.0	0.1-3.0	0.3-5.0	5-15	0.5-15	12-25	3.0	0.5-5.0	7.0-10	1-10	2-30	2-60
V_{CE} Range (Volts)	30-300	30-350	25-400	40-100	30-750	40-400	40-80	40-400	60-100	40-400	40-1500	40-1500
P_D (Watts)	10	6.25-12.5	12.5-40	65-100	15-100	125-150	6.0	5-10	60	20-100	36-300	36-300

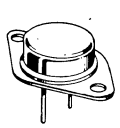
NEW FROM MOTOROLA . . . High-Current Darlingtons

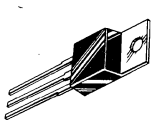


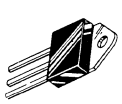
Device		Operating Current (AMP)	$V_{CEO(SUS)}$ (Volts)
 Case 353	MJ10041*, MJ10042	25	850
	MJ10044*, MJ10045	50	450
	MJ10047*, MJ10048	100	250
Case 346	MJ10050, MJ10051*	50	850
	MJ10100, MJ10101*	100	450
	MJ10200, MJ10201*	200	250

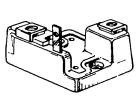
* Indicates devices with speed-up diode for use in high frequency inverters and pulse width modulated motor controls.

OVER 200 STANDARD POWER MOSFETs FROM MOTOROLA


TO-204


TO-220


TO-218



- Breakdown Voltages to 1000 Volts
- Current Ratings to 90 Amperes
- $r_{DS(on)}$ as low as 0.02 Ohms

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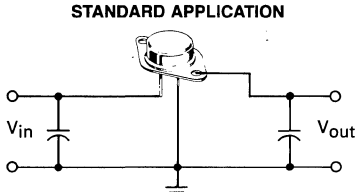
STANDARD APPLICATION



MOTOROLA
SEMICONDUCTORS
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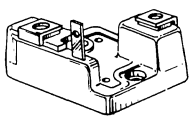
THYRISTORS
SCRs • TRIACS
TRIGGERS

NEW FOR '83

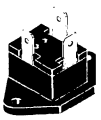
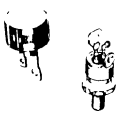
MOS SCRs — MCR1000
Fast SCRs — MCR2080 (t_q < 6.0 μs @ I_F = 5.0 A)
MCR2150 (t_q < 4.0 μs @ I_F = 15 A)
SIDAC — MK1V

CHIPSCRETES

A chipscrete is a TO-220 with the tab clipped, leads bent and leadframe flag soldered to a ceramic insulator. Any TO-220 can become a chipscrete.



Families Recommended For New Designs

PACKAGES	0.2A (Formerly TO-92) (TO-226AA)	4A (C-77)	6-55A (TO-220)	OVERMOLDED  (342-01)	≥25A  (174-03, 311-01)
SCRs	2N5060-4	2N6236-41	2N6394-9	MCR525	2N3870-3
	MCR100	MCR106	2N6400-5	MCR568	2N3896-9
	MCR101-4	C106	2N6504-9	MCR569	2N6171-4
	MCR120		C122		MCR63-5
	MCR22		MCR72		MCR3835
			MCR218		MCR3935
			MCR264		C35
			MCR265		C228-9
TRIACS	MAC91-96	2N6068-74	2N6342A-9A	MAC515	2N5441-6
	MAC91A-96A	2N6068A-75A	MAC15,A	MAC525	2N6157-9
		2N6068B-75B	MAC220-3		2N6160-5
			MAC222A		T6400-1
			MAC223A		T6410-1
			T2800-2		T6420-1
			T2500		
			SC141		
			SC146		
			MAC224		
			MAC228		
TRIGGERS	UJT 2N4870-1				
	UJT MU4891-4				
	PUT 2N6027-8				
	PUT MPU131-3				
	DIACS 1N5758-61				
	SBS MBS4991				

All devices have glass passivation for controlled high-temperature operation. For new designs, the plastic units offer the best cost/performance tradeoff for large production runs.

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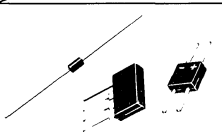
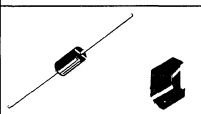
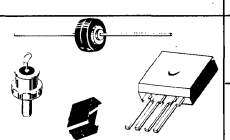
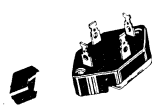
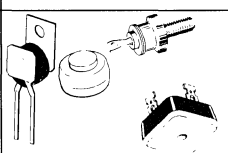
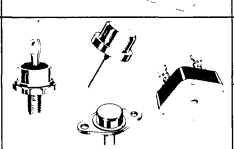
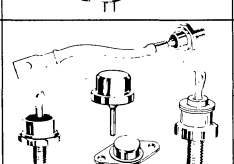
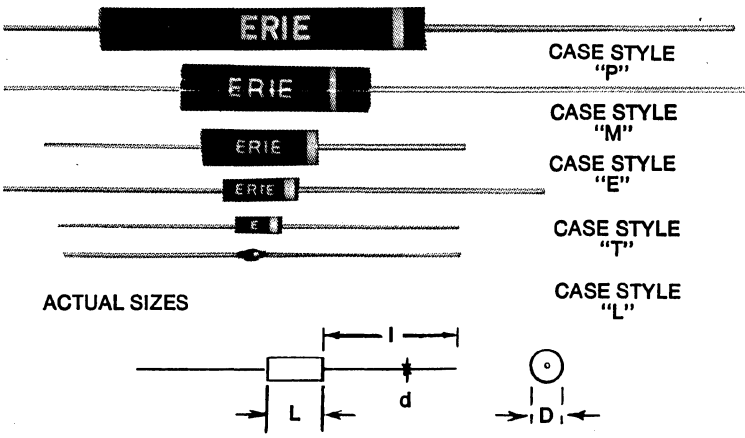
I_O	V_R	DISCRETES / BRIDGES	GENERAL PURPOSE BRIDGES	ULTRA-FAST RECOVERY	FAST RECOVERY	SCHOTTKY
0.5A / 2A	20-45 50-1000		1N5391-9 1N4001-7 MR5059-MR5061† --- MDA920A series MDA100A* series MDA200* series	MUR105-MUR120	1N4933-7 MR810 series	1N5817-9 MBR120P series
3A	20-45 50-1000		1N4997-1N5003 1N5400-9 1N4719-25 MR500	MUR800-MUR820	MR830 series MR850 series MR910 series	MBR320P series 1N5820-2 MBR1020 series 1 MBR1520CT series 2
5A / 6A	20-45 50-1000		MR750 series --- MDA970A series	MUR800-MUR820	MR820 series 1N3879 series 1N3879A series	MBR735-MBR745 MBR835-MBR845 3 MBR320M series 1N5823-5 MBR1020 series 1 MBR1520CT series 2
10A / 15A	20-45 50-1000		MR1120 series 1N1199,A,B series 1N1199C series --- MDA800* series MDA1200* series MDA980 series	MUR1605CT-MUR1620CT MUR800-MUR820 MUR1500-MUR1520	1N3889 series 1N3889A series	MBR1645 1N5626-8 MBR1520 series MBR1020 series 1 MBR1520CT series 2
20A / 25A	20-45 50-1000		1N1191 series MR2000S series 1N3491 series MR2500 series MR2400 series --- MDA2500*FR* series MDA2550 series MDA990 series		1N3899 series MR2400F series	MBR2045CT 1N5829-31 MBR2520 series
30A / 35A	20-45 50-1000		1N3659 series 1N1183 series --- MDA3500*FR* series MDA3500 series	MUR3020PT	R710XPT 1N3909 series	MBR3045PT MBR3545CT 3 SD41, MBR3520 series 1N6095-6 MBR3020CT series SD241
40A / 75A	20-45 50-1000		1N1183A series MR5005 series		MR860 series MR870 series	MBR6045CT 3 1N5832-4, MBR4020 series 1N6097/8, SD51, MBR6020 series, MBR7520 series SD5171, MBR6020B MBR8045 3 MBR6545 3
100A / 300A	35-45 50-400	POWERTAP 		MUR10020CT		MBR12045CT MBR20045CT MBR30045CT

*UL Recognized †Avalanche 1 Single-diode TO-220 2 Dual-diode TO-220 3-175°C Schottky

high voltage silicon rectifiers
fast recovery, HX / low leakage, HV

MURATA ERIE NORTH AMERICA, INC.



Murata Erie high voltage silicon rectifiers are available with peak reverse voltage ratings from 1KV to 30KV, in either transfer molded or epoxy protected packages. Features include nanoampere leakage, compact design and high reliability over a wide temperature range. These rectifiers have found applications in numerous military, industrial and aerospace projects.

Case Style	Dimensions (Inches) L (Max.)	D (Max.)	l (Min.)	d
P	.130	.085	.75	.015
M	.25	.105	.75	.015
E	.625	.20	.70	.015
T	1.03	.26	1.0	.030
L	1.70	.235	1.00	.030

ELECTRICAL CHARACTERISTICS AND RATINGS

Part Number	Case Style	Peak Reverse Voltage (P.R.V.) Volts Peak	Min. Peak Transient Reverse Voltage Rating (P.T.R.V.) Volts Peak	Max. Forward Current (I_o) @ 100°C mA DC	Max. Forward Voltage (V_f) @ 10mADC and 25°C Volts DC	Max. Reverse Current (I_r) @ P.R.V. At 25°C nA	At 100°C µA	Reverse Recovery Time (Typical) (T_{rr}) TEK "S" 2mAI_f→2mAI_r µS	Max. Capacitance @ 100VDC pF	Max. Operating Temperature °C	Storage Temperature Range °C	Cathode Identification
HV10P	P	1000	1500	50	5.0	10	1.0	2.5		150		1 Brown Dot
HV10M	M	1000	1500	50	5.0	10	1.0	2.5		150		Cathode Band
HX10P	P	1000	1500	40	7.5	100	3.0	0.25		125		2 Brown Dots
HX10M	M	1000	1500	40	7.5	100	3.0	0.25		125		Cathode Band
***HV20P**	P	2000	3000	50	5.0	10	1.0	2.5		150		1 Red Dot
HV20M	M	2000	3000	50	5.0	10	1.0	2.5		150		Cathode Band
***HX20P**	P	2000	3000	40	7.5	100	3.0	0.25		125		2 Red Dots
HX20M	M	2000	3000	40	7.5	100	3.0	0.25		125		Cathode Band
***HV30P**	P	3000	4500	50	5.0	10	1.0	2.5		150		1 Orange Dot
***HV30M**	M	3000	4500	50	5.0	10	1.0	2.5		150	−55	Cathode Band
***HX30P**	P	3000	4500	40	7.5	100	3.0	0.25		125	to	2 Orange Dots
***HX30M**	M	3000	4500	40	7.5	100	3.0	0.25		125	+175	Cathode Band
***HV40P**	P	4000	6000	50	5.0	10	1.0	2.5	0.5	150		1 Yellow Dot
***HV40M**	M	4000	6000	50	5.0	10	1.0	2.5		150		Cathode Band
***HX40P**	P	4000	6000	40	7.5	100	3.0	0.25		125		2 Yellow Dots
***HX40M**	M	4000	6000	40	7.5	100	3.0	0.25		125		Cathode Band
***HV50P**	P	5000	7500	50	5.0	10	1.0	2.5		150		1 Green Dot
***HV50M**	M	5000	7500	50	5.0	10	1.0	2.5		150		Cathode Band
***HX50P**	P	5000	7500	40	7.5	100	3.0	0.25		125		2 Green Dots
***HX50M**	M	5000	7500	40	7.5	100	3.0	0.25		125		Cathode Band
HX50E	E	5000	7500	40	7.5	100	3.0	0.25		125		Cathode Band
***HV80ML**	M	8000	12000	25	10.0	50	3.0	2.5		150		Cathode Band
***HX80ML**	M	8000	12000	20	15.5	100	5.0	0.25		125		Cathode Band
HTV100	T	10000	15000	5.0	25	100	5.0	0.25		100	−55	Cathode Band
***HTV125S**	E	12500	18000	5.0	30	100	5.0	0.25		125	to	Cathode Band
***HTV150S**	E	15000	20000	5.0	30	100	5.0	0.25		125	+150	Cathode Band

* **NOTE:** Further encapsulation is recommended for rectifiers marked "*"

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Varistors (Temperature Compensating Diodes)	Biasing diodes for hostile environments
Varistors (Voltage Compensating Diodes)	
Varactors (Variable Capacitance Diodes)	For tuning, AFC
Bridge Rectifiers	1 Amp to 40 Amps, up to 1000 volts
HV Rectifiers (Avalanche Silicon)	High voltage and high current
ZENER DIODES	From ½ to 50 watts, from 2.4 to 200 volts
INDUSTRIAL RECTIFIERS	From 3 to 2200 Amps up to 1600 volts
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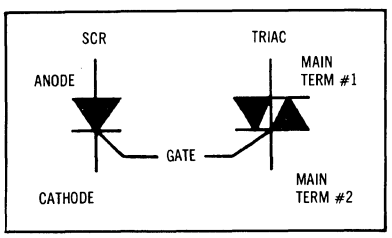
THYRISTORS

A thyristor is a four-layer semiconductor (pnpn) that can be switched from an OFF to an ON state. This is usually done by a voltage or current pulse to the gate terminal. The device will then continue to conduct so long as the principal current of the device flows through the thyristor's two main terminals.

In many respects a thyristor is analogous to an electromechanical latching relay. In fact, thyristors have largely replaced these relays in newer equipment designs. But, misapplications and/or failure to fully understand the parameters of these and other solid state devices often leads to catastrophic field failures.

The terminology shown on this page has been condensed from common industry data books and is intended to be a guide for the engineer.



di/dt: *Critical rate of rise of ON state current* is the user's maximum design limit (Fig. 1).

di_R/dt: *Rate of decay of ON state current* (Fig. 1 & 2).

dv/dt (critical): *Rate of rise of OFF state voltage*. Lowest voltage rate of rise to cause a thyristor to turn ON.

dv/dt (reapplied) : *Rate of rise of reapplied OFF state voltage.*

I_{FSM}: *Nonrepetitive ON state surge current in diodes.* Maximum peak value of ½ cycles (60 Hz) a diode can withstand up to 100 times in its lifetime.

I_{TSM}: *Nonrepetitive ON state surge current in thyristors*. Maximum peak value of 60 Hz cycles a thyristor can withstand up to 100 times in its lifetime.

I_{DRM}/I_{RRM}: *Maximum peak forward/ reverse leakage current* at specified temperature and repetitive conditions.

I_{GDM}: *Continuous gate current not to trigger*. Highest dc gate current that will *not* cause thyristor to switch from OFF to ON at a specific temperature.

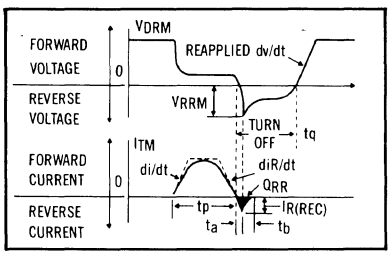


Fig. 1. Concurrent voltage and current waveforms

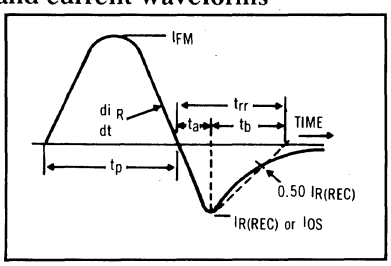


Fig. 2. Recovery current waveform

I_{GT}: *Continuous gate trigger current.* Absolute minimum gate current required to switch thyristor from OFF to ON.

I_H: *Holding Current*. Minimum current required to hold thyristor ON.

I_L: *Latching current*. Minimum current required to hold thyristor ON after removal of gate drive.

$I_{(REC)}$; *Recovery current*. Peak value of reverse current during recovery or turn OFF (Fig. 1 & 2).

I_{OS}: *Overshoot current*. See $I_{R(REC)}$.

I^2t: Maximum ON state, short time thermal capacity of the silicon element for operations less than ½ cycle of 180° conduction angle.

$I_{T(AV)}$: *Average ON state current* (max.)

Q_{RR}: *Reverse recovered charge* (Fig. 1).

$R_{\theta JC}$: *Junction-to-case thermal resistance* in degrees C per watt.

$T_{C(MAX)}$: *Max. allowable case temperature*.

$T_{J(MAX)}$: *Maximum allowable junction temp*.

t_d: *Delay time*. Interval between a specified point at beginning of gate pulse and the instant at which the principal voltage drops to a specified value. (OFF-ON) (Fig. 3)

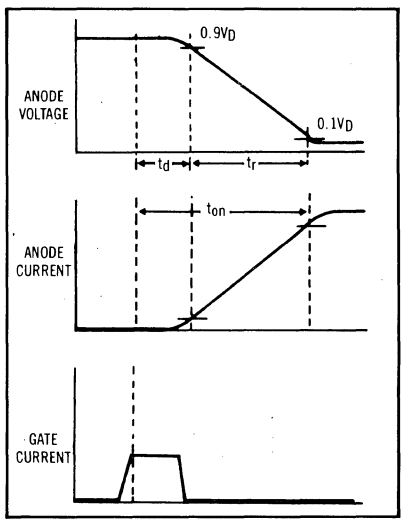


Fig. 3. Turn-on time waveforms

t_{on}: *Turn-on time*. The sum of delay time and rise time. (OFF-ON) (Fig. 3)

t_q: *Turn-off time*. Time between principal current reaching zero and the instant thyristor can block forward voltage without turning ON. (Fig. 1)

t_r: *Rise time*. Time between principal voltage dropping from one value to a second lower value when thyristor turns from OFF to ON. (Fig. 3)

t_{rr}: *Reverse recovery time*. (Fig. 2)

V_{DRM}/V_{RRM}: *Maximum repetitive peak OFF state/reverse voltage* excluding non-repetitive transients.

V_{DSM}/V_{RSM}: *Maximum nonrepetitive peak OFF state/reverse voltage*.

V_{FM}/V_{TM}: *Maximum forward voltage drop* at a specific forward current and case temp.

V_{GDM}: *Gate nontrigger voltage*. Highest dc voltage that will *not* cause thyristor to switch from OFF to ON.

V_{LATCH}: *Latching voltage*. Voltage required for thyristor to latch ON at a given gate current and junction temp.

$V_{TM(DYN)}$: *Dynamic ON state voltage*. Transient ON state voltage of thyristor when triggered into conduction for a given load and time.

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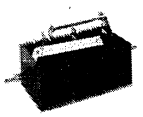
Selenium Surge Suppressors Polarized (DC) Non Polarized (AC) Max. DC Volts 25-750 Max. Clamping Volts 16-1800 Peak Current Rating 3A-270A

DIRECTRON ELEVATOR CONTROL RECTIFIERS

Part No.	AC Input Volts Up To	Phase	Amps	Units Required
CD260	260	1ϕ	1.5	2
		3ϕ	2.2	3
DD260	260	1ϕ	2.2	2
		3ϕ	3.3	3
ED260	260	1ϕ	3.4	2
		3ϕ	5.1	3
FD260	260	1ϕ	6.6	2
		3ϕ	10.	3
GD260	260	1ϕ	10.	2
		3ϕ	15.	3
COMPACT UNIT (Double Decker)				
3D260	260	3ϕ	3.	1

	Otis Part No.
CENTER TAP	230AV1 230AS1
HALF WAVE (blocking)	230AR1 230AR3 230AZ1 230AZ2
1ϕ FWB	230AY3 230AY1
3ϕ FWB	230AL1 230AL2 230AL3 230AG1 230AJ1 230AW1 230BA1 230BJ3 230BJ4 230BJ5



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18V In — 14V Out		36V In — 28V Out		54V In — 42V Out		130V In — 100V Out		160V In — 130V Out		260V In — 200V Out	
No.	Max. Amps	No.	Max. Amps	No.	Max. Amps	No.	Max. Amps	No.	Max. Amps	No.	Max. Amps
A18	½	A36	½	A54	½	A130	½	A160	½	A260	½
B18	1	B36	1	B54	1	B130	1	B160	1	B260	1
C18	2	C36	2	C54	2	C130	2	C160	2	C260	2
D18	3	D36	3	D54	3	D130	3	D160	3	D260	3
E18	4	E36	4	E54	4	E130	4	E160	4	E260	4
F18	6	F36	6	F54	6	F130	6	F160	6	F260	6
G18	10	G36	10	G54	10	G130	10	G160	10	G260	10
H18	12	H36	12	H54	12	H130	12	H160	12	H260	12
J18	15	J36	15	J54	15	J130	15	J160	15	J260	15
K18	20	K36	20	K54	20	K130	20	K160	20	K260	20
L18	24	L36	24	L54	24	L130	24	L160	24	L260	24
M18	30	M36	30	M54	30	M130	30	M160	30	M260	30
P18	36	P36	36	P54	36	P130	36	P160	36	P260	36
R18	50	R36	50	R54	50	R130	50	R160	50	R260	50

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- High Operating Voltage (Up to 600 p.i.v.)
- High Efficiency (99% compared to about 75% for selenium)
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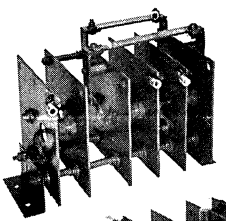
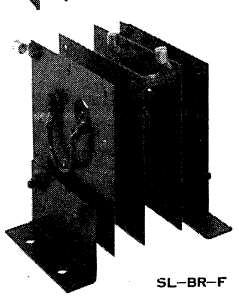


SL-PH-F



SL-BR-F

CENTER-TAP

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled
SI-CT-A	18-0-18	16	40	80
SI-CT-B	36-0-36	32	40	80
SL-CT-A	18-0-18	16	50	100
SL-CT-B	36-0-36	32	50	100
SL-CT-D	72-0-72	64	50	100
SL-CT-F	140-0-140	125	50	100
SK-CT-A	18-0-18	16	100	200
SK-CT-B	36-0-36	32	100	200
SK-CT-D	72-0-72	64	100	200
SK-CT-F	140-0-140	125	100	200
SM-CT-A	18-0-18	16	200	400
SM-CT-B	36-0-36	32	200	400
SM-CT-D	72-0-72	64	200	400
SM-CT-F	140-0-140	125	200	400
SO-CT-B	36-0-36	32	400	800

3ϕ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled
SL-PH-A	36	48	75	150
SL-PH-B	72	96	75	150
SL-PH-C	105	144	75	150
SL-PH-D	140	188	75	150
SL-PH-E	220	290	75	150
SK-PH-E	220	290	100	200
SM-PH-E	220	290	200	400
SO-PH-E	220	290	400	800

1ϕ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled
SA-BR-D	140	125	1	*
SA-BR-F	280	250	1	*
SC-BR-D	140	125	2	*
SC-BR-F	280	250	2	*
SD-BR-A	36	32	6	12
SD-BR-D	140	125	6	12
SD-BR-F	280	250	6	12
SE-BR-A	36	32	10	20
SE-BR-D	140	125	10	20
SE-BR-F	280	250	10	20
SF-BR-A	36	32	20	40
SF-BR-D	140	125	20	40
SF-BR-F	280	250	20	40
SI-BR-A	36	32	40	80
SI-BR-B	72	64	40	80
SI-BR-C	105	90	40	80
SI-BR-D	140	125	40	80
SI-BR-F	280	250	40	80
SL-BR-A	35	32	50	100
SL-BR-B	72	64	50	100
SL-BR-D	140	125	50	100
SL-BR-F	280	250	50	100
SG-BR-A	36	32	70	140
SG-BR-B	72	64	70	140
SG-BR-D	140	125	70	140
SG-BR-F	280	250	70	140
SK-BR-A	36	32	100	200
SK-BR-B	72	64	100	200
SK-BR-D	140	125	100	200
SK-BR-F	280	250	100	200
SM-BR-A	36	32	200	400
SM-BR-B	72	64	200	400
SM-BR-D	140	125	200	400
SM-BR-F	280	250	200	400
SO-BR-B	72	64	400	800
SO-BR-F	280	250	400	800

All above ratings based on 30°C ambient. Fan-cooled ratings based on air velocity of 1000 linear ft/minute. For resistive or inductive loads, as rated. For capacitive or battery loads, derate amperage 20%. Doublers, triplers, 3 phase half wave and 3 phase center-tap also available. Custom-built stacks, 24 hour service.

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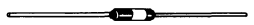
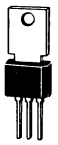
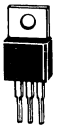


DO-35 — HT

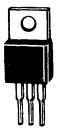
TO-92 — E



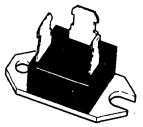
TO-202 AB — F



TO-220 AB ISOLATED — L



TO-220 AB NON-ISOLATED — R



TO-3 BASE — P

LOGIC TRIACS

$I_{T(RMS)}$	PART NUMBER	V_{DRM}	I_{GT}*(mA)	PKG. TYPE
1 AMP	L201E3	200	3	E
	L201E5	200	5	
	L201E7	200	10	
	L201E9	200	25	
	L401E3	400	3	
	L401E5	400	5	
	L401E7	400	10	
	L401E9	400	25	
1.6 AMPS	L2001L3	200	3	L
	L2001L5	200	5	
	L2001L7	200	10	
	L2001L9	200	25	
	L4001L3	400	3	
	L4001L5	400	5	
	L4001L7	400	10	
	L4001L9	400	25	
4 AMPS	L2004L3	200	3	
	L2004L5	200	5	
	L2004L7	200	10	
	L2004L9	200	25	
	L4004L3	400	3	
	L4004L5	400	5	
	L4004L7	400	10	
	L4004L9	400	25	
4 AMPS	L2004F31	200	3	F
	L2004F51	200	5	
	L2004F71	200	10	
	L2004F91	200	25	
	L4004F31	400	3	
	L4004F51	400	5	
	L4004F71	400	10	
	L4004F91	400	25	

*I_{GT} *in Quadrants I, II, III, & IV*

QUADRACS
(Internal Diac Trigger)

$I_{T(RMS)}$	PART NUMBER	V_{DRM}	VOLTS	PKG. TYPE
1.6 AMPS	Q2001LT	200	30–40	L
	Q4001LT	400		
3 AMPS	Q2003LT	200		
	Q4003LT	400		
4 AMPS	Q2004FT1	200	30–40	F
	Q4004FT1	400		
	Q5004FT1	500		
	Q6004FT1	600		
4 AMPS	Q2004LT	200	30–40	L
	Q4004LT	400		
	Q5004LT	500		
	Q6004LT	600		
6 AMPS	Q2006FT1	200	30–40	F
	Q4006FT1	400		
	Q5006FT1	500		
	Q6006FT1	600		
	Q2006LT	200	30–40	L
	Q4006LT	400		
	Q5006LT	500		
	Q6006LT	600		
8 AMPS	Q2008FT1	200	30–40	F
	Q4008FT1	400		
	Q5008FT1	500		
	Q6008FT1	600		
8 AMPS	Q2008LT	200	30–40	L
	Q4008LT	400		
	Q5008LT	500		
	Q6008LT	600		
10 AMPS	Q2010FT1	200	30–40	F
	Q4010FT1	400		
	Q5010FT1	500		
	Q6010FT1	600		
10 AMPS	Q2010LT	200	30–40	L
	Q4010LT	400		
	Q5010LT	500		
	Q6010LT	600		
15 AMPS	Q2015LT	200	30–40	
	Q4015LT	400		
	Q5015LT	500		
	Q6015LT	600		

SIDACS

PART NUMBER	VOLTS	PKG. TYPE
K1050E	105	E
K1100E	110	
K1200E	120	
K1300E	130	
K2000F1	200	F
K2200F1	220	
K2400F1	240	

DIACS

PART NUMBER	V_{BO}	PKG. TYPE
HT-5760	28	HT
HT-32	32	
HT-5761	32	
HT-5761A	32	
HT-5762	36	
HT-35	40	
HT-40	45	
HT-50	58	
HT-60	60	
HT-105	113	
HT-110	118	
HT-120	125	
HT-130	138	
HT-200	200	
HT-220	230	
HT-240	250	

TRIACS

$I_{T(RMS)}$	PART NUMBER	V_{DRM}	$I_{GT(mA)}$	PKG. TYPE
1 AMP	Q201E3	200	10	E
	Q201E4	200	25	
	Q401E3	400	10	
	Q401E4	400	25	
1 AMP	Q2001L3	200	10	L
	Q2001L4	200	25	
	Q4001L3	400	10	
	Q4001L4	400	25	
3 AMPS	Q2003L3	200	10	
	Q2003L4	200	25	
	Q4003L3	400	10	
	Q4003L4	400	25	
4 AMPS	Q2004F31	200	10	F
	Q2004F41	200	25	
	Q4004F31	400	10	
	Q4004F41	400	25	
	Q5004F41	500	25	
	Q6004F41	600	25	
4 AMPS	Q2004L3	200	10	L
	Q2004L4	200	25	
	Q4004L3	400	10	
	Q4004L4	400	25	
	Q5004L3	500	10	
	Q5004L4	500	25	
	Q6004L4	600	25	
	Q8004L4	800	25	
4 AMPS	Q2004R4	200	25	R
	Q4004R4	400	25	
	Q5004R4	500	25	
	Q6004R5	600	50	
6 AMPS	Q2006F41	200	25	F
	Q4006F41	400	25	
	Q5006F41	500	25	
	Q6006F51	600	50	
6 AMPS	Q2006L4	200	25	L
	Q2006L5	200	50	
	Q4006L4	400	25	
	Q4006L5	400	50	
	Q5006L4	500	25	
	Q5006L5	500	50	
	Q6006L5	600	50	

TRIACS (Cont'd.)

$I_{T(RMS)}$	PART NUMBER	V_{DRM}	$I_{GT(mA)}$	PKG. TYPE
6 AMPS	Q2006R4	200	25	R
	Q4006R4	400	25	
	Q5006R4	500	25	
	Q6006R5	600	50	
8 AMPS	Q2008F41	200	25	F
	Q4008F41	400	25	
	Q5008F41	500	25	
	Q6008F51	600	50	
8 AMPS	Q2008L4	200	25	L
	Q2008L5	200	50	
	Q4008L4	400	25	
	Q4008L5	400	50	
	Q5008L4	500	25	
	Q5008L5	500	50	
	Q6008L5	600	50	
8 AMPS	Q2008R4	200	25	R
	Q4008R4	400	25	
	Q5008R4	500	25	
	Q6008R5	600	50	
10 AMPS	Q2010F41	200	25	F
	Q4010F41	400	25	
	Q5010F41	500	25	
	Q6010F51	600	50	
10 AMPS	Q2010L4	200	25	L
	Q2010L5	200	50	
	Q4010L4	400	25	
	Q4010L5	400	50	
	Q5010L4	500	25	
	Q5010L5	500	50	
	Q6010L5	600	50	
	Q8010L5	800	50	
10 AMPS	Q2010R4	200	25	R
	Q4010R4	400	25	
	Q5010R4	500	25	
	Q6010R5	600	50	
	Q8010R5	800	50	
12 AMPS	Q2012L5	200	50	L
	Q4012L5	400	50	
	Q5012L5	500	50	
	Q6012L5	600	50	
	Q8012L5	800	50	
12 AMPS	Q2012R5	200	50	R
	Q4012R5	400	50	
	Q5012R5	500	50	
	Q6012R5	600	50	
	Q8012R5	800	50	
15 AMPS	Q2015L5	200	50	L
	Q4015L5	400	50	
	Q5015L5	500	50	
	Q6015L5	600	50	
	Q8015L5	800	50	
15 AMPS	Q2015R5	200	50	R
	Q4015R5	400	50	
	Q5015R5	500	50	
	Q6015R5	600	50	
	Q8015R5	800	50	
25 AMPS	Q2025L5	200	50	L
	Q4025L5	400	50	
	Q5025L5	500	50	
	Q6025L5	600	50	
25 AMPS	Q2025R5	200	50	R
	Q4025R5	400	50	
	Q5025R5	500	50	
	Q6025R5	600	50	
	Q2025P	200	80	P
	Q4025P	400	80	
	Q5025P	500	80	
	Q6025P	600	80	
40 AMPS	Q2040P	200	100	
	Q4040P	400	100	
	Q5040P	500	100	
	Q6040P	600	100	

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SENSITIVE SCR's

$I_{T(RMS)}$	PART NUMBER	V_{DRM} V_{RRM}	$I_{GT(\mu A)}$	PKG. TYPE
.8 AMPS	EC103Y	30	200	E
	EC103Y1	30	10	
	EC103Y2	30	50	
	EC103Y3	30	500	
	EC103A	100	200	
	EC103A1	100	10	
	EC103A2	100	50	
	EC103A3	100	500	
	EC103B	200	200	
	EC103B1	200	10	
	EC103B2	200	50	
	EC103B3	200	500	
	EC103C	300	200	
	EC103C1	300	10	
	EC103C2	300	50	
	EC103C3	300	500	
	EC103D	400	200	
	EC103D1	400	10	
	EC103D2	400	50	
	EC103D3	400	500	
	EC103E	500	200	
	EC103E1	500	10	
	EC103E2	500	50	
	EC103E3	500	500	
	EC103M	600	200	
	EC103M1	600	10	
	EC103M2	600	50	
	EC103M3	600	500	
.9 AMPS	2N5060	30	200	
	2N5061	60	200	
	2N5062	100	200	
	2N5063	150	200	
	2N5064	200	200	
1.6 AMPS	S0301LS1	30	100	L
	S0301LS2	30	200	
	S0301LS3	30	500	
	S0501LS1	50	100	
	S0501LS2	50	200	
	S0501LS3	50	500	
	S1001LS1	100	100	
	S1001LS2	100	200	
	S1001LS3	100	500	
	S2001LS1	200	100	
	S2001LS2	200	200	
	S2001LS3	200	500	
	S4001LS1	400	100	
	S4001LS2	400	200	
	S4001LS3	400	500	
3 AMPS	S0303LS1	30	100	
	S0303LS2	30	200	
	S0303LS3	30	500	
	S0503LS1	50	100	
	S0503LS2	50	200	
	S0503LS3	50	500	
	S1003LS1	100	100	
	S1003LS2	100	200	
	S1003LS3	100	500	
	S2003LS1	200	100	
	S2003LS2	200	200	
	S2003LS3	200	500	
	S4003LS1	400	100	
	S4003LS2	400	200	
	S4003LS3	400	500	
4 AMPS	T106Q1	15	200	F
	T107Q1	15	500	
	T106Y1	30	200	
	T107Y1	30	500	
	T106F1	50	200	
	T107F1	50	500	
	T106A1	100	200	
	T107A1	100	500	
	T106B1	200	200	
	T107B1	200	500	
	T106C1	300	200	
	T107C1	300	500	
	T106D1	400	200	
	T107D1	400	500	
	T106E1	500	200	
	T107E1	500	500	
	T106M1	600	200	
	T107M1	600	500	
6 AMPS	S0306FS21	30	200	
	S0306FS31	30	500	
	S0506FS21	50	200	
	S0506FS31	50	500	
	S1006FS21	100	200	
	S1006FS31	100	500	
	S2006FS21	200	200	
	S2006FS31	200	500	
	S4006FS21	400	200	
	S4006FS31	400	500	
	S0306LS2	30	200	L
	S0306LS3	30	500	
	S0506LS2	50	200	
	S0506LS3	50	500	
	S1006LS2	100	200	
	S1006LS3	100	500	
	S2006LS2	200	200	
	S2006LS3	200	500	
	S4006LS2	400	200	
	S4006LS3	400	500	

SEN. SCR's (Cont'd.)

$I_{T(RMS)}$	PART NUMBER	V_{DRM} V_{RRM}	$I_{GT(\mu A)}$	PKG. TYPE
8 AMPS	S0308FS21	30	200	F
	S0308FS31	30	500	
	S0508FS21	50	200	
	S0508FS31	50	500	
	S1008FS21	100	200	
	S1008FS31	100	500	
	S2008FS21	200	200	
	S2008FS31	200	500	
	S4008FS21	400	200	
	S4008FS31	400	500	
	S0308LS2	30	200	L
	S0308LS3	30	500	
	S0508LS2	50	200	
	S0508LS3	50	500	
	S1008LS2	100	200	
	S1008LS3	100	500	
	S2008LS2	200	200	
	S2008LS3	200	500	
	S4008LS2	400	200	
	S4008LS3	400	500	
10 AMPS	S0310FS21	30	200	F
	S0310FS31	30	500	
	S0510FS21	50	200	
	S0510FS31	50	500	
	S1010FS21	100	200	
	S1010FS31	100	500	
	S2010FS21	200	200	
	S2010FS31	200	500	
	S4010FS21	400	200	
	S4010FS31	400	500	
	S0310LS2	30	200	L
	S0310LS3	30	500	
	S0510LS2	50	200	
	S0510LS3	50	500	
	S1010LS2	100	200	
	S1010LS3	100	500	
	S2010LS2	200	200	
	S2010LS3	200	500	
	S4010LS2	400	200	
	S4010LS3	400	500	

SCR's

$I_{T(RMS)}$	PART NUMBER	V_{DRM} V_{RRM}	$I_{GT(mA)}$	PKG. TYPE
1 AMPS	S031E	30	10	E
	S051E	50	10	
	S101E	100	10	
	S201E	200	10	
	S401E	400	10	
	S601E	600	10	
1.6 AMPS	S0301L	30	10	L
	S0501L	50	10	
	S1001L	100	10	
	S2001L	200	10	
	S4001L	400	10	
	S6001L	600	10	
3 AMPS	S0303L	30	10	
	S0503L	50	10	
	S1003L	100	10	
	S2003L	200	10	
	S4003L	400	10	
	S6003L	600	10	
4 AMPS	S0304F1	30	10	F
	S0504F1	50	10	
	S1004F1	100	10	
	S2004F1	200	10	
	S4004F1	400	10	
	S6004F1	600	10	
6 AMPS	S0306F1	30	15	
	S0506F1	50	15	
	S1006F1	100	15	
	S2006F1	200	15	
	S4006F1	400	15	
	S6006F1	600	15	
	S0306L	30	15	L
	S0506L	50	15	
	S1006L	100	15	
	S2006L	200	15	
	S4006L	400	15	
	S6006L	600	15	
8 AMPS	S0308F1	30	15	F
	S0508F1	50	15	
	S1008F1	100	15	
	S2008F1	200	15	
	S4008F1	400	15	
	S6008F1	600	15	
	S0308L	30	15	L
	S0508L	50	15	
	S1008L	100	15	
	S2008L	200	15	
	S4008L	400	15	
	S6008L	600	15	

SCR's (Cont'd.)

$I_{T(RMS)}$	PART NUMBER	V_{DRM} V_{RRM}	$I_{GT(mA)}$	PKG. TYPE
8 AMPS	S0308R	30	15	R
	S0508R	50	15	
	S1008R	100	15	
	S2008R	200	15	
	S4008R	400	15	
	S6008R	600	15	
10 AMPS	S0310F1	30	15	F
	S0510F1	50	15	
	S1010F1	100	15	
	S2010F1	200	15	
	S4010F1	400	15	
	S6010F1	600	15	
	S0310L	30	15	L
	S0510L	50	15	
	S1010L	100	15	
	S2010L	200	15	
	S4010L	400	15	
	S6010L	600	15	
12 AMPS	S0312L	30	20	
	S0512L	50	15	
	S1012L	100	20	
	S2012L	200	20	
	S4012L	400	20	
	S6012L	600	20	
	S0312R	30	15	R
	S0512R	50	15	
	S1012R	100	20	
	S2012R	200	20	
	S4012R	400	20	
	S6012R	600	20	
15 AMPS	S0315L	30	30	L
	S0515L	50	15	
	S1015L	100	30	
	S2015L	200	30	
	S4015L	400	30	
	S6015L	600	30	
	S8015L	800	50	
16 AMPS	S0316R	30	30	R
	S0516R	50	15	
	S1016R	100	30	
	S2016R	200	30	
	S4016R	400	30	
	S6016R	600	30	
	S8016R	800	50	
20 AMPS	S0320L	30	30	L
	S0520L	50	30	
	S1020L	100	30	
	S2020L	200	30	
	S4020L	400	30	
	S6020L	600	30	
	S8020L	800	50	
25 AMPS	S0325L	30	30	
	S0525L	50	30	
	S1025L	100	30	
	S2025L	200	30	
	S4025L	400	30	
	S6025L	600	30	
	S8025L	800	50	
	S0325R	30	30	R
	S0525R	50	30	
	S1025R	100	30	
	S2025R	200	30	
	S4025R	400	30	
	S6025R	600	30	
	S8025R	800	50	
65 AMPS	S0365P	30	50	P
	S0565P	50	50	
	S1065P	100	50	
	S2065P	200	50	
	S4065P	400	50	
	S6065P	600	50	

VARO Silicon Rectifiers and Bridges

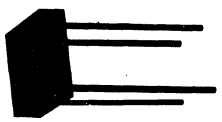
Epoxy Axial Lead Rectifiers
Fast Recovery (200 ns) or Controlled Avalanche. Glass passivated chips.

V3 Series: 3 a, 100-200 a surge; 50 to 1,000v

Epoxy Bridge Rectifiers
Fast Recovery (200 ns) or Controlled Avalanche. Glass passivated chips.

VM Series: 1 a Bridge; 50 to 1,000v

VE Series: 1 a; 25 to 1,000v



VS, VH, VJ Series: 2, 6 & 10 a; 50 to 1,000v

VK Series: 30 a; 200 to 1,000v

Integrated Bridge Rectifiers
Fast Recovery (200 ns) or Controlled Avalanche. Glass passivated chips.

IN, VT, VY Series: 10 to 36 a; 200 to 600v; press fit, stud, T03 flange packages; full-wave bridge, center tap or three phase

R700 Series: 30 a; 200 to 600v; T03 package

Schottky Barrier Rectifiers
Extremely Fast Recovery (<10 ns)

VSB Series: 750 ma Bridge; 20 to 40v

VSK Series: 1 to 5 a; 20 to 40v

VSK Series: 6 a; 20 to 40v

VSK Series: 12 a; 20 to 40v

VSK Series: 15 to 30 a; 20 to 45v

VSK Series: 30 a; 20 to 40v

VSK Series: 40 to 60 a; 20 to 45v

High Temperature Schottky Rectifiers (175°C)
Extremely Fast Recovery (<10 ns)

VSK Series: 10 a; 20 to 45v

VSK Series: 20 a; 20 to 45v

VSK 31, 32 Series: 30 a; 50 to 60v

VSK 231, 232 Series. 60 a; 50 to 60v

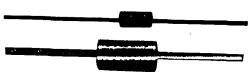
VSK 71, 72 Series: 75 a; 50 to 60v

VSK 2000 Series: 200 a; 50 to 60v

In the concept stage? Design stage? Full production? Look to Varo for the solution to your specific rectifier requirements. And count on reliability and economy as part of the answer. Standard devices are stocked for fast delivery; specially modified or custom designed/manufactured devices can be shipped in minimum time.

Silicon Rectifiers and Bridges

EPI High Efficiency Rectifiers
Fast Recovery (35 to 50 ns)



VHE Series: 1 to 6 a; 50 to 600v

VHE 1400 Series: 10 a; 50 to 600v

VHE 2400 Series: 20 a; 50 to 600v

VHE 700 Series: 30 a; 50 to 200v

VHE 2600 Series: 50 a; 50 to 200v

VHE 800 Series: 70 a; 50 to 200v

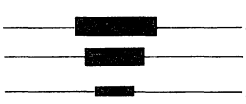
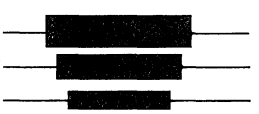
Very Fast Recovery Rectifiers
Fast Recovery (100 ns)

TG Series: 1 to 2 a; 400 to 1,000v

TG Series: 8 a; 400 to 1,000v

TG Series: 16 a; 400 to 1,000v

High Voltage Silicon Rectifiers
Fast Recovery (100 to 250 ns) or Standard

H 1700 Series: 3 ma; 3 kV to 27 kV

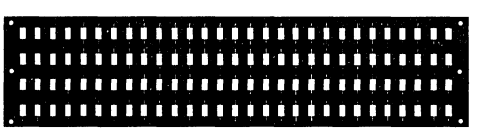
VA, VB, VG Series: 5 to 200 ma; 1 kV to 20 kV

VF Series: 40 to 130 ma; 5 kV to 50 kV

H 1601 Series: 70 to 400 ma; 1 kV to 18 kV

VC Series: 1 to 2 a; 2 kV to 12 kV

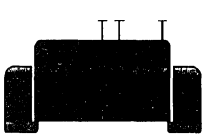
High Voltage Rectifier Assemblies
Fast Recovery (100 to 250 ns) or Standard



H Series: X-ray applications; 220 ma, in oil; 75 kV to 200 kV

H Series: Pollution control applications; 500 ma to 1.7 a in oil; 100 kV to 360 kV

High Voltage Multipliers



MH Series: Doubler, Tripler. Quadrupler; 2 ma; to 15 to 40 kV

For application information, specifications or a sample device, call: (214) 271-8511 VARO Semiconductor, Inc., Box 469013, Garland, Texas 75046-9013. TWX 910-860-5178

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The World's Leading Rectifier Company

VARO

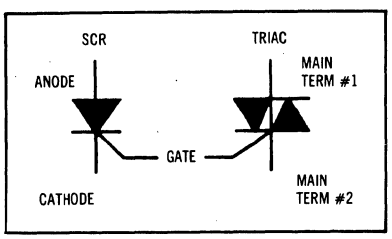
eem MINIGLOSSARY THYRISTORS/ HIGH POWER DIODES

THYRISTORS

A thyristor is a four-layer semiconductor (pnpn) that can be switched from an OFF to an ON state. This is usually done by a voltage or current pulse to the gate terminal. The device will then continue to conduct so long as the principal current of the device flows through the thyristor's two main terminals.

In many respects a thyristor is analogous to an electromechanical latching relay. In fact, thyristors have largely replaced these relays in newer equipment designs. But, misapplications and/or failure to fully understand the parameters of these and other solid state devices often leads to catastrophic field failures.

The terminology shown on this page has been condensed from common industry data books and is intended to be a guide for the engineer.



di/dt: *Critical rate of rise of ON state current* is the user's maximum design limit (Fig. 1).

di_R/dt: *Rate of decay of ON state current* (Fig. 1 & 2).

dv/dt (critical): *Rate of rise of OFF state voltage*. Lowest voltage rate of rise to cause a thyristor to turn ON.

dv/dt (reapplied) : *Rate of rise of reapplied OFF state voltage.*

I_{FSM}: *Nonrepetitive ON state surge current in diodes.* Maximum peak value of ½ cycles (60 Hz) a diode can withstand up to 100 times in its lifetime.

I_{TSM}: *Nonrepetitive ON state surge current in thyristors.* Maximum peak value of 60 Hz cycles a thyristor can withstand up to 100 times in its lifetime.

I_{DRM}/I_{RRM}: *Maximum peak forward/reverse leakage current* at specified temperature and repetitive conditions.

I_{GDM}: *Continuous gate current not to trigger*. Highest dc gate current that will *not* cause thyristor to switch from OFF to ON at a specific temperature.

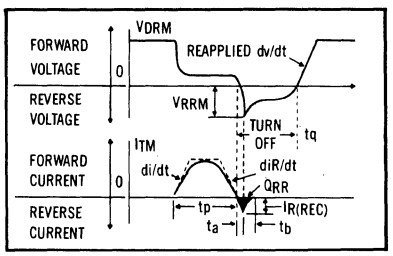


Fig. 1. Concurrent voltage and current waveforms

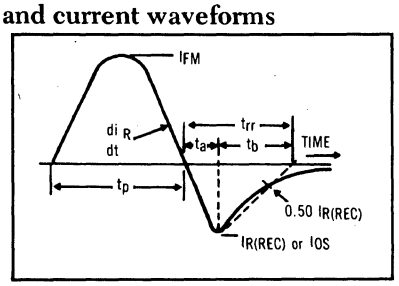


Fig. 2. Recovery current waveform

I_{GT}: *Continuous gate trigger current.* Absolute minimum gate current required to switch thyristor from OFF to ON.

I_H: *Holding Current*. Minimum current required to hold thyristor ON.

I_L: *Latching current*. Minimum current required to hold thyristor ON after removal of gate drive.

$I_{(REC)}$; *Recovery current*. Peak value of reverse current during recovery or turn OFF (Fig. 1 & 2).

I_{OS}: *Overshoot current*. See $I_{R(REC)}$.

I^2t: Maximum ON state, short time thermal capacity of the silicon element for operations less than ½ cycle of 180° conduction angle.

$I_{T(AV)}$: *Average ON state current* (max.)

Q_{RR}: *Reverse recovered charge* (Fig. 1).

$R_{\theta JC}$: *Junction-to-case thermal resistance* in degrees C per watt.

$T_{C(MAX)}$: *Max. allowable case temperature.*

$T_{J(MAX)}$: *Maximum allowable junction temp.*

t_d: *Delay time*. Interval between a specified point at beginning of gate pulse and the instant at which the principal voltage drops to a specified value. (OFF-ON) (Fig. 3)

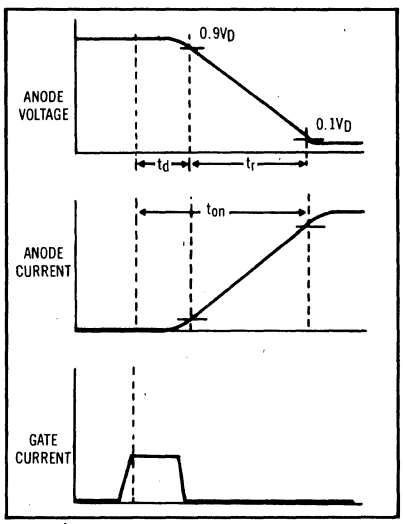


Fig. 3. Turn-on time waveforms

t_{on}: *Turn-on time*. The sum of delay time and rise time. (OFF-ON) (Fig. 3)

t_q: *Turn-off time.* Time between principal current reaching zero and the instant thyristor can block forward voltage without turning ON. (Fig. 1)

t_r: *Rise time*. Time between principal voltage dropping from one value to a second lower value when thyristor turns from OFF to ON. (Fig. 3)

t_{rr}: *Reverse recovery time*. (Fig. 2)

V_{DRM}/V_{RRM}: *Maximum repetitive peak OFF state/reverse voltage* excluding non-repetitive transients.

V_{DSM}/V_{RSM}: *Maximum nonrepetitive peak OFF state/reverse voltage.*

V_{FM}/V_{TM}: *Maximum forward voltage drop* at a specific forward current and case temp.

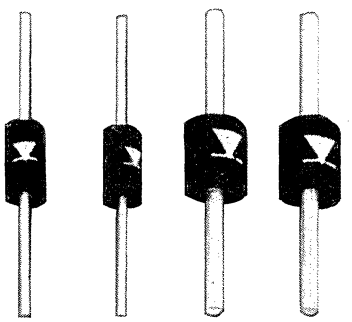
V_{GDM}: *Gate nontrigger voltage*. Highest dc voltage that will *not* cause thyristor to switch from OFF to ON.

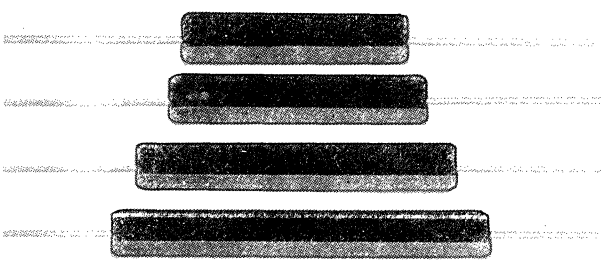
V_{LATCH}: *Latching voltage*. Voltage required for thyristor to latch ON at a given gate current and junction temp.

$V_{TM(DYN)}$: *Dynamic ON state voltage*. Transient ON state voltage of thyristor when triggered into conduction for a given load and time.

HIGH VOLTAGE DISCRETES 1.5 KV to 10 KV

- 25 MA to 100 NS Recovery Time (Body Size .090" x .200")
- 100 MA - 250 MA to 100 NS Recovery Time (Body Size .125" x .250")
- 500 MA - 2 AMP to 100 NS Recovery Time (Body Size .200" x .250")



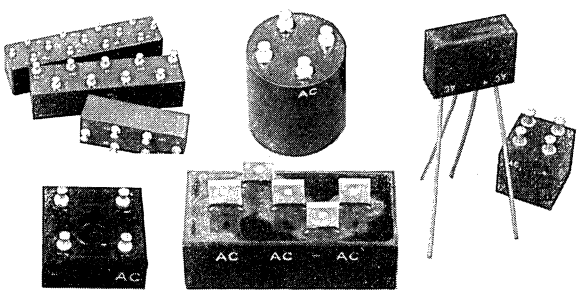


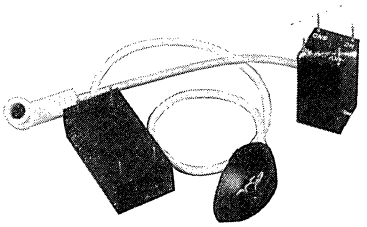
HIGH VOLTAGE RECTIFIER STACKS

Stacked High Voltage Discretes repotted to provide the PIV needed. Size made depending on operating in air or oil media.

HIGH or LOW VOLTAGE ASSEMBLIES

Single bridge or multiple bridge configurations available or to your package criteria. Low voltage with or without MIL QPL Rectifiers.





HIGH VOLTAGE MULTIPLIERS

Multipliers made with number of stages to yield output to 150 KV+.

CUSTOM PACKAGING/PROCESSING

- Packaging can be tailored to characteristics and space
- Processing of discretes or assemblies can be to specs or MIL.

VOLTAGES MULTIPLIERS, INC.

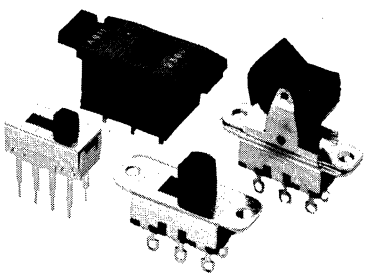
8711 West Roosevelt ▪ Visalia, California 93291 ▪ (209) 651-1402

For Switches . . .Who Else But

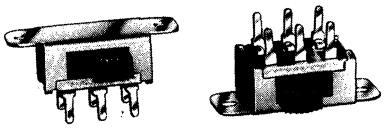
SWITCHCRAFT

Who else but the industry's leader in proven-quality standard size and miniaturized "option loaded" pushbutton, slide, lever switches . . . lighted & unlighted; single & multiple-station.

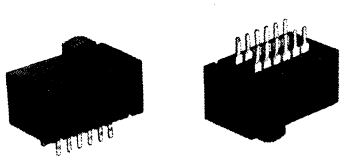
Instrument Quality Slide Switches



A broad line of standard size and miniaturized switches with features like "snap-slide" lifting, "double-wipe" slide switching action for clean, effective contact over many years.



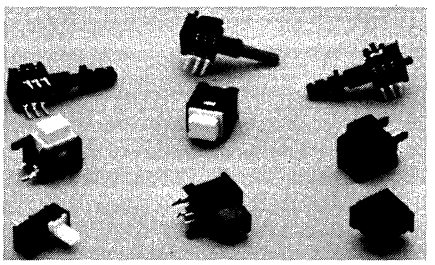
New Series 62000 miniaturized right angle slide switches, 2C (DPDT) locking action, have knob actuator on the side – offering especially low profile, PC board space savings.



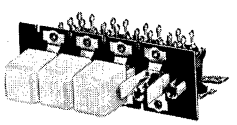
New space-saving Series C63000 miniature slide switches offer 4 pole/2-position switching for close PC mounting on .100 x .200 inch centers.

Long Life Single/Multiple-Station Pushbutton Switches

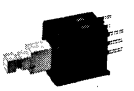
Switchcraft offers a broad line of single-station pushbutton switches with large selection of circuits, terminal styles, colors, functions. Shown above is the Box Switch, Series BXR offering terminal versatility, broad switching capabilities in minimum space.



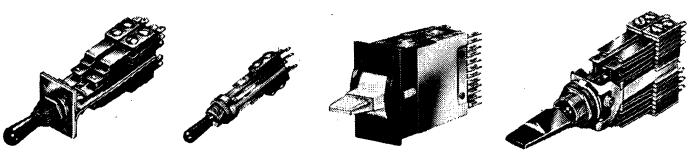
New P70000 Series lighted/unlighted miniature key switches offer designers variety of features; short stroke switching action; long life; audible "click" positive tactile feel for operation awareness.



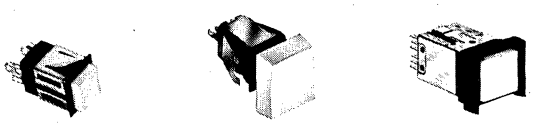
The Company pioneered economical, commercially-feasible multiple-station switches; Multi-Switch® switches, with up to 18 stations.



Series 98000 IBS miniaturized pushbutton switches have special versatility, low cost, low contact resistance (tested to 20 milliohms). IBS Multi-Switch key switches offer 10, 15, 20 mm centers; 1-12 stations; interlock, non-lock, push-lock/push-release.



Lever Switches – Large variety of standard size/miniature switches; lighted/unlighted; up to 4PDT in locking or momentary actions. Ratings up to 3 A, 300 W max.; AC non-inductive load. Lighted types have up to 8 A, 125 V AC contacts; up to 8PDT switching. Levers can light different color for each position.



Pushbutton Switches – lighted/unlighted, standard size/miniature. Offer tactile push-button action; legends; ultra-compact, space savings capabilities; dry circuit to high current; multiple-pole contacts; momentary/locking actions; color buttons; single-hole panel/chassis or pendant (cord) mount; solder/PC terminals.

Industry's innovator of switches, connectors, telecomponents, audio accessories, molded cable assemblies, keyboards.
Call 312-792-2700

SWITCHCRAFT® INC.

A Raytheon Company

5555 No. Elston Ave.,Chicago, Ill. 60630

SWITCHES * Indicates MIL Type

Manufacturer	DIP	Lever	Pushbutton				Reed	Rocker	Rotary		Slide	Snap Action	Thumbwheel	Toggle	Hardware	Circuit Breaker	Explosion Proof	Illuminated	Interlocking	High Voltage	Key Lock	Mercury	Power	RF	Sealed	Coded	Foot, Mat, Ribbon, Etc.
			Momentary	Positive Action	Interlock	Push-on/ Push-Off			Single Section	Multisection								*							*		
Aerospace Optics			1•2226*			1•2226*																					
Alcoswitch/Augat	1•2224		1•2222	1•2222		1•2222		1•2220			1•2218	1•2222		1•2218				●			●				●	●	
Alps Electric		1•2227	1•2227						1•2227	1•2227	1•2227							●									
AME															1•2237												
American Research	1.2228																								●		
American Switch		1•2229	1•2229	1•2229		1•2229		1•2229						1•2229				●					●				
AMP Inc.	1•2230								1•2232		1•2231							●								●	
Arcoelectric		1•2238	1•2238					1•2238										●					●				
Capitol		1•2242	1•2242	1•2242	1•2242	1•2242												●								●	
Carlingswitch								1•2240						1•2240		●		●					●				
Cherry			1•2243	1•2243		1•2243						1•2243	1•2243			●		●							●	●	
Chicago Lock												1•2244									●		●				
Cole Instrument									1•2245*	1•2245*																●	
Crosspoint															1•2316												
Crouse-Hinds			1•2252	1•2252		1•2252		1•2246			1•2256			1•2246	1•2257			●					●				
Crouzet								1•2258					1•2258													●	
Dai-ichi Shoji			1•2259	1•2259		1•2259		1•2259						1•2259				●					●				
Daven/Armtec	1•2239								1•2239	1•2239																●	
EAO			1•2271	1•2271	1•2271	1•2271												●			●		●		●		
Eaton			1•2263	1•2263		1•2263												●					●				
EECO	1•2260		1•2260						1•2260				1•2261*					●							●	●	
Electro-Mech			1•2272	1•2272	1•2272	1•2272												●					●				
Electronic Components			1•2278	1•2278	1•2278	1•2278						1•2282						●									
Electroswitch									1•2277	1•2277		1•2277								●			●				
Fifth Dimension 1•2284																						●			●		
Gordos							1•2288		1•2290													●				●	
Grayhill	1•2293*		1•2301	1•2300				1•2294*	1•2302*	1•2302*	1•2297	1•2300		1•2297									●		●	●	
Hamlin							1•2213													●			●				
Hasco Components							1•2314																				
Hermetic Switch							1•2315													●			●		●		
Inter-Market													1•2317													●	
Int'l Resource Services								1•2318			1•2318																
Interswitch													1•2319													●	
ITT Jennings 1•2321																				●					●		
ITT Schadow			1•2322	1•2322	1•2322	1•2322									1•2322			●	●				●		●		
Janco Corp.			1•2327*	1•2327*					1•2326*	1•2326*							●			●			●		●	●	
Landis & Gyr.												1•2330								●			●				
Ledex			1•2328	1•2328	1•2328	1•2328				1•2328								●			●				●		
Micro Switch/Honeywell		1•2331	1•2331	1•2331	1•2331	1•2331		1•2331				1•2331		1•2331	1•2360			●	●		●		●		●		
Oak Switch Systems		1•2383	1•2383			1•2383			1•2382	1•2382*								●			●				●	●	
Ohmite									1•2381	1•2381										●			●				
Omron		1•2384	1•2385			1•2385						1•2384						●					●			●	
Oslo Controls			1•2386	1•2386		1•2386		1•2387										●					●				
Otto Engineering		1•2388	1•2389	1•2389		1•2389						1•2388		1•2388									●		●		
Power Dynamics														1•2390													
Radio Switch									1•2391	1•2391										●			●	●			
Secor			1•2393		1•2393	1•2393							1•2392					●			●					●	
Shallco									1•2394	1•2394													●				
Sorenson						1•1717												●									
Switchcraft		1•2216, 1•2398	1•2398	1•2216, 1•2398	1•2398	1•2216, 1•2398					1•2216, 1•2398								●					●			
Tapeswitch 1•2401																											●
Tech Labs									1•2402	1•2402			1•2402	1•2403						●							
Unimax			1•2404	1•2404	1•2404							1•2404	1•2404	1•2404			●	●							●	●	
Veetronix			1•2405	1•2405			1•2405											●	●				●		●		

AUGAT® ALCOSWITCH®

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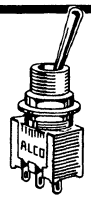
TT & TSS PC MOUNTABLES

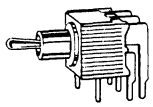
Quality and Innovation

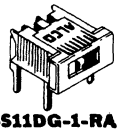
TT13D-3T

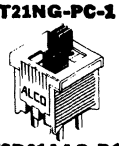
TTE23N-3T

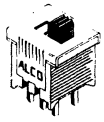

TT13D-9T¼

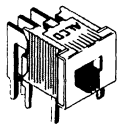
TT21NG-PC-1


TT21NG-RA-1


TSS11DG-1-RA


TSD21AAG-PC


TSS21NG-PC


TSS21NG-RA

SERIES TT AND TTE 3A SUBMINIATURE TOGGLE SWITCHES WITH LUG TERMINALS

Series TT and **TTE** subminiature toggle switches with silver contacts; rated 3 A @ 125 VAC or 28 VDC; gold flashed solder lug terminals. Choice of ¼-40 or 10-48 threaded bushings. These tiny instrument grade toggle switches can be mounted only ⅝" apart on panel. Uniform 0.1" spacing between all terminals and mounting studs permits mounting on standard "perf" boards. **TTE** models have watertight bushings and panel seals.

Alcoswitch No.	Contacts	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
TT13A-2T	SPST	On-none-off	$2.20	$1.87	$1.76	$1.65
TT13D-2T	SPDT	On-none-on	2.05	1.74	1.64	1.54
TT13E-2T	SPDT	On-off-on	2.55	2.17	2.04	1.91
TT23K-2T	DPST	On-none-off	3.25	2.76	2.60	2.44
TT23N-2T	DPDT	On-none-on	2.95	2.51	2.36	2.21
TT23P-2T	DPDT	On-off-on	3.50	2.98	2.80	2.63
TT13A-3T§	SPST	On-none-off	2.20	1.87	1.76	1.65
TT13D-3T§	SPDT	On-none-on	2.05	1.74	1.64	1.54
TT13E-3T§	SPDT	On-off-on	2.55	2.17	2.04	1.91
TT23K-3T§	DPST	On-none-off	3.25	2.76	2.60	2.44
TT23N-3T§	DPDT	On-none-on	2.95	2.51	2.36	2.21
TT23P-3T§	DPDT	On-off-on	3.50	2.98	2.80	2.63
TT23PA-3T	DPDT	On-on-on	3.70	3.15	2.96	2.78
TT13A-4T	SPST	On-none-off	2.45	2.08	1.96	1.84
TT13D-4T	SPDT	On-none-on	2.30	1.96	1.84	1.73
TT13E-4T	SPDT	On-off-on	2.80	2.38	2.24	2.10
TT23K-4T	DPST	On-none-off	3.50	2.98	2.80	2.63
TT23N-4T	DPDT	On-none-on	3.20	2.72	2.56	2.40
TT23P-4T	DPDT	On-off-on	3.75	3.19	3.00	2.81
TT23PA-4T	DPDT	On-on-on	3.95	3.36	3.16	2.96
TT13A-4T¼†	SPST	On-none-off	2.60	2.21	2.08	1.95
TT13D-4T¼†	SPDT	On-none-on	2.45	2.08	1.96	1.84
TT13E-4T¼†	SPDT	On-off-on	2.95	2.51	2.36	2.21
TT23K-4T¼†	DPST	On-none-off	3.65	3.10	2.92	2.74
TT23N-4T¼†	DPDT	On-none-on	3.35	2.85	2.68	2.51
TT23P-4T¼†	DPDT	On-off-on	3.90	3.32	3.12	2.93
TT13A-6T	SPST	On-none-off	2.50	2.13	2.00	1.88
TT13D-6T	SPDT	On-none-on	2.35	2.00	1.88	1.76
TT13E-6T	SPDT	On-off-on	2.85	2.42	2.28	2.14
TT23K-6T	DPST	On-none-off	3.55	3.02	2.84	2.66
TT23N-6T	DPDT	On-none-on	3.25	2.76	2.60	2.44
TT23P-6T	DPDT	On-off-on	3.80	3.23	3.04	2.85
TT23PA-6T	DPDT	On-on-on	4.00	3.40	3.20	3.00
TT13A-6T¼†	SPST	On-none-off	2.55	2.17	2.04	1.91
TT13D-6T¼†	SPDT	On-none-on	2.40	2.04	1.92	1.80
TT13E-6T¼†	SPDT	On-off-on	2.90	2.47	2.32	2.18
TT23K-6T¼†	DPST	On-none-off	3.60	3.06	2.88	2.70
TT23N-6T¼†	DPDT	On-none-on	3.30	2.81	2.64	2.48
TT23P-6T¼†	DPDT	On-off-on	3.85	3.27	3.08	2.89
TT23PA-6T¼†	DPDT	On-on-on	4.05	3.44	3.24	3.04
TTE13D-9T¼†	SPDT	On-none-on	2.95	2.51	2.36	2.21
TTE13E-9T¼†	SPDT	On-off-on	3.45	2.93	2.76	2.59
TTE23N-9T¼†	DPDT	On-none-on	3.85	3.27	3.08	2.89
TTE23P-9T¼†	DPDT	On-off-on	4.40	3.74	3.52	3.30
TT13A-9T¼†	SPST	On-none-off	2.35	2.00	1.88	1.76
TT13D-9T¼†	SPDT	On-none-on	2.20	1.87	1.76	1.65
TT13E-9T¼†	SPDT	On-off-on	2.70	2.30	2.16	2.03
TT23K-9T¼†	DPST	On-none-off	3.40	2.89	2.72	2.55
TT23N-9T¼†	DPDT	On-none-on	3.10	2.64	2.48	2.33
TT23P-9T¼†	DPDT	On-off-on	3.65	3.10	2.92	2.74
TT23PA-9T¼†	DPDT	On-on-on	3.85	3.27	3.08	2.89

†¼-40 threaded bushing. §10-48 threaded bushing.

SERIES TSS SUBMINIATURE SLIDE SWITCHES WITH PC OR RIGHT ANGLE PC TERMINALS

Instrument grade subminiature slide switches; gold plated terminals, spaced for 0.1" PC grids. Choice of 0.11" extended or flush actuators. **-PC** types have straight PC terminals; **-RA** types, right-angle PC terminals. 1 or 2 actuators optional on double pole versions.

Alcoswitch No.	Contacts	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
TSS11AG-PC	SPST	On-none-off	2.55	$2.17	$2.04	$1.91
TSS11DG-PC	SPDT	On-none-on	2.35	2.00	1.88	1.76
TSS11EG-PC	SPDT	On-off-on	2.75	2.34	2.20	2.06
TSS21KG-PC	DPST	On-none-off	3.75	3.19	3.00	2.81
TSS21NG-PC	DPDT	On-none-on	3.35	2.85	2.68	2.51
TSS21PG-PC	DPDT	On-off-on	3.95	3.36	3.16	2.96
TSS21PAG-PC	DPDT	On-on-on	4.35	3.70	3.48	3.26
TSS11AG-1-PC	SPST	On-none-off	2.55	2.17	2.04	1.91
TSS11DG-1-PC	SPDT	On-none-on	2.35	2.00	1.88	1.76
TSS11EG-1-PC	SPDT	On-off-on	2.75	2.34	2.20	2.06
TSS21KG-1-PC	DPST	On-none-off	3.75	3.19	3.00	2.81
TSS21NG-1-PC	DPDT	On-none-on	3.35	2.85	2.68	2.51
TSS21PG-1-PC	DPDT	On-off-on	3.95	3.36	3.16	2.96
TSS21PAG-1-PC	DPDT	On-on-on	4.35	3.70	3.48	3.26
TSD21AAG-PC	2XSPST	On-none-off	3.95	3.36	3.16	2.96
TSD21DDG-PC	2XSPDT	On-none-on	3.55	3.02	2.84	2.66
TSD21EEG-PC	2XSPDT	On-off-on	4.35	3.70	3.48	3.26
TSD21AAG-1-PC	2XSPST	On-none-off	3.95	3.36	3.16	2.96
TSD21DDG-1-PC	2XSPDT	On-none-on	3.55	3.02	2.84	2.66
TSD21EEG-1-PC	2XSPDT	On-off-on	4.35	3.70	3.48	3.26
TSS11DG-RA	SPDT	On-none-on	2.60	2.21	2.08	1.95
TSS11EG-RA	SPDT	On-off-on	3.00	2.55	2.40	2.25
TSS21NG-RA	DPDT	On-none-on	4.05	3.44	3.24	3.04
TSS21PG-RA	DPDT	On-off-on	4.65	3.95	3.72	3.49
TSS21PAG-RA	DPDT	On-on-on	5.05	4.29	4.04	3.79
TSS11DG-1-RA	SPDT	On-none-on	2.60	2.21	2.08	1.95
TSS11EG-1-RA	SPDT	On-off-on	3.00	2.55	2.40	2.25
TSS21NG-1-RA	DPDT	On-none-on	4.05	3.44	3.24	3.04
TSS21PG-1-RA	DPDT	On-off-on	4.65	3.95	3.72	3.49
TSS21PAG-1-RA	DPDT	On-on-on	5.05	4.29	4.04	3.79
TSD21DDG-RA	2XSPDT	On-none-on	4.25	3.61	3.40	3.19
TSD21EEG-RA	2XSPDT	On-off-on	5.05	4.29	4.04	3.79
TSD21DDG-1-RA	2XSPDT	On-none-on	4.25	3.61	3.40	3.19
TSD21EEG-1-RA	2XSPDT	On-off-on	5.05	4.29	4.04	3.79

SERIES TT SUBMINIATURE TOGGLE SWITCHES WITH PC AND RIGHT ANGLE PC TERMINALS

"World's Smallest" PC mounted toggle switches; gold plated contacts. Terminals spaced for 0.1" PC grids. Available with short 0.210" long toggle and unthreaded 0.186" bushing or 0.413" long toggle and ¼-40 threaded bushing. **-PC** types have upright PC terminals; **-RA** types, right-angle PC terminals; **-WW** types, 0.590" extended PC terminals.

TT11AG-PC-1	SPST	On-none-off	$2.10	$1.79	$1.68	$1.58
TT11DG-PC-1	SPDT	On-none-on	1.95	1.66	1.56	1.46
TT11EG-PC-1	SPDT	On-off-on	2.45	2.08	1.96	1.84
TT21KG-PC-1	DPST	On-none-off	3.15	2.68	2.52	2.36
TT21NG-PC-1	DPDT	On-none-on	2.85	2.42	2.28	2.14
TT21PG-PC-1	DPDT	On-off-on	3.40	2.89	2.72	2.55
TT21PAG-PC-1	DPDT	On-on-on	3.60	3.06	2.88	2.70
TT11AG-PC-9T¼†	SPST	On-none-off	2.35	2.00	1.88	1.76
TT11DG-PC-9T¼†	SPDT	On-none-on	2.20	1.87	1.76	1.65
TT11EG-PC-9T¼†	SPDT	On-off-on	2.70	2.30	2.16	2.03
TT21KG-PC-9T¼†	DPST	On-none-off	3.40	2.89	2.72	2.55
TT21NG-PC-9T¼†	DPDT	On-none-on	3.10	2.64	2.48	2.33
TT21PG-PC-9T¼†	DPDT	On-off-on	3.65	3.10	2.92	2.74
TT21PAG-PC-9T¼	DPDT	On-on-on	3.85	3.27	3.08	2.89
TT11DG-WW-2T§	SPDT	On-none-on	2.40	2.04	1.92	1.80
TT11EG-WW-2T§	SPDT	On-off-on	2.90	2.47	2.32	2.18
TT21NG-WW-2T§	DPDT	On-none-on	3.65	3.10	2.92	2.74
TT21PG-WW-2T§	DPDT	On-off-on	4.20	3.57	3.36	3.15
TT11DG-RA-1*	SPDT	On-none-on	2.25	1.91	1.80	1.69
TT11EG-RA-1*	SPDT	On-off-on	2.75	2.34	2.20	2.06
TT21NG-RA-1*	DPDT	On-none-on	3.60	3.06	2.88	2.70
TT21PG-RA-1*	DPDT	On-off-on	4.15	3.53	3.32	3.11
TT21PAG-RA-1	DPDT	On-on-on	4.35	3.70	3.48	3.26
TT11DG-RA-9T¼†	SPDT	On-none-on	2.50	2.13	2.00	1.88
TT11EG-RA-9T¼†	SPDT	On-off-on	3.00	2.55	2.40	2.25
TT21NG-RA-9T¼†	DPDT	On-none-on	3.85	3.27	3.08	2.89
TT21PG-RA-9T¼†	DPDT	On-off-on	4.40	3.74	3.52	3.30
TT21PAG-RA-9T¼	DPDT	On-on-on	4.60	3.91	3.68	3.45
TT11DG-VRA-1*	SPDT	On-none-on	2.40	2.04	1.92	1.80
TT11EG-VRA-1*	SPDT	On-off-on	2.90	2.47	2.32	2.18
TT21NG-VRA-1*	DPDT	On-none-on	3.75	3.19	3.00	2.81
TT21PG-VRA-1*	DPDT	On-off-on	4.30	3.66	3.44	3.23
TT11AG-PC-9T¼-ES	SPST	On-none-off	2.95	2.51	2.36	2.21
TT11DG-PC-9T¼-ES	SPDT	On-none-on	2.80	2.38	2.24	2.10
TT11EG-PC-9T¼-ES	SPDT	On-off-on	3.30	2.81	2.64	2.48
TT21KG-PC-9T¼-ES	DPST	On-none-off	4.10	3.49	3.28	3.08
TT21NG-PC-9T¼-ES	DPDT	On-none-on	3.80	3.23	3.04	2.85
TT21PG-PC-9T¼-ES	DPDT	On-off-on	4.35	3.70	3.48	3.26
TT21PAG-PC-9T¼-ES	DPDT	On-on-on	4.55	3.87	3.64	3.41

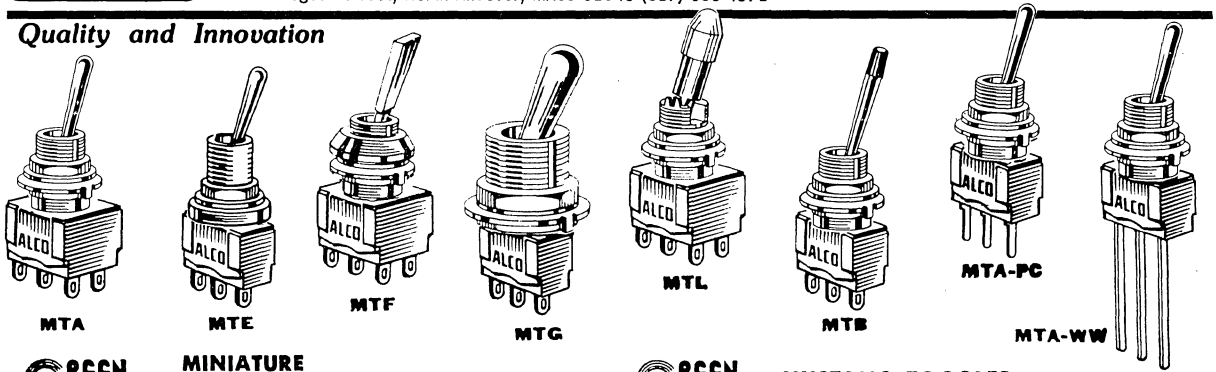
*.186 dia. unthreaded bushing. †¼-40 threaded bushing. §10-48 threaded bushing.

AUGAT® ALCOSWITCH®

1551 Osgood Street, North Andover, MASS 01845 (617) 685-4371

SUBMINIATURE TOGGLE SWITCHES

Quality and Innovation



GREEN SERIES MINIATURE TOGGLE SWITCHES

All ALCO Green Series miniature switches have molded-in terminals which prevent solder, flux and other contaminants from entering the contact area. All contacts are fine silver. Contacts and terminals have gold finish to inhibit oxidation, prolong shelf life, and facilitate soldering. Green diallyl phthalate case withstands high temperatures. All toggle types are U.L. listed and have anti-push-in lever captivation to prevent accidental damage. All types have ¼"-40 high torque bushings, except MTG series; MTG types have 15/32"-32 bushings. Rated 6 amps at 125 VAC, 3 amps at 250 VAC.

GREEN SERIES MINIATURE BAT HANDLE TOGGLES

Terminals accept two #20 AWG wires.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MTA-106D	SPDT‡	On-none-on	$2.25	$1.91	$1.80	$1.69
MTA-106E	SPDT	On-off-on	2.75	2.34	2.20	2.06
MTA-106F	SPDT	On-none-on†	2.85	2.42	2.28	2.14
MTA-106G	SPDT	On†-off-on†	2.95	2.51	2.36	2.21
MTA-106H	SPDT	On-off-on†	2.95	2.51	2.36	2.21
MTA-206N	DPDT	On-none-on	3.10	2.64	2.48	2.33
MTA-206P	DPDT	On-off-on	3.65	3.10	2.92	2.74
MTA-206R	DPDT	On-none-on†	3.75	3.19	3.00	2.81
MTA-206S	DPDT	On†-off-on†	3.85	3.27	3.08	2.89
MTA-206T	DPDT	On-off-on†	3.85	3.27	3.08	2.89
MTA-206PA	DPDT	On-on-on	4.45	3.78	3.56	3.34
MTA-206SA	DPDT	On†-on-on†	4.65	3.95	3.72	3.49
MTA-206TA	DPDT	On-on-on†	4.65	3.95	3.72	3.49
MTA-306D	3PDT	On-none-on	5.35	4.55	4.28	4.01
MTA-306E	3PDT	On-off-on	5.85	4.97	4.68	4.39
MTA-306F	3PDT	On-none-on†	5.95	5.06	4.76	4.46
MTA-306H	3PDT	On-off-on†	6.05	5.14	4.84	4.54
MTA-406N	4PDT	On-none-on	6.95	5.91	5.56	5.21
MTA-406P	4PDT	On-off-on	7.45	6.33	5.96	5.59
MTA-406PA	4PDT	On-on-on	8.85	7.52	7.08	6.64

GREEN SERIES MINIATURE WATERPROOF TOGGLES

Bat handle, "O" ring seals inside bushing and at panel. Solder lug terminals.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MTE-106D	SPDT	On-none-on	$2.85	$2.42	$2.28	$2.14
MTE-106E	SPDT	On-off-on	3.35	2.85	2.68	2.51
MTE-106F	SPDT	On-none-on†	3.45	2.93	2.76	2.59
MTE-106G	SPDT	On†-off-on†	3.55	3.02	2.84	2.66
MTE-106H	SPDT	On-off-on†	3.55	3.02	2.84	2.66
MTE-206N	DPDT	On-none-on	3.70	3.15	2.96	2.78
MTE-206P	DPDT	On-off-on	4.25	3.61	3.40	3.19
MTE-206PA	DPDT‡	On-on-on	5.05	4.29	4.04	3.79
MTE-206R	DPDT	On-none-on†	4.35	3.70	3.48	3.26
MTE-206S	DPDT	On†-off-on†	4.45	3.78	3.56	3.34
MTE-206T	DPDT	On-off-on†	4.45	3.78	3.56	3.34
MTE-306D	3PDT	On-none-on	5.95	5.06	4.76	4.46
MTE-306E	3PDT	On-off-on	6.45	5.48	5.16	4.84
MTE-406N	4PDT	On-none-on	7.55	6.42	6.04	5.66
MTE-406P	4PDT	On-off-on	8.05	6.84	6.44	6.04

GREEN SERIES MINIATURE FLAT HANDLE TOGGLES

Flat lever type has matte chrome finish. Solder lug terminals.

MTF-106D	SPDT	On-none-on	$3.00	$2.55	$2.40	$2.25
MTF-106E	SPDT	On-off-on	3.50	2.98	2.80	2.63
MTF-106F	SPDT	On-none-on†	3.60	3.06	2.88	2.70
MTF-106G	SPDT	On†-off-on†	3.70	3.15	2.96	2.78
MTF-106H	SPDT	On-off-on†	3.70	3.15	2.96	2.78
MTF-206N	DPDT	On-none-on	3.85	3.27	3.08	2.89
MTF-206P	DPDT	On-off-on	4.40	3.74	3.52	3.30
MTF-206R	DPDT	On-none-on†	4.50	3.83	3.60	3.38
MTF-206S	DPDT	On†-off-on†	4.60	3.91	3.68	3.45
MTF-206T	DPDT	On-off-on†	4.60	3.91	3.68	3.45
MTF-206PA	DPDT	On-on-on	5.20	4.42	4.16	3.90
MTF-206SA	DPDT	On†-on-on†	5.40	4.59	4.32	4.05
MTF-306D	3PDT	On-none-on	6.10	5.19	4.88	4.58
MTF-406N	4PDT	On-none-on	7.70	6.55	6.16	5.78

†Indicates momentary position.

GREEN SERIES MUSTANG TOGGLES

15/32" bushing, solder lug terminals.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MTG-106D	SPDT	On-none-on	$3.25	$2.76	$2.60	$2.44
MTG-106E	SPDT	On-off-on	3.75	3.19	3.00	2.81
MTG-106F	SPDT	On-none-on†	3.85	3.27	3.08	2.89
MTG-106G	SPDT	On†-off-on†	3.95	3.36	3.16	2.96
MTG-106H	SPDT	On-off-on†	3.95	3.36	3.16	2.96
MTG-206N	DPDT	On-none-on	4.10	3.49	3.28	3.08
MTG-206P	DPDT	On-off-on	4.65	3.95	3.72	3.49
MTG-206R	DPDT	On-none-on†	4.75	4.04	3.80	3.56
MTG-206S	DPDT	On†-off-on†	4.85	4.12	3.88	3.64
MTG-206PA	DPDT‡	On-on-on	5.45	4.63	4.36	4.09
MTG-206N-PC	DPDT	On-none-on	4.20	3.57	3.36	3.15
MTG-306D	3PDT	On-none-on	6.35	5.40	5.08	4.76
MTG-306E	3PDT	On-off-on	6.85	5.82	5.48	5.14
MTG-406N	4PDT	On-none-on	7.95	6.76	6.36	5.96
MTG-406P	4PDT	On-off-on	8.45	7.18	6.76	6.34

GREEN SERIES MINIATURE LOCKING TOGGLES

Lever lock toggle must be pulled out to operate. Solder lug terminals.

MTL-106D	SPDT	On-none-on	$3.90	$3.32	$3.12	$2.93
MTL-106E	SPDT	On-off-on†	4.40	3.74	3.52	3.30
MTL-206N	DPDT	On-none-on	4.75	4.04	3.80	3.56
MTL-206P	DPDT	On-off-on	5.30	4.51	4.24	3.98
MTL-206PA	DPDT‡	On-on-on	6.10	5.19	4.88	4.58
MTL-206S	DPDT	On†-off-on†	5.50	4.68	4.40	4.13
MTL-306D	3PDT	On-none-on	7.00	5.95	5.60	5.25
MTL-406N	4PDT	On-none-on	8.60	7.31	6.88	6.45
MTL-406PA	4P3T	On-on-on	10.50	8.93	8.40	7.88

†Momentary positions. ‡Usable as SP3T; wiring on request.

GREEN SERIES MINIATURE BATON LEVER TOGGLES

Stylish 0.6" long baton having black plastic tip. Solder lug terminals.

MTB-106D	SPDT	On-none-on	$2.40	$2.04	$1.92	$1.80
MTB-106E	SPDT	On-off-on	2.90	2.47	2.32	2.18
MTB-106F	SPDT	On-none-on†	3.00	2.55	2.40	2.25
MTB-106G	SPDT	On†-off-on†	3.10	2.64	2.48	2.33
MTB-206N	DPDT	On-none-on	3.25	2.76	2.60	2.44
MTB-206T	DPDT	On-off-on†	4.00	3.40	3.20	3.00
MTB-306D	3PDT	On-none-on	5.50	4.68	4.40	4.13
MTB-406N	4PDT	On-none-on	7.10	6.04	5.68	5.33

GREEN SERIES MINIATURE TOGGLE SWITCHES WITH PC AND WIRE WRAP TERMINALS

PC terminals are 0.250" long; WW types have 0.031" x 0.050" x 0.740" long terminals.

MTA-106D-PC	SPDT	On-none-on	$2.30	$1.96	$1.84	$1.73
MTA-106E-PC	SPDT	On-off-on	2.80	2.38	2.24	2.10
MTA-106F-PC	SPDT	On-none-on†	2.90	2.47	2.32	2.18
MTA-106G-PC	SPDT	On†-off-on†	3.00	2.55	2.40	2.25
MTA-106H-PC	SPDT	On-off-on†	3.00	2.55	2.40	2.25
MTA-206N-PC	DPDT	On-none-on	3.20	2.72	2.56	2.40
MTA-206P-PC	DPDT	On-off-on	3.75	3.19	3.00	2.81
MTA-206R-PC	DPDT	On-none-on†	3.85	3.27	3.08	2.89
MTA-206S-PC	DPDT	On†-off-on†	3.95	3.36	3.16	2.96
MTA-206T-PC	DPDT	On-off-on†	3.95	3.36	3.16	2.96
MTA-206PA-PC	DPDT	On-on-on	4.55	3.87	3.64	3.41
MTA-306D-PC	3PDT	On-none-on	5.50	4.68	4.40	4.13
MTA-306E-PC	3PDT	On-off-on	6.00	5.10	4.80	4.50
MTA-306F-PC	3PDT	On-none-on†	6.10	5.19	4.88	4.58
MTA-306H-PC	3PDT	On-off-on†	6.20	5.27	4.96	4.65
MTA-406N-PC	4PDT	On-none-on	7.15	6.08	5.72	5.36
MTA-406P-PC	4PDT	On-off-on	7.65	6.50	6.12	5.74
MTA-406PA-PC	4PDT	On-on-on	9.05	7.69	7.24	6.79
MTA-106D-WW	SPDT	On-none-on	2.55	2.17	2.04	1.91
MTA-106E-WW	SPDT	On-off-on	3.05	2.59	2.44	2.29
MTA-206N-WW	DPDT	On-none-on	3.70	3.15	2.96	2.78
MTA-206P-WW	DPDT	On-off-on	4.25	3.61	3.40	3.19
MTA-306D-WW	3PDT	On-none-on	6.25	5.31	5.00	4.69
MTA-406N-WW	4PDT	On-none-on	8.15	6.93	6.52	6.11

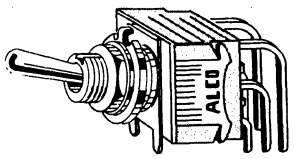
*With white cap. †Momentary positions. ‡Usable as SP3T; wiring on request. §Rocker. IUL Listed E46765.

AUGAT® ALCOSWITCH®

1551 Osgood Street, North Andover, MASS 01845 (617) 685-4371

SUBMINIATURE TOGGLE & ROCKER SWITCHES

Quality and Innovation



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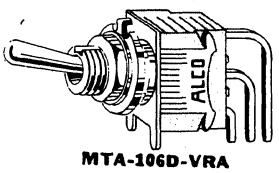

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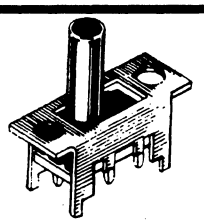

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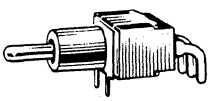

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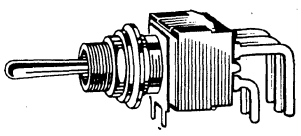

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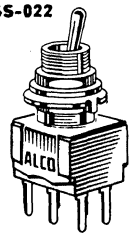

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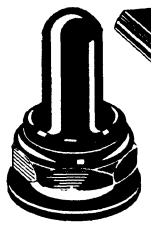

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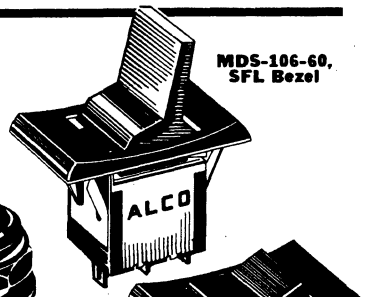
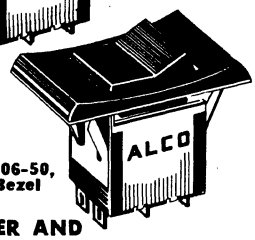


MDS-106-60, SFL Bezel



MDS-206-50, SFL Bezel

GREEN SERIES MINIATURE SHORT LEVER TOGGLE

0.27″ long toggle. PC terminals and ¼-40 threaded bushing.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MTM-106D-PC	SPDT	On-none-on	$2.30	$1.96	$1.84	$1.73
MTM-106E-PC	SPDT	On-off-on	2.80	2.38	2.24	2.10
MTM-206N-PC	DPDT	On-none-on	3.20	2.72	2.56	2.40
MTM-206P-PC	DPDT	On-off-on	3.75	3.19	3.00	2.81
MTM-206PA-PC	DPDT‡	On-on-on	4.55	3.87	3.64	3.41
MTM-306D-PC	3PDT	On-none-on	5.50	4.68	4.40	4.13
MTM-406N-PC	4PDT	On-none-on	7.15	6.08	5.72	5.36

†Momentary positions. ‡Usable as SP3T; wiring on request.

GREEN SERIES MINIATURE RIGHT-ANGLE SWITCHES WITH PC TERMINALS

MTM-RA types have 0.27″ long toggle and unthreaded bushing. **MTA-RA** and **MTA-VRA** types have 0.41″ long toggle and ¼-40 threaded bushing. All three types have right-angle PC terminals.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MTM-106D-RA	SPDT	On-none-on	$2.85	$2.42	$2.28	$2.14
MTM-106E-RA	SPDT	On-off-on	3.35	2.85	2.68	2.51
MTM-106F-RA	SPDT	On-none-on†	3.45	2.93	2.76	2.59
MTM-206N-RA	DPDT	On-none-on	4.25	3.61	3.40	3.19
MTM-206P-RA	DPDT	On-off-on	4.80	4.08	3.84	3.60
MTM-206R-RA	DPDT	On-none-on†	4.90	4.17	3.92	3.68
MTM-106D-VRA	SPDT	On-none-on	2.85	2.42	2.28	2.14
MTM-106E-VRA	SPDT	On-off-on	3.35	2.85	2.68	2.51
MTM-106F-VRA	SPDT	On-none-on†	3.45	2.93	2.76	2.59
MTM-206N-VRA	DPDT	On-none-on	4.25	3.61	3.40	3.19
MTM-206P-VRA	DPDT	On-off-on	4.80	4.08	3.84	3.60
MTM-206R-VRA	DPDT	On-none-on†	4.90	4.17	3.92	3.68
MTA-106D-RA	SPDT	On-none-on	2.80	2.38	2.24	2.10
MTA-106E-RA	SPDT	On-off-on	3.30	2.81	2.64	2.48
MTA-106F-RA	SPDT	On-none-on†	3.40	2.89	2.72	2.55
MTA-206N-RA	DPDT	On-none-on	4.20	3.57	3.36	3.15
MTA-206P-RA	DPDT	On-off-on	4.75	4.04	3.80	3.56
MTA-206R-RA	DPDT	On-none-on†	4.85	4.12	3.88	3.64
MTA-106D-VRA	SPDT	On-none-on	2.80	2.38	2.24	2.10
MTA-106E-VRA	SPDT	On-off-on	3.30	2.81	2.64	2.48
MTA-106F-VRA	SPDT	On-none-on†	3.40	2.89	2.72	2.55
MTA-206N-VRA	DPDT	On-none-on	4.20	3.57	3.36	3.15
MTA-206P-VRA	DPDT	On-off-on	4.75	4.04	3.80	3.56
MTA-206R-VRA	DPDT	On-none-on†	4.85	4.12	3.88	3.64

†Momentary positions. Color caps available. Specify model and color. See Hardware.

SPLASHPROOF SEALS

Seals are made for toggle and pushbutton switching applications. They protect against contaminants such as dirt, gas and liquids. Flexible neoprene is black with choice of black or nickel mount.

Alcoswitch No.	Mount Color	Size	Net Each, Lots of 1-24	26-49	50-99	100-249
B-1048	Black	10-48 Toggle	$1.15	$1.06	$0.98	$0.91
B-210	Nickel	¼-40 Toggle	1.30	1.20	1.11	1.03
B-221	Black	¼-40 Toggle	1.30	1.20	1.11	1.03
B-1440	Black	¼-40 Toggle	1.30	1.20	1.11	1.03
B-588	Nickel	15/32-32 Toggle	1.35	1.24	1.15	1.07
B-226	Black	15/32-32 Toggle	1.35	1.24	1.15	1.07
B-1532	Black	15/32-32 Toggle	1.45	1.33	1.23	1.15
BP-1048	Black	10-48 Pushbutton	1.20	1.10	1.02	.95
BP-190	Nickel	¼-40 Pushbutton	1.35	1.24	1.15	1.07
BP-201	Black	¼-40 Pushbutton	1.35	1.24	1.15	1.07
BP-1440	Black	¼-40 Pushbutton	1.35	1.24	1.15	1.07
BP-589	Nickel	15/32-32 Pushbutton	1.45	1.33	1.23	1.15
BP-590	Black	15/32-32 Pushbutton	1.45	1.33	1.23	1.15
BP-1532	Black	15/32-32 Pushbutton	1.45	1.33	1.23	1.15

MINIATURE ROCKER AND PADDLE WITH SNAP-IN MOUNTING

Designed to snap into a rectangular panel cutout. No mounting hardware is required. Mod-styled levers are accentuated by use of attractive mating bezels. Choice of colors available. Features same as MST Series.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MDS-106D	SPDT	On-none-on	$2.80	$2.38	$2.24	$2.10
MDS-106E	SPDT	On-off-on	3.30	2.81	2.64	2.48
MDS-106F	SPDT	On-none-on†	3.40	2.89	2.72	2.55
MDS-206N	DPDT	On-none-on	3.65	3.10	2.92	2.74
MDS-206P	DPDT	On-off-on	4.20	3.57	3.36	3.15
MDS-206R	DPDT	On-none-on†	4.30	3.66	3.44	3.23

*Specify color: (0)—Black; (2)—Red; (8)—Gray; (9)—White. †Momentary position.

CST SERIES TOGGLE SWITCHES

Low-cost baton lever toggles. DPDT, 3 mA at 125 VAC.

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
CST-022	DPDT	$1.35	$1.15	$1.08	$1.01
CST-022-1	DPDT	1.35	1.15	1.08	1.01
CST-022N	DPDT	1.45	1.23	1.16	1.09
CST-022S	DPDT	1.45	1.23	1.16	1.09
CST-022RN	DPDT	1.50	1.28	1.20	1.13
CST-022RN	DPDT	1.50	1.28	1.20	1.13
CST-023	DP3T	1.50	1.28	1.20	1.13
CST-023SA	DP3T	1.60	1.36	1.28	1.20
CST-023TA	DP3T	1.60	1.36	1.28	1.20
CST-042N	4PDT	1.80	1.53	1.44	1.20
CST-042S	4PDT	1.80	1.53	1.44	1.35
CST-042RS	4PDT	1.85	1.57	1.48	1.39
CST-042RS	4PDT	1.85	1.57	1.48	1.39
CST-043N	4P3T	1.90	1.62	1.52	1.43
CST-043SA	4P3T	1.95	1.66	1.56	1.46
CST-043TA	4P3T	1.95	1.66	1.56	1.46
CST-062N	6P2T	2.20	1.87	1.76	1.65
CST-062S	6P2T	2.20	1.87	1.76	1.65

MST MINIATURE TOGGLE SWITCHES

Slim, bat handle toggle switches for miniature applications with limited back-of-panel clearance. Terminals and contacts are solid silver (center terminal, copper with silver plate). Case material, black phenolic resin; ¼-40 threaded bushing. Rated 6 amps at 125 VAC. Offering high capacity for small size, SPDT and DPDT types have life cycle of over 80,000 on-off operations; 3PDT and 4PDT, over 20,000. High voltage barriers between terminals and contacts; 1 piece body.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MST-105D	SPDT‡	On-none-on	$2.25	$1.91	$1.80	$1.69
MST-105E	SPDT	On-off-on	2.75	2.34	2.20	2.06
MST-105F	SPDT	None-on-on†	2.85	2.42	2.28	2.14
MST-105G	SPDT	On†-off-on†	2.95	2.51	2.36	2.21
MST-105H	SPDT	On-off-on†	2.95	2.51	2.36	2.21
MST-115D*	SPDT	On-none-on	2.10	1.79	1.68	1.58
MST-205N	DPDT‡	On-none-on	3.10	2.64	2.48	2.33
MST-205P	DPDT	On-off-on	3.65	3.10	2.92	2.74
MST-205PA	DPDT‡	On-on-on	4.45	3.78	3.56	3.34
MST-205R	DPDT	None-on-on†	3.75	3.19	3.00	2.81
MST-205S	DPDT	On†-off-on†	3.85	3.27	3.08	2.89
MST-205SA	DPDT‡	On†-on-on†	4.65	3.95	3.72	3.49
MST-205T	DPDT	On-off-on†	3.85	3.27	3.08	2.89
MST-205TA	DPDT‡	On-on-on†	4.65	3.95	3.72	3.49
MST-215N*	DPDT	On-none-on	2.95	2.51	2.36	2.21
MST-305D	3PDT	On-none-on	5.35	4.55	4.28	4.01
MST-305E	3PDT	On-off-on	5.85	4.97	4.68	4.39
MST-305F	3PDT	None-on-on†	5.95	5.06	4.76	4.46
MST-305H	3PDT	On-off-on†	6.05	5.14	4.84	4.54
MST-315D*	3PDT	On-none-on	5.10	4.34	4.08	3.83
MST-405N	4PDT	On-none-on	6.95	5.91	5.56	5.21
MST-405P	4PDT	On-off-on	7.45	6.33	5.96	5.59
MST-415N*	4PDT	On-none-on	6.60	5.61	5.28	4.95

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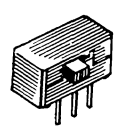
SLIDE & ROCKER SWITCHES

Quality and Innovation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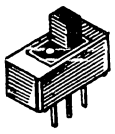
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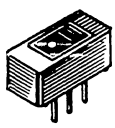
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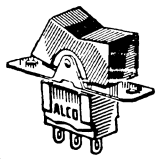

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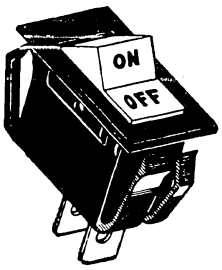

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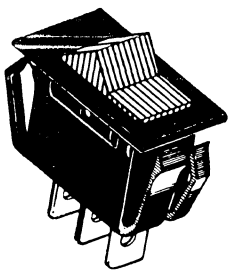
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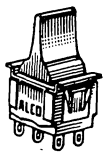
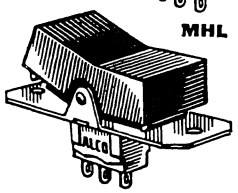


MLD-206N-80

MLD-106D-70



MRL-30

MINIATURE PC SLIDE SWITCHES

Instrument grade miniature slide switches designed for printed circut board mounting. Primarily for use in programming, test apparatus and other instrumentation applications. All models available in SPDT and DPDT. Rated at 2 amps @ 230 VAC and 4 amps @ 115 VAC. **"G"** suffix indicates gold plated terminals.

Alcoswitch No. MSSA-	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
104D	1 Pole, 2 Pos., upright	$1.95	$1.66	$1.56	$1.46
104D-1	1 Pole, 2 Pos., flush	1.95	1.66	1.56	1.46
104D-RA	1 Pole, 2 Pos., right ang.	2.05	1.74	1.64	1.54
101DG-WW	1 Pole, 1 Pos., wire wrap	2.30	1.96	1.84	1.73
104E	1 Pole, 2 Pos., upright	2.40	2.04	1.92	1.80
104E-1	1 Pole, 2 Pos., flush	2.40	2.04	1.92	1.80
104E-RA	1 Pole, 2 Pos., right ang.	2.50	2.13	2.00	1.88
101EG-WW	1 Pole, 2 Pos., wire wrap	2.70	2.30	2.16	2.05
204N	2 Pole, 2 Pos., upright	2.85	2.42	2.28	2.14
204N-1	2 Pole, 2 Pos., flush	2.85	2.42	2.28	2.14
204N-RA	2 Pole, 2 Pos., right ang.	3.00	2.55	2.40	2.25
201NG-WW	2 Pole, 2 Pos., wire wrap	3.55	3.02	2.84	2.66
204P	2 Pole, 2 Pos., upright	3.35	2.85	2.68	2.51
204P-1	2 Pole, 2 Pos., flush	3.35	2.85	2.68	2.51
204P-RA	2 Pole, 2 Pos., right ang.	3.50	2.98	2.80	2.63
201PG-WW	2 Pole, 2 Pos., wire wrap	4.15	3.53	3.32	3.11

GREEN SERIES MLD SERIES ROCKER AND PADDLE SWITCHES

Miniature rocker or lever switches with 6 Amp current carrying capacity. Mounts without hardware with clips. Case material is high temperature DAP. Gold flash contacts and terminals. Actuators available in red, black, grey, green, blue, orange or yellow. Please specify.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MLD-106D	SPDT	On-none-on	$2.80	$2.38	$2.24	$2.10
MLD-106E	SPDT	On-off-on	3.30	2.81	2.64	2.48
MLD-106F	SPDT	On-none-(on)	3.40	2.89	2.72	2.55
MLD-206N	DPDT	On-none-on	3.65	3.10	2.92	2.74
MLD-206P	DPDT	On-off-on	4.20	3.57	3.36	3.15
MLD-206R	DPDT	On-none-(on)	4.30	3.66	3.44	3.23

-70 indicates rocker type; **-80** indicates lever type.

GREEN SERIES MINIATURE ROCKERS AND PADDLES

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MRL-106D-30/40	SPDT	On-none-on	$2.85	$2.42	$2.28	$2.14
MRL-106E-30/40	SPDT	On-off-on	3.35	2.85	2.68	2.51
MRL-106F-30/40	SPDT	On-none-on†	3.45	2.93	2.76	2.59
MRL-206N-30/40	DPDT	On-none-on	3.70	3.15	2.96	2.78
MRL-206P-30/40	DPDT	On-off-on	4.25	3.61	3.40	3.19
MRL-206R-30/40	DPDT	On-none-on†	4.35	3.70	3.48	3.26
MRL-306D-30/40	3PDT	On-none-on	5.95	5.06	4.76	4.46
MRL-406N-30/40	4PDT	On-none-on	7.55	6.42	6.04	5.66

-30 denotes rocker type; **-40** denotes lever type.

GREEN SERIES MHL MINIATURE ROCKER WITH MOUNTING BRACKET

Small rocker actuator mounted on basic MT Toggle Switch body.

MHL-106D-10(*)	SPDT	On-none-on	$2.85	$2.42	$2.28	$2.14
MHL-106F-10(*)	SPDT	On-none-on†	3.45	2.93	2.76	2.59
MHL-206N-10(*)	DPDT	On-none-on	3.70	3.15	2.96	2.78
MHL-206R-10(*)	DPDT	On-none-on†	4.35	3.70	3.48	3.26
MHL-306D-10(*)	3PDT	On-none-on	5.95	5.06	4.76	4.46
MHL-306F-10(*)	3PDT	On-none-on†	6.55	5.57	5.24	4.91
MHL-406N-10(*)	4PDT	On-none-on	7.55	6.42	6.04	5.66
MHL-406R-10(*)	4PDT	On-none-on†	8.25	7.01	6.60	6.19

†Indicates momentary position. * Specify color: **0**—Black; **2**—Red; **5**—Green; **6**—Blue; **8**—Gray; **9**—White.

Alcoswitch No.	Description	Net Each, Lots of 10 Min.	20-90	100-490	500-990
378	Lamp: 6.3 V, .2 A	$0.55	$0.50	$0.44	$0.41
362	Lamp: 14 V, .08 A	.55	.50	.44	.41
399	Lamp: 28 V, .04 A	.53	.48	.42	.39

ROCKER AND PADDLE SWITCHES

Compact miniature rocker and paddle switches mount without hardware. Snap-fit into cutouts in panels. Will carry loads up to 10 Amps at 125 VAC. Select from a wide assortment to suit your application. Special legends available on quantity orders.

SINGLE-POLE ROCKER—XR1 SERIES

Alcoswitch No.	Application	Net Each, Lots of 1-24	26-49	50-99	100-499
XR110A-	On-none-off	$1.60	$1.28	$1.12	$0.85
XR110D-	On-none-on	1.60	1.28	1.12	.85
XR110E-	On-off-on	1.60	1.28	1.12	.85
XR110F-	On-none-on*	1.90	1.52	1.33	1.01

SINGLE-POLE PADDLE—XP1 SERIES

XP110A-	On-none-off	$1.60	$1.28	$1.12	$0.85
XP110D-	On-none-on	1.60	1.28	1.12	.85
XP110E-	On-off-on	1.60	1.28	1.12	.85
XP110F-	On-none-on*	1.90	1.52	1.33	1.01

DOUBLE-POLE ROCKER—XR2 SERIES

XR210K	One-none-off	$2.70	$2.16	$1.89	$1.43
XR210N	On-none-on	2.70	2.16	1.89	1.43
XR210P	On-off-on	2.70	2.16	1.89	1.43
XR210R	On-none-on*	3.30	2.31	2.64	2.31

SINGLE-POLE LIGHTED ROCKER—XRL1 SERIES

XRL110A-	On-none-off	$3.20	$2.56	$2.24	$1.70

SINGLE-POLE LIGHTED PADDLE—XPL1 SERIES

XPL110A-	On-none-off	$3.20	$2.56	$2.24	$1.70

DOUBLE-POLE LIGHTED ROCKER—XRL2 SERIES

XRL210A-	On-none-off	$3.60	$2.88	$2.52	$1.91
XRL210D-	On-none-on	3.70	2.96	2.59	1.96
XRL210F-	On-none-on*	3.90	3.12	2.73	2.07

*Momentary.

To identify the switch being ordered, it is necessary to specify colors by adding the appropriate code number suffix shown below:
00—Black body, Black actuator.
02—Black body, Red actuator.
09—Black body, White actuator.
90—White body, Black actuator.
92—White body, Red actuator.

For lighted models, add color code number:
04—Black body, Amber lens
99—White body, Clear lens
004—Black body, Black lever, Amber lens
024—Black body, Red lever, Amber lens
094—Black body, White lever, Amber lens
909—White body, Black lever, Clear lens
929—White body, Red lever, Clear lens

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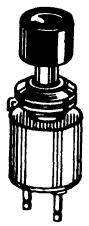
PUSHBUTTON SWITCHES

Quality and Innovation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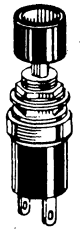
MSP-105F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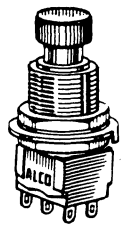
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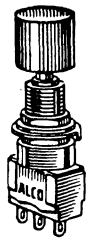
MPA-106

MSP SERIES MINIATURE PUSHBUTTON SWITCHES

MSP-105, MSP-205—Snap action. Rated 6 A, 125 VAC. Solid silver contacts and terminals. Bushing ¼"-40 with keyway. Black phenolic case. Life, 25,000 cycles. **MSP-103**—Economy, low pressure operation. Rated 1 A, 125 VAC. Silver-plated brass contacts and terminals. Plunger travel, .098". Bushing ¼"-40. Diameter .408". **MSPS-103C**—Similar to MSP-103, but smaller diameter, .310". Rated 0.5 A at 125 VAC.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MSP-105D	SPDT	Push on-off	$3.55	$3.02	$2.84	$2.66
MSP-105F	SPDT	Momentary	3.55	3.02	2.84	2.66
MSP-205N	DPDT	Push on-off	4.50	3.83	3.60	3.38
MSP-205R	DPDT	Momentary	4.50	3.83	3.60	3.68
MSP-103B	SPST	N.C., (Black)	1.45	1.23	1.16	1.09
MSP-103C	SPST	N.O., (Red)	1.45	1.23	1.16	1.09
MSP-103C-B	SPST	N.O., (Black)	1.45	1.23	1.16	1.09
MSP-103C-2	SPST	N.O., (Red)	1.55	1.32	1.24	1.16
MSPS-103B	SPST	N.C., (Black)	.80	.68	.64	.60
MSPS-103C	SPST	N.O., (Red)	.80	.68	.64	.60
MSPS-103C-B	SPST	N.O., (Black)	.80	.68	.64	.60

BUTTONS FOR MSP SERIES

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-49	50-99	100-499
C-12	Plastic button for MSP-105	$0.22	$0.20	$0.18	$0.17
C-13	Large plastic button for MSP-105	.29	.26	.24	.22
C-14	Small chrome button for MSP-105	.22	.20	.18	.17
C-14L	Large chrome button for MSP-105	.27	.24	.23	.20

MPB SERIES MINIATURE PUSHBUTTON SWITCHES

MPB-103 miniature momentary pushbuttons have over-travel to provide 3 A @ 125 VAC rating. Normally open types have snap-on .395" dia. button; normally closed types have black button.

Alcoswitch No.	Contacts	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
MPB-103B	SPST	N.C.	$1.75	$1.49	$1.40	$1.31
MPB-103C	SPST	N.O.	1.75	1.49	1.40	1.31

MSPF SERIES MOMENTARY PUSHBUTTON

Series features large button and 15-32 body. Allows choice of front or rear panel mounting. Unique contact design allows self-leveling, assuring minimum contact resistance. All models have epoxy seals on terminals. Choice of button color.

Alcoswitch No.	Contacts	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
MSPF-101B	SPST	N.C. (Black)	$1.95	$1.66	$1.56	$1.46
MSPF-101C	SPST	N.O. (Red)	1.95	1.66	1.56	1.46
MSPF-101BC	2 Ckt.	N.O./N.C.*	2.35	2.00	1.88	1.76

*Specify color: **0**—Black; **2**—Red; **6**—Blue; **9**—White.

MAGNETIC REED PUSHBUTTON SWITCHES

SPST momentary for data processing equipment; ceramic magnets eliminate springs. Contacts are glass-encapsulated reeds for long life; plunger is keyed and non-rotating; metal case withstands abuse. Rated 100 mA at 50 VDC; resistance, 100 milliohms. Contact bounce, 1 msec; plunger travel, 5/64". Oper. force, 2 oz. Life, 10 million cycles.

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-99	50-99	100-499
MSPM-101B*	NC; solder lugs	$5.25	$4.73	$4.46	$4.20
MSPM-101C†	NO; solder lugs	5.25	4.73	4.46	4.20
MSPM-101B-1*	NC; .110" terminal	5.25	4.73	4.46	4.20
MSPM-101C-1†	NO; .110" terminal	5.25	4.73	4.46	4.20
MSPM-101BP	Push-pull	5.35	4.82	4.55	4.28
MSPM-101CP	Push-pull	5.35	4.82	4.55	4.28
MSPM-101BS-1	NC; solder lug	5.05	4.55	4.29	4.04
MSPM-101CS-1	NO; solder lug	5.05	4.55	4.29	4.04
MSPM-101BS	NC; PC terminal	5.05	4.55	4.29	4.04
MSPM-101CS	NO; PC terminal	5.05	4.55	4.29	4.04

*Supplied with C-22 black button. †Supplied with C-22 red button. MSPM Series also accept C23 cap.

GREEN SERIES

MUSTANG PUSHBUTTONS

1 13/32" bushing with solder lug terminals. PC suffix for PC terminals.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MPG-106D	SPDT	Push on/off	$4.35	$3.70	$3.48	$3.26
MPG-106F	SPDT	Momentary	4.35	3.70	3.48	3.26
MPG-206N	DPDT	Push on/off	5.30	4.51	4.24	3.98
MPG-206R	DPDT	Momentary	5.30	4.51	4.24	3.98
MPG-306D	3PDT	Push on/off	6.75	5.74	5.40	5.06
MPG-306F	3PDT	Momentary	6.75	5.74	5.40	5.06
MPG-406N	4PDT	Push on/off	8.75	7.44	7.00	6.56
MPG-206N-PC	DPDT	Push on/off	5.40	4.59	4.32	4.05
MPG-206R-PC	DPDT	Momentary	5.40	4.59	4.32	4.05

Supplied with Black C-9 cap only.

SUBMINIATURE PUSHBUTTON SWITCHES

Subminiature pushbutton switch with one piece bushing and case construction. Current Rating: 3 amps @ 125 VAC D & F Series, 1 amp @ 125 VAC B & C Series. Supplied with black cap, C5.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MPA-103B	SPST	N. C. Mom.	$1.65	$1.40	$1.32	$1.24
MPA-103C	SPST	N. O. Mom	1.65	1.40	1.32	1.24
MPA-103D	SPDT	Push on/off	2.95	2.51	2.36	2.21
MPA-103F	SPDT	Momentary	2.95	2.51	2.36	2.21
C-5	Small plastic cap blk, red, grn. or wht.		.11	.10	.09	.08
C-8	Large plastic cap blk, red, grn, or wht.		.12	.11	.10	.09

GREEN SERIES

MINIATURE PUSHBUTTONS

Supplied with black C-22 button.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MPA-106D	SPDT	Push on/off	$3.55	$3.02	$2.84	$2.66
MPA-106F	SPDT	Momentary	3.55	3.02	2.84	2.66
MPA-206N	DPDT	Push on/off	4.50	3.83	3.60	3.38
MPA-206R	DPDT	Momentary	4.50	3.83	3.60	3.38
MPA-306D	3PDT	Push on/off	5.95	5.06	4.76	4.46
MPA-306F	3PDT	Momentary	5.95	5.06	4.76	4.46
MPA-406N	4PDT	Push on/off	7.95	6.76	6.36	5.96
MPA-406R	4PDT	Momentary	7.95	6.76	6.36	5.96
C-9	Colored cap—red, blue, pink, yel. or wht.		.14	.13	.12	.11

GREEN SERIES

MINIATURE WATERPROOF PUSHBUTTONS

"O" rings inside bushing and at panel.

Alcoswitch No.	Contacts	Application	Net Each, Lots of 1-24	26-49	50-99	100-249
MPE-106D	SPDT	Push on/off	$4.25	$3.61	$3.40	$3.19
MPE-106F	SPDT	Momentary	4.25	3.61	3.40	3.19
MPE-206N	DPDT	Push on/off	5.20	4.42	4.16	3.90
MPE-206R	DPDT	Momentary	5.20	4.42	4.16	3.90
MPE-306D	3PDT	Push on/off	6.65	5.65	5.32	4.99
MPE-306F	3PDT	Momentary	6.65	5.65	5.32	4.99
MPE-406N	4PDT	Push on/off	8.65	7.35	6.92	6.49
MPE-406R	4PDT	Momentary	8.65	7.35	6.92	6.49

PLASTIC BUTTONS FOR MPA AND MPE SERIES

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-49	50-99	100-499
C-22†	Small button	$0.19	$0.17	$0.16	$0.14
C-23†	Large button	.23	.21	.19	.17
KG-22AB	Grooved, black top	.45	.41	.38	.34
KG-22AR	Grooved, red top	.45	.41	.38	.34
KG-22AG	Grooved, green top	.45	.41	.38	.34

†Specify Red, Black, Green, Blue, Orange or Ivory.

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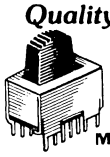
Slide Switches

Quality and Innovation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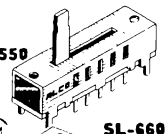
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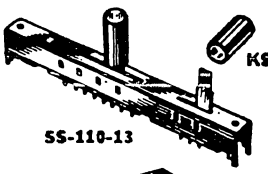
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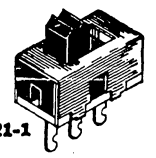
SS-110-13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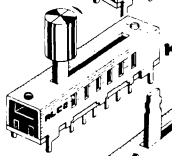
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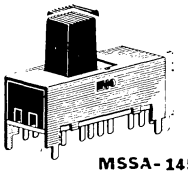
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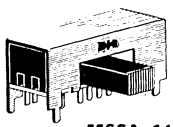
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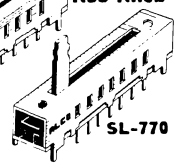
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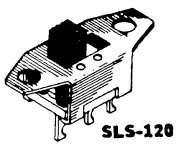
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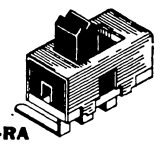
SLS-121-RA

MINIATURE PRINTED CIRCUIT SLIDE SWITCHES

Mount directly to PC board. Rated 300 mA, 125 VAC. Life, 15,000 cycles at rated load. Silver-plated contacts except where noted gold (gold-plated nickel); movable contacts beryllium plated brass. MSS-4300, -6200, and larger sizes, 4-40 screw holes; others tab.

Alcoswitch No. MSS-	Contacts	Description	Net Each, Lots of 1-24	26-99	100-499	500-999
1200R	SPDT	Right angle	$0.90	$0.63	$0.54	$0.47
1200RG	SPDT	Right angle, gold	1.25	.88	.75	.65
1300	SP3T	Upright	.95	.67	.57	.49
1300R	SP3T	Right angle	1.05	.74	.63	.55
1400	SP4T	Upright	1.05	.74	.63	.55
2200	DPDT	Upright	.90	.63	.54	.47
2200G	DPDT	Upright, gold	1.40	.98	.84	.73
2220	DPDT	Upright, .197" lever	.90	.63	.54	.47
2220G	DPDT	Upright, .197" lever, gold	1.40	.98	.84	.73
2225	DPDT	Upright, .250" lever	.90	.63	.54	.47
2225G	DPDT	Upright, .250" lever, gold	1.40	.98	.84	.73
2250	DPDT	Upright, long lever	.90	.63	.54	.47
2250G	DPDT	Upright, long lever, gold	1.40	.98	.84	.73
2250R	DPDT	Right angle, long lever	.95	.67	.57	.49
2250RG	DPDT	Rt. angle, lg. lever, gold	1.45	1.02	.87	.75
4200	4PDT	Upright	1.05	.74	.63	.55
4200G	4PDT	Upright, gold	2.25	1.58	1.35	1.17
4250	4PDT	Upright, long lever	1.10	.77	.66	.57
4200R	4PDT	Right angle	1.30	.91	.78	.68
4200RG	4PDT	Right angle, gold	2.45	1.72	1.47	1.27
4300	4P3T	Upright	1.45	1.02	.87	.75
4300G	4P3T	Upright, gold	3.15	2.21	1.89	1.64
4335	4P3T	Upright, .365" lever	1.50	1.05	.90	.78
4300R	4P3T	Right angle	1.60	1.12	.96	.83
4300RG	4P3T	Right angle, gold	3.25	2.28	1.95	1.69
4350R	4P3T	Right angle, long lever	1.65	1.16	.99	.86
4350RG	4P3T	Rt. angle, lg. lever, gold	3.30	2.31	1.98	1.72
6200	6PDT	Upright	1.45	1.02	.87	.75
6200G	6PDT	Upright, gold	3.90	2.73	2.34	2.03
6300	6P3T	Upright	1.70	1.19	1.02	.88
6300G	6P3T	Upright, gold	4.95	3.47	2.97	2.57
6350	6P3T	Upright, long lever	1.75	1.23	1.05	.91
6350R	6P3T	Right angle, long lever	1.80	1.26	1.08	.94
8300	8P3T	Upright	2.35	1.65	1.41	1.22
10300	10P3T	Upright	2.55	1.79	1.53	1.33
12300	12P3T	Upright	2.95	2.07	1.77	1.53

MSSA PC SLIDE SWITCHES

Expanded line of 1, 2, 3 and 4 pole PC mountable slide switches. Rated 300 mA at 125 VAC. Life Expectancy, 15,000 cycles at rated load. Available in vertical and right-angle models. Switches feature positive wiping and have "Make-Before-Break" action. Contacts are silver or gold plated.

MSSA-			1-24	26-49	50-99	100-249
1350	SP3T	Upright	$1.30	$1.04	$0.98	$0.88
1350G	SP3T	Upright, gold	1.95	1.56	1.46	1.33
1350R	SP3T	Right angle	1.40	1.12	1.05	.95
1350RG	SP3T	Right angle, gold	2.05	1.64	1.54	1.39
1450	SP4T	Upright	1.40	1.12	1.05	.95
1450G	SP4T	Upright, gold	2.05	1.64	1.54	1.39
1450R	SP4T	Right angle	1.50	1.20	1.13	1.02
1450RG	SP4T	Right angle, gold	2.15	1.72	1.61	1.46
2350	DP3T	Upright	1.50	1.20	1.13	1.02
2350G	DP3T	Upright, gold	2.80	2.24	2.10	1.90
2350R	DP3T	Right angle	1.60	1.28	1.20	1.09
2350RG	DP3T	Right angle, gold	2.90	2.32	2.18	1.97
2450	DP4T	Upright	1.65	1.32	1.24	1.12
2450G	DP4T	Upright, gold	2.95	2.36	2.21	2.01
2450R	DP4T	Right angle	1.75	1.40	1.31	1.19
2450RG	DP4T	Right angle, gold	3.05	2.44	2.29	2.07
3350	3P3T	Upright	1.80	1.44	1.35	1.22
3350G	3P3T	Upright, gold	3.75	3.00	2.81	2.55
3350R	3P3T	Right angle	1.90	1.52	1.43	1.29
3350RG	3P3T	Right angle, gold	3.85	3.08	2.89	2.62
3450	3P4T	Upright	1.95	1.56	1.46	1.33
3450G	3P4T	Upright, gold	3.90	3.12	2.93	2.65
3450R	3P4T	Right angle	2.05	1.64	1.54	1.39
3450RG	3P4T	Right angle, gold	4.00	3.20	3.00	2.72
4350	4P3T	Upright	1.95	1.56	1.46	1.33
4350G	4P3T	Upright, gold	4.55	3.64	3.41	3.09
4350R	4P3T	Right angle	2.05	1.64	1.54	1.39
4350RG	4P3T	Right angle, gold	4.65	3.72	3.49	3.16
4450	4P4T	Upright	2.15	1.72	1.61	1.46
4450G	4P4T	Upright, gold	4.75	3.80	3.56	3.23
4450R	4P4T	Right angle	2.25	1.80	1.69	1.53
4450RG	4P4T	Right angle, gold	4.85	3.88	3.64	3.30

SL SERIES MULTI-POSITION SLIDE SWITCH WITH PC TERMINALS

Designed specifically for PC applications. Save space, installation time and wiring errors. Substitute for rotary switches and other ideal uses. Feature a ball detent for positive tactile feel. Contacts are self-cleaning and terminals are sealed for added protection. Internal construction is similar to the MSS Series.

Alcoswitch No.	Type	Net Each, Lots of 1-24	26-99	100-499	500-999
SL-220	2 Positions	$1.20	$0.84	$0.72	$0.62
SL-330	3 Position	1.30	.91	.78	.68
SL-550	5 Position	1.55	1.09	.93	.81
SL-660	6 Position	1.70	1.19	1.02	.88
SL-770	7 Positions	1.85	1.30	1.11	.96
SL-880	8 Positions	2.05	1.44	1.23	1.07
KSS-20A	Natural Aluminum Knob	.30	.29	.26	.25

SS SERIES SLIDE SWITCHES

Designed for printed circuit boards. Offer operational versatility, high density, light weight, and a broad variety of control functions. Rated to carry 300 mA at 30 VDC. Make before break. Have silver contacts, sealed terminals. For use in matrix applications, adjustable voltage dividers, x-y positioning, and others.

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-49	50-99	100-249
SS-110-13	Single pole, 10+3 pos.	$2.90	$2.32	$2.18	$1.97
SS-111	Single pole, 11 positions	2.45	1.96	1.84	1.67
SS-24	Double pole, 4 positions	1.65	1.32	1.24	1.12

KSS KNOBS

Alcoswitch No.	Description	Net Each, Lots of 1-24	26-49	50-99	100-499
KSS-1A	Natural, small, less hairline	$0.35	$0.33	$0.31	$0.29
KSS-1B	Black, small, less hairline	.35	.33	.31	.29
KSS-2A	Natural, large, less hairline	.35	.33	.31	.29
KSS-2B	Black, large less hairline	.35	.33	.31	.29
KSS-3A	Natural, large, double hairline	.40	.38	.35	.34
KSS-3B	Black, large, double hairline	.40	.38	.35	.34
KSS-20	Natural Aluminum	.30	.29	.26	.25

SLS BOBBIN CONTACT MINIATURE SLIDE SWITCHES

New family of SLS Bobbin Contact switches provide improved tactile feel. More positive detent. Rated 250 mA at 125 VAC; 150 mA at 12 VDC. Silver plated contacts and terminals.

Alcoswitch No.	Description	Net Each, Lots of 1-99	101-499	500-999	1000-2499
SLS-121-PC	SPDT, w/o tabs, w/PC terminals	$0.65	$0.49	$0.42	$0.33
SLS-121-RA	SPDT, w/o tabs, w/right angle term.	.75	.56	.49	.38
SLS-131-PC	SP3P, w/o tabs, w/PC terminals	.90	.68	.59	.45
SLS-131-RA	SP3P, w/o tabs, w/right angle term.	1.00	.75	.65	.50
SLS-141-PC	SP4P, w/o tabs, w/PC terminals	1.15	.86	.75	.58
SLS-141-RA	SP4P, w/o tabs, w/right angle term.	1.25	.94	.81	.63
SLS-151-PC	SP5P, w/o tabs, w/PC terminals	1.40	1.05	.91	.70
SLS-151-RA	SP5P, w/o tabs, w/right angle term.	1.50	1.13	.98	.75
SLS-121-1	SPDT, w/o tabs, w/PC terminals	.65	.49	.42	.33
SLS-121	SPDT, w/tabs, panel mounted	.65	.49	.42	.33

SLS MINIATURE SLIDE SWITCHES

Economical miniature slide switch, 5/16" wide and approximately 1/4" long. Rated at 0.5 amps @ 125 VAC except 121M series, 0.3 amps @ 125 VAC; -130 and -240 series, .25 amps @ 125 VAC.

SLS-120	SPDT, w/Tabs	$0.60	$0.45	$0.39	$0.30
SLS-120-1	SPDT, w/o Tabs	.60	.45	.39	.30
SLS-220	DPDT, w/Tabs	.75	.56	.49	.38
SLS-220-1	DPDT, w/o Tabs	.75	.56	.49	.38
SLS-240-PC	DP4P, w/o Tabs, w/PC terminals	1.35	1.01	.88	.68

AUGAT® ALCOSWITCH®

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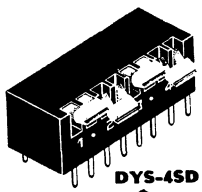
DIP & KEYLOCK SWITCHES

Quality and Innovation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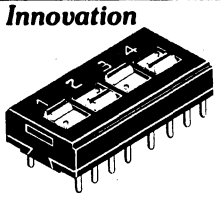
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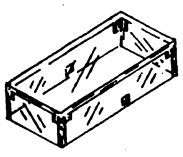
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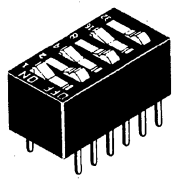
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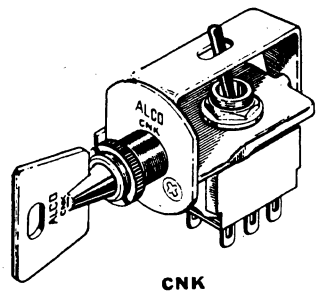
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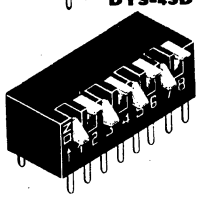
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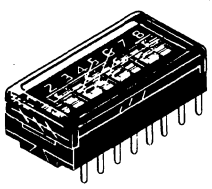
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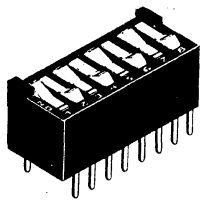

DSS-8

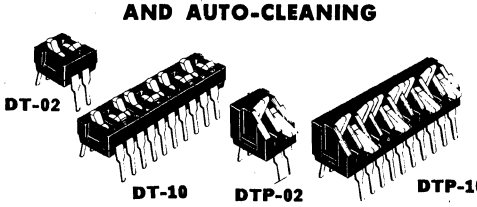
DIP SERIES DUAL IN-LINE MOUNTING

DIP switches provide high reliability at reasonable cost. All models are designed for soldering onto PC boards or may be optionally used with standard DIP sockets. Terminals and contacts are beryllium copper with gold plated over nickel to assure dependable service for low-energy level use. The low-profile DLS and DLS-SD models have molded-in terminals; all other types have epoxy sealed bases for protection during the soldering operation. The DLS and DLS-SD models are supplied with a protective cover having an "actuator lock" feature that prevents accidental operation and protects the inner mechanism during cleaning cycles. These covers are also available as an option for the DSS models.

Alco-switch No.	Type	Lever	Net Each, Lots of 1-24	26-49	50-99	100-249
DSS-4	4PST	Rocker	$3.45	$3.11	$2.93	$2.76
DSS-6	6PST	Rocker	3.95	3.56	3.36	3.16
DSS-7	7PST	Rocker	4.20	3.78	3.57	3.36
DSS-8	8PST	Rocker	4.45	4.01	3.78	3.56
DSS-10	10PST	Rocker	4.95	4.46	4.21	3.96
DSS-C*	Protective Cover		.15	.14	.13	.12
DBS-5	5PST	Rocker	3.70	3.33	3.15	2.96
DBS-6	6PST	Rocker	3.95	3.56	3.36	3.16
DLS-4	4PST	Slide	3.55	3.20	3.02	2.84
DLS-6	6PST	Slide	4.05	3.65	3.44	3.24
DLS-8	8PST	Slide	4.55	4.10	3.87	3.64
DLS-10	10PST	Slide	5.05	4.55	4.29	4.04
DLS-2SD	(2) N.O.-N.C.	Slide	3.55	3.20	3.02	2.84
DLS-3SD	(3) N O.-N.C.	Slide	4.05	3.65	3.44	3.24
DLS-4SD	(4) N.O.-N.C.	Slide	4.55	4.10	3.87	3.64
DLS-5SD	(5) N.O.-N.C.	Slide	5.05	4.55	4.29	4.04
DYS-4	4PST	Piano	3.40	3.06	2.89	2.72
DYS-6	6PST	Piano	4.35	3.92	3.70	3.48
DYS-8	8PST	Piano	4.85	4.37	4.12	3.88
DYS-10	10PST	Piano	5.35	4.82	4.55	4.28
DYS-2SD	(2) N.O.-N.C.	Piano	3.85	3.47	3.27	3.08
DYS-3SD	(3) N.O.-N.C.	Piano	4.35	3.92	3.70	3.48
DYS-4SD	(4) N.O.-N.C.	Piano	4.85	4.37	4.12	3.88
DYS-5SD	(5) N.O.-N.C.	Piano	5.35	4.82	4.55	4.28

*Specify size: (4), (6), (7), (8) or (10).

DIP SWITCHES FOR WAVE SOLDERING AND AUTO-CLEANING



No tape seal required—allows extended actuators. Self-cleaning design allows exposure to dirt and contaminants without falling. Contact Rating: 1 amp at 24 VDC without switching, 100 mA at 5 VDC with switching. Initial Contact Resistance: 30 milliohms, max. Operating Temperature Range: −30° C to +85° C. Life Expectancy: 10,000 cycles.

Alco-Switch No.	Type	Lever Type	Net Each, Lots of 1-99	100-499	500-999	1000 Up
DT-02	2PST	Top	$1.30	$1.04	$0.91	$0.85
DT-04	4PST	Top	1.45	1.16	1.02	.94
DT-06	6PST	Top	1.60	1.28	1.12	1.04
DT-08	8PST	Top	1.80	1.44	1.26	1.17
DT-10	10PST	Top	2.05	1.64	1.44	1.33
DTP-02	2PST	Side	1.75	1.40	1.23	1.14
DTP-04	4PST	Side	1.90	1.52	1.33	1.24
DTP-06	6PST	Side	2.05	1.64	1.44	1.33
DTP-08	8PST	Side	2.25	1.80	1.58	1.46
DTP-10	10PST	Side	2.50	2.00	1.75	1.63

SAFETY KEYSWITCHES

Compact, high quality keyswitches for safety where unintentional switching could be hazardous. Keys removable from any position. Mount in ⅜" hole in panels up to ¼" thick. Anti-rotation device prevents movement after mounting. Available with 6 or 10 Amp switches.

Alcoswitch No.	Contacts	Action	Net Each, Lots of 1-24	26-49	50-99	100-249
CNK-106D	SPDT	On-none-on	$6.15	$5.23	$4.92	$4.61
CNK-106F	SPDT	On-none-on†	6.75	5.74	5.40	5.06
CNK-206N	DPDT	On-none-on	7.00	5.95	5.60	5.25
CNK-206R	DPDT	On-none-on†	7.60	6.46	6.08	5.70
CNK-306D	3PDT	On-none-on	9.15	7.78	7.32	6.86
CNK-406N	4PDT	On-none-on	10.65	9.05	8.52	7.99
CNK§	Keyswitch adapter unit		3.55	3.02	2.84	2.66
CNK-Key	Extra key for CNK		.75	.71	.66	.60
CNK-2-106D	SPDT	On-none-on	6.25	5.31	5.00	4.69
CNK-2-206N	DPDT	On-none-on	7.10	6.04	5.68	5.33
CNK-2-306D	3PDT	On-none-on	9.25	7.86	7.40	6.94
CNK-2-406N	4PDT	On-none-on	10.65	9.05	8.52	7.99
CNK-2§	Keyswitch adapter unit		3.65	3.10	2.92	2.74
CNK-2-Key	Extra key for CNK-2		.65	.62	.57	.52

†Momentary position.
§Net Each, Lots of: 1-9, 11-19, 20-99, 100-499.

KEYLOCK SWITCH

Roller-type mechanical action with positive contact. Choice of 25 keys. Rated 5 A resistive, 115 VAC; 15 A. 24 VDC. Flatted ¼" diameters barrel fits panels to ¾" thick.

Alcoswitch No.	Description	Net Each, Lots of 1-9	11-19	20-99	100-499
SWK-12	SPST Off or On	$6.95	$6.26	$5.91	$5.35
SWK-12-1	SPST Off	6.95	6.26	5.91	5.35
SWK-12-3	SPST On	6.95	6.26	5.91	5.35
SWK-12K	Single key for SWK-12	1.10	1.05	.97	.88
SWK-13-1	Rmv. key/Off Pos.	4.45	4.01	3.78	3.43
SWK-13-2	Rmv. key/Off or On Pos.	4.45	4.01	3.78	3.43
SWK-13-3	Rmv. key/On Pos.	4.45	4.01	3.78	3.43
SWK-23-1	Rmv. key/Off Pos. Mom.	4.65	4.19	3.95	3.58
SWK-23-3	Rmv. key/On Pos. Mom.	4.65	4.19	3.95	3.58
SWK-13K	Single key for SWK-13/-23	.80	.76	.70	.64

DESIGNER SERIES KEYLOCK SWITCHES

New SKF, SKM and SKT keylocks available with reed contacts as well as multipole options. Appealing square flange design plus built-in detent and square bow keys. Available in 1.0 VA, 3 amp or 4 amp ratings. A wide variety available; information on request.

Alcoswitch No.	Contacts	Action	Net Each, Lots of 1-9	11-19	20-99	100-249
SKF-13-1	SPST	Off-on	$4.75	$4.28	$4.04	$3.66
SKF-13-2	SPST	Off-on	4.75	4.28	4.04	3.66
SKF-13-3	SPST	On-off	4.75	4.28	4.04	3.66
SKF-23-1	SPST	Off-on†	4.95	4.46	4.21	3.81
SKF-23-3	SPST	On-on†	4.95	4.46	4.21	3.81
SKT-33-1	DPDT	Off-on	6.95	6.26	5.91	5.35
SKT-33-2	DPDT	Off-on	6.95	6.26	5.91	5.35

†Momentary position.

AUGAT® ALCOSWITCH®
1551 Osgood Street, North Andover, MASS 01845 (617) 685-4371

Rotary Switches

Quality and Innovation

MRS SERIES MINIATURE ROTARY SWITCHES

MRS Series 30° and 36° miniature rotary switches are rated 150 ma @ 115 VAC. Terminals are permanently molded into DAP base. A choice of 1, 2, or 3 poles with adjustable stops up to twelve positions. The MRSE is nonadjustable with an internal O-ring shaft-to-bushing seal and also an outer seal for protection in wet environments. The suffix "S" indicates long shaft and the suffix "PC" indicates printed circuit mounting. Suffix "C" indicates continuous rotation. Suffix "X" indicates shorting (make-before-break) contacts.

Alcoswitch No.	Poles	Positions	Net Each, Lots of 1-24	26-49	50-99	100-249
MRS-1-10C	1	1-10	$ 7.85	$ 6.28	$5.50	$5.02
MRS-1-10C-PC	1	1-10	8.55	6.84	5.99	5.47
MRS-1-10	1	2-10	7.85	6.28	5.50	5.02
MRS-1-10-PC	1	2-10	8.55	6.84	5.99	5.47
MRS-1-12C	1	1-12	8.95	7.16	6.27	5.73
MRS-1-12C-PC	1	1-12	9.65	7.72	6.76	6.18
MRS-1-12	1	2-12	8.95	7.16	6.27	5.73
MRS-1-12-PC	1	2-12	9.65	7.72	6.76	6.18
MRS-2-5	2	2-5	8.85	7.08	6.20	5.66
MRS-2-5-PC	2	2-5	9.55	7.64	6.69	6.11
MRS-2-6	2	2-6	9.95	7.96	6.97	6.37
MRS-2-6-PC	2	2-6	10.65	8.52	7.46	6.82
MRS-3-3	3	2-3	10.85	8.68	7.60	6.94
MRS-3-3-PC	3	2-3	11.55	9.24	8.09	7.39
MRS-3-4	3	2-4	11.95	9.56	8.37	7.65
MRS-3-4-PC	3	2-4	12.65	10.12	8.86	8.10
MRS-1-10CS	1	1-10	7.85	6.28	5.50	5.02
MRS-1-10CS-PC	1	1-10	8.55	6.84	5.99	5.47
MRS-1-10S	1	2-10	7.85	6.28	5.50	5.02
MRS-1-10S-PC	1	2-10	8.55	6.84	5.99	5.47
MRS-1-12CS	1	1-12	8.95	7.16	6.27	5.73
MRS-1-12CS-PC	1	1-12	9.65	7.72	6.76	6.18
MRS-1-12S	1	2-12	8.95	7.16	6.27	5.73
MRS-1-12S-PC	1	2-12	9.65	7.72	6.76	6.18
MRS-2-5S	2	2-5	8.85	7.08	6.20	5.66
MRS-2-5S-PC	2	2-5	9.55	7.64	6.69	6.11
MRS-2-6S	2	2-6	9.95	7.96	6.97	6.37
MRS-2-6S-PC	2	2-6	10.65	8.52	7.46	6.82
MRS-3-3S	3	2-3	10.85	8.68	7.60	6.94
MRS-3-3S-PC	3	2-3	11.55	9.24	8.09	7.39
MRS-3-4S	3	2-4	11.95	9.56	8.37	7.65
MRS-3-4S-PC	3	2-4	12.65	10.12	8.86	8.10
MRSE-1-10	1	10*	8.65	6.92	6.06	5.54
MRSE-1-10-PC	1	10*	9.35	7.48	6.55	5.98
MRSE-1-12	1	12*	9.75	7.80	6.83	6.24
MRSE-1-12-PC	1	12*	10.45	8.36	7.32	6.69
MRSE-2-5	2	5*	9.65	7.72	6.76	6.18
MRSE-2-5-PC	2	5*	10.35	8.28	7.25	6.62
MRSE-2-6	2	6*	10.75	8.60	7.53	6.88
MRSE-2-6-PC	2	6*	11.45	9.16	8.02	7.33
MRSE-3-3	3	3*	11.65	9.32	8.16	7.46
MRSE-3-3-PC	3	3*	12.35	9.88	8.65	7.90
MRSE-3-4	3	4*	12.75	10.20	8.93	8.16
MRSE-3-4-PC	3	4*	13.45	10.76	9.42	8.61

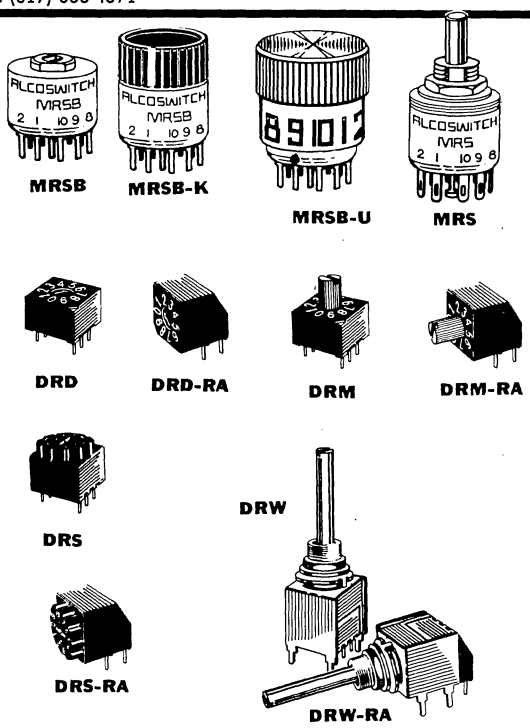
*Not adjustable

DR SERIES ENCODED ROTARY DIP SWITCHES

Rotary DIP switches have internal sealing to allow wave soldering and immersion cleaning. Screwdriver, knob, and shaft types are available in both upright and right angle versions. Contact Rating: 0.4 VA at 20 VDC. Initial Contact Resistance: 50 milliohms max. at 2 VDC. Insulation Resistance: 1000 megohms min. at 100 VDC. Life Expectancy: 20,000 cycles min.

Alcoswitch No.#	Circuit Description	Characters	Net Each, Lots of 1-24	26-49	50-99	100-249
DRD-10	BCD	0-9	$2.45	$1.96	$1.72	$1.57
DRD-10C	BCD Comp.	0-9	2.45	1.96	1.72	1.57
DRD-16	BC	0-9 & A-F	2.75	2.20	1.93	1.76
DRD-16C	BC Comp.	0-9 & A-F	2.75	2.20	1.93	1.76
DRD-10-RA	BCD	0-9	2.95	2.36	2.07	1.89
DRD-10C-RA	BCD Comp.	0-9	2.95	2.36	2.07	1.89
DRD-16-RA	BC	0-9 & A-F	3.25	2.60	2.28	2.08
DRD-16C-RA	BC Comp.	0-9 & A-F	3.25	2.60	2.28	2.08
DRM-10	BCD	0-9	2.95	2.36	2.07	1.89
DRM-10C	BCD Comp.	0-9	2.95	2.36	2.07	1.89
DRM-16	BC	0-9 & A-F	3.25	2.60	2.28	2.08
DRM-16C	BC Comp.	0-9 & A-F	3.25	2.60	2.28	2.08
DRM-10-RA	BCD	0-9	3.45	2.76	2.42	2.21
DRD-10C-RA	BCD Comp.	0-9	3.45	2.76	2.42	2.21
DRM-16-RA	BC	0-9 & A-F	3.75	3.00	2.63	2.40
DRM-16C-RA	BC Comp.	0-9 & A-F	3.75	3.00	2.63	2.40
DRS-10	BCD	0-9	4.65	3.72	3.26	2.98
DRS-10C	BCD Comp.	0-9	4.65	3.72	3.26	2.98
DRS-16	BC	0-9 & A-F	4.95	3.96	3.47	3.17
DRS-16C	BC Comp.	0-9 & A-F	4.95	3.96	3.47	3.17
DRS-10-RA	BCD	0-9	5.15	4.12	3.61	3.30
DRS-10C-RA	BCD Comp.	0-9	5.15	4.12	3.61	3.30
DRS-16-RA	BC	0-9 & A-F	5.45	4.36	3.82	3.49
DRS-16C-RA	BC Comp.	0-9 & A-F	5.45	4.36	3.82	3.49
DRW-10	BCD	0-9	2.95	2.36	2.07	1.89
DRW-10C	BCD Comp.	0-9	2.95	2.36	2.07	1.89
DRW-16	BC	0-9 & A-F	3.25	2.60	2.28	2.08
DRW-16C	BC Comp.	0-9 & A-F	3.25	2.60	2.28	2.08
DRW-10-RA	BCD	0-9	3.45	2.76	2.42	2.21
DRW-10C-RA	BCD Comp.	0-9	3.45	2.76	2.42	2.21
DRW-16-RA	BC	0-9 & A-F	3.75	3.00	2.63	2.40
DRW-16C-RA	BC Comp.	0-9 & A-F	3.75	3.00	2.63	2.40

#Actuator color code: **10**, red; **10C**, orange; **16**, black; **16C**, white.



MRSB SERIES PROGRAMMABLE

These 30° and 36° rotary switches are rated 150 ma @ 115 VAC. All models in this series are completely sealed, allowing flow soldering and submersible defluxing without the need for caps, disposable covers, etc. Standard MRSB switches have screwdriver adjust; "K" and "U" versions have built-on aluminum knobs for compactness and ease of operation. The "U" version also allows switching position to be read from edge of PC board. MRSB switches are identical to the standard MRS Series in size and operational features. Models with an "X" suffix have shorting (make-before-break) contacts. All models in this series are nonadjustable.

Alcoswitch No.	Poles	Positions	Net Each, Lots of 1-24	26-49	50-99	100-249
MRSB-1-10-PC	1	10	$ 6.45	$5.16	$4.52	$4.13
MRSB-1-12-PC	1	12	7.55	6.04	5.29	4.83
MRSB-2-5-PC	2	5	7.45	5.96	5.22	4.77
MRSB-2-6-PC	2	6	8.55	6.84	5.99	5.47
MRSB-3-3-PC	3	3	9.45	7.56	6.62	6.05
MRSB-3-4-PC	3	4	10.55	8.44	7.39	6.75
MRSB-1-10K-PC	1	10	7.65	6.12	5.36	4.90
MRSB-1-12K-PC	1	12	8.75	7.00	6.13	5.60
MRSB-2-5K-PC	1	10	8.65	6.92	6.06	5.54
MRSB-2-6K-PC	2	6	9.75	7.80	6.83	6.24
MRSB-3-3K-PC	3	3	10.65	8.52	7.46	6.82
MRSB-3-4K-PC	3	4	11.75	9.40	8.23	7.52
MRSB-1-10U-PC	1	10	8.25	6.60	5.78	5.28
MRSB-1-12U-PC	1	12	9.35	7.48	6.55	5.98
MRSB-2-5U-PC	2	5	9.25	7.40	6.48	5.92
MRSB-2-6U-PC	2	6	10.35	8.28	7.25	6.62
MRSB-3-3U-PC	3	3	11.25	9.00	7.88	7.20
MRSB-3-4U-PC	3	4	12.35	9.88	8.65	7.90

Vivisun 20/20™ Sunlight Readable Switches

Mil-Spec 22885/90

NOW DUSTPROOF/DRIPPROOF

ENVIRONMENTAL

Dripproof: VIVISUN 20/20 dripproof switch meets the enclosure design type (2) requirements of Mil-S-22885 as specified in para 3.6.17.2. When tested per para. 4.8.17.2 dripproof seal does not allow leakage of water through the seal as determined by visual examination and dielectric test of para. 4.8.16.1

Sand & Dust: The seal effectively prohibits the entrance of sand and dust per MIL-STD-108E.

MECHANICAL

Dimensions: The dripproof sealed switch design, construction, and physical dimensions conform to figures V & VI. For other VIVISUN 20/20 dimensions refer to standard data sheet 99-1-78-2 page 6.

Mounting: Each dripproof unit is supplied with a mounting sleeve, dripproof mounting spacer, dripproof mounting flange and dripproof sealed cap. The dripproof mounting spacer may be discarded for mounting without edge-lighted panel. (refer to figure V).

Seal Materials: Seal is high grade durable silicone rubber per ZZ-R-765. Surface is black matte finish.

Front Lamp Replaceable: To replace lamps simply lift back corner of seal from edge of mounting flange and peel back. Slip fingernails under seal in extraction slots and pull forward. For resealing, press cap back into switch and apply finger pressure firmly to the corners and around the outer edge of seal.

Flexibility: VIVISUN 20/20 dripproof is offered as a momentary and alternate action switch in 1, 2, or 3 pole and as an indicator. Momentary and alternate action switches are limited to −48°C in some applications.

Low Weight: 1.5 ounces maximum, including mounting sleeve and dripproof mounting spacer.

VISUAL

Sunlight Readable: First fully qualified pushbutton switch per Mil-S-22885/90. Legends are readable in a light ambient of 10,000 ft. candles (sunlight) and remain completely deadface when not energized.

Low Level Uniformity: Message remains uniform at reduced voltage levels—no hot spots.

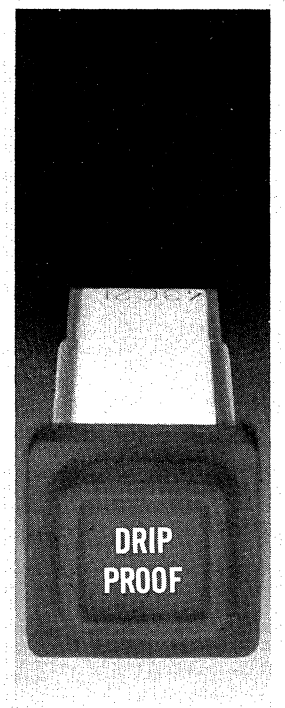


FIGURE V—DIMENSIONS

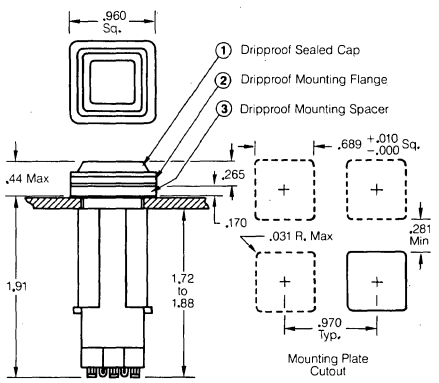
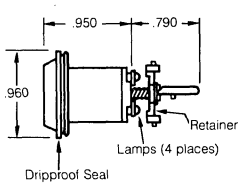


FIGURE VI—DRIPPROOF SEALED CAP



DRIPPROOF SEAL AND PUSHBUTTON CAP ARE INTEGRAL ONE PIECE ASSEMBLY

Refer to Standard Data Sheet 99-1-78-2 pg. 6 for all other electrical, mechanical, visual and environmental characteristics of Vivisun 20/20.

How to order Vivisun 20/20 DRIPPROOF

Product Series	Body Type	Cap Style	Artwork P/N
9 9	– 4	– 2	–

DRIPPROOF OPTION

To designate a VIVISUN 20/20 dripproof switch simply insert the number 4 in the third position and the number 2 in the eighth position of the standard 12 digit part number. For additional information on how to order VIVISUN 20/20 refer to page 7 of data sheet 99-1-78-2.

HOW TO ORDER SPARE COMPONENTS

To order spare dripproof caps and bodies use the digits 4 and 2 in appropriate space as shown in example. For additional ordering information pertaining to spare components refer to page 8 of data sheet 99-1-78-2.

Supplement No. 1
DATA SHEET NO. 99-1-78-2
Issued 2-79

AEROSPACE OPTICS INC.
3201 Sandy Lane - Dept E-83
Fort Worth, Texas 76112
(817) 451-1141 • Telex 75-8461

6-A

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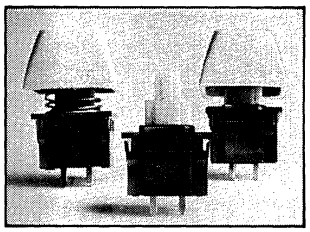
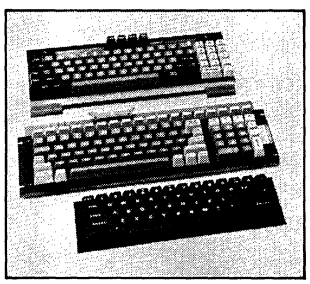


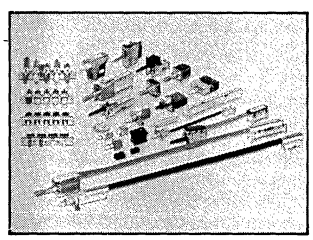
KEY SWITCHES

Choose from several contact types: mechanical, conductive rubber or tactile feedback. Snap-in mounting. Double-shot molded keytops in many colors, shapes, legends. Fully automated assembly assures maximum reliability, with ratings up to 20-million operating cycles.



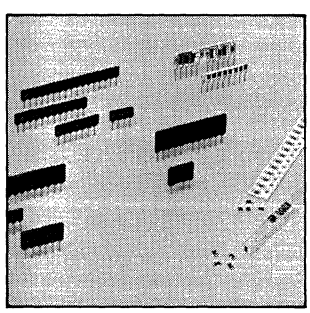
KEYBOARDS

Standard and custom keyboards, fully assembled including switches, keytops, PC board, matrix circuit, encoder circuit. NEW!—Series KFL Low Profile Keyboards meet all the latest European DIN standards for full-travel key switches with reduced profile dimensions.



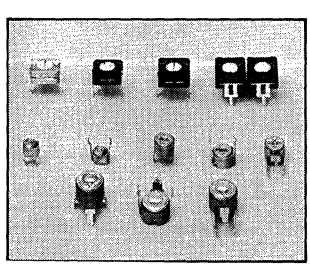
SWITCHES

Alps produces more than 900,000,000 switches per year, including some of the world's smallest, in a variety of types—rotary, push, slide, lever, power, flex and digital—all noteworthy for their unsurpassed smooth-action performance, built-in quality and long-life reliability.



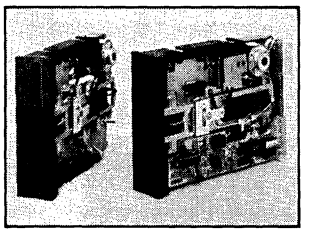
RESISTOR NETWORKS & CHIP RESISTORS

Thick film cermet element on alumina substrate, for extremely high stability. Networks in SIP configuration, from 4 to 17 pins, with resistance values from 10 ohms to 1 megohm. Chips are international standard size, 1.6 × 3.2 × .55 mm, with values from 10 ohms to 10 megohms. Available in bulk, reel tape, or plastic magazine for automatic chip placement machines.



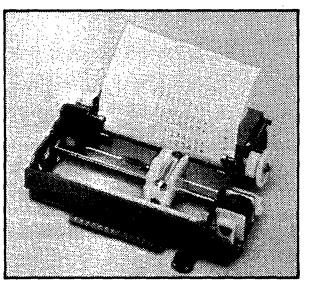
TRIMMER CAPACITORS

Ceramic or film elements, trimmer ranges from 2.5–6 pF to 10–150 pF. Snap-in terminals, with standard, reverse or side mounting—front or rear adjustment. Minimum drift, with virtually linear temperature characteristics. Precision structure protects dielectric from contamination by flux or wax.



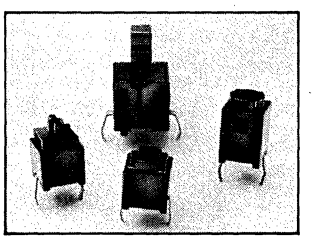
FLOPPY DISK DRIVES

New Series 2000, for 5¼" disks, offers super-slim profile—only 1.69" thick, half the conventional thickness. Standard features include fast access time, automatic eject, long-life ceramic head, and surprisingly low price! Available with or without built-in electronics control board.



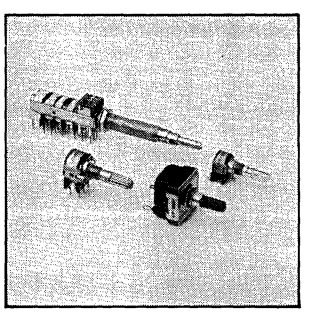
MICROMINIATURE PRINTERS

An incredible example of "The Alps Advantage" in technical innovation, Series DPG printers handle Alpha-Numeric-Graphic requirements, actually *writing* with microminiature ball point pens (1 or 4 colors!) invented by Alps using exclusive ink technology. Available for 2¼" or 4½" ordinary plain paper. Their small size and small price will astound you!



TACT SWITCHES

Tactile key switches with a "snap" (conductive rubber) or "click" (metal contacts) feeling to signal when contact is made. Available in a wide range of life cycle ratings, shapes, sizes, and "feelings"—ideal for many types of mini-keyboard applications.



VARIABLE RESISTORS

Rotary and slide types, ranges from 500 ohms to 2 megohms, with a wide variety of diameters, strokes, tapers, mounting, shafts, levers, etc. Exclusive lubricants for high quality smooth action. Miniature trimmer pots, sizes from 4mm to 16mm, with cermet, carbon film or carbon composition elements—ranges from 100 ohms to 2.2 megohms. Stick controls packaged with 2, 3 or 4 pots.

OTHER PRODUCTS now available from Alps include: telephone keypads, liquid crystal displays, magnetic heads, cassette mechanisms, RF modulators, switchers, TV tuners.

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NEW GENERAL CATALOG 20 pages of products with "The Alps Advantage"— ask for your free copy today!

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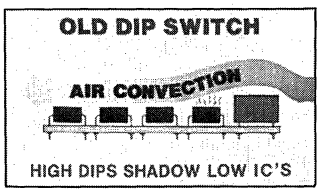
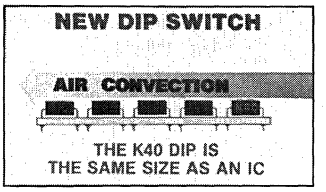
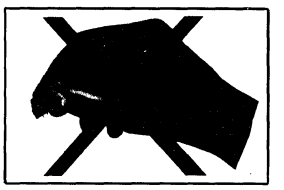
WORLD'S SMALLEST DIP SWITCHES

Same Size as an I.C.!



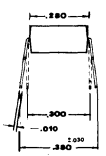


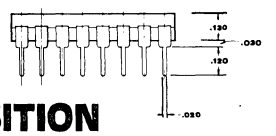


Better Heat Convection

No More Hand Labor

YOU CAN USE AUTOMATIC INSERTION EQUIPMENT





AVAILABLE SWITCHES

EIGHT POSITION

MODEL K40 8

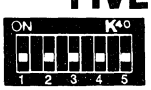
SEVEN POSITION

MODEL K40 7

SIX POSITION

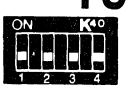
MODEL K40 6

FIVE POSITION



MODEL K40 5

FOUR POSITION



MODEL K40 4

THREE POSITION

MODEL K40 3

TWO POSITION

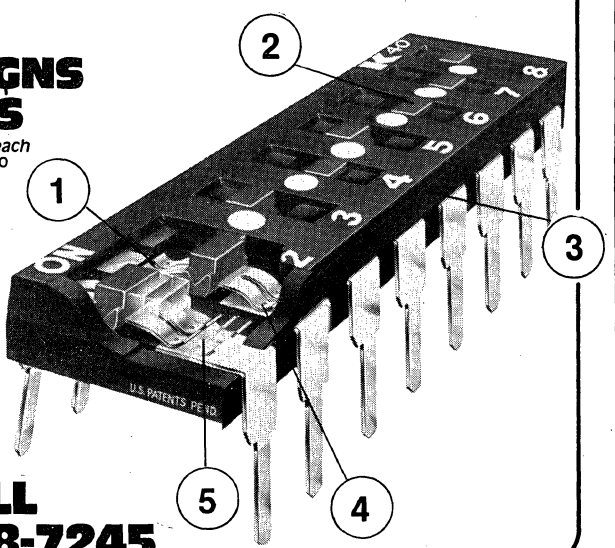
MODEL K40 2

ONE POSITION

MODEL K40 1

THREE NEW PATENT DESIGNS THAT USE 40% LESS PARTS

1. The slides are split, or bifurcated, so there are two separate slides for *each* contact point. This doubles the contact reliability because you have two independent gold plated contacts at each switch point.
2. The switches are flush with the cover to eliminate accidental, on-off movement once the DIP is programmed. Simple.
3. The package is sealed. The lead frame is molded directly into the housing to provide a one piece, no-leak construction. The cover is ultrasonically molded to the frame after the switch is assembled. There is *no* better construction. Wicking can happen, but it won't get into the switch.
4. The slides are made from beryllium copper, heat tempered to a full hardness, spring formed, plated in a 100 micro inch nickel bath and then spot gold plated 10 micro inch deep at all the contact points. This is the best proven switch contact surface that money can buy.
5. Every one of the switch contact surfaces on the main lead frame are gold plated with 30 micro inch of gold over 50 micro inch of nickel.



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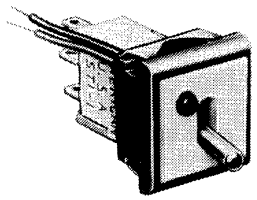

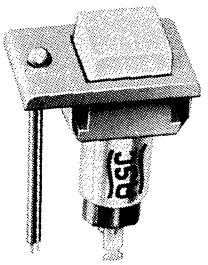

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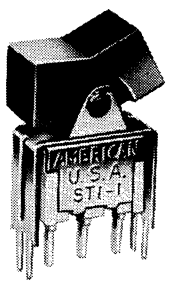
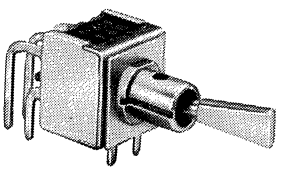
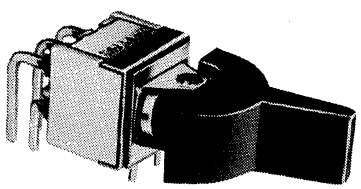
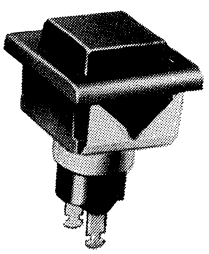




Shown are just a few of our many thousands of quality engineered and produced switches used in countless applications throughout the world. Our lines include miniature toggle, rocker, lever and pushbutton switches, both lighted and unlighted. Standard hardware panel mounting, printed circuit mounting and the hardwareless snap-in models are available in zillions of combinations. Long life **L.E.D. Indicators** integrated with the switch are available for virtually every model switch we make in a choice of cosmetically appealing and colorful bezels. Our highly reliable and time proven mechanisms cover ratings from dry circuit to 6 amp, 125 volts and many are UL recognized. An extensive array of options are available to meet your particular needs.





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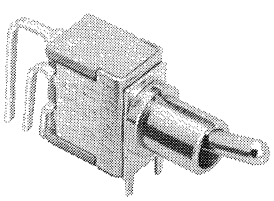
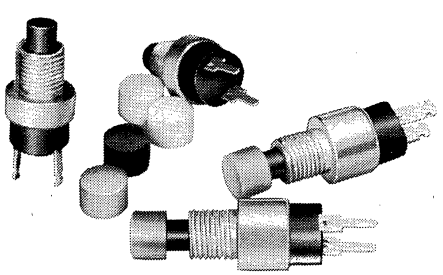
Contact us for fast response, much quicker than usual deliveries and competitive pricing.





AMP Dual In-Line Package Switches

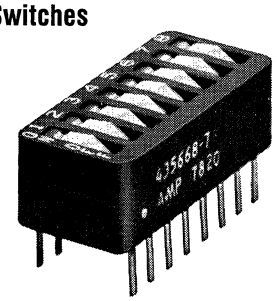
Features: ■ High Density — Low profile, compact design requires a minimum of pc board area ■ Available in standard, low profile, right angle, multipole and LED versions ■ Simple Operation — Rocker actuators instantly change program ■ Easy Mounting — Switches can be flow-soldered directly to pc board or simply inserted into DIP headers or IC packaging receptacles ■ Low profile switches available with sealing tape to keep out contaminants during assembly operations ■ Economical — Board mounted switches eliminate the need for interconnection wiring to perform switching functions ■ High Reliability — Fully enclosed design protects contact surfaces from environmental hazards. Optional transparent cover is also available ■ Versatile Application — Switches furnished in various sizes, ranging from 2 to 12 positions

Standard Switches

7000 Series, Single Pole Single Throw

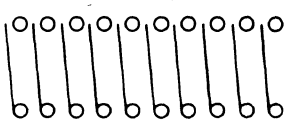
Economy Switches

7100 Series, Single Pole Single Throw



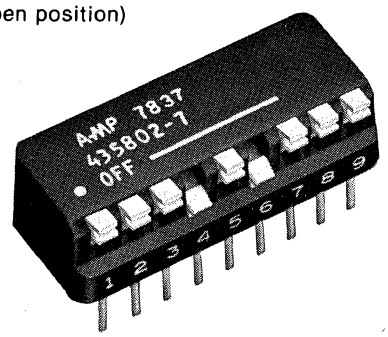
No. of Switch Positions	7000 Series Std. Profile Part No.	7000 Series Std. Profile (with Plastisol Sealant) Part No.	7000 Series Low Profile (without Tape) Part No.	7000 Series Low Profile (with Tape) Part No.	7100 Series Std. Profile Part No.	7100 Series Std. Profile (with Plastisol Sealant) Part No.
2	2-435166-9	4-435166-7	1-435626-9	3-435626-6	2-435640-9	3-435640-3
3	3-435166-0	4-435166-8	2-435626-0	3-435626-7	3-435640-0	3-435640-4
4	435166-2	4-435166-9	435626-1	3-435626-8	435640-2	3-435640-5
5	435166-3	5-435166-0	435626-2	3-435626-9	435640-3	3-435640-6
6	435166-4	5-435166-1	435626-3	4-435626-0	435640-4	3-435640-7
7	435166-1	5-435166-2	435626-4	4-435626-1	435640-1	3-435640-8
8	435166-5	5-435166-3	435626-5	4-435626-2	435640-5	3-435640-9
9	435166-6	5-435166-4	435626-6	4-435626-3	435640-6	4-435640-0
10	435166-7	5-435166-5	435626-7	4-435626-4	435640-7	4-435640-1
11	3-435166-1	5-435166-6	2-435626-1	4-435626-5	3-435640-1	4-435640-2
12	3-435166-2	5-435166-7	2-435626-2	4-435626-6	3-435640-2	4-435640-3

Contact Arrangement



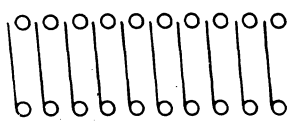
(Switches shown in open position)

7000 Series, Single Pole Single Throw Side Actuated



No. of Switch Positions	Side Actuated Part No.	Side Actuated (with Plastisol Sealant) Part No.
2	1-435802-0	1-435802-3
3	435802-2	1-435802-4
4	435802-3	1-435802-5
5	435802-4	1-435802-6
6	435802-5	1-435802-7
7	435802-6	1-435802-8
8	435802-1	435802-9
9	435802-7	1-435802-9
10	435802-8	2-435802-0
11	1-435802-1	2-435802-1
12	1-435802-2	2-435802-2

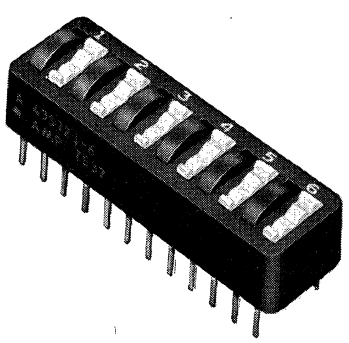
Contact Arrangement



(Switches shown in open position)

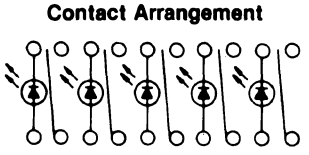
LED Switches

7200 Series, Single Pole Single Throw



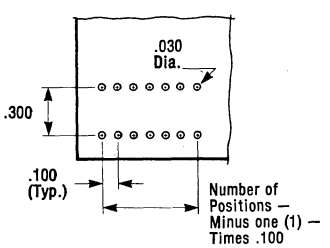
No. of Pairs	7200 Series Part No.
1	435721-1
2	435721-2
3	435721-3
4	435721-4
5	435721-5
6	435721-6

Contact Arrangement



(Switches shown in open position)

Printed Circuit Board Layout



Request Catalog No. 75-332 for complete listing

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

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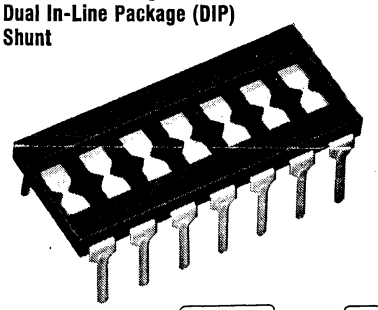
AMP Programmable Dual-in-Line (DIP) Shunt

Features: ■ Very low profile — .079 above board ■ Low cost tamper-proof programming ■ Housings made of UL recognized, 94V-0 rated, glass-filled thermoplastic polyester ■ Large current capacity — 5 amperes (one conductor) ■ Hand tool available for programming shunts ■ Cut straps can be reconnected; by solder bridging, then reopened; by use of solder wick ■ No extra space required for end-to-end mounting ■ Ideal for volume requirements of similar programs ■ Can be supplied pre-programmed

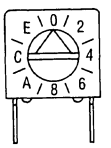
7600 Series, Programmable Dual In-Line Package (DIP) Shunt



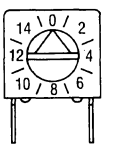
No. of Positions	7600 Series Part No.
2	435704-2
3	435704-3
4	435704-4
5	435704-5
6	435704-6
7	435704-7
8	435704-8
9	435704-9
10	1-435704-0
11	1-435704-1
12	1-435704-2

Request Catalog No. 75-332

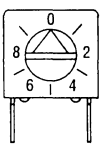
AMP Preprogrammed Printed Circuit Board Switches



Style I

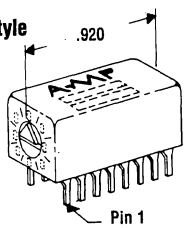


Style II

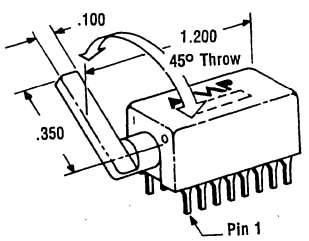


Style IV

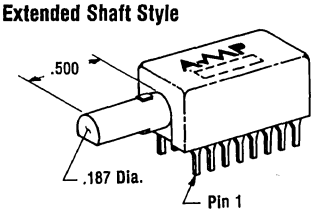
Screwdriver Slot Style



Lever Style



Extended Shaft Style



Switch Type	Actuator Slot	Stamping Legend Style	Bottom Sealed	Switch Part No.
Hexadecimal w/complement (16 Position)	Screwdriver Slot	I	No	53137-1
Hexadecimal w/complement (16 Position)	Screwdriver Slot	II	No	53137-2
Hexadecimal w/complement (16 Position)	Screwdriver Slot	I	Yes	53137-5
Hexadecimal w/complement (16 Position)	Screwdriver Slot	II	Yes	53137-6
Hexadecimal w/complement (16 Position)	Extended Shaft	None	No	54359-1
BCD w/complement (10 Position)	Screwdriver Slot	IV	No	53919-1
BCD w/complement (10 Position)	Screwdriver Slot	IV	Yes	53919-2
BCD w/complement (10 Position)	Extended Shaft	None	No	54308-1
Input/Output (2 Position)	Lever	As Illustrated	No	53921-1

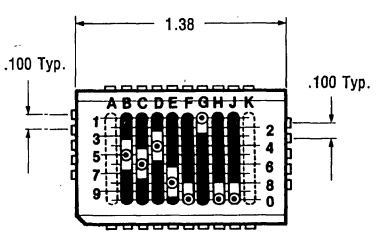
Request Catalog No. 75-332

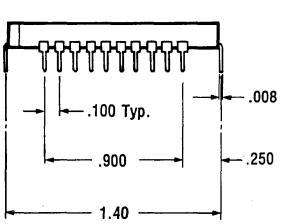
Mini-Matrix Slide Switch

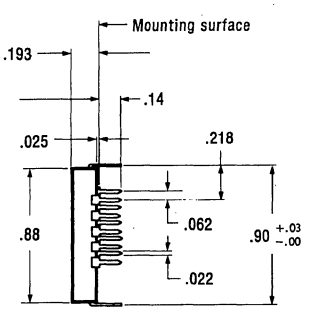
Specifications

Electrical Specifications
Contact Current Rating: Switching — 100 mA at 28 VDC, max.; 0.5 mA at 50 mVDC, min. Non-switching — 500 mA at 28 VDC, max.
Contact Resistance (Dry Circuit): Less than 100 mOhm
Insulation Resistance: 1 x 10^{10} Ohms min. at 100 VDC
Dielectric Withstanding Voltage: 300 VDC, min.
Cycle Life: 5000 detents/slide, min.

Material Specifications
Structural Plastic: UL recognized, 94V-0 rated, glass-filled thermoplastic
Column and Row Buses: Copper alloy, contact areas gold plated
Slide Springs and Contacts: Beryllium copper, gold plated







Switch Configuration	Slots Omitted*	Switch Part Number
10 x 10	—	436270-1
9 x 10	A	436270-2
8 x 10	A, K	436270-3
7 x 10	A, B, K	436270-4
6 x 10	A, B, J, K	436270-5
5 x 10	A, B, C, J, K	436270-6
4 x 10	A, B, C, H, J, K	436270-7

*Slots are omitted for unused slide locations.

Note: An 8 x 10 switch is shown here. Other Mini-Matrix Slide Switches have the same dimensions, but fewer or more slides.

Request Catalog No. 81-647

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

Specifications subject to change. Consult AMP Incorporated for latest design specifications.

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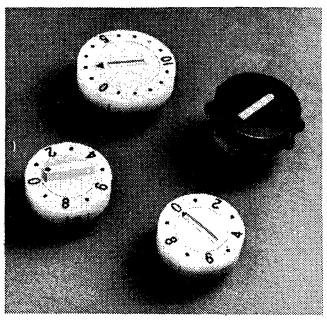
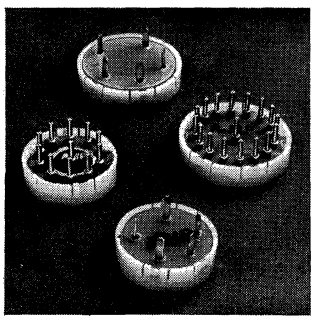
Printed Circuit Board Rotary Switches

6000 Series With Screw Driver Slot, Bar Type Knob, Thumb-wheel Actuation

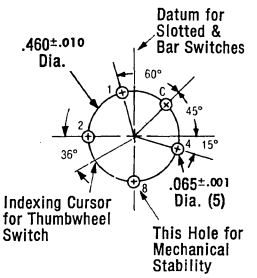




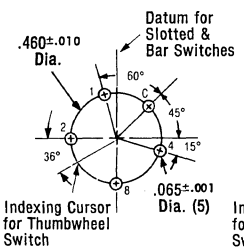
■ Compact Design — Small diameter, low profile switches are ideal for pc board mounting ■ Wide Choice of Outputs — 8 position binary coded octal, 10 position binary coded decimal, 16 position hexadecimal and 8, 10 or 16 position single pole ■ Versatile Application — Available styles include slotted version for screwdriver or coin actuation, plus bar-type knob and thumbwheel versions for hand rotation ■ Economical — Board mounting eliminates need for input/output wiring to perform switching functions ■ Positive Switching — Contacts have positive detent action; all switch positions easily identified by large readable numerals ■ Optimum Reliability — Fully enclosed design protects contact surfaces from dust, dirt and other environmental contaminants

Typical Board Hole Pattern (Switch Side)

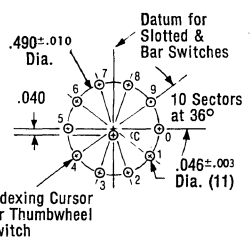
8-Position (Binary Coded Octal)



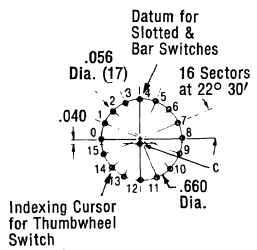
10-Position (Binary Coded Decimal)



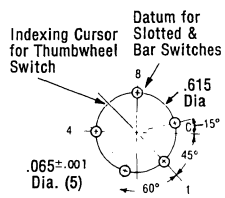
10-Position (Single Pole)



16-Position (Single Pole)



16-Position (Hexadecimal)



8-Position BCD

Switch Position	Common to: 1 2 4
0	
1	●
2	●
3	●●
4	●
5	● ●
6	●●
7	●●●

10-Position BCD

Switch Position	Common to: 1 2 4 8
0	
1	●
2	●
3	●●
4	●
5	● ●
6	●●
7	●●●
8	●
9	● ●

10-Position SP

Switch Position	Common to: 0 1 2 3 4 5 6 7 8 9
0	●
1	●
2	●
3	●
4	●
5	●
6	●
7	●
8	●
9	●

16-Position SP

Switch Position	Common to: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0	●
1	●
2	●
3	●
4	●
5	●
6	●
7	●
8	●
9	●
10	●
11	●
12	●
13	●
14	●
15	●

16-Position HD

Dial Position	Common to: 1 2 4 8
0	
1	●
2	●
3	●●
4	●
5	● ●
6	●●
7	●●●
8	●
9	● ●
10	● ●
11	●● ●
12	●●
13	● ●●
14	●●●
15	●●●●

Specifications

Electrical
Contact Life Expectance: 10,000 Cross Points
Contact Current Rating: 250 Milliamperes
Initial Contact Resistance (at 50 Millivolts, 20 Milliamperes): 50 Milliohms
Insulation Resistance: 1 x 10^8 Ohms
Dielectric Breakdown Voltage: 500 Volts, DC
Circuit Capacitance (at 135 KHz): 3 Picofarads

Materials

Contacts: Phosphor Bronze, Gold-over-Nickel Plated
Solder Tabs and Pins: Coded Switches — Beryllium Copper, Tin Plated Single Pole Switches — Brass, Tin Plated
Structural Parts: Polyacetal Printed Circuit Boards: Glass Epoxy

Switch Type	Screwdriver/ Coin-Actuated	Bar-Type Knob	Thumbwheel
8 BCD	435174-1	1-435174-1	2-435174-1
10 BCD	435005-1	435123-1	435128-1
10 SP	1-435097-1	2-435097-1	435097-1
16 SP	435304-1	1-435304-1	2-435304-1
16 HD	435167-1	1-435167-1	2-435167-1

Request Catalog No. 74-276

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

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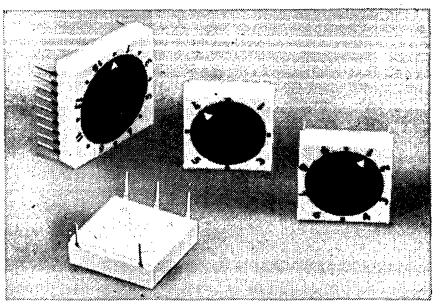
AMP INCORPORATED

Printed Circuit Board Rotary Switches

6100 Series With Screw Driver/Coin Actuation Slot



Features

- Economical
- Improved, compact design with ball and spring detent action
- Compatible with .100 x .100 [2.54 x 2.54] standard pc board leg spacing
- Reliable with longer life
- Wide variety of code outputs available
- Mechanically indexed
- Low profile
- Broad application capability

Request Catalog No. 80-564

Electrical

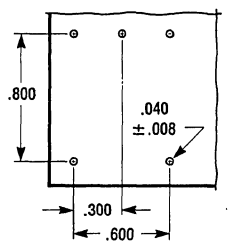
Current/Voltage Rating: Nonswitching — 115 VAC or 28 VDC at 250 milliamperes max. Switching — 115 VAC or 28 VDC at 125 milliamperes max.
Contact Resistance: 75 milliohms max.
Insulation Resistance: 100 megohms min.
Dielectric Withstanding Voltage: 500 VDC min.
Capacitance: 5 picofarads max.

Mechanical/Environmental

Operating Torque: 2-12 inch-ounce [0.014-0.085 N-m]
Operating Temperature: 0° to 190°F [—17.8°C to 88°C]

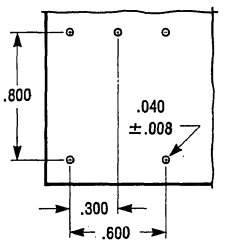
Typical Board Hole Pattern

8 Position BCO
Part Number 436198-1



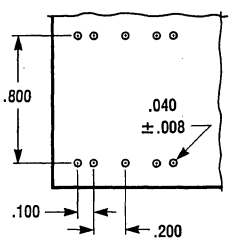
Switch Position	Common to: 1 2 4
0	
1	●
2	●
3	● ●
4	●
5	● ●
6	● ●
7	● ● ●

8 Position BCO Complement
Part Number 436198-2



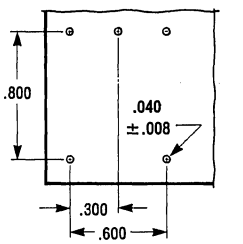
Switch Position	Common to: 1 2 4
0	● ● ●
1	● ●
2	● ●
3	●
4	● ●
5	●
6	●
7	

8 Position Decimal
Part Number 436198-3



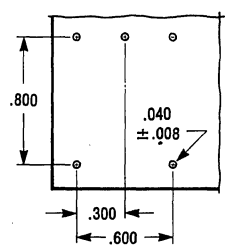
Switch Position	Common to: 0 1 2 3 4 5 6 7
0	●
1	●
2	●
3	●
4	●
5	●
6	●
7	●

10 Position BCD
Part Number 436199-1



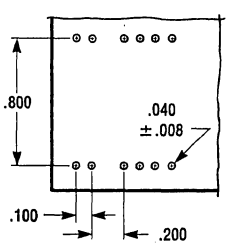
Switch Position	Common to: 1 2 4 8
0	
1	●
2	●
3	● ●
4	●
5	● ●
6	● ●
7	● ● ●
8	●
9	● ●

10 Position 9's Complement
Part Number 436199-2



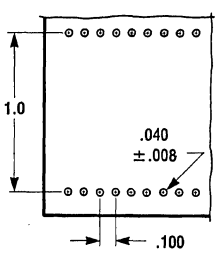
Switch Position	Common to: 1 2 4 8
0	● ●
1	●
2	● ● ●
3	● ●
4	● ●
5	●
6	● ●
7	●
8	●
9	

10 Position Decimal
Part Number 436199-3



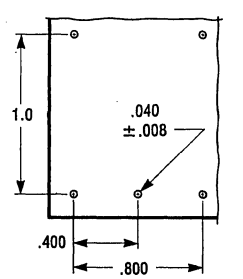
Switch Position	Common to: 0 1 2 3 4 5 6 7 8 9
0	●
1	●
2	●
3	●
4	●
5	●
6	●
7	●
8	●
9	●

16 Position Decimal
Part Number 436200-1



Switch Position	Common to: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0	●
1	●
2	●
3	●
4	●
5	●
6	●
7	●
8	●
9	●
10	●
11	●
12	●
13	●
14	●
15	●

16 Position Hexa-Decimal
Part Number 436200-2



Switch Position	Common to: 1 2 4 8
0	
1	●
2	●
3	● ●
4	●
5	● ●
6	● ●
7	● ● ●
8	●
9	● ●
10	● ●
11	● ● ●
12	● ●
13	● ● ●
14	● ● ●
15	● ● ● ●

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

Specifications subject to change. Consult AMP Incorporated for latest design specifications.
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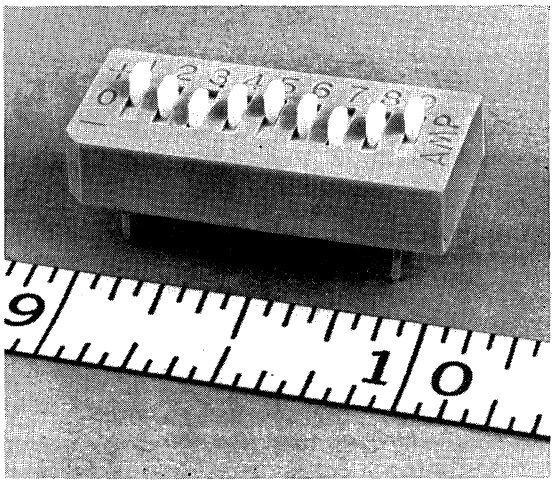
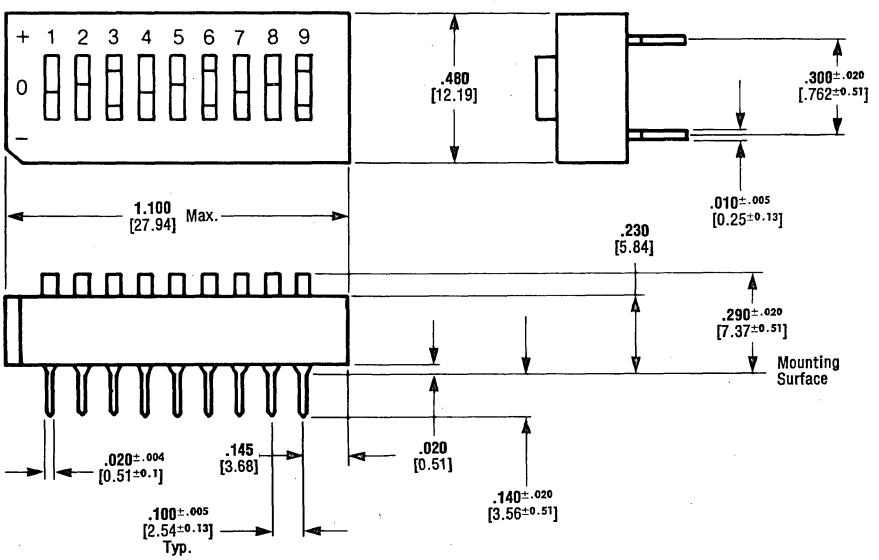
3 x 9 Slide Switch 7800 Series

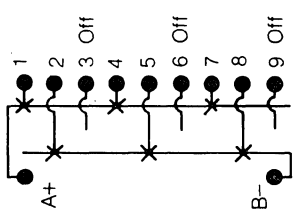


Features

- 9-pole, double throw configuration
- Used for logic level applications or for controlling AC/DC circuits
- Nine separate 3 position slide switches
- Fits .100 x .300 [2.54 x 7.62] centerline standard DIP headers
- Can be soldered directly to pc board
- 19,683 code variations

Part No. 436172-2





Contact Arrangement

Request Catalog No. 80-592

Materials

Case and Base:
Polyester, glass filled

Slide:
Polyester

Spring contacts and Leads:
Copper alloy; plating in accordance with AMP Product Specification 108-7047

Electrical Characteristics

Current Rating:
Nonswitching — 1.5 amperes, max. @ 50 VDC (resistive load), 40°C rise
Switching — 100 milliamperes, max. @ 5 VDC (resistive load); 25 milliamperes, max. @ 24 VDC (resistive load)

Contact Resistance, Dry Circuit:
50 milliohms, max. initial 100 milliohms, max. at end of durability

Temperature Rise (Nonswitching):
40°C, max. from ambient

Insulation Resistance:
1×10^{11}, min. initial
1×10^{9}, min. after environmental testing

Dielectric Withstanding Voltage:
500 VAC, min. @ standard atmospheric conditions

Capacitance:
5 picofarads, max.

Mechanical/Environmental Characteristics

Actuation Force:
10-40 ounces [2.78-5.56 N]

Solderability:
AMP Spec. 109-11-5

Vibration:
10-2000-10 Hz traversed in 20 minutes at .06 inch [1.52 mm] total excursion; AMP Spec. 109-21, Cond. E with 0.1 ampere applied

Shock:
50 G's @ 11 milliseconds AMP Spec. 109-26, Cond. A

Durability:
100 cycles

Terminal Strength:
Pull — 2 lb. [8.9 N] axial
Bend — Two 45° bend cycles

Thermal Shock:
5 nonoperating cycles @ −67°F to +225F° [−55°C to 107°C]

Humidity:
40°C and 95% RH for 96 hr.

Operating Temperature:
−40°F to +190°F
[−40°C to +88°C]

Nonoperating Temperature:
−100°F to +275°F
[−73°C to +135°C]

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

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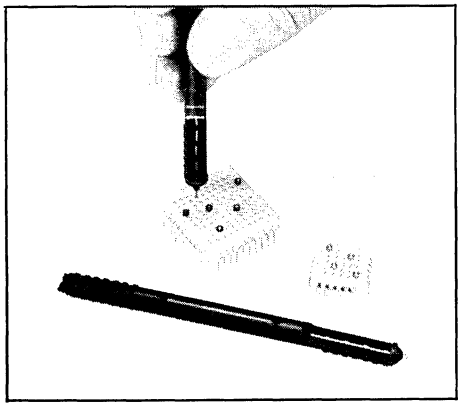
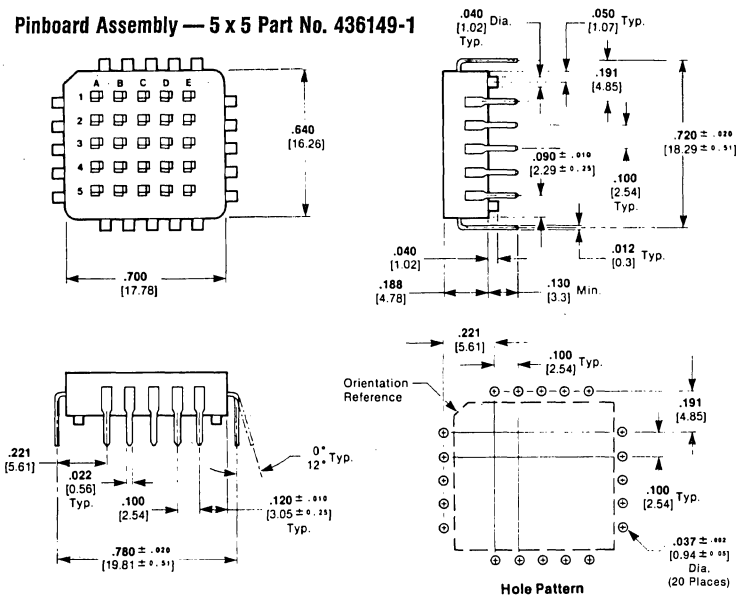
AMP Miniature Pinboards



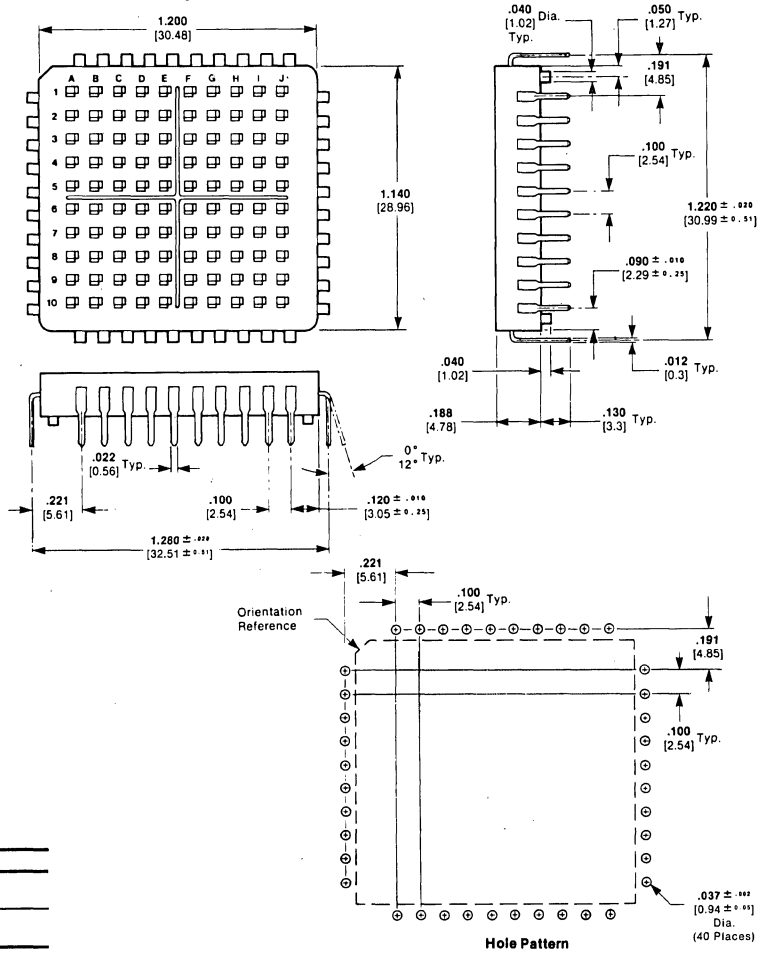
Features: ■ Provides up to 100 crosspoints in a minimum space ■ Can be machine soldered to pc boards ■ Contact terminals and programming holes on .100 [2.54] centerlines ■ Very low profile — extends only .230 [5.84] above pc board ■ Pin program is easily discernable for rapid program checking ■ Available in 10 x 10 and 5 x 5 sizes ■ Inexpensive insertion tool makes shorting pin insertion simple and economical

Request Catalog No. 80-561

Pinboard Assembly — 5 x 5 Part No. 436149-1



Pinboard Assembly — 10 x 10 Part No. 1-436149-1



Specifications:

Electrical Characteristics

Current/Voltage (non-switching): 125 VAC or DC at 2.0 amperes, max.
Contact Resistance: 20 milliohms, max.
Insulation Resistance: 1 x 10^6 ohms, min.
Dielectric Withstanding Voltage: 500 VAC (RMS), 200 VDC
Capacitance: 10 picofarads, max.

Mechanical Characteristics

Insertion Force (shorting pins): 10 lb. max.
Extraction Force (shorting pins): 16 oz. min.

Environmental Characteristics

Operating Temperature: −32° to +158°F [−35.6° to +70°C]
Storage Temperature: −55 to +105°C

Materials

Panel: Thermoplastic Urethane
Lead Frame: Phosphor Bronze, gold over nickel plated
Shorting Pin Bodies: Brass, gold over nickel plated
Shorting Pin Insulating Caps: Glass Filled PBT

Hand Tool with Program Pins (Disposable)

Description	Part Number
Tool with 15 insulated programming pins	436147-1
Tool with 15 non-insulated programming pins	436147-2

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

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Los Angeles Division
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714-578-9600
Powell Electronics, Inc.
Sunnyvale, CA
408-739-4321
Pyramid Electronics Supply, Inc.
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714-773-0781
Pyramid Electronics Supply, Inc.
Santa Clara, CA
408-727-9810
RPS Electronics, Inc.
Los Angeles, CA
213-744-0355
714-521-5230

COLORADO
CSID, Inc.
Denver, CO
303-292-9594

FLORIDA
Hammond Electronics, Inc.
Orlando, FL
305-849-6060

GEORGIA
Schweber Electronics Corp.
Norcross, GA
404-449-9170

ILLINOIS
Semiconductor Specialists, Inc.
Elmhurst, IL
312-279-1005

INDIANA
Graham Electronics
Indianapolis, IN
317-634-8202

KANSAS
C. Tennant, Sons & Co.
Edwardsville, KS
913-441-1801

MARYLAND
MS Electronics, Inc.
Rockville, MD
301-340-6400

MASSACHUSETTS
Cronin Electronics
Needham, MA
617-449-0500

MICHIGAN
RS Electronics,
Grand Rapids, MI
616-241-3483
RS Electronics
Livonia, MI
313-525-1155

MISSOURI
Lectronix, Inc.
St. Charles, MO
314-946-6424

NEW HAMPSHIRE
C&H Electronics
Hudson, NH
603-882-1133

NEW JERSEY
Federated Purchaser
Kenilworth, NJ
201-272-0505

NEW YORK
Harrison Radio Corporation
Farmingdale, NY
516-293-7990
Peerless Radio Corporation
Lynbrook, NY
516-593-2121
Summit Distributors Inc.
Buffalo, NY
716-884-3450

NORTH CAROLINA
Southeastern Electronics
Raleigh, NC
919-828-2311

OHIO
Akron Electronic Supply Co.
Akron, OH
216-762-8818
Hughes-Peters, Inc.
Columbus, OH
614-294-5351

PENNSYLVANIA
Almo Electronics Corporation
Philadelphia, PA
215-698-4000
Powell Electronics, Inc.
Philadelphia, PA
215-365-1900

TEXAS
Kent Electronics Corporation
Austin, TX
512-834-1900
Kent Electronics Corporation
Dallas, TX
214-669-2600
Kent Electronics Corporation
Houston, TX
713-780-7770
Solid State Electronics Co.
Irving, TX
214-438-5700

UTAH
Kimball Electronics, Inc.
Salt Lake City, UT
801-328-2075

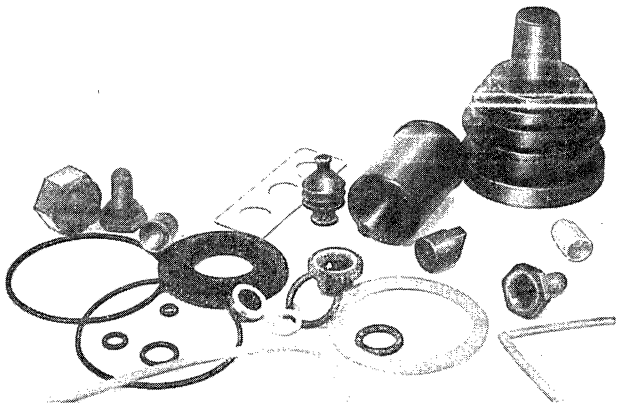
WASHINGTON
Interface Electronics Corporation
Kent, WA
206-872-5800

For product and Distributor information too late to be included here, contact AMP Distributor Marketing Division, P.O. Box 1776, Paoli, PA 19301. (215) 647-1000.

DISTRIBUTOR MARKETING DIVISION
Division of AMP Products Corporation
AMP is a trademark of AMP Incorporated.

AMP means productivity.

AME SWITCH SEALS



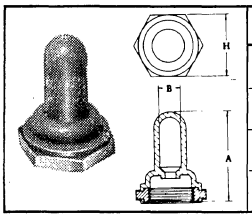
Backed by over 25 years of engineering solutions — for an ever-changing and demanding market.

The wide demand for custom-molded panel and switch seals, threaded inserts bonded to rubber, O-rings, boots and seals, etc., translated is really a demand for talent and know-how to handle the engineering and molding of particularly thorny or unusual custom requirements that frequently plague industry. AME meets the demand. . . with experience, service and unique production techniques.

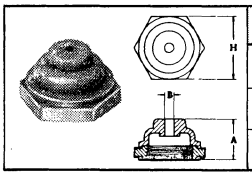
CUSTOM ENGINEERED PRECISION MOLDED ELASTOMERS

- Color filters for incandescent lamps
- Rubber to metal bonding
- Clear silicone products
- Self-sealing hex nuts
- Self-sealing washers
- Extrusions
- O-rings
- Boots
- Gaskets
- Seals
- Conductive rubber
- Die cutting

TOGGLE SWITCH SEALS

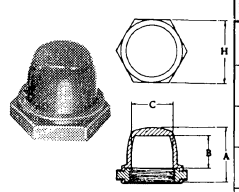


Part Number	Equiv. Military Part Number	Thread Size	Unit	A	B	H	Material Specifications
1100	M5423/01-01	15/32-32 UNS-2B	in.	.86	.22	.625 Hex	Nut-Brass, Nickel Plated, Rubber-Silicone per ZZ-R-765 Class III, Grade 50 Gray
			mm	(21.84)	(5.59)	(15.88)	
1102	None	15/32-32 UNS-2B	in.	.86	.22	.625 Hex	
			mm	(21.84)	(5.59)	(15.88)	
1103	None	15/32-32 UNS-2B	in.	.90	.22	.625 Hex	Nut-Brass, Rubber-Neoprene, 50 Durometer Black
			mm	(22.86)	(5.59)	(15.88)	
1105	M5423/05-01	1/4-40 UNS-2B	in.	.50	.064	.375 Hex	Nut-Brass, Nickel Plated, Rubber-Silicone per ZZ-R-765 Class III, Grade 30 Gray
			mm	(12.70)	(1.63)	(9.53)	



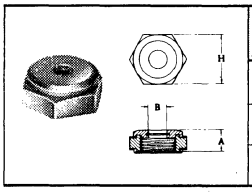
Part Number	Equiv. Military Part Number	Thread Size	Unit	A	B	H	Material Specifications
1101	M5423/02-01	15/32-32 UNS-2B	in.	.40	.09	.625 Hex	Nut-Brass, Nickel Plated, Rubber-Silicone per ZZ-R-765 Class III, Grade 50 Gray
			mm	(10.16)	(2.29)	(15.88)	
1104	None	5/8-24 UNEF-2B	in.	.75	.09	.812 Hex	
			mm	(19.05)	(2.29)	(20.62)	
1106	M5423/11-01	1/4-40 UNS-2B	in.	.25	.05	.375 Hex	
			mm	(6.35)	(1.27)	(9.53)	

PUSH BUTTON SWITCH SEALS



Part Number	Equiv. Military Part Number	Thread Size	Unit	A	B	C	H	Material Specifications
2100	M5423/07-01	15/32-32 UNS-2B	in.	.55	.32	.42	.625 Hex	Nut-Brass, Nickel Plated, Rubber-Silicone per ZZ-R-765 Class III, Grade 60 Gray
			mm	(13.97)	(8.13)	(10.67)	(15.88)	
2101	None	1/2-32 UNS-2B	in.	.46	.29	.41	.750 Dia.	
			mm	(11.68)	(7.37)	(10.41)	(19.05)	
2102	M5423/07-02	15/32-32 UNS-2B	in.	.72	.48	.42	.625 Hex	
			mm	(18.29)	(12.19)	(10.67)	(15.88)	
2103	M5423/10-01	1/4-32 UNEF-2B	in.	.31	.20	.19	.375 Hex	
			mm	(7.87)	(5.08)	(4.83)	(9.53)	
2104	M5423/10-02	1/4-40 UNS-2B	in.	.31	.20	.19	.375 Hex	
			mm	(7.87)	(5.08)	(4.83)	(9.53)	

ROTARY SWITCH & POTENTIOMETER SEALS



Part Number	Equiv. Military Part Number	Thread Size	Unit	A	Size of Shaft B	H	Material Specifications
3100	M5423/09-02	3/8-32 UNEF-2B	in.	.22	.250	.500 Hex	Nut-Brass, Nickel Plated, Rubber-Silicone per ZZ-R-765 Class III, Grade 60 Gray
			mm	(5.59)	(6.35)	(12.70)	
3101	M5423/09-01	3/8-32 UNEF-2B	in.	.22	.125	.500 Hex	
			mm	(5.59)	(3.18)	(12.70)	
3102	M5423/09-04	15/32-32 UNS-2B	in.	.22	.250	.625 Hex	
			mm	(5.59)	(6.35)	(15.88)	

MANY OTHER SIZES AND TYPES AVAILABLE

Pressure capabilities: Internal Pressure
1 Atmosphere, 15 psi (103.4 kPa)
External Pressure
2 Atmospheres, 30 psi (206.8 kPa)
For Part #1106 — Internal pressure
.7 Atmosphere, 10 psi (69 kPa)
External pressure
1.4 Atmospheres, 20 psi (138 kPa)

Endurance: Exceeds 100,000 actuations (depending on environment).

Useful life: 20 years to unlimited (depending on environment).

Switch Seals are designed and manufactured to meet or exceed applicable military specifications.

Switch Seals

An elastomeric boot which seals, thus protecting a switch and internal components against hazardous foreign elements. AME's one piece switch seal is constructed of a flexible rubber boot element bonded during molding to a threaded metal insert that fully encapsulates the switch and bushing to the panel.

This assembly replaces the panel mounting nut and seals the mounting hole making it watertight. It protects against moisture, oil, dirt, dust, most solvents, many acids (see elastomer selection guide).

Switch seals provide vibration resistant mounting and act as double insulation with no interference to switch movement.

CAST URETHANE & SILICONE

AME supplies cast urethane and silicone products precision engineered to meet your most demanding requirements.

If you need high tensile/tear strength, excellent resistance to abrasion and high impact capability, our cast urethane is ideally suited for the job. Superb temperature resistance to the damaging sub-zero cold or searing heat extremes is found in the cast silicone custom engineered by AME Corporation.

AME CORPORATION
Dept. EM, 101 E. Main St.
P.O. Box 191
Little Falls, NJ 07424
(201) 256-3939

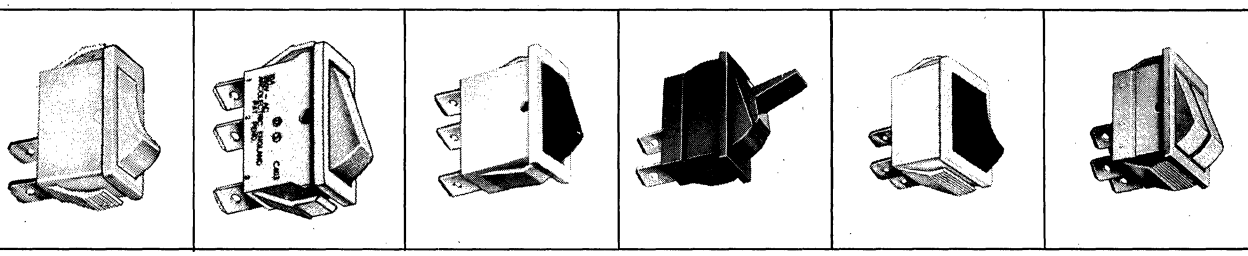
SWITCH SEALS

ARCOLECTRIC CORPORATION

Dept. EM, P.O. Box 348 • 5547 Cleon Avenue • North Hollywood, California 91603
Tel. (213) 985-3130 Tel. (213) 877-6969 Telex 65-1349

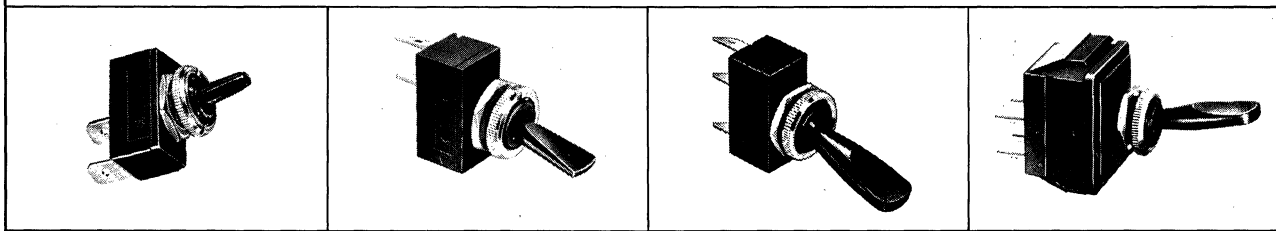
Details of international approvals on request.

ROCKER SWITCHES



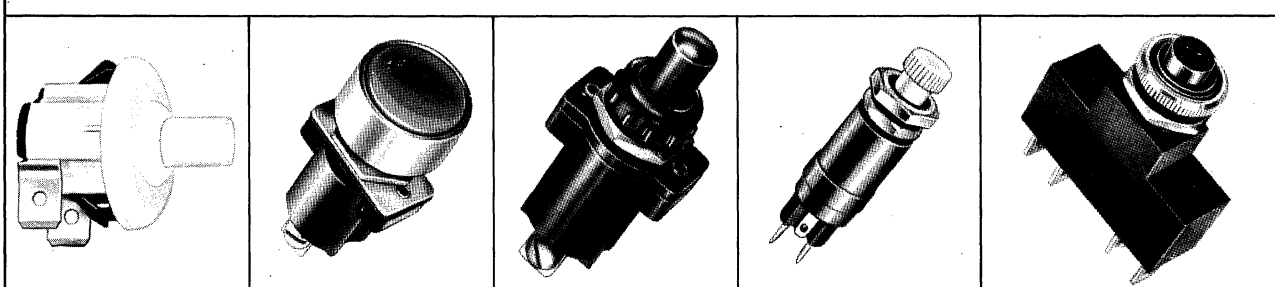
Our extensive range comprised of lighted and non lighted single and double pole, available in 10 Amp and 16 Amp ratings.
Snap in mounting, cut out size requirements:
Single Pole: 12.2 x 27.2(A), 11.0 x 30.0(M), 11.5 x 28.2(Q), 14.0 x 28.5(R)
Double Pole: 22.3 x 27.2(A), 22.0 x 29.4(E), 22.3 x 28.2(Q), All Dia. mm.

LEVER SWITCHES



Silver contact points suitable for low and high amperage circuits up to 10 amps. Some types rated at 15 amps. Variety of lever styles. Lighted 12 volt versions. Standard solder/tab terminals. Mounting Hole: 12.7mm. Single and double pole circuits only.

MOMENTARY PUSHBUTTON



Ratings from ½ amp to 10 amp. Single and double pole circuits.

FOR COMPLETE INFORMATION REQUEST CATALOG 150A
ARCOLECTRIC INDICATOR LIGHTS SHOWN IN EEM SECTION 2450, PAGE 2•1652

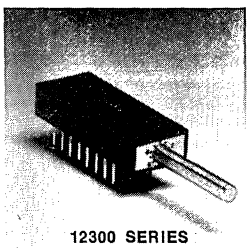
DAVEN SWITCHES

MINIATURE ROTARY AND PCB SWITCHES

BC DIPSWITCH®

Since 1971 Daven switches have featured self-cleaning wiper action, thousands of custom programs, and environmentally sealed switches that enable wave soldering on PC or PW boards.

These and other features are offered in the new DIPSWITCH line.

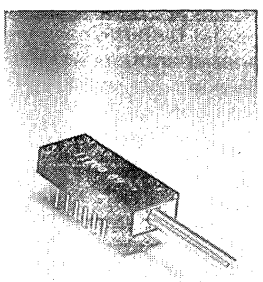


12300 SERIES

16-PIN DIPSWITCH

New 8-pole rotary switch. Application oriented features are:

- ☐ Any combination up to 8 contact closures in any shaft position
- ☐ Coded outputs
- ☐ 1.125″ long, .440″ wide, .232″ high
- ☐ 60°, 45°, 36° indexing

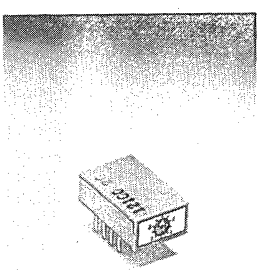


11700 SERIES

14-PIN DIPSWITCH

Versatile 6-pole, 14-pin rotary switches. Application oriented features are:

- ☐ Any combination up to 6 contact closures in any shaft position
- ☐ Coded outputs
- ☐ 35,000 cycle life @ .250 Amp.
- ☐ .995″ long, .440″ wide, .232″ high
- ☐ 60°, 45°, 36° indexing



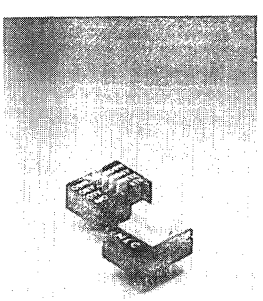
12100 SERIES

8-PIN DIPSWITCH

Versatile 4-pole, 8-pin rotary switches. Application oriented features are:

- ☐ Any combination up to 4 contact closures in any shaft position
- ☐ Coded outputs
- ☐ 35,000 cycle life @ .250 Amp.
- ☐ .730″ long, .440″ wide, .232″ high
- ☐ 60°, 45°, 36° indexing

The 16, 14, and 8 pin switches are available with a bushing mounted front panel adapter.



12000 SERIES

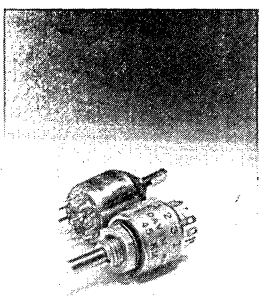
FORM C DIPSWITCH

This 12-pin center-off DIPSWITCH provides four electrically isolated switches, each with distinct center-off positions. Switches may be simultaneously operated with our optional adapter. Low contact capacitance. Less than .5 pf. Ask us how this switch can provide HEXIDECIMAL output. It is truly omnifarious.

G/K ½″ SERIES SWITCHES

Subminiature series G (sealed) and K (unsealed) rotary switches are available in one-pole (2- to 12-position) through four-pole (2- and 3-position) types.

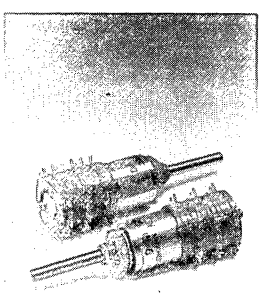
- ☐ Shorting or non-shorting
- ☐ Switching capacity: up to 1 Amp.
- ☐ Indexing: 30°, 36°, 45°, 60°
- ☐ QPL per MIL-S-3786/20E
- ☐ Ideally suited for high shock and vibration applications
- ☐ Contact resistance: .020 ohms max.
- ☐ P/C and solder terminals
- ☐ Mounting hardware supplied
- ☐ Spring Return 36° and 60°
- ☐ BCD Coding 30°



"G/K" SERIES

S SERIES SWITCHES

The S Series provides up to 10 decks, 20 positions per deck (200 poles), in a miniature (¾″ over terminals) bushing mounted rotary switch. Coded Outputs.

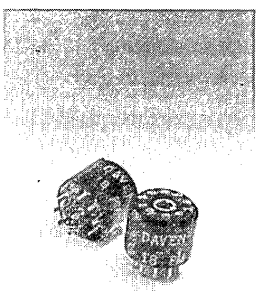


"S" SERIES

P SERIES SWITCHES

Subminiature Series P rotary switches are available in one-pole (up to 10 positions) and two-pole (up to 5 positions) types.

- ☐ Shorting or non-shorting
- ☐ Switching capacity: up to ½ Amp.
- ☐ Indexing: 36°
- ☐ Printed circuit terminals
- ☐ Stop strength: 24 inch ounces
- ☐ Contact resistance: .030 ohms max.
- ☐ Screwdriver operated
- ☐ Sealed for wave soldering



"P" SERIES

FOR MORE INFORMATION

Many standard switches and accessories are available for immediate delivery from stock. Standard switches can be modified quickly and economically by our custom design service to meet special application requirements. Contact our sales department, or your local representative, for application assistance and prices. Detailed information is available in free brochure DCG-0381.

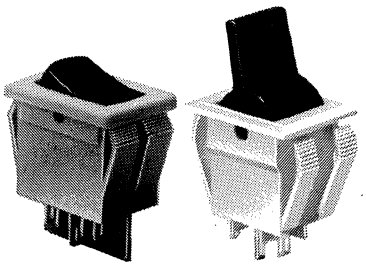
ARMTEC

Armtec is a Bestobell Company

Manchester Municipal Airport Manchester, NH 03103 Tel: 603-669-0940 · TWX: 710-220-1747

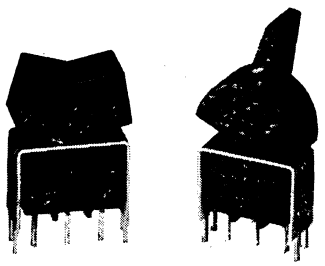
Carlingswitch offers custom quality at catalog prices.

Solving your design problems with quality "standard" and "custom" switching devices is our specialty. We continually lead the industry with new product innovations which incorporate modern materials, innovative styling, patented and patent pending switching mechanisms—all at competitive catalog prices.



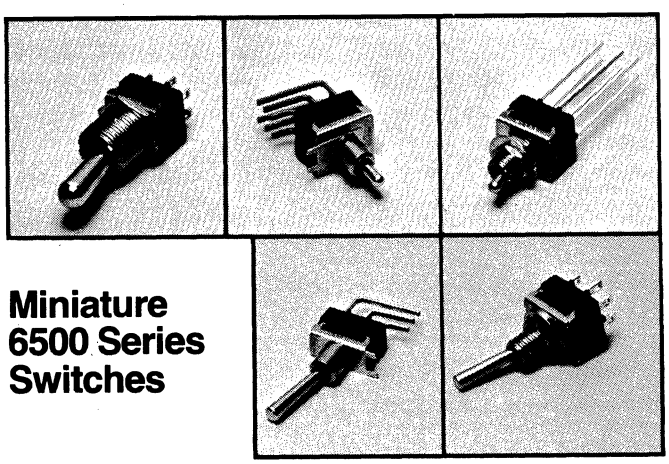
Miniature All-nylon Power Rocker/Paddle Switches

All-nylon miniature rocker and paddle switches offer high reliability, low cost, snap-in mounting, multiple circuit choices, plus ratings for power switching or low level dry circuit switching applications. These attractive switches are available in a wide variety of standard and custom-matched colors. They feature our patented self-cleaning wiping action contacts and are designed to meet European standards.



New Miniature 6600 Series Switches

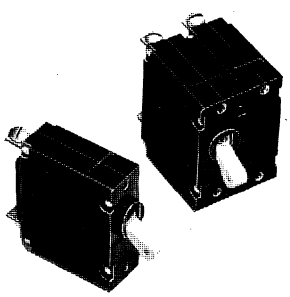
High quality, *low cost* Solder 'n' Wash™ miniatures are ultrasonically sealed, wave solderable and *washable*. They can be soldered directly to pc boards with other components—then the whole assembly can be washed; eliminating extra step of assembling switches separately. Single and double pole models available in toggle, rocker and paddle-actuated models. Bushing mount, straight and right angle pc versions. Static resistant rocker and paddle versions. Many toggle options. All popular ratings available.



Miniature 6500 Series Switches

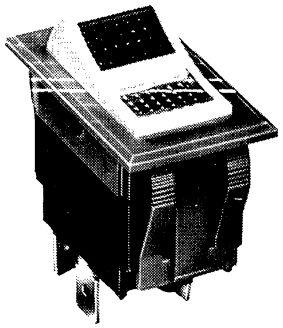
Single and double pole metal-toggle miniatures are well-suited to pc board applications. Variations include: heavy-duty large pinned toggle models with $^{15}/_{32}$" bushing; gold plated pc terminals and contacts for dry circuit use; WIRE-WRAP® terminals with ultra short actuator; right angle pc terminals; built-in front panel splash protection for moist environments. Rocker and paddle-actuated models available. All popular ratings with these high-quality, low-cost switches.

®Gardner-Denver Co. Registered Trademark



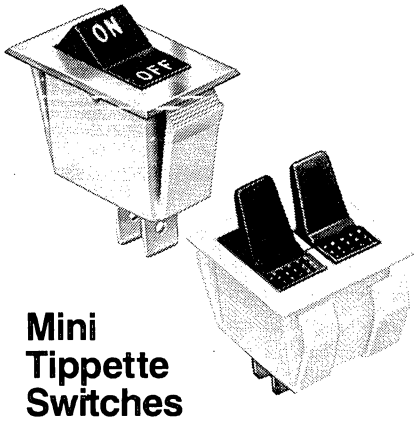
Magnetic Circuit Breakers

Industry-standard magnetic circuit breakers are available in single or multiple-pole configurations with single or multiple actuators. Rated from .100A to 30.0A @ 277VAC and 65VDC (max). Instantaneous, ultra short, short, medium and long time delays; switch only, series, shunt or relay trip circuits. Special color caps available in eight attractive colors. Well-suited for new designs or as direct replacements for competitive protectors.



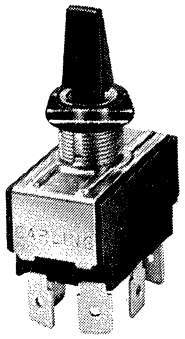
Full Size Tippette® Rocker Switches

Tippette rocker switches are available in an almost endless variety of circuits, current ratings, actuator and bezel styles, mounting brackets and termination types. Other options include legend imprinting, standard or custom-matched bezel and actuator colors. Plus, our patented "Drip Dry" option is an inexpensive way of protecting switch from dirt, moisture and other contaminants. Lighted versions feature single or multiple indicator lights—available with voltages from 6VDC to 240VAC. Will be available in European-approved versions, consult factory.



Mini Tippette Switches

All-nylon low cost insulated switches are tested at full load for 100,000+ cycles. Single or double pole versions offered. All feature convenient snap-in mounting, paddle or rocker actuation. Choose from various current ratings, circuit designs, termination types, colors (standard or custom matches) and legend imprinting. Lighted versions with lamp voltages from 6VDC to 240VAC. Will be available in European-approved versions, consult factory.

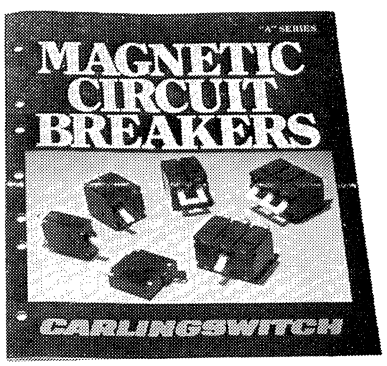


Full Size Toggle Switches

These toggle switches are available in one through four poles in ratings up to 20 amps. Single and double pole switches are available with a variety of circuit, termination and actuator variations including an insulated all-nylon model. New lighted versions utilize a translucent actuator which displays three colors to indicate switch positions. Add a neoprene bushing seal that protects against dust and moisture and you have the right switch combination for marine and automotive applications. Will be available in European-approved versions, consult factory.

Catalogs of Value

Complete specifications for literally thousands of switching devices are yours *free* in our new Full Line and Magnetic Circuit Breaker Catalogs. They're both available from your nearest Carlingswitch Representative or Distributor. Or contact:
Carlingswitch, Inc.
505 New Park Ave.
West Hartford, CT 06110
(203) 233-5551 • Telex: 710-425-0034
For name, address and phone number of your local Carlingswitch Rep or Distributor, dial toll free:
1-800-243-8556.



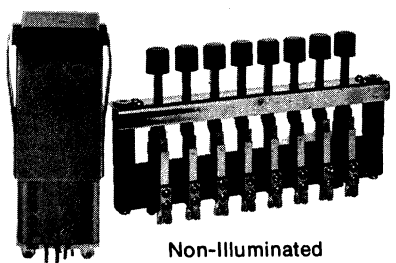
CARLINGSWITCH
INNOVATION BY DESIGN

*Carlingswitch Registered Trademark

Which Switch to Switch to?

...the total line of high quality, precision circuit selector pushbutton and lever switches ...illuminated and non-illuminated

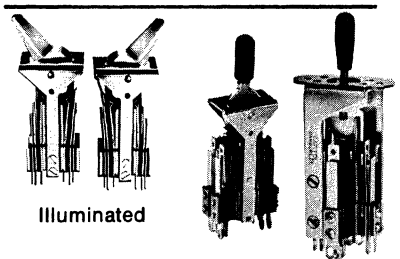
Alternate Action Push Button Switches



Illuminated Single Position

Non-Illuminated Multiple Position

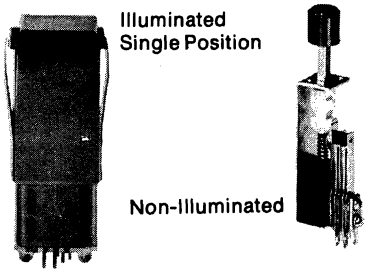
Lever Switches



Illuminated

Non-Illuminated

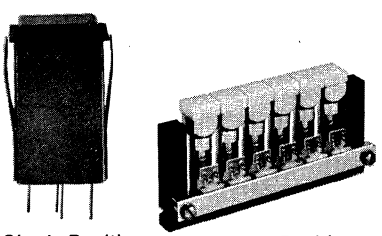
Momentary Push Button Switches



Illuminated Single Position

Non-Illuminated

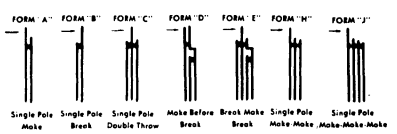
Indicator Lites



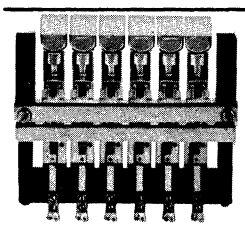
Single Position

Multiple Position

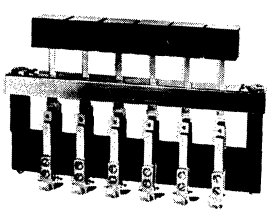
Standard Contact Assemblies Available



Interlocking Push Button Switches



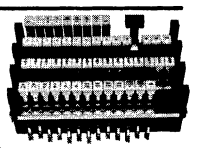
Illuminated Multiple Position

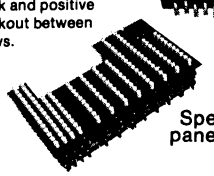


Non-Illuminated Multiple Position

Special Switches

Model SP-ID-4-115, includes: (4) Model SP-ID-115 switches banked together with mechanical interlock and positive lockout between rows.





Special panel assembly.

Write or phone today for the complete illustrated catalog of Capitol Switches.

Representatives in principal cities:
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Chicago St. Louis Dallas
Los Angeles San Francisco
Seattle Toronto Montreal

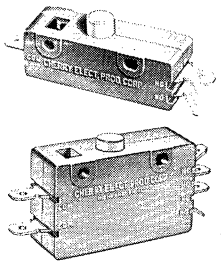
Federal Supply Code 01548

Capitol SWITCH

The Capitol Machine and Switch Company
87 Newtown Road
Danbury, CT 06810
203/744-3300

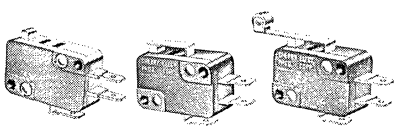
CHERRY precision switches

SNAP-ACTION SWITCHES



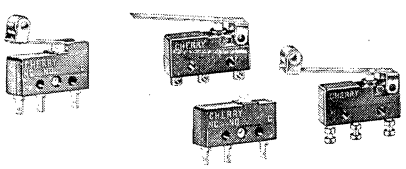
GENERAL PURPOSE

ratings: 0.1, 15, 20, 25A @ 125/250 VAC
circuitry: SPDT, DPDT, SPST, NO or NC, DPST NO or NC
size: 1 13/16" x 41/64" x 41/64" (SP) or 1⅛" (DP)



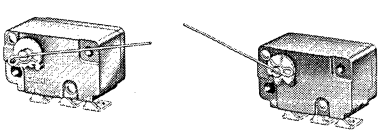
MINIATURE

Standard or light force operation.
ratings: 0.1, 3, 5, 10, 15A @ 125/250 VAC
circuitry: SPDT, SPST, NO or NC
size: 1 3/32" x 13/32" x ⅝"



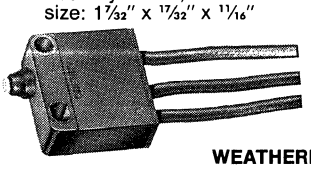
SUBMINIATURE

Standard or light force operation.
Solid base available.
ratings: 0.1, 5, 10.1A @ 125/250 VAC
circuitry: SPDT, SPST NO or NC
Size: 25/32" x ¼" x 23/64"



LOW TORQUE

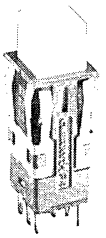
ratings: 0.1, 5A @ 125/250 VAC
circuitry: SPDT, SPST NO or NC
size: 1 7/32" x 17/32" x 1 1/16"



WEATHERPROOF

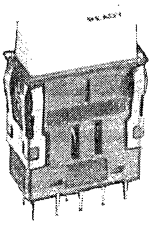
ratings: 0.1, 10.1A @ 125/250 VAC
circuitry: SPDT
size: 0.92" x 0.37" x 0.875"

MODULAR PANEL SWITCHES & ENCODERS



Light or unlighted switches in square (1 x 1) configuration with choice of momentary or alternate action, QC or PCB terminals, rated at choice of 3A @ 125VAC/2A @ 250VAC or 0.1A @ 24VDC.

size: .745" x .745" x 1.83"



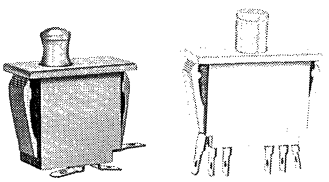
Unique user-programmable 8-bit encoder with choice of 256 different codes. 1 x 2 configuration, base keyed for foolproof PC board orientation.

size: .745" x 1.533" x 1.89"

3-Bit encoder with up to 8 different 3-bit codes, single common.

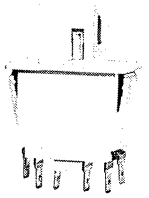
size: .745" x .745" x 1.83"

PANEL MOUNT PUSHBUTTON SNAP-ACTION SWITCHES



Momentary contact, push-pull, push-push and "cheat" interlock available.
ratings: 0.1, 10A @ 125/250 VAC
circuitry: SPDT, SPST NO or NC, DPDT, DPST NO or NC
size: 0.91" (SP) or 1.24" (DP) x 0.54" x 0.97"

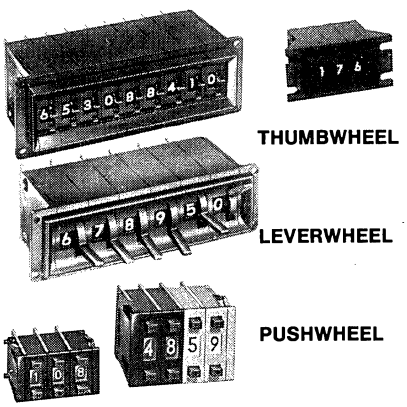
LINE INTERRUPT SWITCHES



Meet worldwide safety specs. Double-make, Double-break contacts.

ratings: 0.1, 10, 16A @ 125/250 VAC combinations
circuitry: form X, Y or Z contacts, 1 or 2 poles
size: 1.24" x 0.524" x 1.075"

SELECTOR SWITCHES



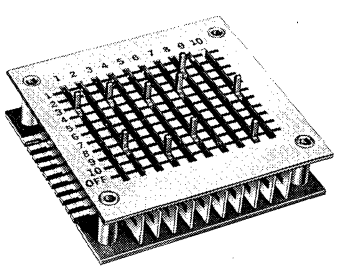
THUMBWHEEL

LEVERWHEEL

PUSHWHEEL

Five sizes from sub-subminiature to industrial for low level switching and encoding. Gangable modules mount front or rear. 8 to 16 positions. Over 75 codes including hex. Pin or PC board termination. Lighted versions available, too.

MATRIX SELECTOR SWITCHES



Eleven standard units from 100 to 2784 crosspoints. Custom modules available.

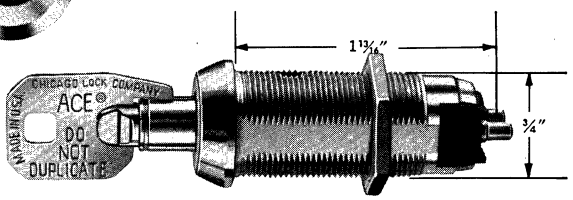
CHERRY SWITCHES

CHERRY ELECTRICAL PRODUCTS CORP. • 3623 Sunset Ave., Waukegan, IL 60087 • 312/578-3500

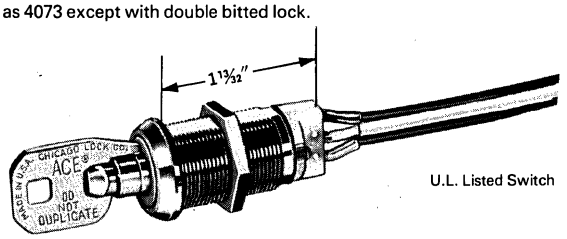
Maximum Security Switch Locks for every application!

Write or call for Switch Lock brochure.

Switch Locks

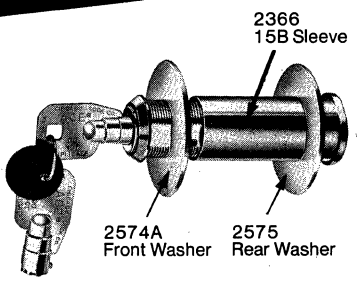


No. 4073—Maintaining contact switch. Key removable "off," "on" or "off-on". Also available as 4073-70 with momentary contact switch. All brass construction. Also offered with die cast outer barrel. No. 2274-80 same as 4073 except with double bitted lock.

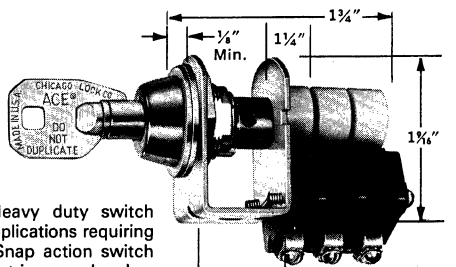


U.L. Listed Switch

No. 4235 — Easy to mount, UL Listed switch SPDT, available with silver plated contacts and 10" wire leads. Offered without 10" leads at reduced cost. Furnished with micro-switch 1SX1-H58.



No. 3039 - SPST switch with adjustable sleeve and washers; dependable wiping contacts. Solder terminals. Lock all brass construction, polished chrome finish. Key removable "off," "on" or "off-on." Also available in die cast outer barrel.

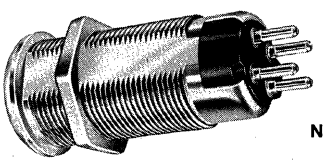


U.L. Listed Switch

UL Micro V3-101

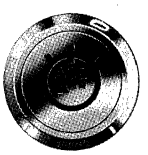
No. EXA-112-3—Heavy duty switch lock designed for applications requiring UL Listed switch. Snap action switch actuated by an eccentric cam when key turned 90 degrees. Multi pole combinations available. Switches are Micro No. V3-101.

SPECIAL APPLICATION — TWO SEPARATE SPST CIRCUITS

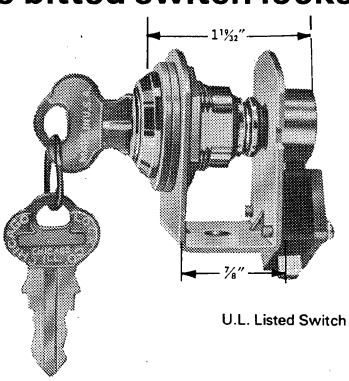


No. 4074

7 Pin Tumbler
ACE II™ Mechanism.
Same as 4073 lock
except with two circuits.

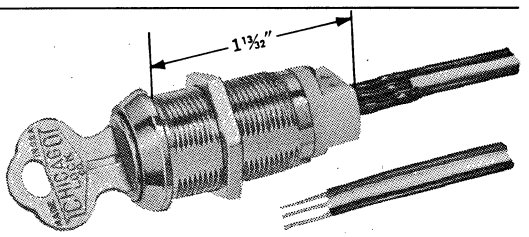


Chicago double bitted switch locks



U.L. Listed Switch

No. EXD-98
Same as EXA-112, except with double bitted cylinder. Designed for high current applications. Multiple pole combinations available. Furnished with micro-switch V3-101.



No. 3535 — UL Listed switch, SPDT. Furnished with silver plated contacts and 10" wire leads. Same as 4235 except has double bitted cylinder. Available without 10" leads at reduced cost. Furnished with micro-switch 1SX1-H58.

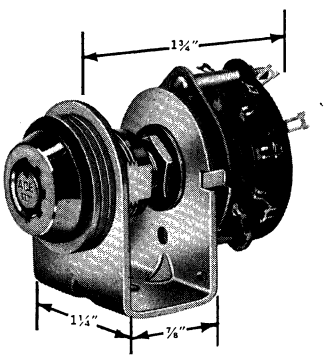
Current Ratings	Lock Numbers
*125-250VAC, 5 AMP; 30 VDC, 3 AMP	3535, 4235
*125-250VAC, 7 AMP; 28 VDC, 7 AMP	2174, 2174-70,
110-120VAC, 10 AMP; 10 VDC, 10 AMP	3039, 4073, 4073-70
125 VDC, ½ AMP	EXD-98, EXA-112†
125-250 VAC, 10 AMP	EXD-98-25
125-250 VAC — Over 10 AMP	EXD-112-25

†When ordering, specify if for appliances requiring T.V. approved switches. Only available on EXD-98 or EXA-112 series.

CURRENT RATINGS for 4188 and 2242	Voltage	AC amps Resistive	DC amps Resistive
	6V	5.5	5.5
	12V	3.5	3.5
	24V	1.75	1.55
	48V	.8	.65
	115V	.23	.21

***Silver plated contacts.** **Also suited for low energy circuits.**

Switch locks with wafer type switches

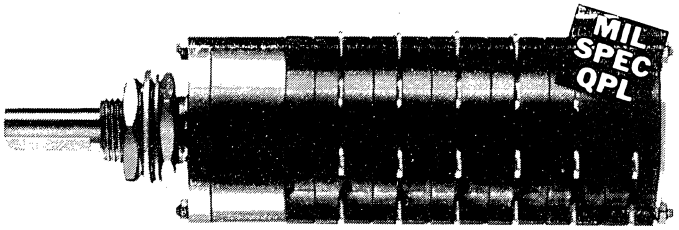


No. 4188 — Key operated with bracket mounting and Ace cylinder. Switch designed for low voltage applications. Multiple poles and various throw arrangements available with stacked wafers. Available with double bitted lock No. 2242.

CHICAGO LOCK CO.

4311 West Belmont Ave., Chicago, Illinois 60641
Phone 1-312-282-7177

COLE ROTARY SWITCHES



3600 SERIES Miniature Enclosed Rotary Switches

A new custom quality rotary switch. The 1-inch 3600 series enclosed miniature; meets MIL-S-3786. A 6 amp. switch for high-rel use in aircraft controls, electronic test equipment in harsh environments.

Quality? Roller bearing silver contacts. Custom quality? Up to 12 decks, 1 to 6 poles per deck; 30, 36, 45 deg. (8, 10 or 12 position). Options like hermetic enclosure; pre-wired to connector.

TECHNICAL DATA

Listed on QPL to MIL-S-3786, Style SR04.
Certified test reports available

Electrical

Contact Rating
Current carrying: 10 amps @ 28 VDC
Make & Break: 6 amp resistive @ 115 VAC
6 amp resistive @ 28 VDC
3 amp inductive @ 28 VDC
Dielectric Strength: 1500V RMS
Contact Resistance:
Initial .005 ohms max.
Insulation Resistance:
10^5 meg ohms min.

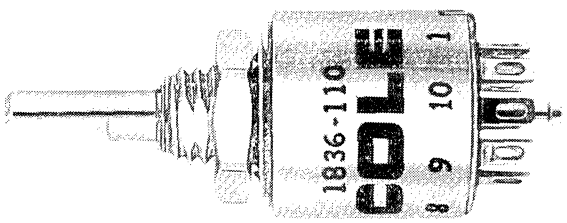
Mechanical

Rotational Torque: 5 in. lbs. max.
Weight: 1.7 ounces + .3 ounces/deck
Life: 100,000 cycles min. mechanical
25,000 cycle min. switching 5 amps @ 120 VAC

ORDERING INFORMATION SAMPLE CODE

36 45-204-3S

- 3S — Shorting Decks (Omit for Non-shorting)
- 4 — Number of Decks
- 5 — Number of Positions
- 2 — Number of Poles
- 0 — Degrees Between Positions
- 45 — Cole Basic Switch and Drawing No.
- 36 — Positions



1800 SERIES Half-Inch Enclosed Rotary Switches

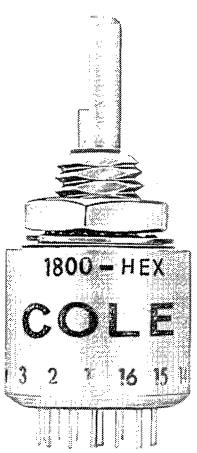
The ultimate in a one half-inch rotary selector switch, the Cole Series 1800 is engineered to meet or exceed applicable MIL-S-3786, Style SR20 requirements.

The Series 1800 enclosed switch was designed for critical ordnance applications, and demanding usage in aircraft, medical and industrial controls and instrumentation, as well as electronic equipment.

This switch is available with 1 pole, 2 to 10 positions, and 2 pole, 2 to 5 positions.

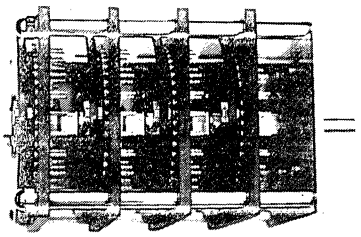
Quality construction, including materials that meet the strictest standards, allows these subminiature switches to combine high current switching capacity with constant low contact resistance. Long life and high reliability are assured by exceedingly stringent inspection and testing procedures.

Available in standard solder lug or printed circuit terminations, the Cole Series 1800 can be furnished with an internal seal. This unique Cole design option renders the switch impervious to water, contaminants and most solvents.



YOUR SOURCE FOR SPECIAL PURPOSE ROTARY SWITCHES

Coded Switches, for direct logic level interfacing
HALF-INCH rotaries, Hexadecimal and BCD code standard, custom codes to your requirements. These are also HI-REL switches, MIL-S-3786 performance.



Instrument Grade, Open Frame Rotary Switches

For heavier current requirements (15 amp continuous; 3 to 5 amp switching.) One MILLION cycles or better life expectancy.

COLE INSTRUMENT CORP.
2650 S. Croddy Way Santa Ana, CA 92704
(714) 556-3100

See our rep and distributor listings.

OUSE-HINDS COMPANY

ARROW HART DIVISION

Crouse-Hinds Company, Arrow Hart Division has a wide range of manual switch products, from heavy duty 60A power toggle switches to dry circuit microminiature pushbuttons. Many of our products are described in literature or can be explained by your nearby Arrow Hart representative. In addition to InterSpec™ switches we offer:

- Internationally-approved miniature Snap-In-Power Rocker Switches (1600/2600 Series)
- New Internationally-approved general purpose AC toggle switches (4000 Series)
- Adapt-a-Switch® illuminated (modular) pushbuttons
- Rotary Keylock power switches
- General-purpose AC and AC/DC toggle switches
- General-purpose AC and AC/DC pushbutton switches
- Heavy duty enclosed/unenclosed AC/DC toggle switches
- Rotary Heater switches
- Slide switches for power tools
- Trigger switches for power tools
- Sump Pump switches
- Military QPL'd full-size and miniature toggle switches

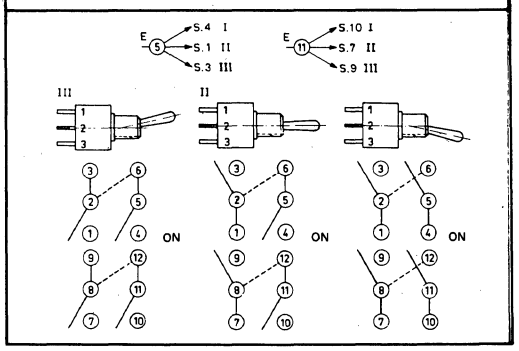
InterSpec™ Switch International Approvals

U.S.A. · Canada · Germany · Switzerland · Sweden · Norway · Denmark · UTE-NF-CCQ France · USE France

InterSpec™ switches offer the widest selection of optional international agency approvals for power applications. **Contact your local representative or the Hartford Product Marketing Department for current approval information.**

FUNCTIONS			
01	ON	—	ON
03	ON	OFF	ON
05	MOM	OFF	MOM
07	ON	OFF	MOM
08	ON	—	MOM
11	ON	ON	ON
13	ON	ON	MOM
15	MOM	ON	MOM

ON-ON-ON



(Dotted line denotes external jumpers added by customer)

Specifications

Specifications are given adjacent to each switch photograph for your convenience. Note also the following applies generally to the switches in this catalog:

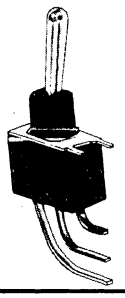
TEMPERATURE	
Operating	−40°C to +85°C
Storage	−55°C to +125°C
LIFE	
Electrical	See individual items
Mechanical	100,000 cycles minimum

Specifications are subject to change without notice.

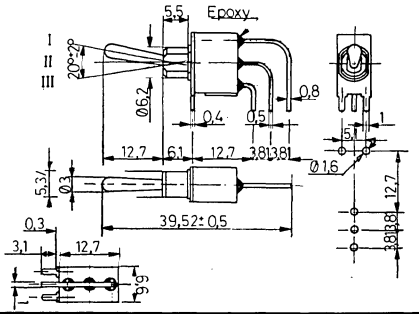
L Series — WASHABLE TOGGLE — single pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,4VA 20VAC or DC
  min. : 10μA 5V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  100.000 operations for 2 position
  50.000 operations for 3 position
* Designed for wave soldering and cleaning of PC board

Available in other circuits and styles.



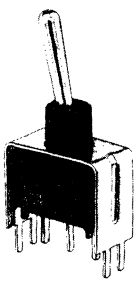
Models	Function III II I
L1010SCRAV2BE	ON — ON



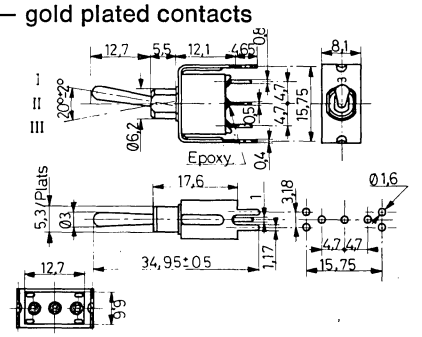
L Series — WASHABLE TOGGLE — single pole — straight PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,4VA 20VAC or DC
  min. : 10μA 5V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  100.000 operations for 2 position
  50.000 operations for 3 position
* Bracket mounting
* Designed for wave soldering and cleaning of PC board

Available in other circuits and styles.



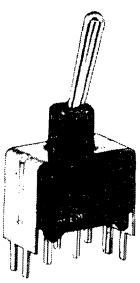
MODELS	FUNCTIONS III II I
L1010SCRV30BE	ON — ON



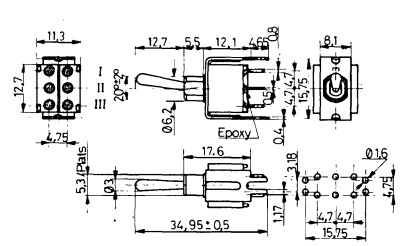
L Series — WASHABLE TOGGLE — double pole — straight PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,4VA 20VAC or DC
  min. : 10μA 5V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  100,000 operations for 2 position
  50,000 operations for 3 position
* Bracket mounting
* Designed for wave soldering and cleaning of PC board

Available in other circuits and styles.



MODELS	FUNCTIONS III II I
L2010SCRV30BE	ON — ON

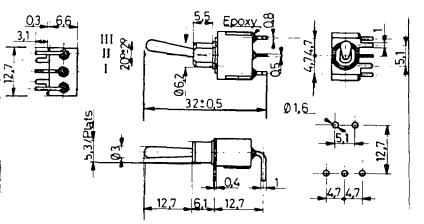


L Series — WASHABLE TOGGLE — single pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,4VA 20VAC or DC
  min. : 10μA 5V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  100.000 operations for 2 position
  50.000 operations for 3 position
* Designed for wave soldering and cleaning of PC board

Available in other circuits and styles.

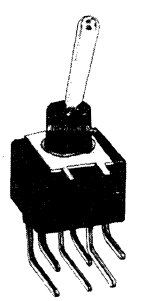
MODELS	FUNCTIONS III II I
L1010SCRABE	ON — ON



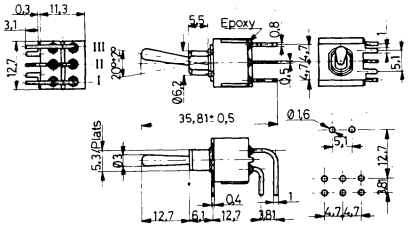
L Series — WASHABLE TOGGLE — double pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,4VA 20VAC or DC
  min. : 10μA 5V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  100,000 operations for 2 position
  50,000 operations for 3 position
* Designed for wave soldering and cleaning of PC board

Available in other circuits and styles.



MODELS	FUNCTIONS III II I
L2010SCRABE	ON — ON

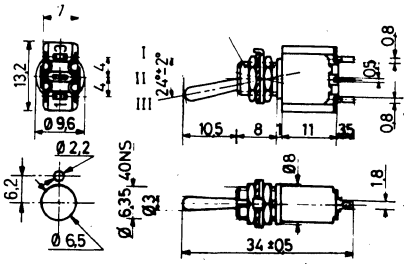


eries — STANDARD TOGGLE — SINGLE POLE — SOLDER LUGS — SILVER CONTACTS

CIFICATIONS :
urrent/voltage rating :
lax. : 3A 250VAC, 5A 30VDC
nin. : 100mA 10V
Initial contact resistance : 10mΩ
Life expectancy with resistive nominal load : 50.000 operations
•Panel thickness : 2,5mm with 2 nuts, 4mm with 1 nut
* Watertight boots (see page 12)
* Optional Approvals: UL - CSA - VDE - SEV

Available in other circuits and styles.

Models	Functions 2-3	1-2
A1080SH3ZQ	ON	MOM
A1010SH3ZQ	ON	ON
A1050SH3ZQ	MOM OFF	MOM
A1070SH3ZQ	ON OFF	MOM
A1030SH3ZQ	ON OFF	ON

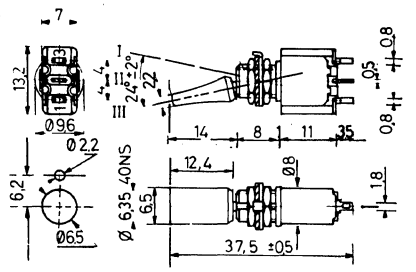


A Series — PADDLE U242 — SINGLE POLE — SOLDER LUGS — SILVER CONTACTS

SPECIFICATIONS :
•Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100mA 10V
•Initial contact resistance : 10mΩ
•Life expectancy with resistive nominal load : 50.000 operations
•Panel thickness : 2,5mm with 2 nuts, 4mm with 1 nut
*Optional Approvals: UL - CSA - VDE - SEV

COLORS : blue : U241, black : U242, green : U243, gray : U244, yellow : U245, red : U246, ivory : U247, orange : U249

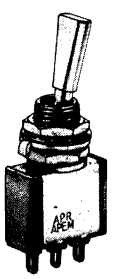
Models	Functions 2-3	1-2
A1010L41H3ZQ2	ON	ON



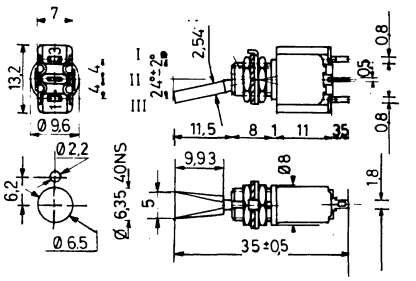
A Series — FLAT TOGGLE P3 — SINGLE POLE — SOLDER LUGS — SILVER CONTACTS

SPECIFICATIONS :
•Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100mA 10V
•Initial contact resistance : 10mΩ
•Life expectancy with resistive nominal load : 50.000 operations
•Panel thickness : 2,5mm with 2 nuts, 4mm with 1 nut
•Optional Approvals: UL

Available in other circuits.



Models	Functions 2-3	1-2
A1010P3H3ZQ	ON	ON

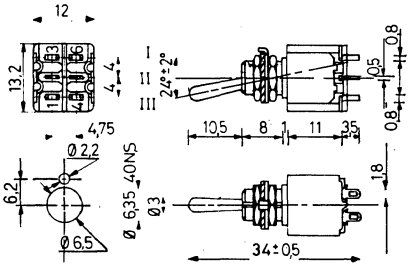


A Series — STANDARD TOGGLE — DOUBLE POLE — SOLDER LUGS — SILVER CONTACTS

SPECIFICATIONS :
•Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100mA 10V
•Initial contact resistance : 10mΩ
•Life expectancy with resistive nominal load : 50.000 operations
•Panel thickness : 2,5mm with 2 nuts, 4mm with 1 nut
*Optional Approvals: UL - VDE - SEV
* Watertight boots (see page 12)
*See connections page 1
A2110SH 3ZQ

Available in other circuits and styles.

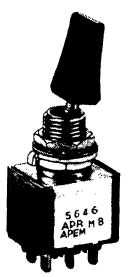
Models	Functions 2-3 5-6	1-2 4-5
A2080SH3ZQ	ON	MOM
A2010SH3ZQ	ON	ON
A2050SH3ZQ	MOM OFF	MOM
A2070SH3ZQ	ON OFF	MOM
A2030SH3ZQ	ON OFF	ON
A2110SH3ZQ	ON ON	ON



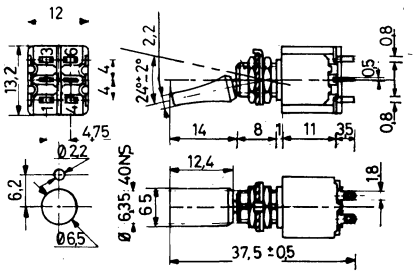
A Series — PADDLE U242 — DOUBLE POLE — SOLDER LUGS — SILVER CONTACTS

SPECIFICATIONS :
•Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100mA 10V
•Initial contact resistance : 10mΩ
•Life expectancy with resistive nominal load : 50.000 operations
•Panel thickness : 2,5mm with 2 nuts, 4mm with 1 nut
*Optional Approvals: UL - VDE - SEV

COLORS : blue : U241, black : U242, green : U243, gray : U244, yellow : U245, red : U246, ivory : U247, orange : U249



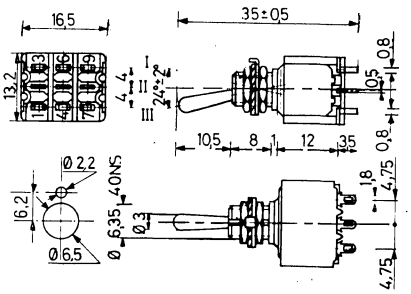
Models	Functions 2-3 5-6	1-2 4-5
A2080L41H3ZQ2	ON	MOM
A2010L41H3ZQ2	ON	ON
A2050L41H3ZQ2	MOM OFF	MOM
A2070L41H3ZQ2	ON OFF	MOM
A2030L41H3ZQ2	ON OFF	ON



A Series — Standard toggle — three poles — solder lugs — silver contacts

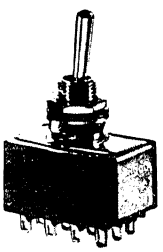
SPECIFICATIONS :
*Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100 mA 10V
*Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Panel thickness : 2,5 mm with 2 nuts,
4 mm with 1 nut
* Watertight boots (see page 12)
* Optional Approvals: UL

Models	Functions		
	2-3 5-6 8-9		1-2 4-5 7-8
A3010SH3ZQ	ON	—	ON
A3030SH3ZQ	ON	OFF	ON

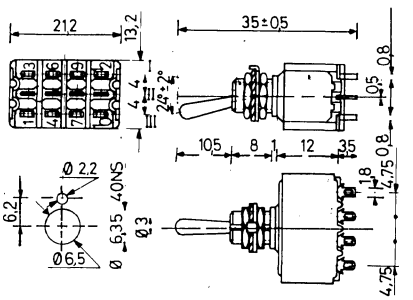


A Series — Standard toggle — four poles — solder lugs — silver contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100 mA 10V
*Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Panel thickness : 2,5 mm with 2 nuts,
4 mm with 1 nut
*Watertight boots (see page 12)
*Optional Approvals: UL



Models	Functions		
	2-3 5-6 8-9 11-12		1-2 4-5 7-8 10-11
A4010SH3ZQ	ON	—	ON
A4030SH3ZQ	ON	OFF	ON

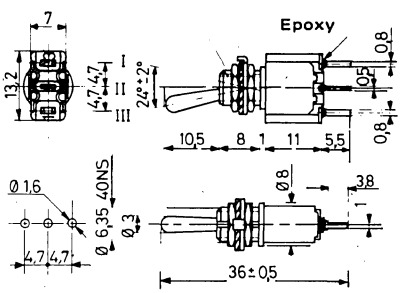


A Series — Standard toggle — single pole — straight PC terminals — gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100 mA 30VDC
min. : 10 mA 50m VDC
*Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Sealed terminals

Available in other circuits and styles.

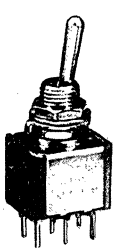
Models	Functions		
	2-3		1-2
A1080SH3CBE	ON	—	MOM
A1010SH3CBE	ON	—	ON
A1050SH3CBE	MOM	OFF	MOM
A1070SH3CBE	ON	OFF	MOM
A1030SH3CBE	ON	OFF	ON



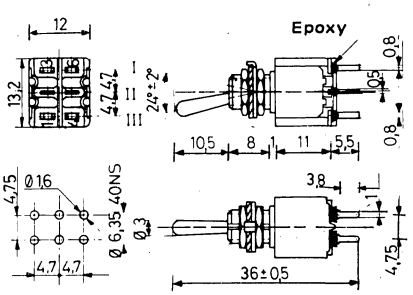
A Series — Standard toggle — double pole — straight PC terminals — gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100 mA 30V DC
min. : 10 mA 50m V DC
*Initial contact resistance : 10 mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Sealed terminals
* Watertight boots (see page 12)

*2110SH3CBE, see connections page 1
Available in other circuits and styles.



Models	Functions		
	2-3 5-6		1-2 4-5
A2080SH3CBE	ON	—	MOM
A2010SH3CBE	ON	—	ON
A2050SH3CBE	MOM	OFF	MOM
A2070SH3CBE	ON	OFF	MOM
A2030SH3CBE	ON	OFF	ON
A2110SH3CBE	ON	ON	ON

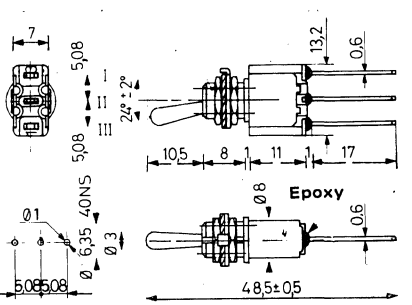


A Series — Standard toggle—single pole—wirewrap—gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100 mA 30V DC
min. : 10 mA 50m V DC
*Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Sealed terminals
*Watertight boots (see page 12)

Available in other circuits and styles.

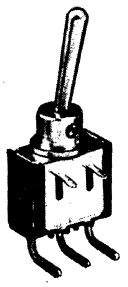
Models	Functions		
	2-3		1-2
A1080SH3WBE	ON	—	MOM
A1010SH3WBE	ON	—	ON
A1050SH3WBE	MOM	OFF	MOM
A1070SH3WBE	ON	OFF	MOM
A1030SH3WBE	ON	OFF	ON



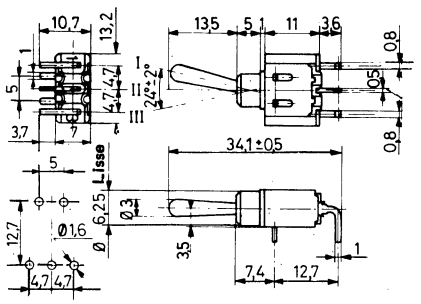
A Series — single pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100mA 30VDC
min. : 10mA 50mVDC
*Initial contact resistance : 10mΩ
Life expectancy with resistive nominal load :
50.000 operations

These models are available with other lever types. Please ask us.



Models	Functions I II III	
	2-3	1-2
A1080SD9AB	ON —	MOM
A1010SD9AB	ON —	ON
A1050SD9AB	MOM OFF	MOM
A1070SD9AB	ON OFF	MOM
A1030SD9AB	ON OFF	ON



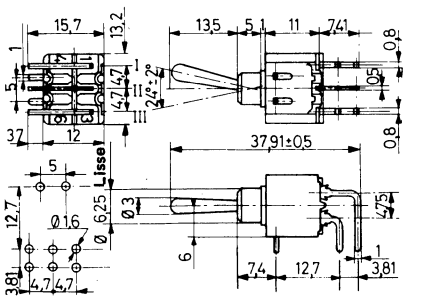
A Series — Toggle — double pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100mA 30VDC
min. : 10mA 50mVDC
*Initial contact resistance : 10mΩ
Life expectancy with resistive nominal load :
50.000 operations

These models are available with other lever types. Please ask us.

*A2110SD9AB, see connections page 1

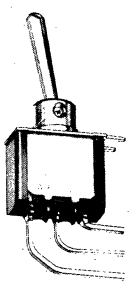
Models	Functions I II III	
	2-3	1-2
	5-6	4-5
A2080SD9AB	ON —	MOM
A2010SD9AB	ON —	ON
A2050SD9AB	MOM OFF	MOM
A2070SD9AB	ON OFF	MOM
A2030SD9AB	ON OFF	ON
A2110SD9AB	ON ON	ON



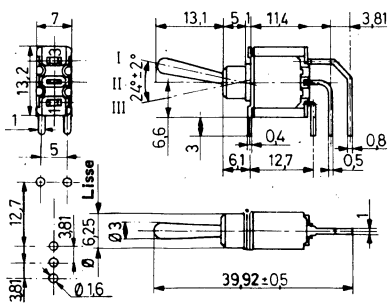
A Series — Toggle — single pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 100mA 30VDC
min. : 10mA 50mVDC
*Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations

These models are available with other lever types. Please ask us.



Models	Functions III II I	
	2-3	1-2
A1080SD9AV2B	ON —	MOM
A1010SD9AV2B	ON —	ON
A1050SD9AV2B	MOM OFF	MOM
A1070SD9AV2B	ON OFF	MOM
A1030SD9AV2B	ON OFF	ON

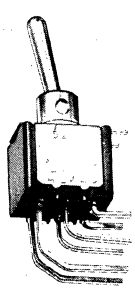


A Series — Toggle — double pole — right angle PC terminals — gold plated contacts

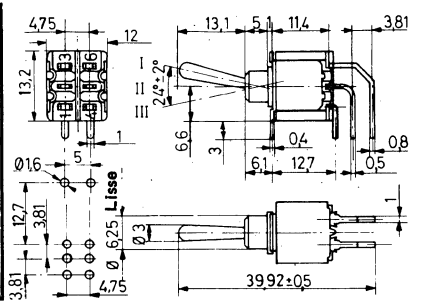
SPECIFICATIONS :
*Current/voltage rating :
max. : 100mA 30VDC
min. : 10mA 50mVDC
*Initial contact resistance : 10 mΩ
*Life expectancy with resistive nominal load :
50.000 operations

These models are available with other lever types. Please ask us.

*2110SD9AV2B, see connections page 1



Models	Functions III II I	
	2-3	1-2
	5-6	4-5
A2080SD9AV2B	ON —	MOM
A2010SD9AV2B	ON —	ON
A2050SD9AV2B	MOM OFF	MOM
A2070SD9AV2B	ON OFF	MOM
A2030SD9AV2B	ON OFF	ON
A2110SD9AV2B	ON ON	ON

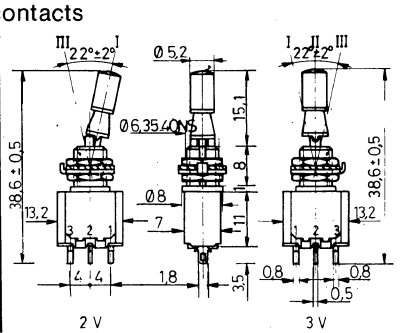


A Series — Locking toggle — single and double pole — solder lugs — silver contacts

SPECIFICATIONS :
*Current/voltage rating :
max. : 3A 250VAC, 5A 30VDC
min. : 100mA 10V
Initial contact resistance : 10mΩ
*Life expectancy with resistive nominal load :
50.000 operations
*Panel thickness : 2,5 mm with 2 nuts,
4 mm with 1 nut
*Optional Approvals: UL

Available in other circuits and styles.

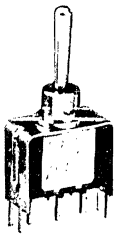
Models	Functions Nut	
	2-3	1-2
Single Pole		
A1010KK2ZQ	ON —	ON
A1030KK3ZQ	ON OFF	ON
Double Pole		
A2010KK2ZQ	ON —	ON



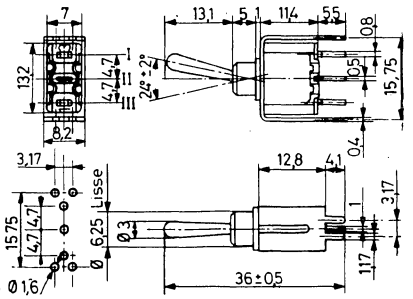
A Series — Toggle—single pole—straight PC terminals—gold plated contacts—bracket mounting

SPECIFICATIONS:
* Current/voltage rating:
  max.: 100mA 30VDC
  min.: 10mA 50mVDC
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load:
  50.000 operations
* Sealed terminals

These models are available in double pole versions, other circuits and styles.



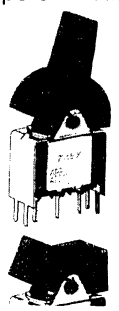
MODELS	FUNCTIONS		
	III	II	I
	2-3		1-2
A1080SD9V30BE	ON	—	MOM
A1010SD9V30BE	ON	—	ON
A1050SD9V30BE	MOM	OFF	MOM
A1070SD9V30BE	ON	OFF	MOM
A1030SD9V30BE	ON	OFF	ON
A2010SD9V30BE	ON	—	ON
A2030SD9V30BE	ON	OFF	ON



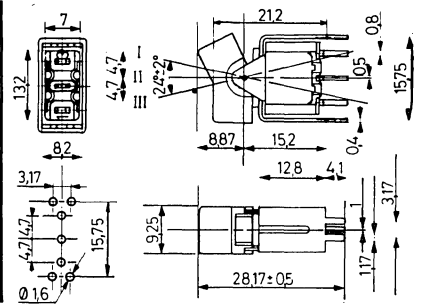
B Series — Paddle or rocker—single pole—straight PC terminals—gold plated contacts—bracket mounting

SPECIFICATIONS:
* Current/voltage rating:
  max.: 100mA 30VDC
  min.: 10mA 50mVDC
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load:
  50.000 operations
* Sealed terminals

COLORS: blue: U611 or U621,
black: U612 or U622, green: U613 or U623,
gray: U614 or U624, yellow: U615 or U625,
red: U616 or U626, ivory: U617 or U627,
orange: U619 or U629.



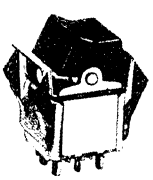
Models	Functions		
	III	II	I
	2-3		1-2
Paddle: B1080J2V3BE2	ON	—	MOM
B1010J2V3BE2	ON	—	ON
Rocker: B1010J1V3BE2	ON	—	ON



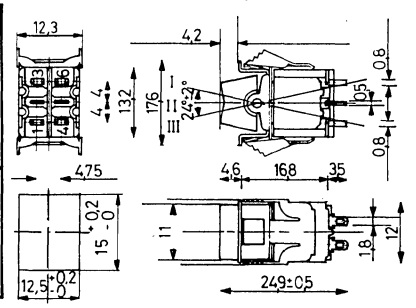
B Series — Rocker and bezel — double pole — solder lugs — silver contacts — SNAP-IN mounting

SPECIFICATIONS:
* Current/voltage rating:
  max.: 3A 250VAC, 5A 30VDC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load:
  50.000 operations
* **Optional Approvals: UL, SEV**

COLORS: blue: U711 + U551,
black: U712 + U552, green: U713 + U553,
gray: U714 + U554, yellow: U715 + U555,
red: U716 + U556, ivory: U717 + U557,
orange: U719 + U559.



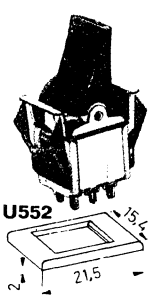
Models	Functions		
	III	II	I
	2-3 5-6		1-2 4-5
Rocker and Bezel B2010J51ZQ22	ON	—	ON



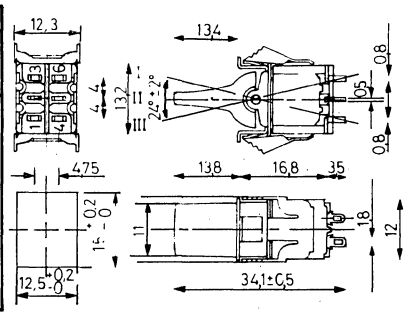
B Series — Paddle and bezel — double pole — solder lugs — silver contacts — SNAP-IN mounting

SPECIFICATIONS:
* Current/voltage rating:
  max.: 3A 250VAC, 5A 30VDC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load:
  50.000 operations
* **Function 4, see connections page 1**
* **Optional Approvals: UL, SEV**

COLORS: blue: U811 + U551,
black: U812 + U552, green: U813 + U553,
gray: U814 + U554, yellow: U815 + U555,
red: U816 + U556, ivory: U817 + U557,
orange: U819 + U559.



Models	Functions		
	III	II	I
Paddle and Bezel	2-3 5-6		1-2 4-5
B2080J61ZQ22	ON	—	MOM
B2110J61ZQ22	ON	ON	ON
B2010J61ZQ22	ON	—	ON
B2050J61ZQ22	MOM	OFF	MOM
B2070J61ZQ22	ON	OFF	MOM
B2030J61ZQ22	ON	OFF	ON

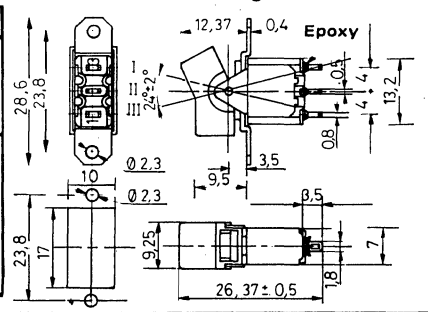


B Series — Paddle or rocker — single pole — solder lugs — gold plated contacts — screw mounting

SPECIFICATIONS:
* Current/voltage rating:
  max.: 100mA 30VDC
  min.: 10mA 50mVDC
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load:
  50.000 operations
* Sealed terminals

COLORS: blue: U611 or U621,
black: U612 or U622, green: U613 or U623,
gray: U614 or U624, yellow: U615 or U625,
red: U616 or U626, ivory: U617 or U627,
orange: U619 or U629.

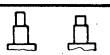
Models	Functions		
	III	II	I
	2-3		1-2
Paddle: B1010J2ZBE2	ON	—	ON
Rocker: B1010J1ZBE2	ON	—	ON

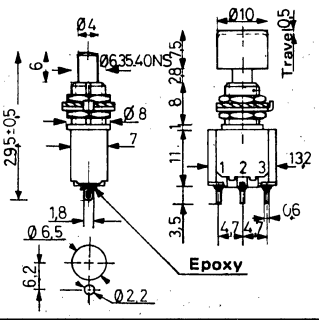


D Series — Sensitive pushbutton — single pole — solderlugs — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : **100µA 50mVDC**
* Initial contact resistance : 50mΩ
* Life expectancy with resistive nominal load :
  50.000 operations
* Max. panel thickness : 2,5mm
* Sealed terminals

Available in other circuits and styles.

Models	Functions
	
D1080PBH3ZBE	**— MOM**

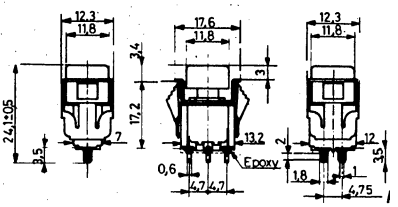


D Series — Sensitive pushbutton — single pole — solder lugs — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : 100µA 50mVDC
* Initial contact resistance : 50mΩ
* Life expectancy with resistive nominal load :
  50.000 operations
* Max. panel thickness : 2,5mm
* Sealed terminals

CAP COLORS : blue : U911, black : U912,
green : U913, gray : U914, yellow : U915
red : U916, ivory : U917, orange : U919

Models	Function	
	1-3	1-2
D1080J81ZBE__ or D1080J8ZZBE__	**ON**	**— MOM**

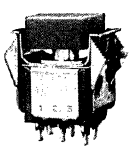


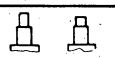
SINGLE POLE **DOUBLE POLE**

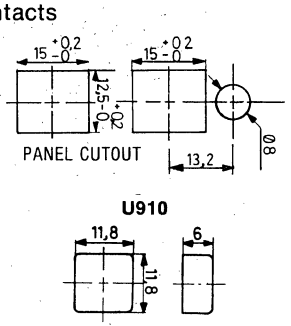
D Series — Sensitive pushbutton — double pole — solder lugs — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : 100µA 50mVDC
* Initial contact resistance : 50mΩ
* Life expectancy with resistive nominal load :
  50.000 operations
* Max. panel thickness : 2,5mm
* Sealed terminals

CAP COLORS : blue : U911, black : U912,
green : U913, gray : U914, yellow : U915
red : U916, ivory : U917, orange : U919



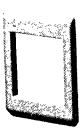
Models	Function
	
D2080J81ZBE__ or D2080J82ZBE__	**ON — MOM**



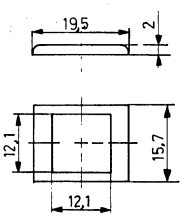
BEZEL

SPECIFICATIONS :
* Panel thickness with bezel :
  min. : 1mm
  max. : 2,5mm

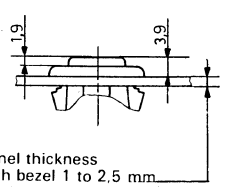
BEZEL COLORS : blue : U1201, black : U1202,
green : U1203, gray : U1204, yellow : U1205
red : U1206, ivory : U1207, orange : U1209



Models
U1200 (U1201-U1209)



J81 + U910 + U1200

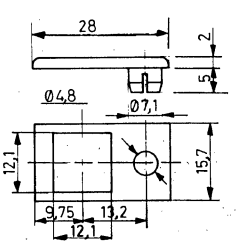


BEZEL FOR LIGHT EMITTING DIODE

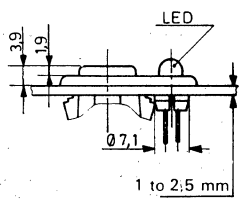
SPECIFICATIONS :
* Panel thickness with bezel :
  min. : 1mm
  max. : 2,5mm

BEZEL COLORS : blue : U1211, black : U1212,
green : U1213, gray : U1214, yellow : U1215
red : U1216, ivory : U1217, orange : U1219

Models
U1210 (U1211-U1219)



J82 + U910 + U1210



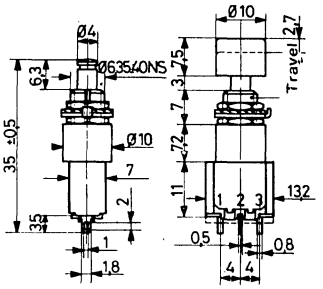
(LED not supplied)

C Series — Latching action pushbutton(push-on push-on)—single pole—solder lugs—silver contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 3A 250VAC
  min. : 100mA 10V
* Initial contact resistance : < 10mΩ
* Life expectancy with resistive nominal load :
  30.000 operations at 3A
* Max. panel thickness : 2,5mm
* Actuator returns to same height regardless of mode

Available in other circuits and styles.

Models	Functions
C1010PBH3ZQ	ON — ON

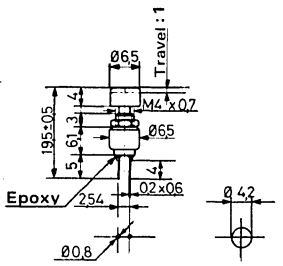


E Series — Microminiature pushbutton — single pole — straight terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : 100μA 50mV
* Initial contact resistance : < 10mΩ
* Life expectancy with resistive nominal load :
  100.000 operations
* Sealed terminals

CAP COLOR : blue : U571, black : U572,
green : U573, gray : U574, yellow : U575,
red : U576, ivory : U577

Models	Functions
E1060MBCBE	

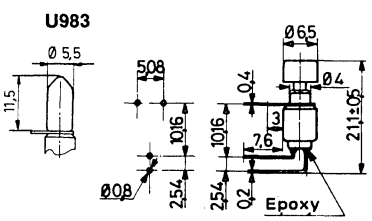


E Series — Microminiature pushbutton — single pole — right angle PC terminals — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : 100μA 50mV
* Initial contact resistance : < 30mΩ
* Life expectancy with resistive nominal load :
  100.000 operations
* Sealed terminals
* Protection during\cleaning by
  boot U983

CAP COLOR : blue : U571, black : U572,
green : U573, gray : U574, yellow : U575,
red : U576, ivory : U577

Models	Functions
E2060MBAVBE	

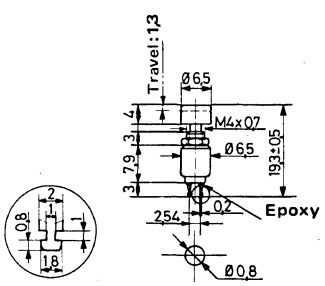


E Series — Microminiature pushbutton — single pole — solder lugs — gold plated contacts

SPECIFICATIONS :
* Current/voltage rating :
  max. : 100mA 30VDC
  min. : 100μA 50mV
* Initial contact resistance : < 30mΩ
* Life expectancy with resistive nominal load :
  100.000 operations
* Panel thickness : 1,5mm max.
* Sealed terminals

CAP COLOR : blue : U571, black : U572,
green : U573, gray : U574, yellow : U575,
red : U576, ivory : U577

Models	Functions
E2040MBZBE	
E2060MBZBE	

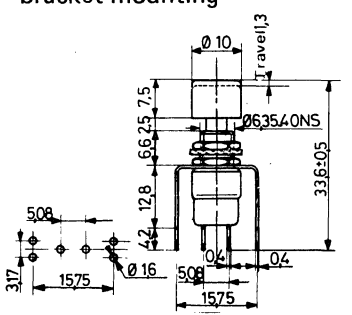


F Series — Pushbutton — single pole — straight PC terminals — silver contacts — bracket mounting

SPECIFICATIONS :
* Current/voltage rating :
  1A 30VDC, 0,3A 250VAC
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  200.000 operations

CAP COLOR : blue : U481, black : U482,
green : U483, gray : U484, yellow : U485,
red : U486, ivory : U487,
chrome plated : U488, orange : U489

Models	Functions
F1060PBV3Q	

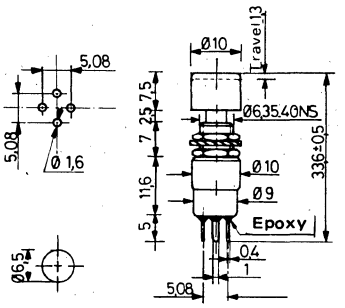


F Series — pushbutton – single pole – straight PC terminals – gold plated contacts

SPECIFICATIONS :
- Current/voltage rating : max. : 0,1 A 30VDC min. : 10mA 50mV
- Initial contact resistance : 30mΩ max.
- Life expectancy with resistive nominal load : 200.000 operations
- Panel thickness : 4 mm max.
- Sealed terminals

CAP COLOUR : blue : U481, black : U482, green : U483, grey : U484, yellow : U485, red : U486, ivory : U487 chrome plated : U488, orange : U489

Models	Functions
F1080PBC2BE	ON – ON

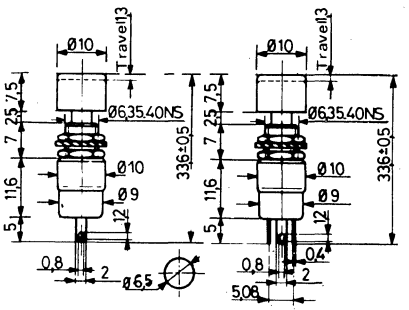


F Series — pushbutton—single pole—solder lugs—silver contacts

SPECIFICATIONS :
- Current/voltage rating : 1A 30VDC, 0,3A 250VAC
- Initial contact resistance : 10mΩ max.
- Life expectancy with resistive nominal load : 200.000 operations
- Panel thickness : 4 mm max.

CAP COLOUR : blue : U481, black : U482, green : U483, grey : U484, yellow : U485, red : U486, ivory : U487, chrome plated : U488, orange : U489

Models	Functions
F1060PBZQ F1080PBZQ	

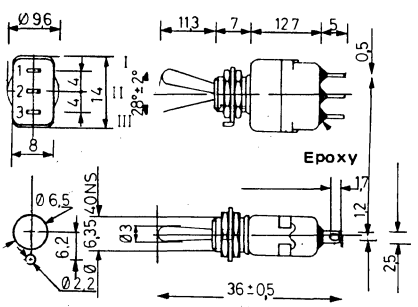


G Series — Toggle—single pole—solder lugs—silver contacts

SPECIFICATIONS :
- Current/voltage rating : max. : 2A 250VAC, 4A 30VDC min. : 100mA 10V
- Initial contact resistance : 10mΩ
- Life expectancy with resistive nominal load : 50.000 operations
- Panel thickness : 2,5mm max.
- Sealed terminals

Available in other styles and circuits.

Models	Functions	
	1-2	2-3
G1010SYZQE	ON	ON

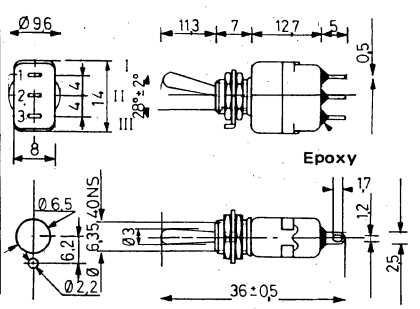


G Series — Black Toggle—single pole—solder lugs—silver contacts

SPECIFICATIONS :
- Current/voltage rating : max. : 2A 250VAC, 4A 30VDC min. : 100mA 10V
- Initial contact resistance : 10mΩ
- Life expectancy with resistive nominal load : 50.000 operations
- Panel thickness : 2,5mm max.
- Sealed terminals
- Black finish on lever, bushing and hardware

Available in other styles and circuits.

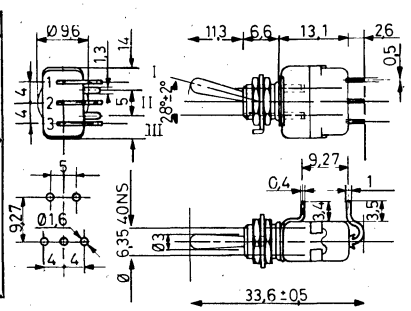
Models	Functions	
	1-2	2-3
G1010SYZQEF1	ON	ON



G Series — Toggle—single pole—right angle PC terminals—silver contacts

SPECIFICATIONS :
- Current/voltage rating : max. : 2A 250VAC, 4A 30VDC min. : 100mA 10V
- Initial contact resistance : 10mΩ
- Life expectancy with resistive nominal load : 50.000 operations

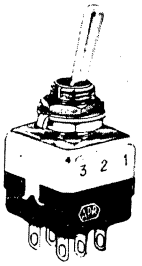
Models	Functions	
	1-2	2-3
G1010SYA4QE	ON	ON



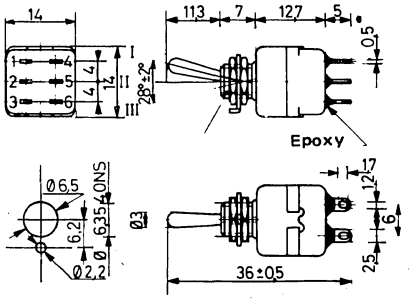
G Series —TOGGLE—DOUBLE POLE—SOLDER LUGS—SILVER CONTACTS

SPECIFICATIONS :
* Current/voltage rating :
  max. : 2A 250VAC, 4A 30VDC
  min. : 100mA 10V
* Initial contact resistance : 10mΩ
* Life expectancy with resistive nominal load :
  50.000 operations
* Panel thickness : 2,5mm max.
* Sealed terminals
* **Watertight boots (see page 12)**

Available in other circuits and styles.



Models	Functions
	1-2 4-5 / 2-3 5-6
G2010SYZQE	ON — ON

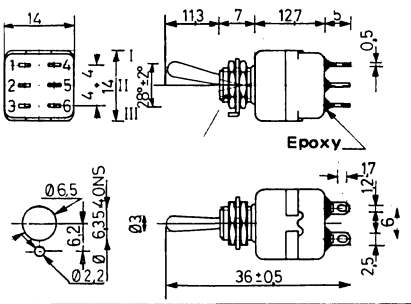


G Series — BLACK TOGGLE—DOUBLE POLE—SOLDER LUGS—GOLD CONTACTS

SPECIFICATIONS :
* Current/voltage rating :
  max. : 0,2A 250VAC
  min. : 10mA 50mV
* Initial contact resistance : < 10mΩ max.
* Life expectancy with resistive nominal load :
  50.000 operations
* Sealed terminals
* Black finish on lever, bushing and hardware

Available in other circuits and styles.

Models	Functions
	1-2 4-5 / 2-3 5-6
G2010SYZ GREF1	ON — ON

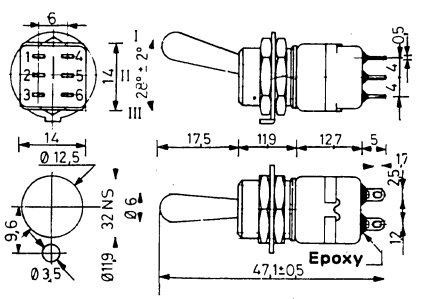


G Series —TOGGLE—DOUBLE POLE—SOLDER LUGS—SILVER CONTACTS BUSHING ϕ 12mm

SPECIFICATIONS :
* Current/voltage rating :
  max. : 2A 250VAC, 4A 30 VDC
  min. : 100mA 10V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  50.000 operations
* Panel thickness : 4,5 mm max.
* Sealed terminals
* High mechanical strength
* **Watertight boots (see page 12)**

Available in other circuits and styles.

Models	Function
	1-2 4-5 / 2-3 5-6
G2010TTZQE	ON — ON

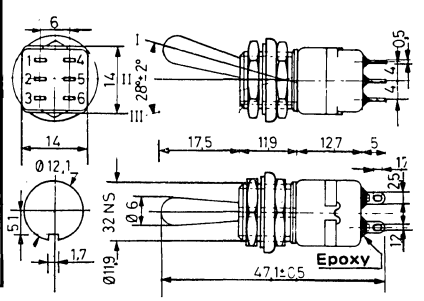


G Series — BLACK TOGGLE—DOUBLE POLE—SOLDER LUGS—SILVER CONTACTS BUSHING ϕ 12mm

SPECIFICATIONS :
* Current/voltage rating :
  max. : 2A 250VAC, 4A 30VDC
  min. : 100mA 10V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  50.000 operations
* Panel thickness : 4,5mm max.
* **Sealed lever to bushing**
* Sealed terminals
* High mechanical strength
* Black finish on lever, bushing and hardware

This model is available with locking lever.

Models	Function
	1-2 4-5 / 2-3 5-6 / I II III
G2010TCR ZQEF1	ON — ON

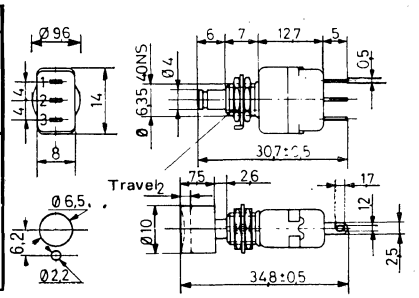


H Series — PUSHBUTTON—SINGLE POLE—SOLDER LUGS—SILVER CONTACTS

SPECIFICATIONS :
* Current/voltage rating :
  max. : 2A 250VAC, 4A 30VDC
  min. : 100mA 10V
* Initial contact resistance : 10mΩ max.
* Life expectancy with resistive nominal load :
  30.000 operations
* Panel thickness : 2mm max.
* **Supplied with CAP U482**

CAP COLOR : blue : U481, black : U482,
green : U483, gray : U484, yellow : U485,
red : U486, ivory : U487,
chrome plated : U488, orange : U489

Models	Function
	1-3 / 1-2
H1080PB 3YZQE2	ON — MOM

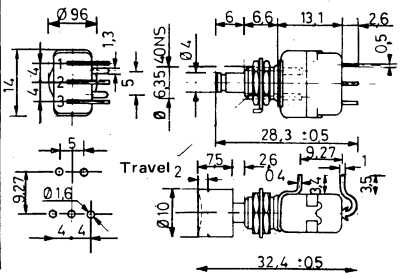


H Series — PUSHBUTTON — SINGLE POLE — RIGHT ANGLE PC TERMINALS — SILVER CONTACTS

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC, 4A 30VDC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ max.
* Life expectancy with resistive nominal load: 30.000 operations
* **Supplied with CAP U482**

CAP COLOR: blue: U481, black: U482, green: U483, gray: U484, yellow: U485, red: U486, ivory: U487, chrome plated: U488, orange: U489

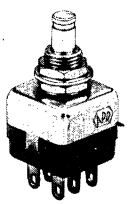
Models	Function	
	1-3	1-2
H1080PB 3YA4QE2	ON	— MOM



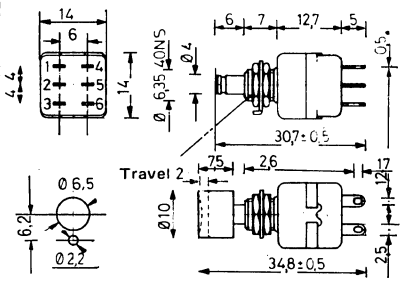
H Series — PUSHBUTTON — DOUBLE POLE — SOLDER LUGS — SILVER CONTACTS

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC, 4A 30VDC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ max.
* Life expectancy with resistive nominal load: 30.000 operations
* Panel thickness: 2mm max.
* **Available with actuator seal**

CAP COLOR: blue: U481, black: U482, green: U483, gray: U484, yellow: U485, red: U486, ivory: U487, chrome plated: U488, orange: U489



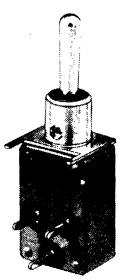
Models	Function	
	1-3 4-6	1-2 4-5
H2080PBYZQE	ON	— MOM



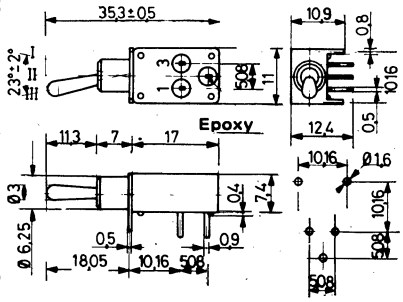
J Series — TOGGLE—single pole—straight PC terminals—silver contacts—plain bushing

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC 4A 30VDC
  min.: 100mA 10V
* Initial contact resistance: 20mΩ max.
* Life expectancy with resistive nominal load: 30.000 operations
* Sealed terminals

Available in other styles and circuits.



Models	Functions	
	III	II I
	2-3	1-2
J1010SD9C2QE	ON	— ON



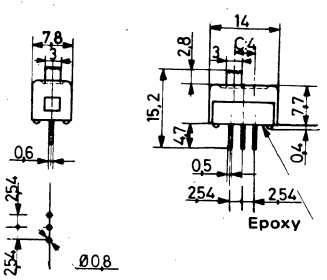
K Series — SLIDE—single pole—straight PC terminals—silver contacts—terminal spacing 2,54

* **Designed to meet the requirements of wave soldering**

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load: 20.000 operations
* Sealed terminals

This model is available with gold plated contacts for low level applications.
Available in on-off-on circuit

Models	Functions
K1010VS2CQE	ON — ON

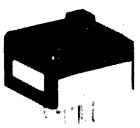


K Series — SLIDE—double pole—straight PC terminals—silver contacts—terminal spacing 2,54

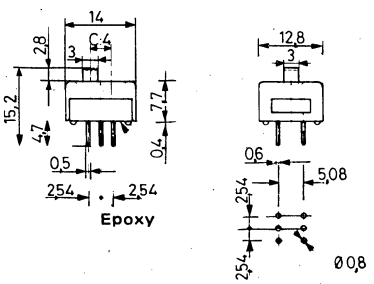
* **Designed to meet the requirements of wave soldering**

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load: 20.000 operations
* Sealed terminals

This model is available with gold plated contacts for low level applications.
Available in on-off-on circuit



Models	Functions
K2010VS2CQE	ON — ON



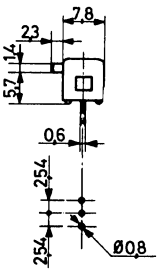
K Series — SLIDE—single pole—straight PC terminals—silver contacts—terminal spacing 2,54

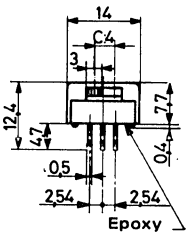
- Designed to meet the requirements of wave soldering

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load: 20.000 operations
* Sealed terminals

This model is available with gold plated contacts for low level applications.
Available in on-off-on circuit

Models	Functions
K1010HS1CQE	ON — ON



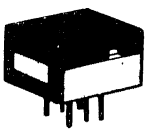


K Series — SLIDE—double pole—straight PC terminals—silver contacts—terminal spacing 5,08

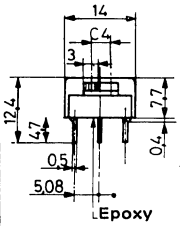
- Designed to meet the requirements of wave soldering

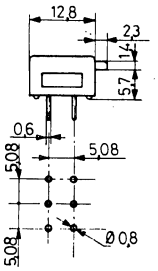
SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load: 20.000 operations
* Sealed terminals

This model is available with gold plated contacts for low level applications.
Available in on-off-on circuit



Models	Functions
K2010HS1C2QE	ON — ON



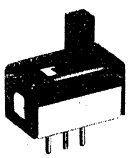


K Series — SLIDE—single pole—straight PC terminals—silver contacts—terminal spacing 2,54

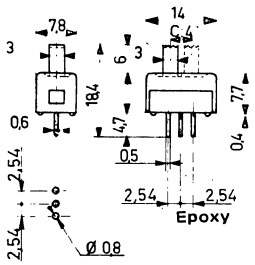
- Designed to meet the requirements of wave soldering

SPECIFICATIONS:
* Current/voltage rating:
  max.: 2A 250VAC
  min.: 100mA 10V
* Initial contact resistance: 10mΩ
* Life expectancy with resistive nominal load: 20.000 operations
* Sealed terminals

This model is available with gold plated contacts for low level applications.
Available in on-off-on circuit



Models	Functions
K1010VS3CQE	ON — ON

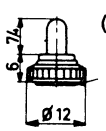


SEAL BOOTS AND MISCELLANEOUS HARDWARE

SEAL BOOTS (Withstand 1 bar (14.5 psi) pressure)

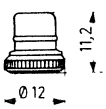
BUSHING ϕ 6,35

U1331
(was U210)



BUSHING ϕ 6,35

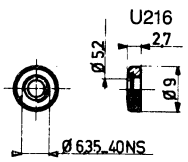
U1401
(was U190)



SPECIAL HARDWARE ϕ 6,35

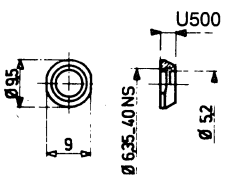
KNURLED CAP NUT

U216



CONIC CAP NUT

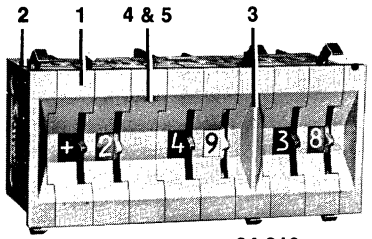
U500



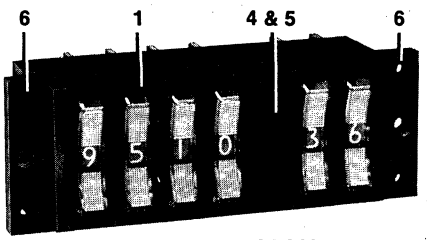
PLEASE NOTE:
Optional Rockers, Paddles and Pushbutton Caps are listed under the Specifications section of each switch description.

Digital Switches - LED Readouts

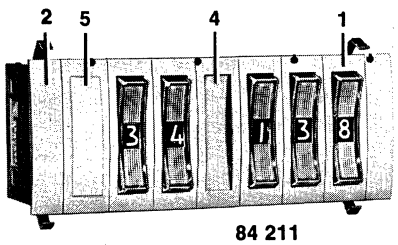
Rocker & Thumbwheel



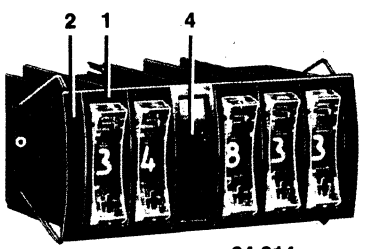
84 210
Thumbwheel Series
Panel Mount



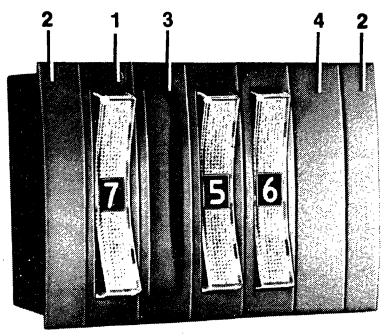
84 213
Rocker Series
Rear Mount



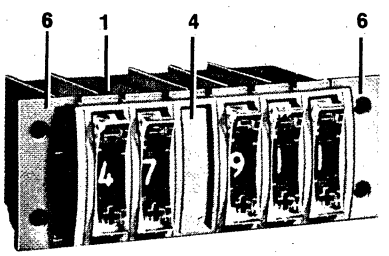
84 211
Rocker Series
Panel Mount



84 214
Rocker Series
Miniature Panel Mount



84 212
Rocker Series
Large Size Panel Mount



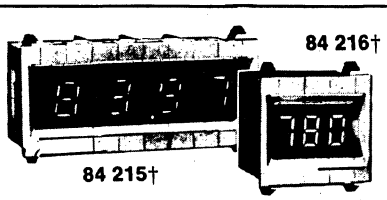
84 218
Rocker Series
Miniature Rear Mount

A Fully Modular System

1. **Basic Module:** Enables data input in coded form.
2. **End Caps:** Snap into place to complete module assembly. Complete with 4 panel clips.
3. **Separator:** Used to fit 2 switch assemblies into one unit. They come with 2 clips.
4. **Spacer:** Blank module used to replace a module assembly.
5. **Encoded "Dummy" Module:** Enables a simultaneous switching to two circuits from one digital switch. It is driven by the adjacent module via a coupling shaft.
6. **End Caps:** For rear mounting of module assembly. They come in pairs.

LED Readouts

- Compatible with Crouzet Rocker* and Thumbwheel† switches
- Easy to assemble snap-on modules
- With or without decoding/memory
- Two sizes available



84 216†

84 215†

84 217*

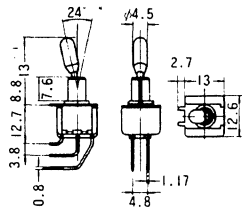
Crouzet Controls, Inc.
1029 State Parkway, Schaumburg, IL 60195
Tel: 1 312/843-2200 - Telex: Crouzet 206 297

MINIATURE SWITCHES

M-SERIES: HIGH QUALITY GOLD FLASH

MS-331	MS-334	MS-342	MS-344	MS-345	MS-351	MS-352

Terminals: Models available with either solder, printed circuit, right angle or vertical terminals (right angle and vertical terminals are available by special order only)



DRAWING: MS-331-F

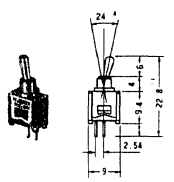
M-SERIES GENERAL RATINGS

RESISTANCE LOAD	6A 125VAC (3A 250VAC) 6A 30VDC
INDUCTIVE LOAD	6A 125VAC (POWER FACTOR 0.8) (3A 250VAC (P.F.0.8)
MECHANICAL LIFE	OVER 30,000 OPERATIONS (SWITCHING FREQUENCY 20 OPERATIONS/MINUTE)
ELECTRICAL LIFE	OVER 10,000 OPERATIONS (SAME AS ABOVE) (RATED LOAD)
INSULATION RESISTANCE	OVER 100MΩ (BY DC 500V TESTER)
VOLTAGE BREAKDOWN	AC 1000V/1 MIN (BETWEEN CONTACT & CASE)
CONTACT RESISTANCE	20mΩ MAXIMUM
AMBIENT TEMPERATURE	−10°C ~ +55°C
AMBIENT HUMIDITY	85%RH MAXIMUM

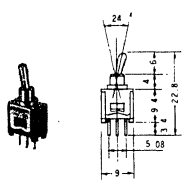
CIRCUIT	SWITCHING FUNCTION									
3P(SPDT)	A. ON - ON	UL	B. ON - (ON)		C. ON - OFF - ON	UL	D. ON - OFF - (ON)		E. (ON) - OFF - (ON)	
6P(DPDT)	F. ON - ON	UL	G. ON - (ON)		H. ON - OFF - ON	UL	I. ON - OFF - (ON)		J. (ON) - OFF - (ON)	

Also available in our economy line of silver plated contacts.

SUB-MINIATURES (LOW CURRENT FOR PC BOARD)



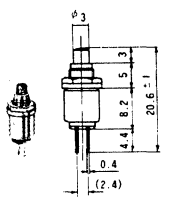
MS-611



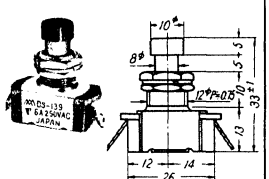
MS-621

PUSHBUTTONS

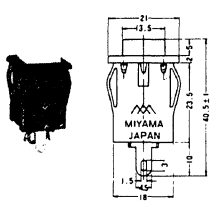
UL LISTED



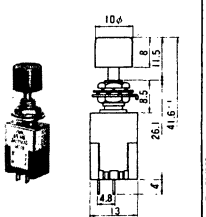
MS-402



DS-139



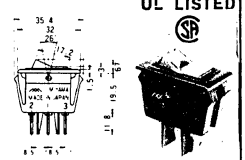
MS-078
MS-080
(WITH 6.3 VOLT LAMP)



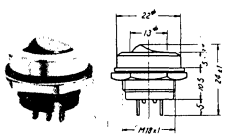
DS-195 2P
D-S-249 2P

ROCKERS

UL LISTED

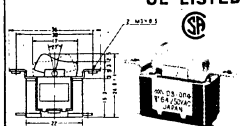


DS-322
(WITH NEON LAMP)



DS-062 (BLACK FRAME)
DS-063 (GOLD FRAME)

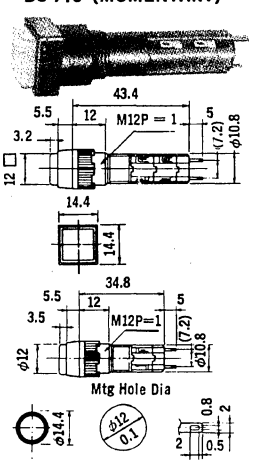
UL LISTED



DS-004

PUSHBUTTONS LED ILLUMINATED

DS-700 (ALTERNATING)
DS-710 (MOMENTARY)



Mtg Hole Dia

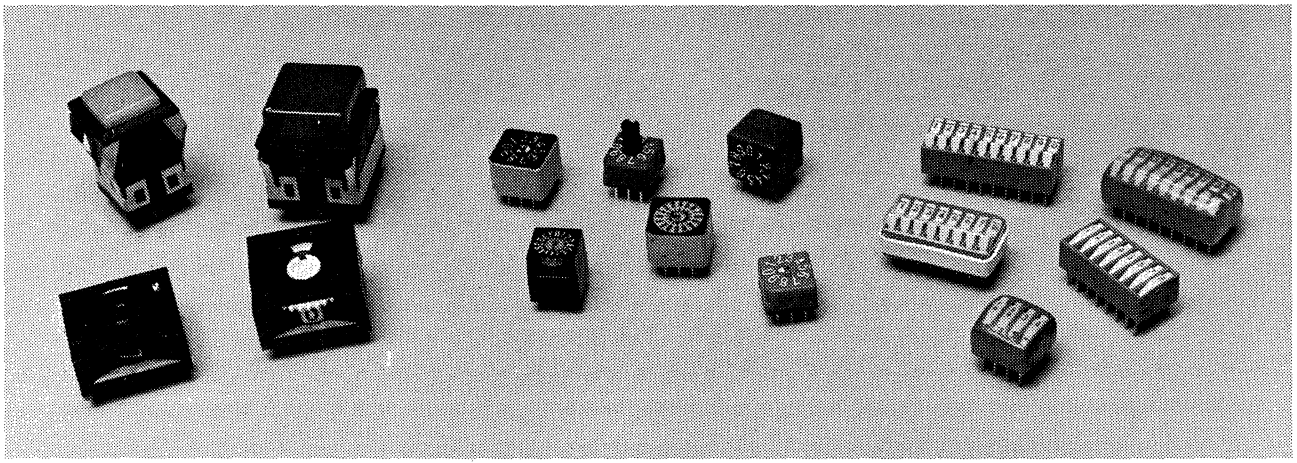
BOTH MODELS ARE AVAILABLE WITH SQUARE OR ROUND SWITCH FACE.

Part No.	MS-611	MS-621	MS-402	MS-078	MS-080	DS-139	DS-195	DS-322	DS-062	DS-004	DS-700	DS-710
Model Type	Toggle	Toggle	Push-button	Push-button with 6.3V Lamp	Push-button with 6.3V Lamp	Push-button	Push-button	Rocker with Neon Lamp	Rocker	Rocker	Push-button with LED	Push-button with LED
Rating	0.3A 125VAC	0.3A 30VDC	0.5A 125VAC	1A 125VAC	1A 125VAC	6A 250VAC	3A 125VAC	15A 125VAC	3A 750VAC	6A 250VAC	1A 250VAC	3A 125VAC
Circuit	2P(SPST) 3P(SPDT) 6P(DPDT)	3P(SPDT) 6P(DPDT)	2P(SPST)	2P(SPST)	2P(SPST)	2P(SPST)	2P(SPST)	2P(SPST)	2P(SPST) 3P(SPDT) 4P(DPST) 6P(DPDT)	2P(SPST)	(SPDT) (DPDT)	(SPDT) (DPDT)
Switching Function	ON-OFF ON-ON	ON-OFF-ON	(Push ON) Momentary	(Push ON) Momentary	(Push OFF) Momentary	ON-OFF Alternate	ON-OFF	ON-OFF	ON-OFF ON-ON	ON-OFF	ON-ON Alternate	ON-(ON) Momentary
Contact Resistance	2.5VDC 1A 20mΩ or less			2.5VDC 1A 10mΩ or less		2.5VDC 1A 20mΩ or less					2.5VDC 10mΩ or less	
Insulation Resistance	500VDC 100MΩ or more											
Voltage Breakdown	1000VAC 1 Minute					1500VAC 1 Minute	1000VAC 1 Minute		1500VAC 1 Minute		1500VAC 1 Minute	1500VAC 1 Minute
Mounting Hole Dia. mm			5.2	18.5x18.5	18.5x18.5	12.5	6	28.5±0.1x 14±0.1	18	30	12	12

DSA offers a complete line of **MIYAMA** toggle switches, rocker switches, sub-miniature switches, pushbutton switches, lever switches and illuminated switches. **MIYAMA** . . . reliability and quality for over 50 years. For complete information on our wide range of products please contact: **DSA-DAI-ICHI SHOJI OF AMERICA, INC.**

150 Fifth Avenue, Suite 516, New York, NY 10011, (212) 691-9050.

EECO Incorporated PCB Switches



2100/2600 Series STRIPSWITCH™

Mounts directly to printed circuit boards

EECO's 2100 and low profile, standard bottom sealed 2600 STRIPSWITCHES are the most economical method of hand setting coded electronic values available. Requiring a minimum of space and eliminating costly wiring, these switches can be mounted horizontally or vertically on either side of the PC board. Each station can be easily set by thumbwheel or screwdriver, and on the 2100 series, optional extended shaft.

- *One to four stations in a strip (2100)*
- *Two legend locations*
- *10- and 16- position models*
- *Available in all popular codes*
- *Integral mounting pins for stability*
- *No mounting hardware required*
- *Optional color coded rotors*
- *Finished bezel for front panel applications*
- ***One year warranty***

2300 Series MICRO-DIP®

One of the world's smallest binary coded dual-in-line switches

Dip socket or printed circuit board mountable, MICRO-DIP features 10- and 16-position (hexadecimal), 1- and 2-pole models. The 2-pole models offer a separate common to not true bits to eliminate pull-up resistors, and are available with standard bottom seals. All MICRO-DIPs have reliable gold contacts, and their small size/low profile allows high density packaging.

- *10- and 16-position, 1- and 2-pole models*
- *Screwdriver adjustable in either direction*
- *No mounting hardware required*
- *Some models with bottom and process seal*
- *Strong terminals for easy insertion*
- *Available in right angle BCD and extended shaft models*
- *.100" x .300" (2.54 x 7.62) centers*
- *10-position models .400" x .380" x .225" (10.16 x 9.65 x 5.72)*
- *10- and 16-position 2-pole models .450" x .450" x .300" (11.43 x 11.43 x 7.62)*
- **One year warranty**

2400 Series MINI-DIP™

Available in SPST configuration

MINI-DIP, EECO's rocker DIP switch series, offers an optional permanent environmental seal to protect during soldering and cleaning processes, and against harsh operating environments. Exclusive gold-on-gold cleaning/wiping action contacts assure low contact resistance while unique locking rod design prevents accidental actuation. Standard dimensions allow retrofitting of all major brands.

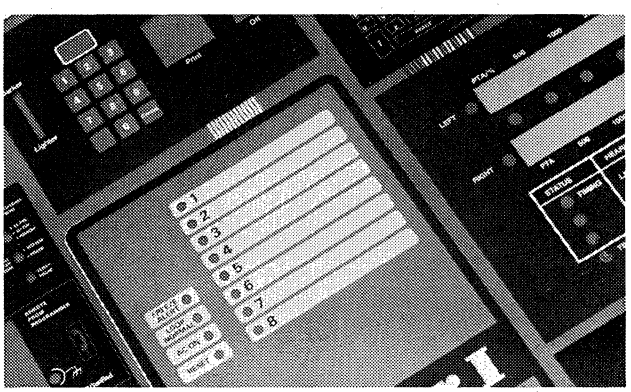
- *SPST, 2-10 stations, raised rocker and low profile*
- *Temporary process seal*
- *Terminals on .100" x .300" (2.54 x 7.62) centers*
- *PCB or DIP socket mountable*
- *Standard bottom seal*
- *Easy-to-read characters*
- *Optional environmental seal*
- ***One year warranty***

2800 Series Lighted Push-Button Switch

Provides high-quality, well-defined illumination

EECO's new lighted push-button switch is available with solder or printed circuit board terminals. For increased operating efficiency, detent life, positive tactile feel and smooth operation, the 2800 Series utilizes conductive rubber at the contact points. Suitable for front panel mounting, this switch is available in 12 mm and 17 mm sizes with high or low profile lens. Ideal for all low-voltage MOS applications.

- *Low profile*
- *Standard base seal*
- *Lamp changes from top with no tools required*
- *Guide grooves for easy station assembly*
- *Snap-in mounting*
- ***One year warranty***



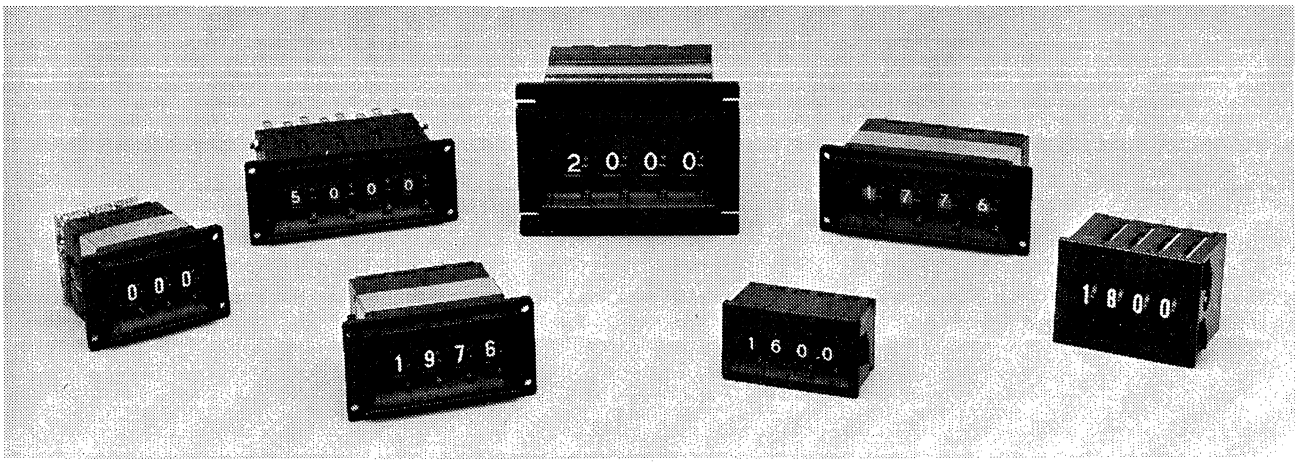
EECOflex® Membrane Switches

Flexible, environmentally sealed keyboard switches

EECO's proven specialty line of custom flexible membrane switches. EECOFLEX is fabricated using photographic screen printing processes which allow virtually any size, shape or color of switch panel or individual switch pad. This state-of-the-art concept enhances appearance and facilitates human interface. Designed for a spectrum of applications from industrial equipment to medical instrumentation, all graphics are printed on the inside surface of the panel's tough outer layer of plastic, safely sealed against dirt and abrasion. EECO's total vertical integration allows for fast order turnaround, while the use of screen printing techniques and steel rule dies make EECOFLEX price competetive.

- *Impervious to moisture, dust, grease, solvents and corrosive gases*
- *Rated for an average life of 10 million actuations*
- *Full-service membrane switch facility*
- *Flat face*
- *Tactile feel*
- *Embossing and read-out windows available*

EECO Incorporated Thumbwheel Switches



Thumbpot

Incremental voltage dividers

The 1976 and 1776 Series Thumbpots offer rapid thumbwheel settings, perfect resettability and large in-line displays.

- *Resolution to .01%*
- *Input resistance: 100 to 100,000 ohms*
- *Available in 1776 and 1976 Series*
- *Optional: lighting, stops and matte finish*
- *Available with fast-mount hardware*
- *Accuracy: 1% to .05% of full scale voltage*
- *Compact behind-panel dimensions*
- *Excellent front panel appearance*
- *Sealed against dust*
- ***One year warranty***

5000/6000 Series

Minature military-type switches

Miniature switches, with field-proven performance, designed to meet the rugged standards of MIL-S-22710/15. 6000 Series is sealed to protect entire contact area from moisture, dust and salt spray. Circuit board, wire cable or wire loop termination available.

- *Optional lighting with long lasting, replaceable lamps*
- *Plastic window readout protection*
- *Over 40 available codes*
- *Field replaceable stops*
- *1,000,000 detent life*
- ***One year warranty***

2000 Series

Industrial/Commercial Switches

A general purpose switch for industrial applications, the 2000 Series offers over 50 codes. Available unsealed or with "O" ring seal, this switch provides fast, "off-the-shelf" solutions to difficult requirements. Removable indicator ring permits easy legend changes in the field. Universal dimensions make retrofit projects easy and inexpensive.

- *Single and double pole models*
- *Lighting available*
- *Optional "O" ring seal available*
- *Field adjustable stops*
- *Provisions for mounting components*
- *Direct wire or connector termination*
- *8, 10, 12 and 16-positions*
- ***One year warranty***

1776/1976 Series

"Revolutionary"

A truly revolutionary design at a nominal price. Optional notched terminals allow switches to be mounted directly to motherboards. The 1776/1976 offer a large selection of codes and its standard dimensions permit ease of retrofitting with other major brands of switches. The 1976 is a slimmer, only .350 (8.89) wide, switch.

- *8, 10, 12 and 16-position models*
- *Optional lighting*
- *Dust seal protection*
- *Provision for mounting components*
- *Stops to limit rotation*
- *1,000,000 detent life*
- *Up to 34 stations per assembly*
- *Double width models*
- *Optional fast-mount hardware*
- *Aluminum wire assembly hardware*
- ***One year warranty***

1800 Series

315" (8.00) wide

A reliable, low cost thumbwheel switch, the 1800 Series switch assemblies offer front, snap-in mounting. Available in 10 position codes, including diode provision, the 1800 Series is offered in three standard housing colors and finishes.

- *Front snap-in mounting*
- *Large, legible .234" (5.94) high characters*
- *Slim .315" (8.00) wide*
- *PCB termination*
- *10-position*
- *Stops to limit rotation*
- *PCB mounting pins available*
- *Available in black, gray or beige*
- *Gloss, matte or textured matte finish*
- ***One year warranty***

1600 Series MINI-THUMBWHEEL

Ideal when front panel space is at a premium

The newest addition, the 1600 Series is also the smallest of EECO's Thumbwheel Switch line. This low cost switch features a snap-together assembly and front snap-in mounting, requiring no tools, and is offered with direct wire or connector termination.

- *Easy-to-read characters*
- *Durable, molded matte finish (standard)*
- *10-position codes available*
- *Low cost snap-together assembly*
- ***One year warranty***

EECO Incorporated Switch Specifications

PERFORMANCE DATA...MECHANICAL			SWITCH SERIES										
CHARACTERISTICS	RATINGS		1776	1976	1800	2000	5000	6000	2100	2600	2300	2400	THUMB POT	1600
	No. of Indexing Positions	Angle of Throw												
No. of Switching Positions Continuous Rotation - Switches may be stopped for limited rotation	8	45	•	•		•	•	•	•					
	10	36	•	•	•	•	•	•	•	•	•		•	•
	12	30	•	•		•	•	•	•					
	16	22-1/2	•	•		•			•		•			
No. of Rockers	2-10 Form "A" 1-5 Form "C"											•		
Tangential Operating Force	4-10 oz.								•	•				
	5-16 oz.			•										
	6-18 oz.		•		•	•							•	•
	6-20 oz.						•	•						
	7-14 oz.										•			
	3-32 oz.											•		
Temp. Range - Operating	−65 C to +100 C						•	•						
	−40 C to +80 C					•								
	−20 C to +85 C				•									•
	−20 C to +75 C			•	•				•	•			•	
	−10 C to +85 C										•	•		
Mechanical Life	Greater than 1,000,000 detent operations		•	•		•	•	•					•	
	Greater than 500,000 detent operations				•				○	○				
	Greater than 100,000 detent operations													•
	Greater than 10,000 detent operations										•			
	2,000 cycles											•		
Type Termination	Direct Wire				•	•	•	•					•	
	Cable						•	•						
	Wire Loop						•	•						
	Solder Tab		•	•										
	Solder Pins - for P.C. Board Insertion				•				•	•	•	•		•
	IC Socket										•	•		
Weight (approx.)	.03 oz.										•			
	4 grams				•									
	0.4 oz.		•	•			•	•				▲		
	0.9 oz.					•								
	.15 oz.								•	•				•

PERFORMANCE DATA...ELECTRICAL			1776	1976	1800	2000	5000	6000	2100	2600	2300	2400	THUMB POT	1600
CHARACTERISTICS	RATINGS	TEST CONDITION												
Current Carrying Capacity (Nonswitching)	3 Amps max. per Common line	At 115 VAC - Maximum Allowable Temp. rise from Ambient, Measured at Contact: 50 C	•	•		•	•	•	•	•			•	
	1 Amp. max. per Common line	At 28 AC or DC			•							•		•
	100 Milliamps per Common line	At 50 VDC									•			
Switching Life Greater than:	0.125 amperes	At 115 VAC (Resistive)	•	•		•	•	•	•	•			•	
1,000,000 Detent Operations	0.125 amperes	At 28 VDC (Resistive)	•	•		•	•	•	•	•			•	
	0.000010 amperes	At 0.020 Volts DC (Resistive)	•	•		•	•	•	•	•			•	
500,000 Detent Operations	0.100 Amps	At 28 AC or DC			•									
100,000 Detent Operations														•
10,000 Detent Operations	100 Milliamp	At 5 DC												
2,000 cycles	.125 Amp	At 28 VAC or DC									•	•		
Insulation Resistance	1000 Megohms Min (dry)		•	•	•	•	•	•	•	•	•		•	•
	100,000 Megohms (Min dry)											▲		
	25 Megohms Min measured with units still in test chamber	In accordance with MIL-STD-202, Method 302, Test Cond. A	•	•		•	•	•	•	•			•	
Dielectric withstanding Voltage	1000 Volts (RMS) 500 Volts (RMS)	60 Cycle (AC) - 1 minute duration. Max. current leakage .0005 amps in accordance with MIL-STD-202, Method 301	•	•		•	•	•	•	•			•	▲
	1000 Volts peak to peak	•			•									
	250 Volts peak to peak	•									•			
	250 Volts RMS	•										▲		
Switch Circuit Resistance	0.100 Ohms (Max)		•	•	•	•	▲	▲	•	•			•	
Before Life Test	Initial Resistance + 0.060 Ohms (Max)	In accordance with MIL-STD-202, Method 307	•	•	▲	•	▲	▲	•	•			•	
Before Life Test	50 Milliohms (max)	•									•	•		
	100 Milliohms	•									•	•		
	150 Milliohms													•
(Not including cable resistance on series 5100/6100)														

PERFORMANCE DATA...ENVIRONMENTAL			1776	1976	1800	2000	5000	6000	2100	2600	2300	2400	THUMB POT	1600
CHARACTERISTICS	RATINGS	TEST CONDITIONS												
Vibration **	10-2000 Cycles at ±15g (W/O Lamps) Open contact duration less than .000010 seconds including bounce	In accordance with MIL-STD-202, Method 204, Condition B	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Shock ** Medium Impact	100G Open contact duration less than .000010 seconds including bounce	In accordance with MIL-STD-202, Method 213, Test Condition I	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Shock ** High Impact	2000 Ft. Lbs.	In accordance with MIL-STD-202, Method 207	▲	▲	▲	▲	•	•			▲	▲	▲	▲
Salt Spray Resistance	48 Hours	In accordance with MIL-STD-202, Method 101, Test Condition B	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Seal	10 PSIG Under 6" Head Water	In accordance with MIL-S-22710, Method I			▲	▲		•			▲	▲		▲
Moisture Resistance	10 days	In accordance with MIL-STD-202, Method 106, per MIL-S-22710	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Humidity	10 days	In accordance with MIL-E-5272, Procedure I	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Attitude	70,000 feet at Rated Load	In accordance with MIL-STD-202, Method 105, Condition C	▲	▲	▲	▲		•			▲	▲	▲	▲
Sand & Dust	6 Hours	In accordance with MIL-STD-202, Method 110, Condition B	▲	▲	▲	▲	•	•			▲	▲	▲	▲
Thermal Shock **	−65 C to +100 C	In accordance with MIL-STD-202, Method 107, Condition A	▲	▲	▲	▲	•	•	•	•	▲	▲	▲	▲
Explosion	Explosion Proof	In accordance with MIL-STC-202, Method 109	▲	▲	▲	▲	•	•			▲	▲	▲	▲

** Does not include lamp. ▲ Consult Factory ○ Greater than 250,000 detent operations at 25 C

FABRICATION: See individual switch series Specification Tables for plastic and metal parts, contacts and printed circuit board material specifications.

EECO Incorporated

1601 E. Chestnut Ave. • P.O. Box 659 Santa Ana, California 92702-0659
• Phone: (714) 835-6000 • TWX 910-595-1550 • Telex 67-8420

EATON
Electrical/Electronic Control

COMPU-LITE
ILLUMINATED PUSHBUTTON SWITCHES

COMPU-LITE SERIES 200 PRODUCT SUMMARY

SWITCH SERIES	PAGE NO.	PANEL MOUNT	P.C. BOARD MOUNT	MOMENTARY ACTION	ALTERNATE ACTION	DOUBLE THROW	POWER SWITCHING	LOW LEVEL SWITCHING	U.L. LISTED SWITCHES	U.L. RECOGNIZED INDICATORS	C.S.A. CERTIFIED	5/8" SQUARE PUSHBUTTON	5/8" x 1" RECTANGULAR PUSHBUTTON	SINGLE LAMP	DUAL LAMP	SINGLE LED-FLUSH	DUAL LAMP/SPLIT LEGEND	OPTIONAL BARRIERS ❶	MATCHING INDICATOR
200	3	●		●	●	●	●	●	●		●		●						
201	3	●		●	●	●	●	●	●		●		●	●					
202	3		●	●	●	●	●	●	●		●		●						
203	3		●	●	●	●	●	●	●		●		●	●					
204	3	●								●	●		●	●					●
205	3		●							●	●		●	●					●
206	4	●		●	●	●	●	●	●		●		●		●		●		
207	4		●	●	●	●	●	●	●		●		●		●		●		
208	4	●								●	●		●		●		●		●
209	4		●							●	●		●		●		●		●
220	5	●		●	●	●	●	●	●		●	●							
221	5	●		●	●	●	●	●	●		●	●		●					
222	5		●	●	●	●	●	●	●		●	●							
223	5		●	●	●	●	●	●	●		●	●		●					
224	5	●								●	●	●		●					●
225	5		●							●	●	●		●					●
231	6	●		●	●	●	●	●	●		●	●				●			
233	6		●	●	●	●	●	●	●		●	●				●			
234	6	●								●	●	●				●			●
235	6		●							●	●	●				●			●
244	7	●								●	●	●			●		●		●
245	7		●							●	●	●			●		●		●

❶ Consult the Sales Office nearest you. See listings on back cover.

BULB CHART NO. I

T 1¾ Subminiature Wedge Base for all Switches and Indicators

Item No.*	To order lamp separately	ASA Lamp Number	Designed Volts	Design Amps	Brightness (MSCP)	Lab Avg. Life (hrs.)
30	28-3158	56	5	.115	.15	20,000
31	28-3158-2	79	6	.20	.60	1,000
32	28-3158-3	84	6.3	.04	.03	20,000
33	28-3158-4	86	6.3	.20	.40	20,000
34	28-3158-5	18	14	.04	.13	5,000
35	28-3158-6	73	14	.08	.30	15,000
36	28-3158-7	85	28	.04	.30	7,000
37	28-3158-8	17	28	.06	.65	5,000

*Use this two digit number for installation in switches and indicators.

BULB CHART NO. II

LED Lamps for Series 231 thru 235 Switches and Indicators

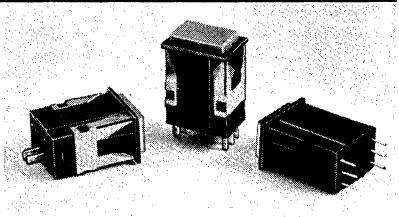
Color	Voltage	W/O Diode Protection Item No.	With Diode Protection Item No.
Red	VDC ❷	01	11
	5 VDC	02	12
	15 VDC	03	13
Yellow	VDC ❷	04	14
	5 VDC	05	15
	15 VDC	06	16
Green	VDC ❷	07	17
	5 VDC	08	18
	15 VDC	09	19

❷ Lamps without internal current limiting resistor. User must include in his circuit — to give current of 20mA to LED.

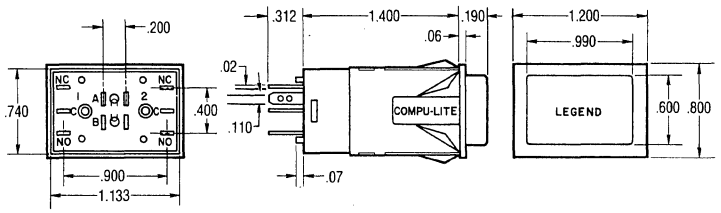
EATON
Electrical/Electronic Control

COMPU-LITE
ILLUMINATED PUSHBUTTON SWITCHES

200 SERIES	NON ILLUMINATED PANEL MOUNT	201 SERIES	ILLUMINATED PANEL MOUNT	202 SERIES	NON ILLUMINATED PRINTED CIRCUIT BOARD MOUNT	203 SERIES	ILLUMINATED PRINTED CIRCUIT BOARD MOUNT

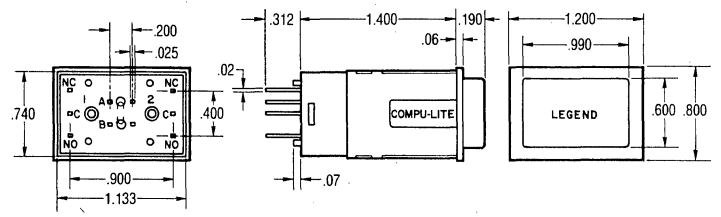


200 & 201 PANEL MOUNT

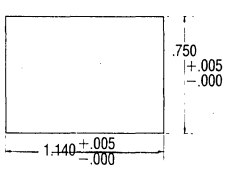


APPROXIMATE DIMENSIONS

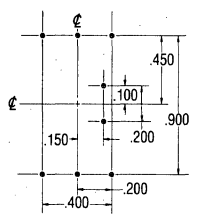
202 & 203 PRINTED CIRCUIT BOARD MOUNT



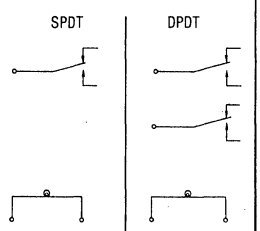
MOUNTING HOLE



P.C. BOARD LAYOUT
Hole Diameter .062"



CIRCUITRY



SPECIFICATIONS

ACTION
- — Momentary
- — Alternate with positive latch down

SWITCH CIRCUITRY
- — Break before make
- — SPDT or DPDT

SWITCH ELECTRICAL RATINGS
- — Silver Contacts
  5 Amps @ 125 VAC or 250 VAC
- — Gold Contacts
  0.1 A @ 125 VAC/DC
- — U.L. Listed
- — C.S.A. Certified

INDICATOR LISTINGS
- — U.L. Recognized
- — C.S.A. Certified

TERMINATION TYPES
- — .020" x .110" Terminations suitable for solder or female 110 connectors
- — .020" x .025" Terminations for printed circuit board mount

PUSHBUTTONS
- — 5/8" x 1" rectangular
- — Matte Style "M" Finish
- — Plain, engraved, or hot stamped

MOUNTING
- — Snap in panel mounting
- — Stainless Steel retaining clips
- — .030" to .188" Panel Thickness
- — P.C. Board mounting

LAMPS
- — One T 1-3/4 Wedge Base
- — Incandescent
- — Front Relampable
- — Lamp stationary to reduce mechanical shock to filament

PUSHBUTTON TRAVEL
- — .190"

ORDERING INFORMATION

CHOOSE ONE OPTION FROM EACH COLUMN. DO NOT USE DASHES (-) IN PART NUMBER.

Switch Series	Product Type	Action	No. of Poles	Contact Mat'ls	Terminations	Mounting	Pushbutton Style	Color	Pushbutton Height	Lamp
200 or 201 (Panel Mount) or 202 or 203 (P.C. Board Mount)	K Switch	1 Mom 2 Alt	1 SPDT 2 DPDT	8 Silver 9 Gold 6 DPDT: top pole silver bottom pole gold	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶	M matte	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	A .19" Full	Use two digit part number from bulb Chart I on page 2

Matching Indicator	Product Type	Terminations	Mounting
204 (Panel Mount) or 205 (P.C. Board Mount)	L Indicator	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶

❶ Contact the Sales Office nearest you. See listings on back cover.

SPECIFY ENGRAVING OR HOT STAMPING INFORMATION WHEN ORDERING FROM SALES OFFICE

EXAMPLES:

201K11910M01A30

DESCRIBES: Series 201 Switch, Panel Mount, Momentary Action, SPDT, Gold Contacts, Solder Terminations, No Barriers, Style M matte pushbutton, white, .19" above panel pushbutton height, with ASA No. 56, 5 volt incandescent lamp installed.

205L20M03A31

DESCRIBES: Series 205 Indicator Light, P.C. Board Mount, P.C. Board Terminations, flat bezel, No Barriers, Style M matte pushbutton, green, .19" above panel pushbutton height, with ASA No. 79, 6 volt incandescent lamp installed.

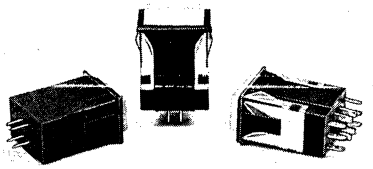
COMPU-LITE PG. 3

EATON
Electrical/Electronic Control

COMPU-LITE ILLUMINATED PUSHBUTTON SWITCHES

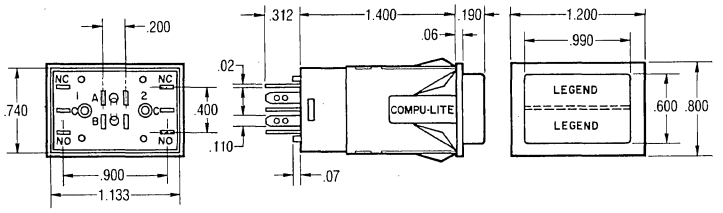
206 SERIES ILLUMINATED PANEL MOUNT

207 SERIES ILLUMINATED PRINTED CIRCUIT BOARD MOUNT



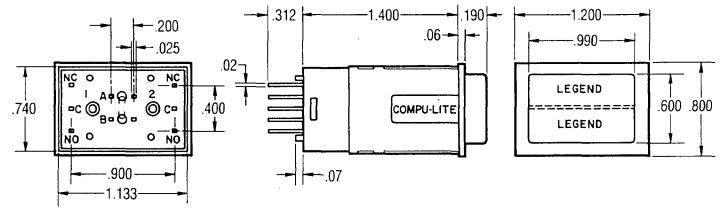
DUAL-LAMP-HORIZONTAL SPLIT LENS OR FULL CAP

206 PANEL MOUNT

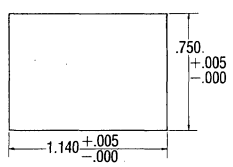


APPROXIMATE DIMENSIONS

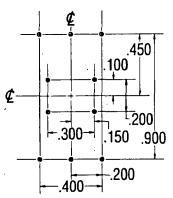
207 PRINTED CIRCUIT BOARD MOUNT



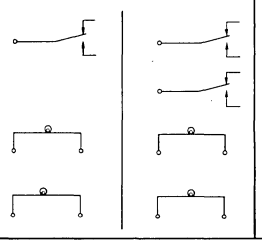
MOUNTING HOLE



P.C. BOARD LAYOUT
Hole Diameter .062"



CIRCUITRY



SPECIFICATIONS

ACTION
- — Momentary
- — Alternate with positive latch down

SWITCH CIRCUITRY
- — Break before make
- — SPDT or DPDT
- — 2 independent lamp circuits

SWITCH ELECTRICAL RATINGS
- — Silver Contacts 5 Amps @ 125 VAC or 250 VAC
- — Gold Contacts 0.1 A @ 125 VAC/DC
- — U.L. Listed
- — C.S.A. Certified

INDICATOR LISTINGS
- — U.L. Recognized
- — C.S.A. Certified

TERMINATION TYPES
- — .020" x .110" Terminations suitable for solder or female 110 connectors
- — .020" x .025" Terminations for printed circuit board mount

PUSHBUTTONS
- — 5/8" x 1" rectangular
- — Matte Style "M" Finish
- — Full or Horizontal Split Lens
- — Plain, engraved, or hot stamped

MOUNTING
- — Snap in panel mounting
- — Stainless Steel retaining clips
- — .030" to .188" Panel Thickness
- — P.C. Board mounting

LAMPS
- — Two T 1-3/4 Wedge Base Lamps
- — Incandescent
- — Front Relampable
- — Lamps stationary to reduce mechanical shock to filament

PUSHBUTTON TRAVEL
- — .190"

ORDERING INFORMATION

CHOOSE ONE OPTION FROM EACH COLUMN. DO NOT USE DASHES (-) IN PART NUMBER.

Switch Series	Product Type	Action	No. of Poles	Contact Mat'ls	Terminations	Mounting	Pushbutton Style	Full Cap or Top Lens Color	Btm. Lens Color ❷	Pushbutton Height	Lamps (accepts 2)
206 (Panel Mount) or 207 (P.C. Board Mount)	K Switch	1 Mom 2 Alt	1 SPDT 2 DPDT	8 Silver 9 Gold 6 DPDT: top pole silver bottom pole gold	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶	M matte	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	A .19" Full S .19" Split	Use two digit part number from bulb Chart I on page 2

Matching Indicator	Product Type	Terminations	Mounting
208 (Panel Mount) or 209 (P.C. Board Mount)	L Indicator	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶

❶ Contact the Sales Office nearest you. See listings on back cover.
❷ For full cap styles this code is not required.

SPECIFY ENGRAVING OR HOT STAMPING INFORMATION WHEN ORDERING FROM SALES OFFICE

EXAMPLES:

207K11910M0501S31

DESCRIBES: Series 207 Switch, P.C. Board Mount, Momentary Action, SPDT, Gold Contacts, Solder Terminations, No Barriers, Style M matte pushbutton, blue and white split lens cap, .19" above panel pushbutton height, with 2 ASA No. 79, 6 volt incandescent lamps installed.

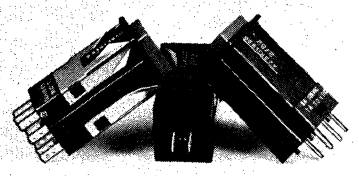
208L10M0203S31

DESCRIBES: Series 208 Indicator Light, Panel Mount, Solder Terminations, No Barriers, Style M matte pushbutton, red and green split lens cap, .19" above panel pushbutton height, with 2 ASA No. 79, 6 volt incandescent lamps installed.

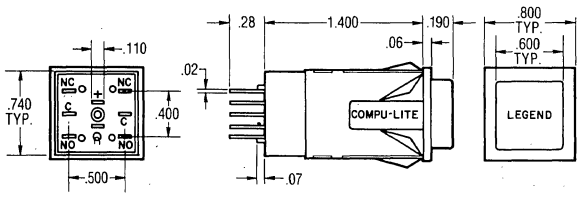
EATON
Electrical/Electronic Control

COMPU-LITE ILLUMINATED PUSHBUTTON SWITCHES

220 SERIES	NON ILLUMINATED PANEL MOUNT	221 SERIES	ILLUMINATED PANEL MOUNT	222 SERIES	NON ILLUMINATED PRINTED CIRCUIT BOARD MOUNT	223 SERIES	ILLUMINATED PRINTED CIRCUIT BOARD MOUNT

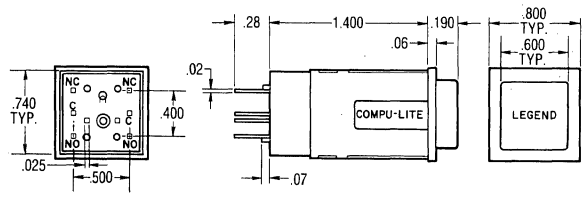


220 & 221 PANEL MOUNT

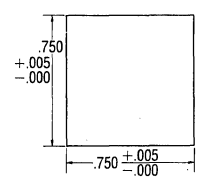


APPROXIMATE DIMENSIONS

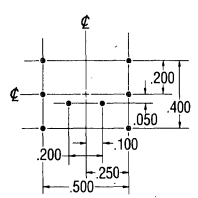
222 & 223 PRINTED CIRCUIT BOARD MOUNT



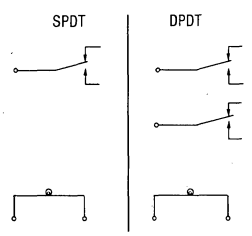
MOUNTING HOLE



P.C. BOARD LAYOUT ❶
Hole Diameter .062"



CIRCUITRY



SPECIFICATIONS

ACTION
- — Momentary
- — Alternate with positive latch down

SWITCH CIRCUITRY
- — Break before make
- — SPDT or DPDT

SWITCH ELECTRICAL RATINGS
- — Silver Contacts
  5 Amps @ 125 VAC or 250 VAC
- — Gold Contacts
  0.1 A @ 125 VAC/DC
- — U.L. Listed
- — C.S.A. Certified

INDICATOR LISTINGS
- — U.L. Recognized
- — C.S.A. Certified

TERMINATION TYPES
- — .020" x .110" Terminations suitable for solder or female 110 connectors
- — .020" x .025" Terminations for printed circuit board mount

PUSHBUTTONS
- — 5/8" square
- — Matte Style "M" Finish
- — Plain, engraved or hot stamped

MOUNTING
- — Snap in panel mounting
- — Stainless Steel retaining clips
- — .030" to .188" Panel Thickness
- — P.C. Board mounting

LAMPS
- — One T 1-3/4 Wedge Base
- — Incandescent
- — Front Relampable
- — Lamp stationary to reduce mechanical shock to filament

PUSHBUTTON TRAVEL
- — .190"

❶ P.C. Board layout for Series 225 is on page 7.

ORDERING INFORMATION

CHOOSE ONE OPTION FROM EACH COLUMN.
DO NOT USE DASHES (-) IN PART NUMBER.

Switch Series	Product Type	Action	No. of Poles	Contact Mat'ls	Terminations	Mounting	Pushbutton Style	Color	Pushbutton Height	Lamp
220 or 221 (Panel Mount) or 222 or 223 (P.C. Board Mount)	K Switch	1 Mom 2 Alt	1 SPDT 2 DPDT	8 Silver 9 Gold 6 DPDT: top pole silver bottom pole gold	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❷ 2 Horizontal Barriers ❷	M matte	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	A .19" Full	Use two digit part number from bulb Chart I on page 2

Matching Indicator	Product Type	Terminations	Mounting
224 (Panel Mount) or 225 (P.C. Board Mount)	L Indicator	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❷ 2 Horizontal Barriers ❷

❷ Contact the Sales Office nearest you. See listings on back cover.

SPECIFY ENGRAVING OR HOT STAMPING INFORMATION WHEN ORDERING FROM SALES OFFICE

EXAMPLES:

222K12620M03A
DESCRIBES: Series 220 Switch, P.C. Board Mount, Momentary Action, DPDT, Top pole silver contacts, Bottom pole gold contacts, P.C. Board Terminations, No Barriers, Style M matte pushbutton, green, .19" above panel pushbutton height.

225L20M04A33
DESCRIBES: Series 225 Indicator Light, P.C. Board Mount, P.C. Board Terminations, No Barriers, Style M matte pushbutton, yellow, .19" above panel pushbutton height, with ASA No. 86, 6.3 volt incandescent lamp installed.

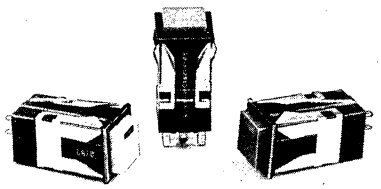
COMPU-LITE PG. 5

EATON
Electrical/Electronic Control

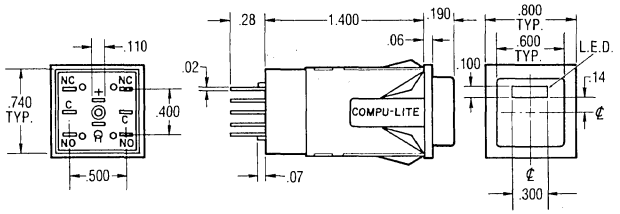
COMPU-LITE ILLUMINATED PUSHBUTTON SWITCHES

231 SERIES — LED DISPLAY PANEL MOUNT

233 SERIES — LED DISPLAY PRINTED CIRCUIT BOARD MOUNT

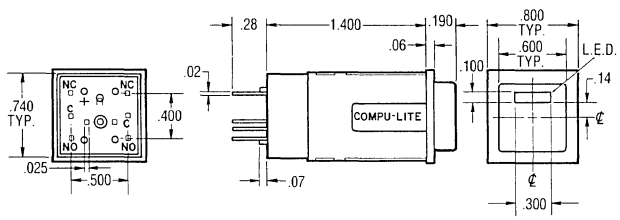


231 PANEL MOUNT

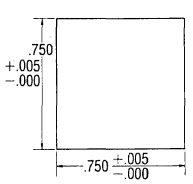


APPROXIMATE DIMENSIONS

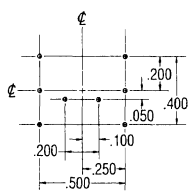
233 PRINTED CIRCUIT BOARD MOUNT



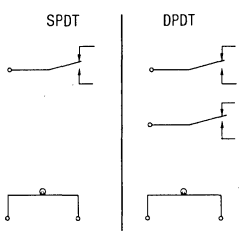
MOUNTING HOLE



P.C. BOARD LAYOUT
Hole Diameter .062"



CIRCUITRY



SPECIFICATIONS

ACTION
- — Momentary
- — Alternate with positive latch down

SWITCH CIRCUITRY
- — Break before make
- — SPDT or DPDT

SWITCH ELECTRICAL RATINGS
- — Silver Contacts
  5 Amps @ 125 VAC or 250 VAC
- — Gold Contacts
  0.1 A @ 125 VAC/DC
- — U.L. Listed
- — C.S.A. Certified

INDICATOR LISTINGS
- — U.L. Recognized
- — C.S.A. Certified

TERMINATION TYPES
- — .020" x .110" Terminations suitable for solder or female 110 connectors
- — .020" x .025" Terminations for printed circuit board mount

PUSHBUTTONS
- — 5/8" square
- — Matte Style "M" Finish
- — Plain, engraved, or hot stamped

MOUNTING
- — Snap in panel mounting
- — Stainless Steel retaining clips
- — .030" to .188" Panel Thickness
- — P.C. Board mounting

LAMPS
- — One rectangular LED flush with cap
- — Various voltages available
- — Diode protection available

PUSHBUTTON TRAVEL
- — .190"

ORDERING INFORMATION

CHOOSE ONE OPTION FROM EACH COLUMN. DO NOT USE DASHES (-) IN PART NUMBER.

Switch Series	Product Type	Action	No. of Poles	Contact Mat'ls	Terminations	Mounting	Pushbutton Style	Color	Pushbutton Height	Lamp
231 (Panel Mount) or 233 (P.C. Board Mount)	K Switch	1 Mom 2 Alt	1 SPDT 2 DPDT	8 Silver 9 Gold 6 DPDT: top pole silver bottom pole gold	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶	M matte	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	A .19" Full	Use two digit part number from bulb Chart II on page 2

Matching Indicator	Product Type	Terminations	Mounting
234 (Panel Mount) or 235 (P.C. Board Mount)	L Indicator	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❶ 2 Horizontal Barriers ❶

❶ Contact the Sales Office nearest you. See listings on back cover.

SPECIFY ENGRAVING OR HOT STAMPING INFORMATION WHEN ORDERING FROM SALES OFFICE

EXAMPLES:

231K22910M04A02
DESCRIBES: Series 231 Switch, Panel Mount, Alternate Action, DPDT, Gold Contacts, Solder Terminations, No Barriers, Style M matte pushbutton, yellow, .19" above panel pushbutton height, with red LED for 5 VDC operation without diode protection.

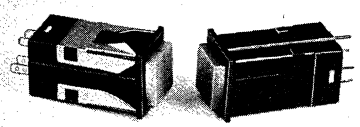
234L10M02A12
DESCRIBES: Series Indicator Light, Panel Mount, Solder Terminations, No Barriers, Style M matte pushbutton, red, .19" above panel pushbutton height, with red LED for 5 VDC operation with diode protection.

EATON
Electrical/Electronic Control

COMPU-LITE ILLUMINATED PUSHBUTTON SWITCHES

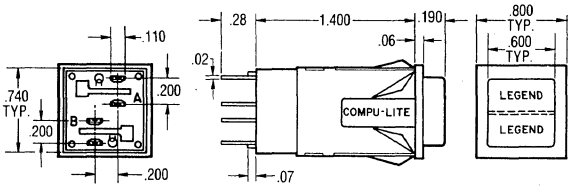
244 SERIES PANEL MOUNT

245 SERIES PRINTED CIRCUIT BOARD MOUNT



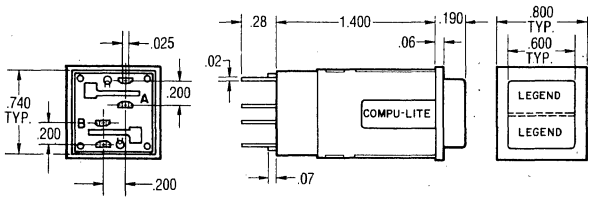
DUAL-LAMP INDICATORS WITH SPLIT LENS OR FULL CAP

244 PANEL MOUNT

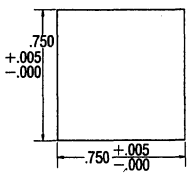


APPROXIMATE DIMENSIONS

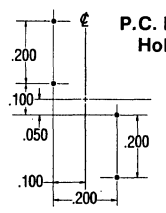
245 PRINTED CIRCUIT BOARD MOUNT



MOUNTING HOLE



P.C. BOARD LAYOUT ❶
Hole Diameter .062"



SPECIFICATIONS

— Pushbutton style indicators match 5/8" square lighted switches

CIRCUITRY
— Two independent lamp circuits

LISTINGS
— U.L. Recognized
— C.S.A. Certified

TERMINATION TYPES
— .025" x .110" Terminations suitable for solder or female 110 connectors
— .020" x .025" Terminations for printed circuit board mount

PUSHBUTTONS
— 5/8" square
— Matte Style "M" Finish
— Same variety of colors as used on 200 Series switches
— Full or horizontal split lens
— Plain, engraved, or hot stamped

MOUNTING
— Snap in panel mounting
— Stainless Steel retaining clips
— .030" to .188" Panel Thickness
— P.C. Board mounting

LAMPS
— Two T 1-3/4 Wedge Base Lamps
— Incandescent
— Front Relampable

❶ For P.C. Board layout on 225 Series shown on page 5 eliminate two bottom terminals.

ORDERING INFORMATION

CHOOSE ONE OPTION FROM EACH COLUMN. DO NOT USE DASHES (-) IN PART NUMBER.

Indicator	Product Type	Terminations	Mounting	Pushbutton Style	Full Cap or Top Lens Color	Btm. Lens Color ❸	Pushbutton Height	Lamps
244 (Panel Mount) or 245 (P.C. Board Mount)	L Indicator	1 Solder 2 P.C. Board	0 No Barriers 1 Vertical Barriers ❷ 2 Horizontal Barriers ❷	M matte	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	00 Orange 01 White 02 Red 03 Green 04 Yellow 05 Blue 10 Amber 12 Lunar White 13 Light Green 15 Clear 20 Gray 21 Black	A .19" Full S .19" Split	Use two digit part number from bulb Chart I on page 2

❷ Contact the Sales Office nearest you. See listings on back cover.
❸ For full cap styles this code is not required.

SPECIFY ENGRAVING OR HOT STAMPING INFORMATION WHEN ORDERING FROM SALES OFFICE

EXAMPLES:

244L10M04A30
DESCRIBES: Series 244 Indicator Light, Panel Mount, Solder Terminations, No Barriers, Style M matte pushbutton, yellow, .19" above panel pushbutton height, with 2 ASA No. 56, 5 volt incandescent lamps installed.

245L20M0203S31
DESCRIBES: Series 245 Indicator Light, P.C. Board Mount, P.C. Terminations, No Barriers, Style M matte pushbutton, red and green split lens cap, .19" above panel pushbutton height, with 2 ASA No. 79, incandescent lamps installed.

COMPU-LITE PG. 7

EATON
Electrical/Electronic Control

OTHER PRODUCTS

NEW MASTER CATALOG DESCRIBING COMPLETE LINE OF CUTLER-HAMMER COMMERCIAL MINIATURE SWITCHES

The complete line of Cutler-Hammer miniature switches is included in a just published 64 page catalog. Electrical and material specifications, product photographs, dimension drawings, construction details and wiring diagrams provide a thorough description for the variety which includes miniature toggle, rocker, illuminated rocker, keylite, and pushbutton switches. Also included are product summary charts for quick selection of standard switches and a section devoted to custom designed miniature switches. Not happy with your present source? Our catalog even includes complete cross references to our competition.

Write for our complete catalog NU-196.

Eaton Corporation
Aerospace/Commercial Controls Division
424 Chapel Street
New Haven, CT 06511

COMPREHENSIVE PRODUCT BROCHURE

Describing Cutler-Hammer's new Econoswitch line of cost efficient sealed switches.

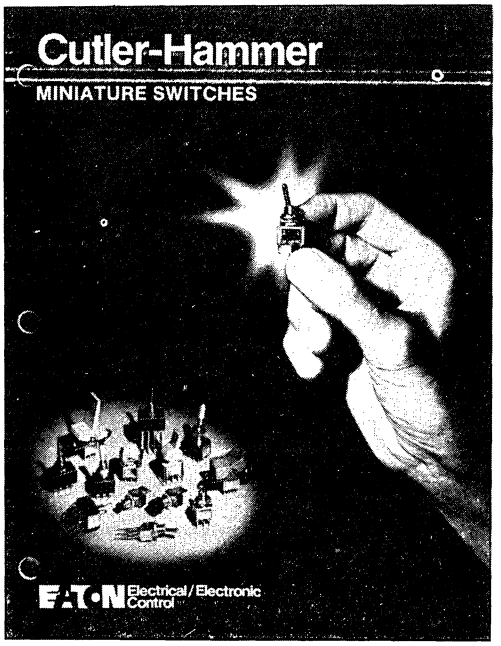
From rocker action to lever-locks, we have it all, and can provide as standard, many combinations of configurations including:

- One, two and four pole switching
- 16 circuit combinations
- Solder, screw or spade type terminations
- Five actuator styles
- Four mounting methods to suit your application

We call it the Econoswitch line. If your application calls for a switch that's dust proof and water/moisture resistant — but the price of a MIL SPEC switch is prohibitive for you — we have a new answer for you.

Write for this complete brochure NU-161.

Eaton Corporation
Aerospace/Commercial Controls Division
2074 Whitfield Avenue East
Sarasota, FL 33580

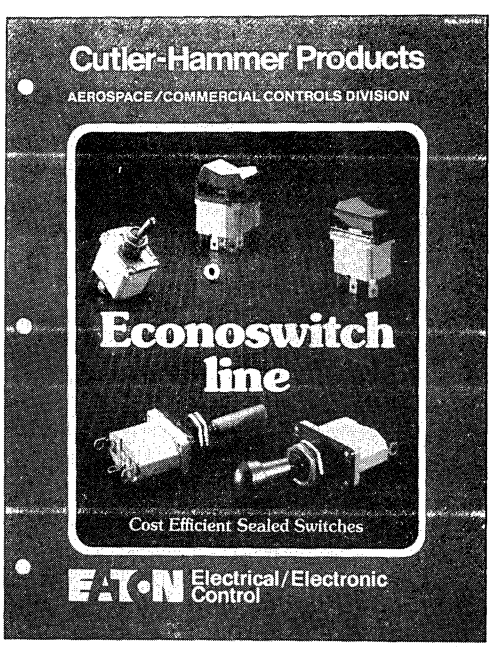


NEW MASTER CATALOG DESCRIBING COMPLETE LINE OF CUTLER-HAMMER SWITCHES AND RELAYS

Switches and relays: Toggle switches, pushbutton switches, sealed switches, tool handle switches, snap action switches, miniature switches, accessories. Power relays and hybrid relays. Engineering data. 230 pages.

Write for our complete catalog NJ-125.

Eaton Corporation
Aerospace/Commercial Controls Division
4201 N. 27th Street
Milwaukee, WI 53216



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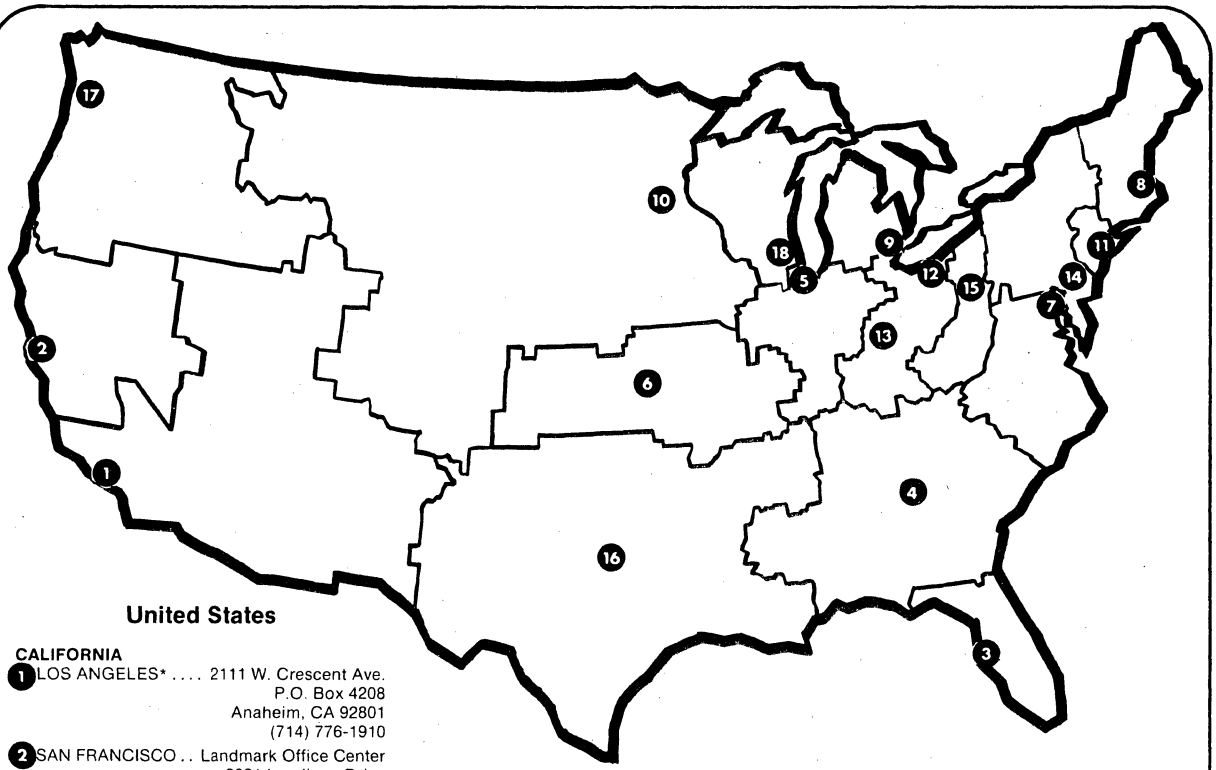

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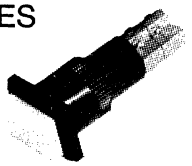
EATON Electrical/Electronic Control

EAO SWITCHES

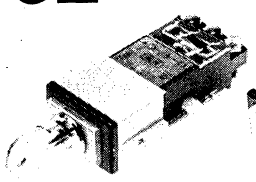
You Can Feel the Difference...

SERIES 01



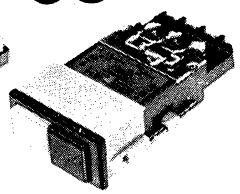
- Round, Square, and Rectangular bezel-front panel mount
- All types mount in a round hole
- 1-4 poles
- Momentary or maintained action
- Maintained action is position indicating
- 2 piece lens cap. Can be separated for insertion of film
- 3 Switching elements—Snap, Low Level, Electronic
- 9 Lens colors
- Front panel replacement of lamps
- Lamps do not travel when the switch is actuated

SERIES 02



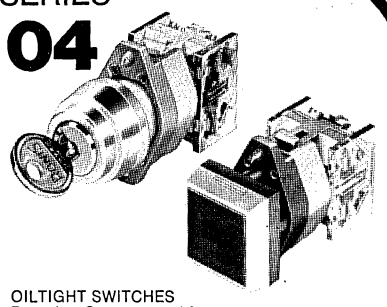
- Double pole, Double throw Momentary or Maintained action on both 380 Volt 10 Amp contacts
- Rectangular lens cap—9 colors
- Key Lock available

SERIES 03



- Full or split display—2 lamp
- Double pole, single or 2 button action
- Momentary, Maintained or combination
- Independent or Interlocked
- Key Switches available

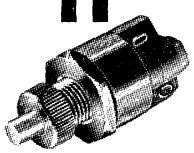
SERIES 04



OILTIGHT SWITCHES

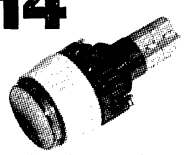
- Round or Square panel front
- Snap together modular design
- Up to 8 pole switching
- Lighted and unlighted pushbuttons
- Mounts in 890" round hole
- Lever, Key-Lock, Emergency Stop actuators

SERIES 11



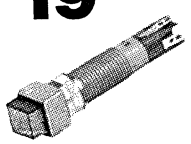
- Round lens cap—6 colors
- Mount from rear of panel
- 1-3 pole switching elements
- Momentary or maintained action
- Lamps replaceable from front
- LED available

SERIES 14



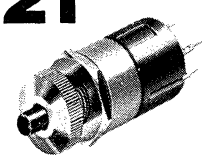
- Combines the rugged design of the 04 oiltight panel seal and the choice of switching elements
  5 Amps 250 volt
  Low level or electronic elements
- Specifically designed for machine tool applications where low level or computer switching is required.
- High-Security Key Lock available

SERIES 19



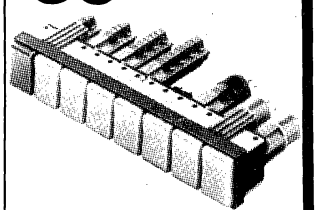
- Miniature lighted pushbuttons & indicators
- 9 mm (.354") centers.
- Round or square bezel
- Low level switching:
  μV up to 60V;
  μA up to 100 mA
- Momentary or maintained action (position indicating)

SERIES 21



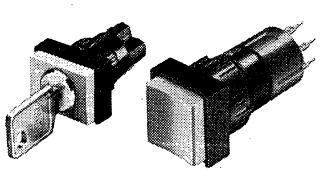
- Non illuminated version of the Series 11 with 6 different colored actuator button.
- Switching Elements
  5 Amp 240 volt 1 to 3 poles
  Low level switch
  Electronic switch Hall effect
- Momentary and maintained (position indicating) action

SERIES 30



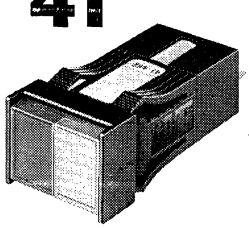
- Mechanical Interlock Switch
- 2—12 Switch units
- 5 different interlock combinations
- Slide Mechanism—All metal construction
- 3 Switching elements—Snap, Low Level, Electronic

SERIES 31/31LL



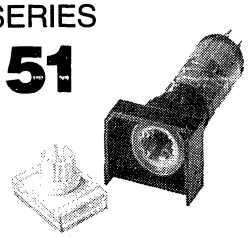
- Square or Rectangular bezel
- Flat or Concave lens
- 1—4 pole snap acting switch, Low Level or Electronic
- Key Lock—round, square, rectangular
- Lamp T-1 ¾ groove base
- Key Lock—round, square, rectangular with 3 levels of security: Low-Cost, Standard and High-Security

SERIES 41



- 2 lamp switch
- Full or split screen
- Same panel dimensions as 31 Series
- Soft mount—from front of panel
- Switching elements same as 31 Series

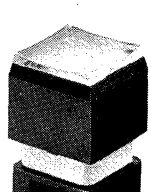
SERIES 51



- Combines style of Series 31 with oil and water tight features of Series 14.
- Integral 'O' ring seal around a special one-piece actuator design to conform to IP65 requirements.
- 1-4 pole, snap acting contacts, low level or electronic switching.
- Round, square and rectangular panel fronts, choice of 8 lens colors.
- High styling and rugged, full seal construction.

SERIES 99

LIGHTED KEYBOARD SWITCH



- Momentary and maintained action
- Gold contacts
- Long life — 5 million operation minimum
- Low level switching — dry circuit
- Low constance resistance — 10 milli-ohms
- Low contact bounce, < 100μ sec

The World's Finest Switching Products

EAO SWITCH CORP.

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electro-mech
LIGHTED PUSH-BUTTON SWITCHES

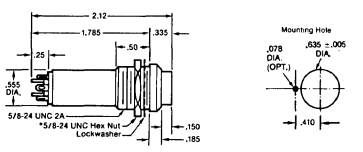
DISPLAY ASSEMBLIES/ INTERLOCK SWITCH ASSEMBLIES/INDICATORS

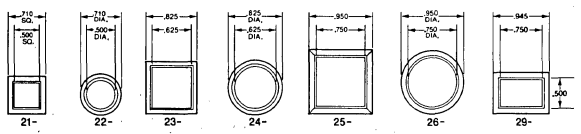
ELECTRO-MECH provides a perfect blend of quality standard products with in-depth experience in answering unique requirements. Proven engineering designs are illustrated by the excellent performance characteristics of each ELECTRO-MECH lighted push-button switch, indicator, and display assembly. Low-bounce, long-life contacts, new innovations in legends, displays, field-service, packaging– all standard features. Whatever your applications, ELECTRO-MECH is prepared to answer your specific needs. Choose from any of the most popular models.

Technical specifications apply to all ELECTRO-MECH Switch models unless otherwise specified:

- **Ratings: 30 Volts DC or 115 Volts AC; 2 amps resistive, 1 amp inductive**
- **Weight: 0.8 oz. (approx.)**
- **Operating Pressure: 2 lbs. + 1 lb.**
- **Plunger Travel: 3/16" (approx.)**
- **Actuations: 100,000**
- **Accommodates all "switchlines" standard lenses. Uses one T1-3/4, AN3140-327, 328, 330 bulb or neon lamp, 3 actuation modes standard**
- **Lenses: Available in ½" to 1" round and square, plus various rectangular sizes.**

MOUNTING SPECIFICATIONS

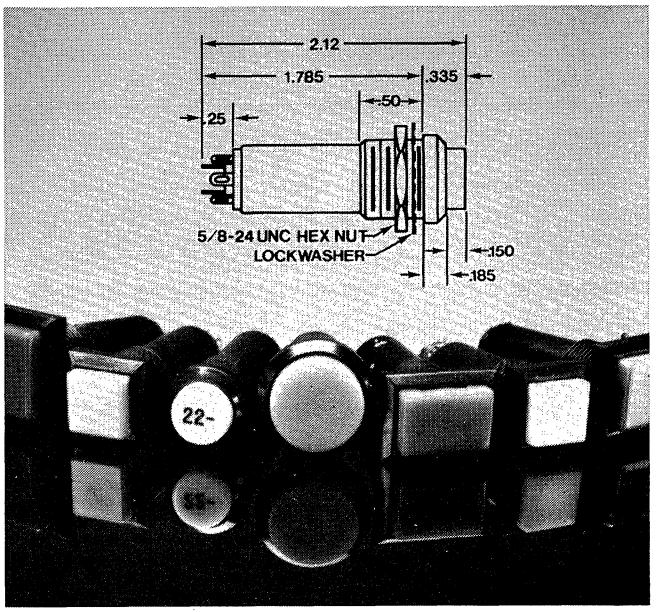




SWITCH FUNCTIONS	SPST N.O.	SPST N.C.	DPST N.O.	DPST N.C.	DPST 1 N.O., 1 N.C.	SPDT	DPDT
MOMENTARY	2*-128	2*-129	2*-130	2*-131	2*-132	2*-149	2*-150
PUSH-ON PUSH-OFF	2*-228	2*-229	2*-230	2*-231	2*-232	2*-249	2*-250
PUSH-ON REMAIN-IN PUSH-OFF	2*-828	2*-829	2*-830	2*-831	2*-832	2*-849	2*-850
N.O. POS	2-5		1-2, 4-5		1-2	1-2	1-2, 4-5
N.C. POS		2-5		2-3, 5-6	5-6	2-3	2-3, 5-6
COMMON POS			2, 5	2, 5		2	2, 5
	A B 2 5	A B 2 5	A B 2 1 5 4	A B 2 3 5 6	A B 2 1 5 6	A B 2 1	A B 2 3 1 5 6 4

*—Indicate style of switch (21- through 26, and 29)

SERIES 20
A NEW CONCEPT OF FAST EASY SWITCH INSTALLATION AND DISPLAY DESIGN VERSATILITY



FEATURES:

- **Momentary or alternate action**
- **Mounts in a ⅝" dia. round hole**
- **High density mounting ability—less than ¾" centers**
- **Low profile appearance in one unitized housing**

ELECTRO-MECH's Series 20 Switches are provided in display configurations.

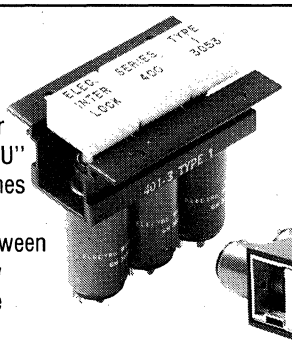
These low profile units are available in any switching mode with independent circuitry from SPST to DPDT including a separate indicator circuit. The all plastic, unitized housing assures ease in handling (no adapters, clamps or brackets). Just drop in round hole and secure with a nut from behind panel.

Series 20 Switches have the same internal parts as the all metal 6100 Series Switches including positive action, reliable circuitry and proven low bounce characteristics made possible by our unique design concept of silver slide bar action.

Available options include gold plating for dry circuit applications. Round slotted nuts for mounting switches on close centers.

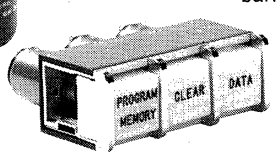
SERIES 400
MULTI-STATION SUB-PANEL ASSEMBLIES

Multi-station switch assemblies designed for sub-panel mounting by means of a flanged "U" channel. All standard ELECTRO-MECH switches can be incorporated with several types of mechanical interlocking/lockout actions between stations. Up to 12 stations in one or two row configurations. The standard center distance between switches is ⅝", ¾", ⅞" and 1".



SERIES 500
INTERLOCKING SWITCH ASSEMBLIES

Added beauty and long-lasting appearance with handsome chrome barriers between each switch or indicator. Independent or interlocking action. Ten types of tracking action and switching sequences. Up to 12 switches in single or dual row, ⅞" or 1" centers.



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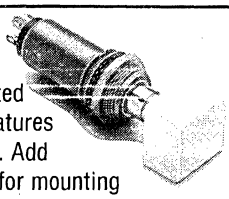
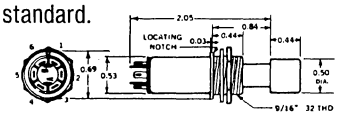
electro-mech
LIGHTED PUSH-BUTTON SWITCHES

COMMUNICATIONS/INDUSTRIAL CONTROLS/DISPLAYS
COMPUTER PERIPHERALS/INSTRUMENTATION

SERIES 2100



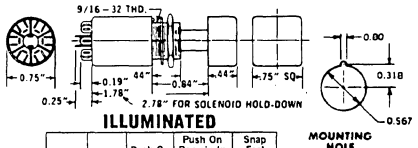
This version of our standard illuminated Pushbutton Switch features silver slide bar action. Add BR after part number for mounting on ⅝" centers. Utilizes AN3140-T 1¾"or Neon bulb. All other specifications same as standard.



	1 PST		2 PST		1 N.O.		
	N.O.	N.C.	2 N.O.	2 N.C.	1 N.C.	1 PDT	2 PDT
Momentary Push-on/ Push-off	2128	2129	2130	2131	2132	2149	2150
	2228	2229	2230	2231	2232	2249	2250

SERIES 2600

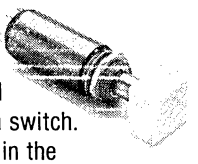
Standard models are available from 2PST to 6PDT in 116 different styles, including non-lighted units. Virtually any standard ELECTRO-MECH lens may be used with the 2600 Series.



ILLUMINATED

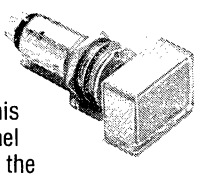
	Mom.	Push On Push Off	Push On Remain In Push Off	Snap Feel Mom.
2 PDT	2650	2750	2850	2550
3 PDT	2651	2751	2851	2551
4 PDT	2652	2752	2852	2552
5 PDT	2653	2753	2853	2553
6 PDT	2654	2754	2854	2554

SERIES 3000

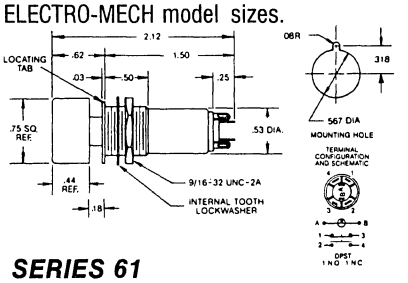


Illuminated Pushbutton switches with an integral hold-down coil which is activated with switch. Holds the push-button in the depressed position until coil is de-energized returning it to relaxed position. Available in all circuit configurations up to 6 PDT. Same specifications as standard model.

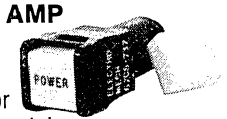
SERIES 6100



High-density packaging requirements are answered with this shorter, front panel mount, providing the same quality design as standard ELECTRO-MECH model sizes.

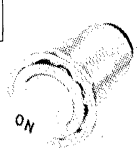


SERIES 4000 10 AMP



Low profile matches standard industry models. Momentary or Alternate Action design takes any standard lens size. 30 VDC or 115 VAC, 10 A Resistive, 5 A Inductive.

SERIES 5000



An exceptionally short momentary switch available in circuit configurations up to 2 PDT.

	1 PST		2 PST				
	N.O.	N.C.	2 N.O.	2 N.C.	1 N.O. 1 N.C.	1 PDT	2 PDT
MOMENTARY	5128	5129	5130	5131	5132	5149	5150

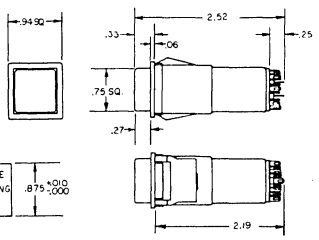
Designer Group Switches

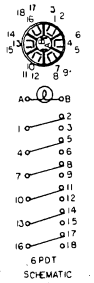
¾" sq., ¾" x 1½", ¾" x ⅞", ½" sq.

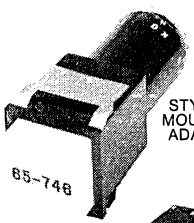
These ELECTRO-MECH Standards feature typical switch functions and mounting options for design flexibility. A choice of dual/quad display units are also available.

All Designer Group units feature:

- **1PST TO 6PDT**
- **Momentary: Alternate action; push-on remain-in; push-on, push-off and momentary snap-feel.**





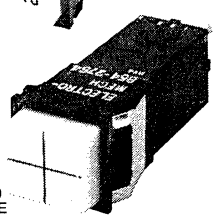


STYLE 65 MOUNTING ADAPTER

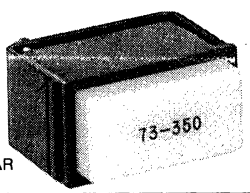
MODEL 65 NO BARRIER

MODEL 68 SINGLE BARRIER (L OR R)

MODEL 67 DOUBLE BARRIER

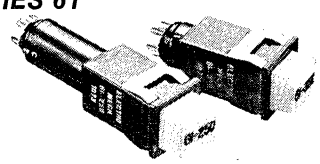


MODEL 600/800 DUAL/QUAD LITE SWITCH



MODEL 73 ¾" x 1½" RECTANGULAR

SERIES 61



ELECTRO-MECH's Series 61 switches are provided in ½-inch square, snap-in or hardmount configurations. Each low-profile unit is available in any function from SPST to 2PDT, each controlled with an independent circuit. The all plastic, unitized housing, helps insulate switch from other surrounding components. The 61 Series is also available in a standard PC Board mounting configuration.

SERIES 60
MOMENTARY SWITCH

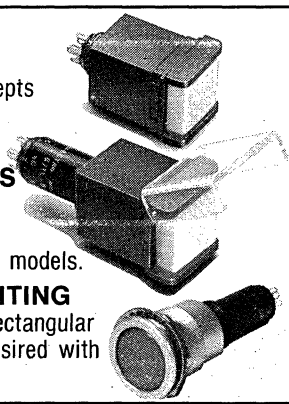
Rear mounted "U" bracket accepts switch installation from front of panel.

LG SERIES SAFETY LENS

Available on all 67-single-station, double-barrier lighted push-button bezel switch models.

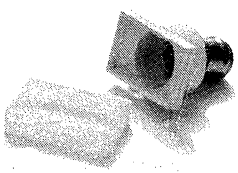
EL SERIES FLUSH MOUNTING

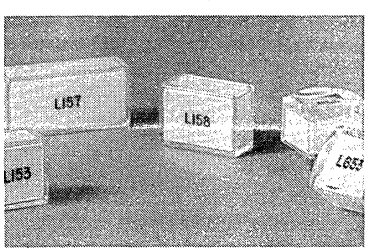
Available in round, square or rectangular styles. Specify switch model desired with "EL" suffix (i.e. 73 EL-2654).



SERIES 150
INTERCHANGABLE LENSES/FILTERS

Displays may be changed or buttons replaced. Non-wearing, clear-acrylic lens and filter buttons. Available in standard, Opaque or Contour.





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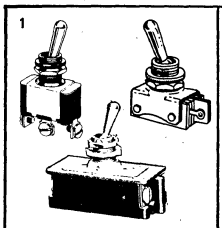
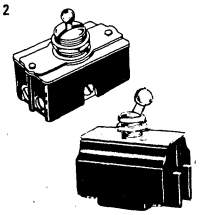
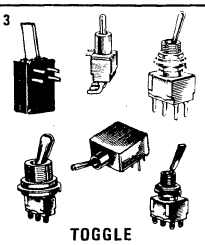
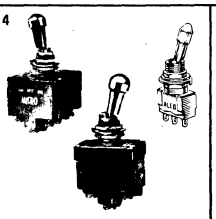
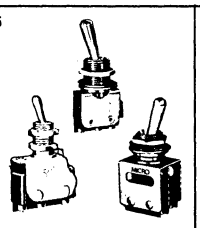
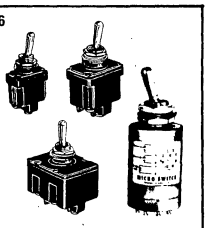
1 
TOGGLE
General Purpose

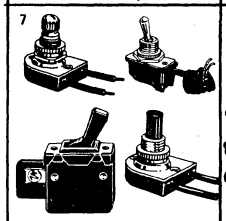
2 
TOGGLE
High Capacity

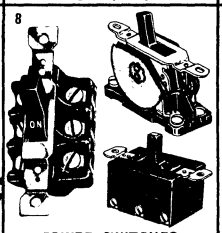
3 
TOGGLE
Miniature & Ultra Miniature

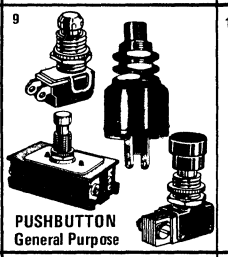
4 
TOGGLE
Locking Lever

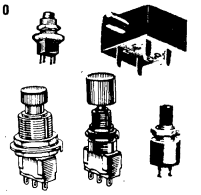
5 
TOGGLE
Precision

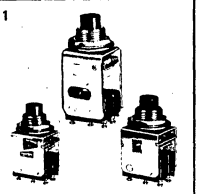
6 
TOGGLE
Environmentally Sealed

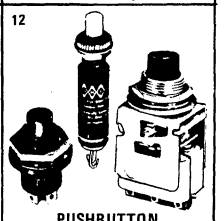
7 
APPLIANCE SWITCHES

8 
POWER SWITCHES

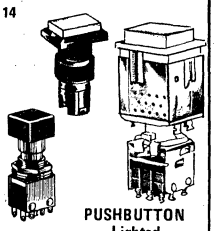
9 
PUSHBUTTON
General Purpose

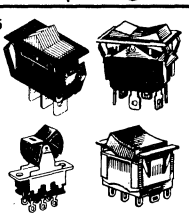
10 
PUSHBUTTON
Miniature / Ultraminiature

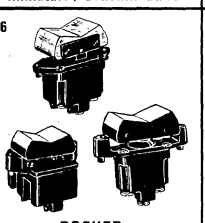
11 
PUSHBUTTON
Precision

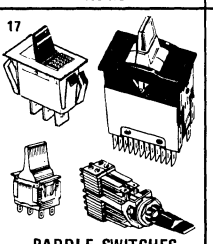
12 
PUSHBUTTON
Environmentally Sealed

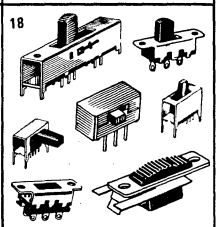
13
PUSHBUTTON
Reed & Solid State

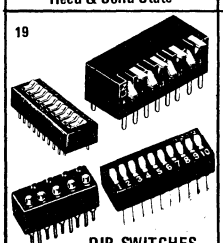
14 
PUSHBUTTON
Lighted

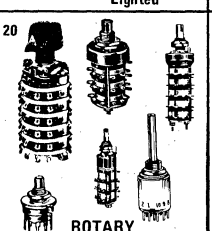
15 
ROCKER
Lighted & Unlighted

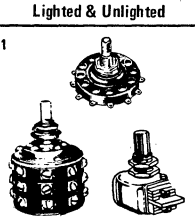
16 
ROCKER
Environmentally Sealed

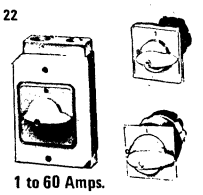
17 
PADDLE SWITCHES

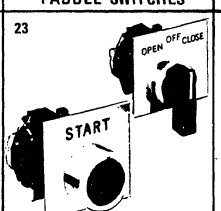
18 
SLIDE SWITCHES

19 
DIP SWITCHES

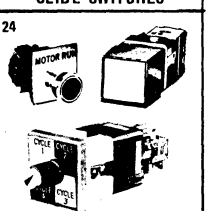
20 
ROTARY
Electronic Duty

21 
ROTARY
General Purpose

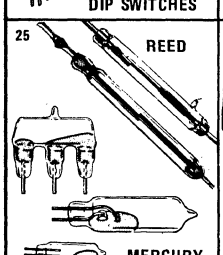
22 
1 to 60 Amps.
CAM – ROTARY
High Capacity HP Rated

23 

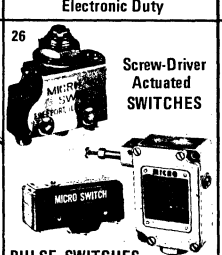
PANEL CONTROLS
Oiltight

24 

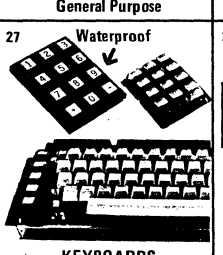
PANEL CONTROLS
Lighted-Oiltight

25 

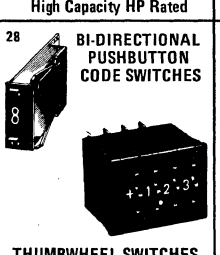
MERCURY

26 

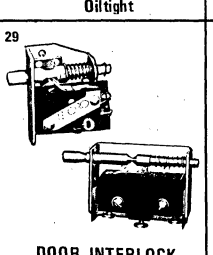
PULSE SWITCHES

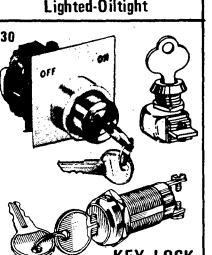
27 

KEYBOARDS

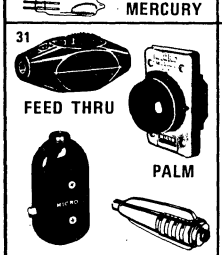
28 

THUMBWHEEL SWITCHES

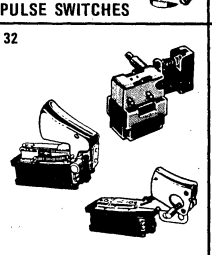
29 
DOOR INTERLOCK

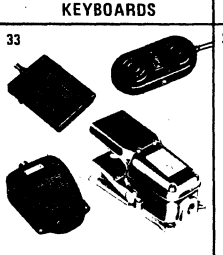
30 

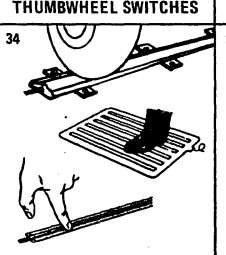
KEY LOCK

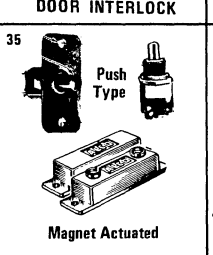
31 

PENDANT

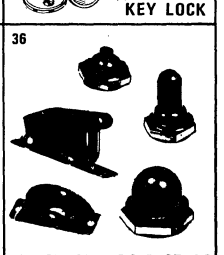
32 
TOOL HANDLE

33 
FOOT SWITCHES

34 
TAPESWITCHES

35 

Magnet Actuated
DOOR SWITCHES

36 
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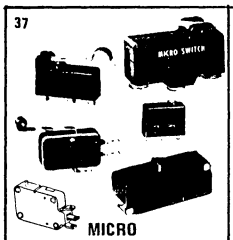
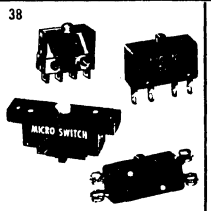
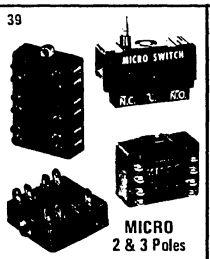
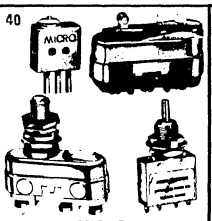
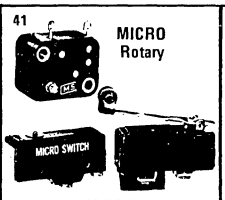
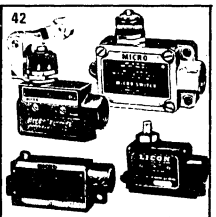
37 
MICRO
Single Break

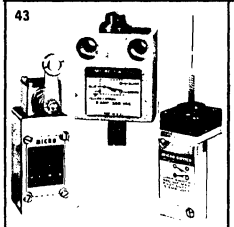
38 
MICRO
Double Break

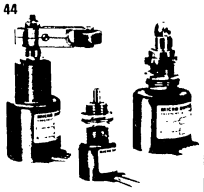
39 
MICRO
2 & 3 Poles

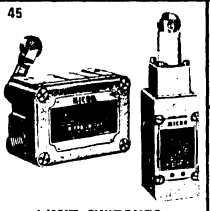
40 
MICRO
Sealed & Hi-Temperature

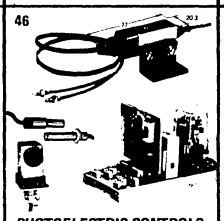
41 
MICRO
Rotary
MICRO
Magnetic Blow-Out Switches
High DC Capacity

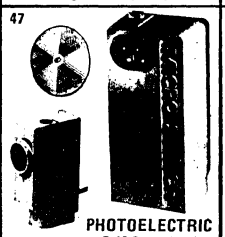
42 
ENCLOSED SWITCHES
Precision

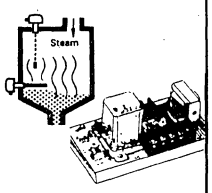
43 
LIMIT SWITCHES

44 
LIMIT SWITCHES
Sealed & High Temperature

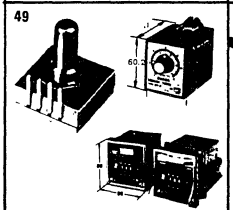
45 
LIMIT SWITCHES
Explosion Proof

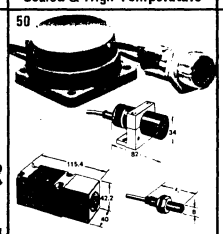
46 
PHOTOELECTRIC CONTROLS
Fiber Optics - L E D - Incandescent

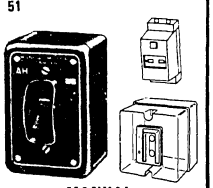
47 
PHOTOELECTRIC
Self-Contained

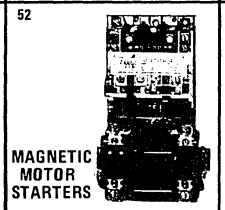
48 

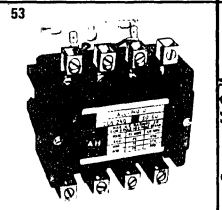
LIQUID LEVEL CONTROLS
Capacitance & Resistance Type

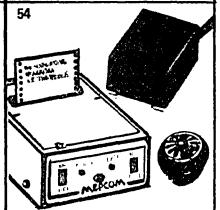
49 
PRESSURE TRANSDUCERS &
TEMPERATURE CONTROLS

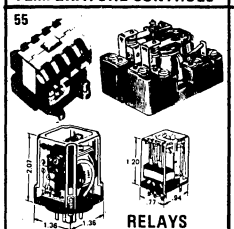
50 
PROXIMITY CONTROLS

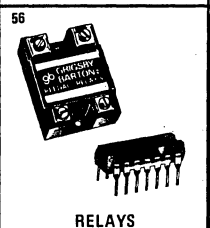
51 
MANUAL
MOTOR STARTERS
Up to 40 Hp., 600 Volts

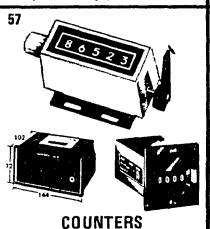
52 
MAGNETIC
MOTOR
STARTERS
Nema Size 00 to Size 6
Up to 400 Hp., 600 Volts

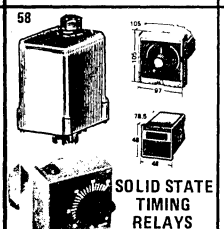
53 
MAGNETIC CONTACTOR
20 Amps. to 400 Amps.

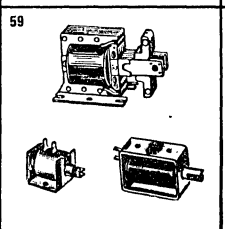
54 
IMPACT PRINTERS &
ELECTRONIC BUZZERS

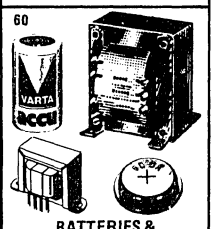
55 
RELAYS
Electro-Mechanical

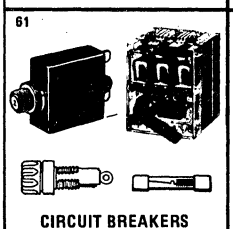
56 
RELAYS
Reeds & Solid State

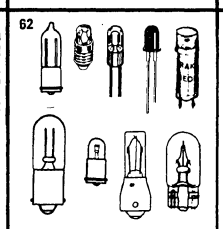
57 
COUNTERS
Electrical & Mechanical

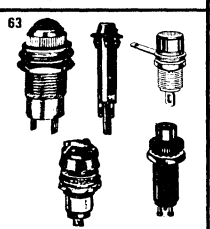
58 
SOLID STATE
TIMING
RELAYS
& TIMERS

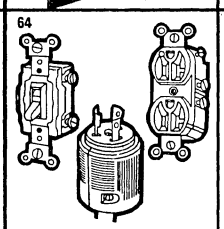
59 
SOLENOIDS

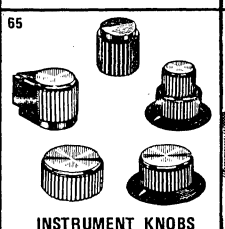
60 
BATTERIES &
TRANSFORMERS

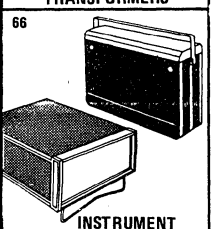
61 
CIRCUIT BREAKERS
FUSES & FUSEHOLDERS

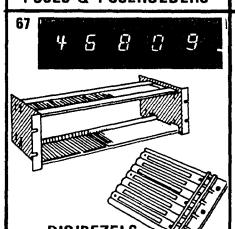
62 
MINIATURE LAMPS & LEDS

63 
INDICATOR LIGHTS

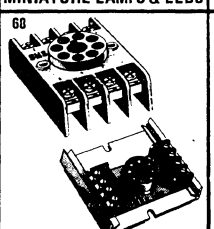
64 
WIRING DEVICES

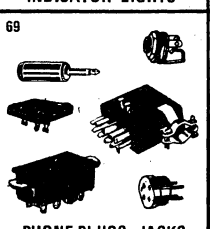
65 
INSTRUMENT KNOBS
Commercial & Military

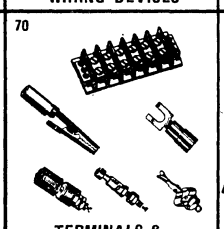
66 
INSTRUMENT
Cases, Bails & Handles

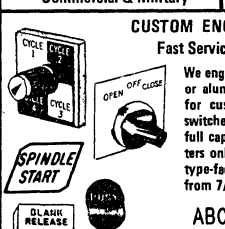
67 

DIGIBEZELS
PC RACKS & BOARDS

68 
SOCKETS & SNAPTRACKS

69 
PHONE PLUGS, JACKS
& CONNECTORS

70 
TERMINALS &
HARDWARE



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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

HEAVY-DUTY ROTARY SWITCHES

NEW CATALOG!

Request Catalog EMC-2 . . . 64 pages of detailed specs, drawings, logic charts, etc. covering snap, detent and cam action switches. Includes switches rated from 5A/600V to 200A/600V . . . with up to 16 positions! A "must" for your idea & reference files.

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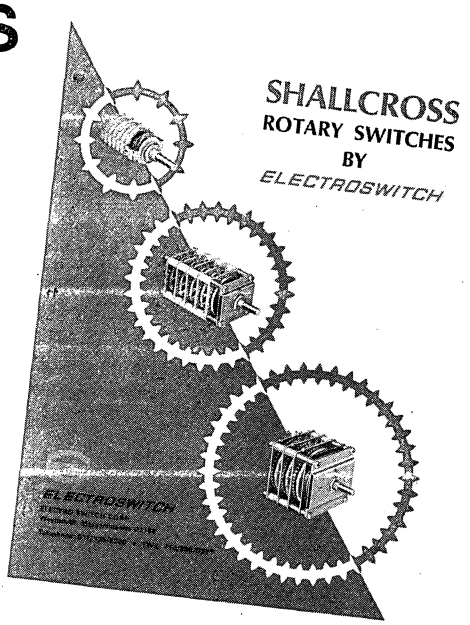

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TA Series Switches

All dimensions in inches.

Technical Data

Key pressure with 2PDT	18 oz.
Key pressure with 4PDT	22 oz.
Key pressure with 6PDT	26 oz.
Key pressure with 8PDT	32 oz.

NOTE: Lighter key pressures available, contact factory for details.

Chassis Spacing Available Series TA

10mm = .394" 17.5mm = .689"
12.5mm = .492" 20mm = .787"
15mm = .590"

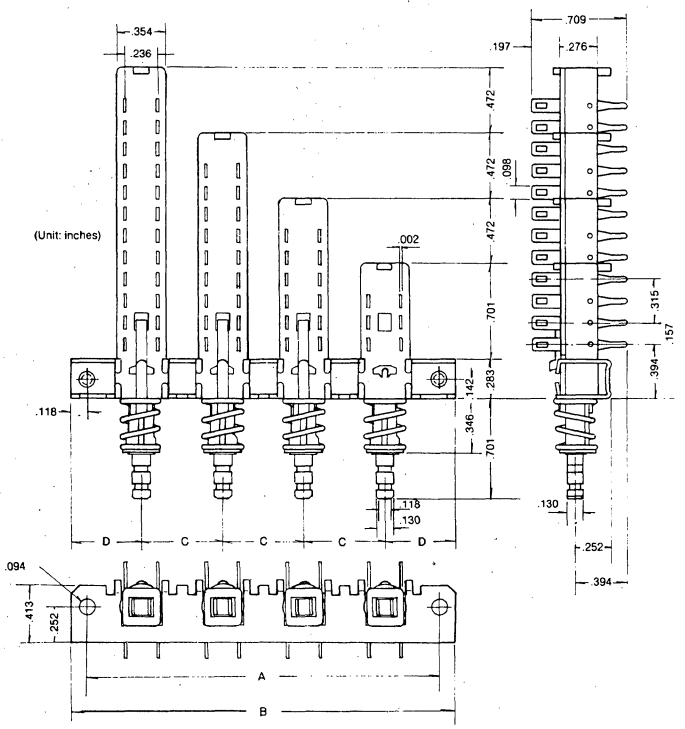
Electrical Terminology: Series TA

2U = DPDT 6U = 6PDT
4U = 4PDT 8U = 8PDT

Mechanical Configuration Terminology

OA = momentary
EE = push-push
GR = interlocking — Use OA modules
GRI, GRII = more than one independent interlocking group on common switch chassis.
AOR — Central release, momentary

Reference Diagrams



Standard Chassis Dimensions

	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C Dim. 10mm (.394)	A MTG.	1.181	1.575	1.969	2.362	2.756	3.150	3.543	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480	7.874	8.268
	B O - ALL	1.417	1.811	2.205	2.598	2.992	3.386	3.780	4.173	4.567	4.961	5.354	5.748	6.142	6.535	6.929	7.323	7.717	8.110	8.504
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C Dim. 12.5mm (.492)	A MTG.	1.201	1.693	2.185	2.677	3.169	3.661	4.154	4.646	5.138	5.630	6.122	6.614	7.106	7.598	8.091	8.583	9.075	9.567	10.059
	B O - ALL	1.437	1.929	2.421	2.913	3.406	3.898	4.390	4.882	5.374	5.866	6.358	6.850	7.343	7.835	8.327	8.819	9.311	9.803	10.295
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C Dim. 15mm (.590)	A MTG.	1.378	1.969	2.560	3.150	3.740	4.331	4.921	5.512	6.102	6.693	7.283	7.874	8.465	9.055	9.646	10.236	10.827	11.417	12.008
	B O - ALL	1.614	2.205	2.795	3.386	3.976	4.567	5.157	5.748	6.339	6.929	7.520	8.110	8.701	9.291	9.882	10.472	11.063	11.654	12.244
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C Dim. 17.5mm (.689)	A MTG.	1.476	2.165	2.854	3.543	4.232	4.921	5.610	6.299	6.988	7.677	8.366	9.055	9.744	10.433	11.122	11.811	12.500	13.189	13.878
	B O - ALL	1.713	2.402	3.091	3.780	4.468	5.157	5.846	6.535	7.224	7.913	8.602	9.291	9.980	10.669	11.358	12.047	12.736	13.425	14.114
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C Dim. 20mm (.787)	A MTG.	1.575	2.362	3.150	3.937	4.724	5.512	6.299	7.807	7.874	8.661	9.449	10.236	11.024	11.811	12.598	13.386	14.173	14.961	15.748
	B O - ALL	1.811	2.598	3.386	4.173	4.961	5.748	6.535	7.323	8.110	8.898	9.685	10.472	11.260	12.047	12.835	13.622	14.409	15.197	15.984

Push Button Switches

Electrical Specification for "TA" Series

All dimensions in inches.

Contact Resistance

Initial / 5 milli ohms max.
After 25,000 cycles / 20 milli ohms max.
Current and Voltage Ratings /
0.5A @ 100 VAC
0.2A @ 250 VAC
1A @ 25 VDC

Dielectric Strength

Contact Gap / 1500 V RMS Min (1 Min.)

Insulation Resistance

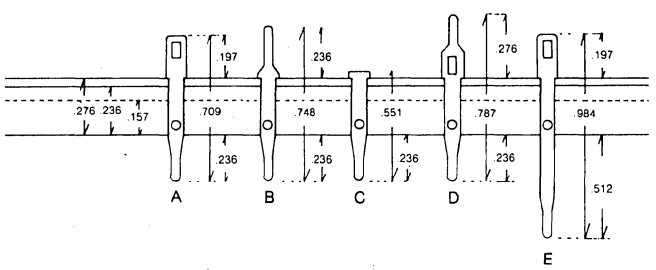
Adjacent Contacts /
2×10^{12} ohms min. (Dry Condition)
3×10^{11} ohms min. (100% Relative Humidity after 96 hours @ 70° F)
Life Test / 100,000 cycles min.

Material List

Desc.: Push Button Switch
Type: "TA" Series

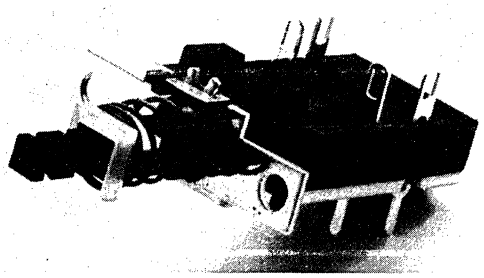
Housing / Polycarbonate (UL 94HB)
Plunger / Duracon (UL 94HB)
Terminal Board / Phenolic & Polycarbonate
(For TA Series) (For NTA Series)
Moving Contacts / Bimetal Brass / Ag Ni
(Sliding Contacts) (0,01 mm, Ag 90%, Ni 10%)
Fixed Contacts / Brass, 0,005 mm with silver plating.
Moving Contact Return Spring / Stainless steel spring
(Sliding Contact Return Spring)
Plunger Return Spring / Baked & Zinc plated steel spring
Alternate Action Staple / Highly resisted steel-wire, Chrome plated
Terminal Die Bond / High strength bonding red resin
Release Bar / Steel / Zinc plated
Chassis / Steel/Nickel plated or Steel/Zinc plated
Release Bar Spring / Stainless Steel

Series "TA" Terminal Configurations Available



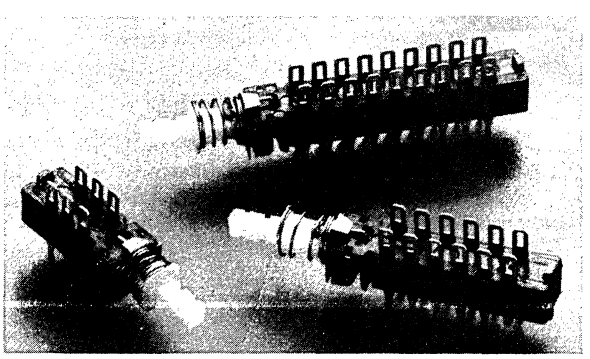
TA/285 Power Switch

VDE, Semko, SEV, Demko, Nemko
UL, CSA 4A/250 V AC



Available as single position mount only.

"TA" Series Alternate Action Modules

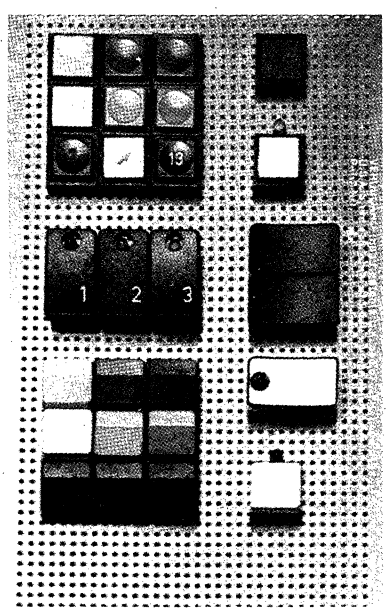


Series 320/323

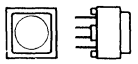
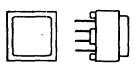
Type 320 Pushbutton Keys

Single-Pole Momentary Contact

- Pushbutton keys with tactile feel
- Closing switches
  1 input, 1 or 2 outputs
- Changeover switches
  1 input, 1 input, 1 or 2 or 3 output
- Individual keys
  for various types of pulse triggering
  (e.g. electrical interlocking)
- Pushbutton key sets Graduation .492 on Series 323
  for mechanical interlocking, momentary and push-push action
- Variable design
- LED display
  LED sockets can be arranged anywhere.
  Supply without LED
- Single key or keyboard construction
- .010" installation grid
- Specify cap color when ordering
- Standard "TA" series buttons snap on to type 320.02 and 320.03 plungers
- LED not included unless specified separately
- Graphics available — contact factory for details.



Subject to change.

Type - Type	- type of contact	Button Color: Black	White	Yellow	Orange	Red	Green	Blue	Grey
320 	E 1 - 1								
	E 1 - 2								
	U 1 - 1								
320.01 	E 1 - 1								
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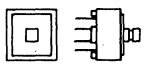
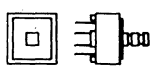
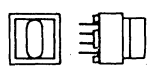
	U 1 - 1								
320.02 	E 1 - 1								
	E 1 - 2								
	U 1 - 1								
320.03 	E 1 - 1								
	E 1 - 2								
	U 1 - 1								
320.04 	E 1 - 1								
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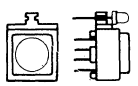
	U 1 - 1								
320.1 	E 1 - 1								
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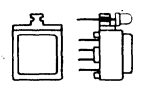
	U 1 - 1								
320.11 	E 1 - 1								
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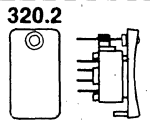
320.2 	E 1 - 1								
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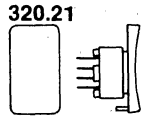
320.21 	E 1 - 1								
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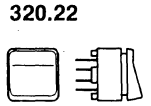
320.22 	E 1 - 1								
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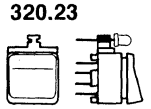
320.23 	E 1 - 1								
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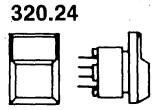
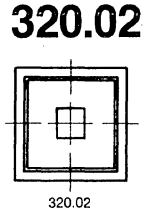
320.24 	E 1 - 1								
	E 1 - 2								
	U 1 - 1								

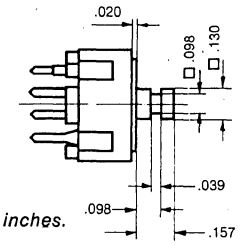
ELECTRONIC COMPONENTS GROUPE
26 NORTH FIFTH STREET, MINNEAPOLIS, MINNESOTA 55403
(612) 375-0011 TWX 910-576-1725

ECG

Type 320

320.02





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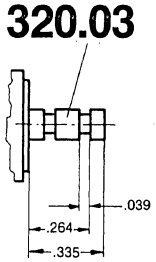
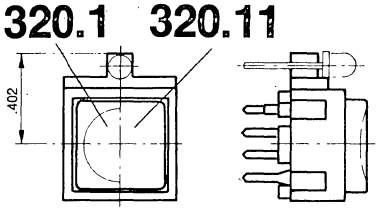


All dimensions in inches.

320.1 320.11



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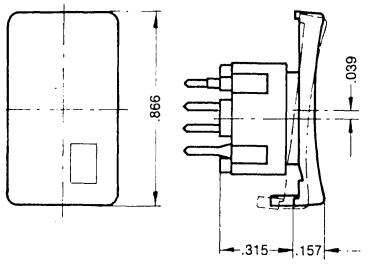

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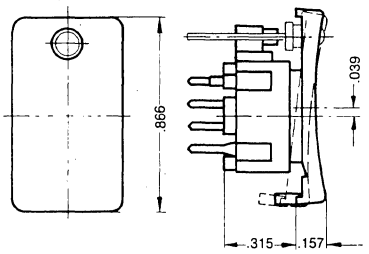

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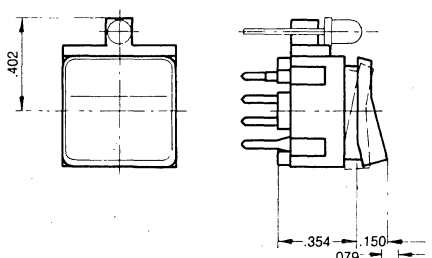

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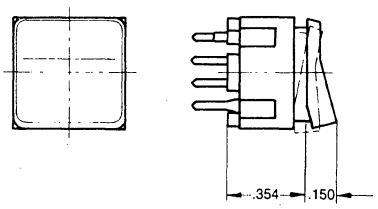

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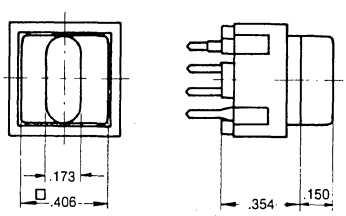

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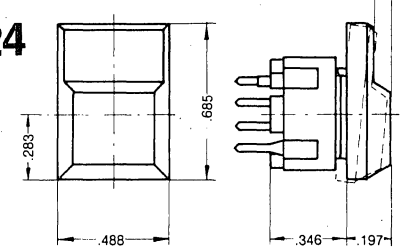

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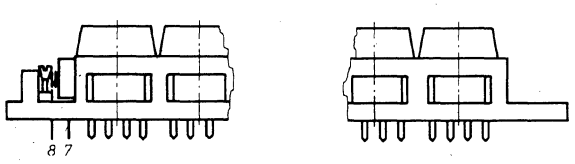
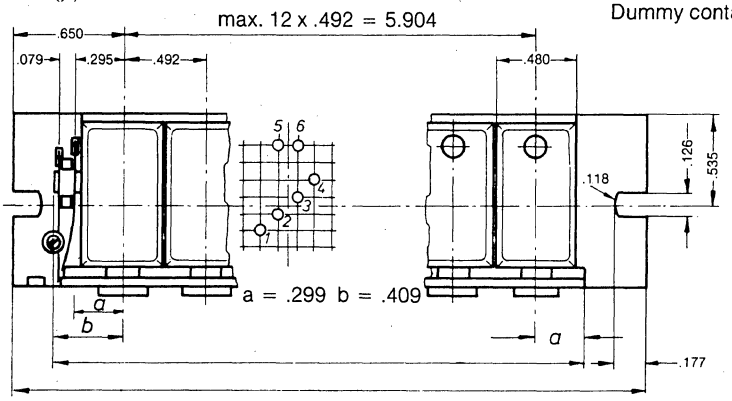
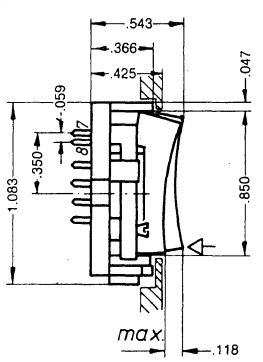


Center to center 12,5 mm/.492"
Interlock
Momentary
Push-Push
Mixed configuration
Dummy contact

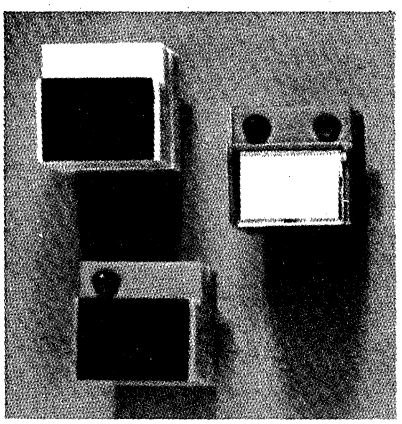




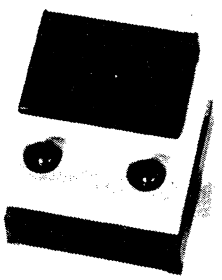
ELECTRONIC COMPONENTS GROUPE
26 NORTH FIFTH STREET, MINNEAPOLIS, MINNESOTA 55403
(612) 375-0011 TWX 910-576-1725

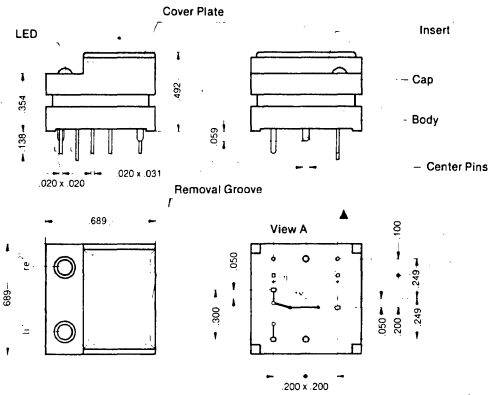
The New "Mini Switches" for Digital Electronics

All dimensions in inches.



Series LDT-11

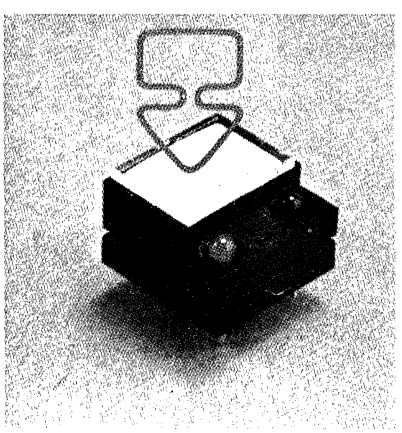




L = LED Pins
TM = Center
1) + = Anode LED
2) = Positions: li = left, re = right, available without or with 1, 2 LED's

Directly Compatible with State-of-the-art Electronics

Two essential advantages extend the scope of application of the Mini-Tast. Together with commercially available IC's, switching functions can easily be achieved, such as mutually excluding, accumulative locking or common release switches. Apart from this, one can feed directly into the electronic circuits by flip-flops.



Feather-Light Switching

Reliability and long life—two major features

- Snap-action contacts—tested to 10 million switching cycles at full load
- Self cleaning contacts—maintenance free
- High quality basic materials—no functional fatigue
- Dust-Proof—by compact design
- LEDs are available from the factory as an option. Please specify as required.

Mechanical Data:

Contact:	1 Form C (SPDT) Momentary
Travel:	1.5 mm
Force:	1.2 N
Life:	$10x10^6$ Operations at Full Load
Temp Range: to DIN 40040:	−25°C to +85°C

Electrical Data:

Max. Switching Voltage:	60 V
Max. Switching Currrent:	250 mA
Max. Switching Power:	15 W resist. load
Bounce Time:	1 ms
Contact Resistance:	20 m OHM
Test Voltage:	500 V AC

Material:

Contacts:	Silvered 10 microns or Gold 3 microns
Body & Cap:	Poly-carbonate

Specification:

LDT 11 □□ . □□□ . □□

CODE FOR CONTACT MATERIAL
0 = Silver, 3 = Gold plated
CODE FOR CAP COLOR
1 = Black, 2 = Grey, 3 = Yellow, 4 = Blue
CODE FOR INSERT
X = No insert, 1 = White,
(Specify Lettering)
CODE FOR COVER PLATE COLOR (Body Always Black)
1 = Clear, 2 = Black, 3 = Grey,
4 = Red, 5 = Green, 6 = Orange, 7 = White
CODE FOR LED'S
X = No Holes Available for LED's
0 = Hole Available but Not Equipped
1 = Red LED
2 = Green LED
3 = Yellow LED

Ordering Examples:

LDT 11 0 0 1 1 1 1 0 — Contact Material Silver
Cap Black, Insert White,
Cover Plate Clear.
Red LED/Left, 1 Hole Available on right.

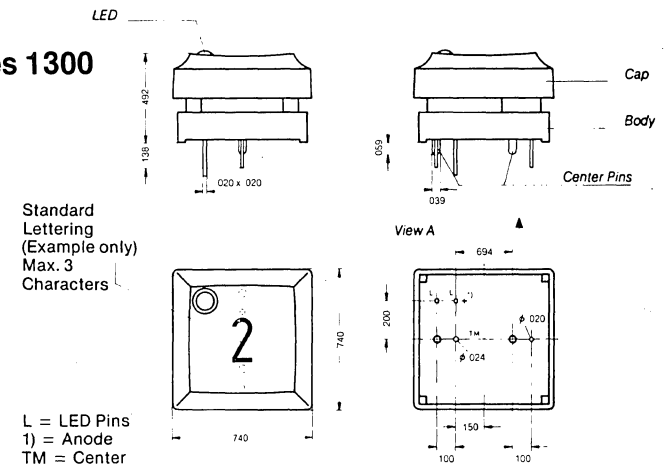
Mini-tast

"Mini-tast E"

All dimensions in inches.

- A high quality, low cost alternative for input switch devices.
- Graphics available as standard feature when required are A-Z and 0-9. Contact factory for other requirements.
- Cap available with capability of legend and insert. See specification section.
- LED optional. Please specify as required.
- Contact factory for variable key pressure if required.

Series 1300



Mechanical Data

Contact Type:	1 Form A
Travel:	1.5 mm
Operating Force:	1N
Life (Full Load):	10 x 10^6 Switching Operations
Temp. Range to DIN 40040:	−25°C + 85°C

Electrical Data:

Max. Switching Voltage:	60 V
Max. Switching Current:	100 mA
Max. Switching Power:	6W Resistive Load

Bounce:	2 ms
Contact Resistance:	50 m OHM
Test Voltage:	500 V AC
Material:	
Contacts:	Silvered 10 microns or Gold 3 microns
Body:	Polycarbonate Black
Cap:	Polycarbonate Black or Grey

Specification:

130 □ □ □ □ □

- CODE FOR CONTACT MATERIAL
  0 = SILVER, 3 = GOLD PLATED
- CODE FOR CAP COLOUR (Body Always Black)
  1 = Black, 2 = Grey, 3 = Green, 4 = Yellow, 5 = Red, 6 = Blue
- CODE FOR LED's
  X = No Hole Available for LED
  0 = Hole Available but Not Equipped
  1 = Red LED
  2 = Green LED
  3 = Yellow LED
- E = Button with Legendable Insert X = Non-Legend Cap
- CODE FOR COVER PLATE
  1 = Black
  2 = White
  3 = Grey
  4 = Orange
  5 = Green
  6 = Yellow
  7 = Clear Lens
  X = Non-Legend Cap

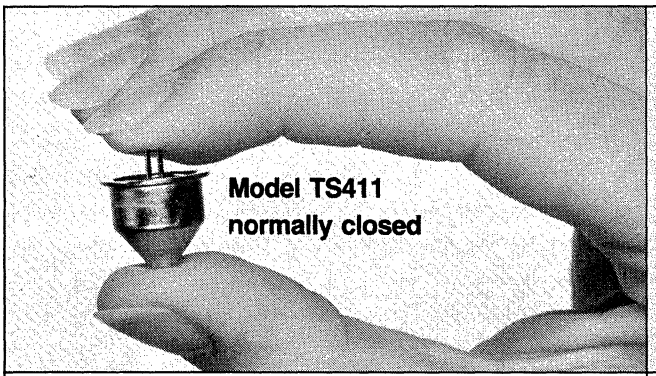
Ordering Example:

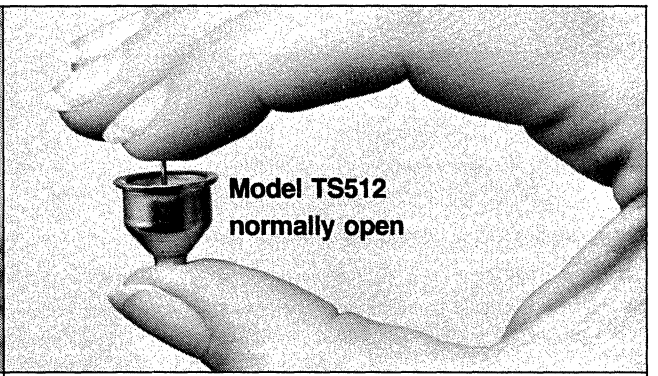
130 [0] [2] [X] [X] [2] Contact Material, Silver, Cap Grey, LED Green

17

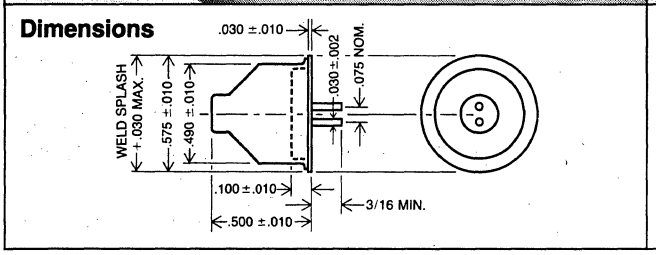
Fifth Dimension Precision Tilt Switches

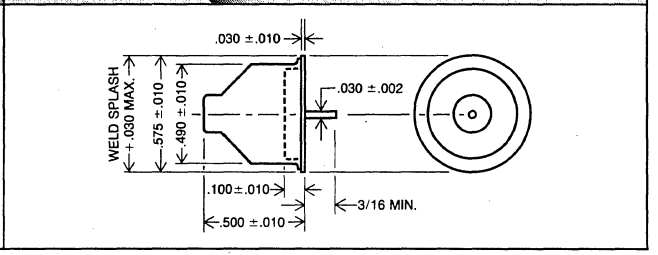
Metal encased miniature tilt switches that operate as closely as ±5° of nominal angle





Dimensions





These rugged, reliable yet inexpensive miniature tilt switches are recommended for applications where operating angle accuracy must be held within tighter limits than most other tilt switches can offer. The Model TS411 normally closed tilt switch exhibits an accuracy of ±5° about its nominal operating angle of 37° (measured from the horizontal). The TS512 tilt switch operates at 35°. Angular accuracy is defined as the angular range over which the contacts of an entire population of tilt switches will open or close.

Both switches measure only 0.575-inches in diameter by 0.512-inches high. Their precise operation is achieved by a unique design. A mercury globule is contained within a well inside the switch. A detent surrounding the well provides a "knife-edge" action (patent applied for). As the switch is tilted, the mercury remains in the detent until the operating angle is reached. The globule then flips over the lip of the detent, providing a highly repeatable "snap action" mode of operation.

The contacts of the TS411 are mercury wetted to provide exceptionally low contact resistance. Typical contact resistance for this switch is 0.025 ohms.

Houses in a rugged welded steel capsule, these switches, unlike fragile glass enclosed types, withstand rough handling and mechanical shock. Low contact resistance permits reliable switching of low-level loads. The contacts are sealed in an oxygen-free atmosphere to prevent mercury wetting the walls of the switch or other oxygen-related failure mechanisms.

These switches can be modified to operate at your desired nominal operating angles with only a small change in tooling. Ask for more information.

Specifications

Contact Form	Degrees from Horizontal (Glass seal up)	
	Normally Closed/Model TS411	Normally Open/Model TS512
Contacts May Open	42°	25°
Contacts Must Open	32°	55°
Contacts May Close	38°	50°
Contacts Must Close	52°	20°

	Model TS411	Model TS512
Load Current @ 115 VAC (Amperes)	1.0	1.0
Load Current @ 12 VDC (Amperes)	2.0	2.0
Contact Resistance Typical (Ohms)	0.025	1.0
Operational Temperature Range (°C)	−38; +85	−38; +85

Specifications subject to change without notice.

FIFTH DIMENSION, INC.
801 New York Avenue, Trenton, NJ 08638 • Tel: 609-393-8350 • TWX: 510-681-8412

Gould R.B.Denison Optic-Electronic Switches

Features:

- **Long Range Sensing** — As far as 100 feet.
- **Versatile** — Retroreflective, proximity, thru beam and point focus.
- **Reliable** — Solid state infrared electronics.
- **Rapid Response** — As fast as 10k Hz switching.
- **Over 75 Models** — Compact, self-contained for down-sized machinery.
- **Applications** — For package detection, bar code reading, breakage and color registration.

Introduction

The types and usage of optic-electronic control applications are increasing at a very rapid rate. This is because optic-electronic controls are extremely versatile and becoming a widely applied method of electric control in industry today.

They can be used to detect the presence or absence of nearly any material or object without contacting it physically, and can function even at a considerable distance from the object to be detected. Optic-electronics are extremely reliable and have rapid response times. This is due to their solid state design, plus no-touch actuation, which results in long, low-cost operation.

Description

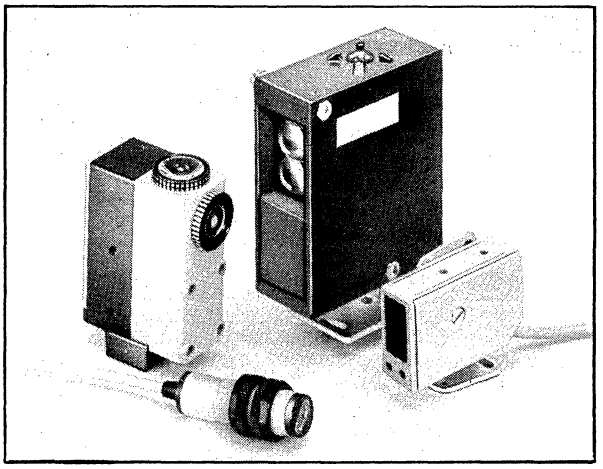
There are two kinds of optic-electronic devices used in photoelectric applications — those which give off light (emitters) and those which receive light (receivers). The emitters give off light when an electric current is passed through them. The receivers change one of their characteristics when light falls upon them.

The classical emitter is the incandescent lamp, which emits electromagnetic radiation over nearly all of the visible range. The light which is given off is continuous, but for some applications may be modulated by a mechanical shutter.

Solid state components made from gallium arsenide (Ga-As) may be caused to emit light in the infrared region. This light can be modulated easily by electrical means and the point source of the light greatly simplifies the optical system.

Modulated LED controls are optic-electronic controls that can be applied in variable or bright ambient light, low visibility scanning conditions, and also in high vibration areas. A modulated LED control is the only type of optic-electronic control recommended for use outdoors, where it is exposed to sunlight and variable weather conditions.

The modulated LED control operates on a pulsed (modulated) infrared beam emitted by an LED. Since the receiver circuitry is tuned to the emitter modulating frequency, the control does not respond to ambient light. Modulation frequency causes the control to respond rather than beam intensity. Controls may be modulated at different frequencies. This prohibits using the emitter of one control with the receivers of the others.



Scanning Techniques

There are several scanning methods for setting up the light source and photoreceiver to detect objects. Use the one that yields the highest signal ratio for the object to be scanned, subject to distance and mounting restrictions.

Various characteristics of objects to be detected have a bearing on the scan method, such as whether the objects are: (1) translucent or opaque; (2) slightly or highly reflective; (3) in the same position or random as they pass the sensor. Detecting change in color requires special considerations.

Methods of Detection

Reflex (retroreflective) — A method of object detection in which the emitter and receiver are located on the same side. A reflector on the far side returns the energy from the emitter to the receiver. Operation is accomplished by interruption of the beam. The sensor then detects the presence or absence of its own reflected beam.

Proximity (direct detection) — A method of object detection in which the emitter and receiver are located on the same side. The receiver senses energy from the emitter, which is bounced back by the object being detected.

Emitter-Receiver (thru-beam) — Utilizes a separate opposing emitter and receiver. Detection is accomplished by interruption of the modulated infrared beam.

Point Focus (fixed range detection) — A method of object detection in which the emitter and receiver are located on the same side. The receiver senses energy from the emitter, which is bounced back by the object being detected, but only when the object is at a fixed distance from the sensor.

CALL OR WRITE FOR 160 PAGE GENERAL CATALOG

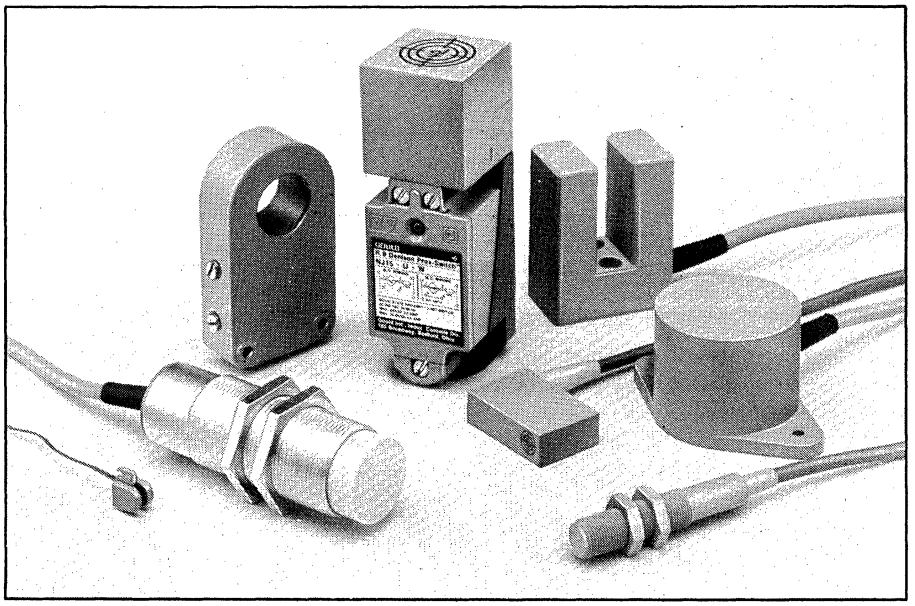
Gould Inc., Industrial Controls Division
100 Relay Road, Plantsville, CT 06479
203/621-6771 • TWX: 910-473-0079
Manufacturer of Gould R.B. Denison Products

GOULD
Electronics

Gould R.B.Denison Proximity Sensors

Features

- Metal detection (ferrous, non-ferrous, foils)
- Solid material, granular material and liquid detection (glass, wood, paper, oil, water, flour, etc.)
- No moving parts (solid state)
- Completely sealed and waterproof
- Non-magnetic
- Accurate positional switching
- Shielded models (not side sensitive)
- Fast switching speeds

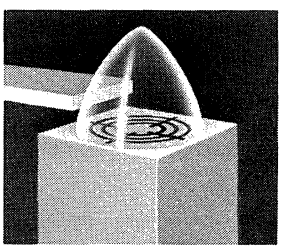


Application

Wherever high switching accuracy and/or high reliability is essential, Prox-Switch inductive proximity switches provide the ideal answer. They detect the presence or absence of metal cams or parts without making physical contact. The metal to be detected, which may be ferrous or non-ferrous, need only to enter or leave the detection area to operate the switch. This method has obvious advantages over mechanically operated limit switches because there are no moving parts to corrode or wear out; and the useful life span is, therefore, many times greater.

As the sensor does not touch the metal being sensed and is non-magnetic, it is also ideal for use on meter movements, weighing machines and delicate mechanisms such as impellers used in flow measurement.

Operation



Sensed metal objects can be stationary or in motion and can approach the proximity sensor from any direction.

The inductive proximity sensor uses an r-f oscillator located in the sensing head. When no metal is present, a small r-f field radiates from the sensing head, and the oscillator functions normally. When in the field of the sensing head, metal absorbs r-f energy. This lowers the activity of the oscillator circuit and causes an output device to switch the load.

Proximity System Elements

The proximity system consists of three basic elements: a sensing oscillator, a solid state amplifier and a switching device. All three elements can be self-contained in one sensor; or just the sensing oscillator can be located separately and the solid state amplifier and switching device built into a control amplifier.

Proximity Sensor With Control Amplifier

- All sensors may be used
- Sensors operate at 8 VDC
- Sensor connects to control amplifier or electronic terminal with choice of hard contact relay, triac or transistor outputs
- Amplifiers may be selected with a variety of options such as on/off, delay timing, under/over rpm control, synchronization, and/or switching, etc.
- Instrinsically safe systems for Class I, Division I, Groups A, B, C, D and Class II Division I, Groups E, F,G.

Self-Contained Proximity Sensor

- Most sensors may be used
- Sensors operate at load voltage
- Sensor connects directly to load — no intermediate control amplifier.
- Sensors with AC outputs can be electrically interchanged with mechanical limit switches. Sensors are designed to switch programmable controllers or relay loads.
- Sensors with DC outputs are designed for direct interface into logic, processors and controllers.

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Manufacturer of Gould R.B. Denison Products

GOULD *Electronics*

Gould R.B.Denison Heavy Duty Limit Switches

Features

- 4-position indexing head
- Plug-in and non-plug-in models directly interchangeable
- 50,000,000 life cycles plus*
- NEMA 1, 4, and 13 housings
- Heavy duty electrical ratings

*exceeds automotive test standards

Options

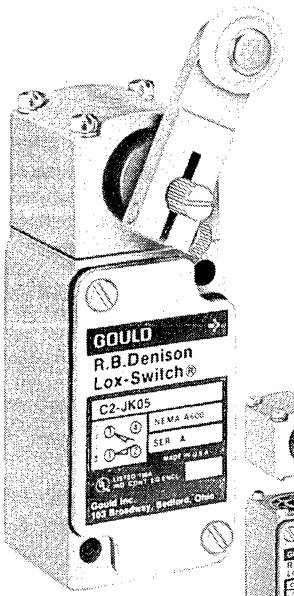
Wide choice of options for lever, plunger and omnidirectional models

- Neon pilot light to indicate switch operation
- Low temperature models to -40°F (-40°C)
- 3/4" conduit entrance
- Viton elastomers for fire-resistant fluids
- Gold impregnated contacts
- Hermetically sealed reed switching
- Solid state triac switching
- Epoxy sealed switch compartments
- Prewired with individual conductors
- Prewired with multiconductor cable
- Prewired with mini-change receptacle
- Manifold mounting

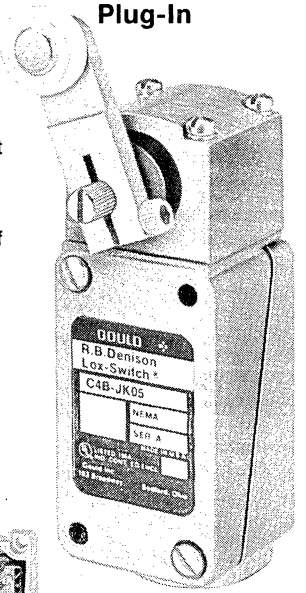
UL LISTED IND. CONT. EQ-196A

CSA® File No. 16565

Non-Plug-In

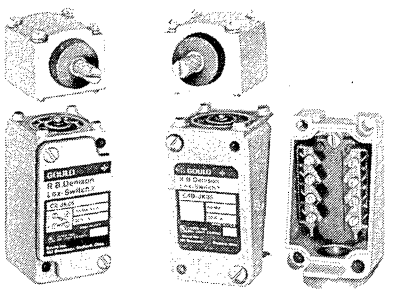


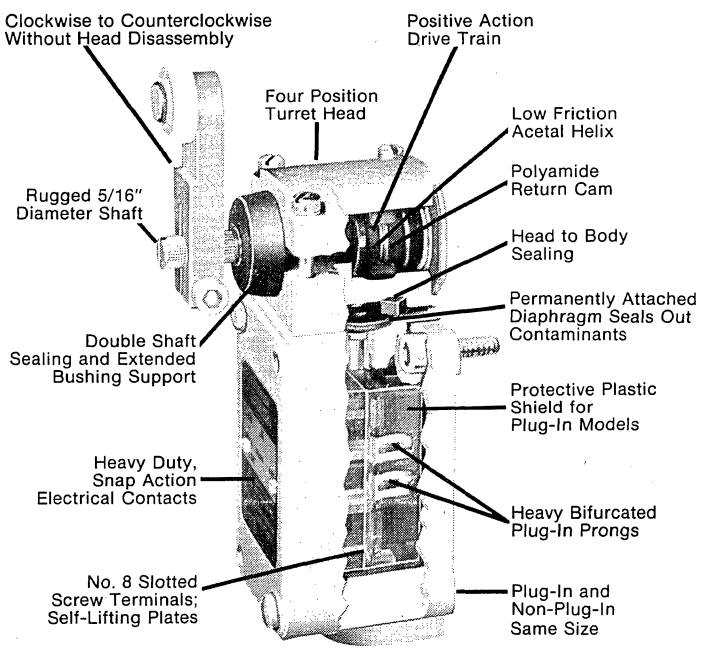
Plug-In



Modular Construction

Non-plug-in models consist of a separate base and head. Plug-in models consist of a separate base (wiring receptacle), top half plug-in (electrical compartment) and the head. THE HEADS ARE INTERCHANGEABLE BETWEEN NON-PLUG-IN AND PLUG-IN MODELS.





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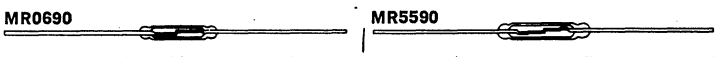
GOULD Electronics

GORDOS CORPORATION

REED SWITCHES

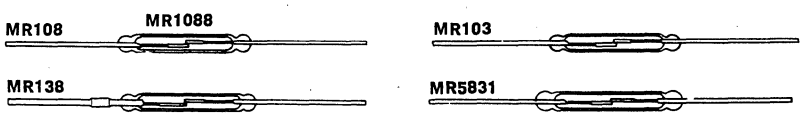


DRY SUB-MINIATURE SPST/FORM A CENTER GAP

Part Number	Max. Glass Dia. mm (Inches)	Max. Glass Length mm (Inches)	Nom. Uncut Switch Length mm (Inches)	Min. Trim Length mm (Inches)	Max. Switching Current (Amps)	Max. Switching Voltage (VDC)	D.C. Contact Rating (Watts)	Min. VBD (Vrms)	Max. Initial Contact Resistance (Ohms)	**Contact Plating Material	Stock Ampere Turn Range
MR0690	1.88 (.075)	11.94 (.470)	50.29 (1.98)	15.24 (.600)	.250	50	7	200	.200	RU	10-30
MR5590	2.24 (.088)	11.94 (.470)	50.29 (1.98)	15.24 (.600)	.500	100	12.5	200	.150	RU	10-40

DRY SUB-MINIATURE SPST/FORM A OFFSET GAP

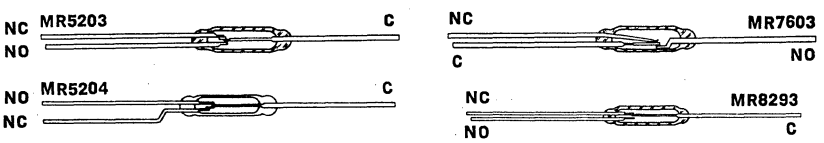
MR458	2.28 (.090)	14.22 (.560)	48.26 (1.90)	17.52 (.690)	.250	100	7	250	.150	RH	15-35



DRY MINIATURE SPST/FORM A CENTER GAP

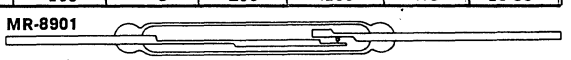
MR103	2.67 (.105)	19.94 (.785)	53.34 (2.10)	26.16 (1.03)	1.0	200	†	250	.500*	W	30-50
MR108	2.67 (.105)	19.94 (.785)	53.34 (2.10)	26.16 (1.03)	.500	200	10	250	.100	RH	20-40
MR138	2.67 (.105)	20.70 (.815)	53.34 (2.10)	31.75 (1.25)	.500	1000	10	1200	.100	RH	20-50
MR1088	2.67 (.105)	19.94 (.785)	53.34 (2.10)	26.16 (1.03)	.500	500	10	1000	.100	RH	20-40
MR5831	2.67 (.105)	21.46 (.845)	53.34 (2.10)	27.94 (1.10)	.500	200	10	250	.100	RH	20-40

† High inrush cond. 50 watt max.
* At 10 AT overdrive



DRY MINIATURE SPDT/FORM C

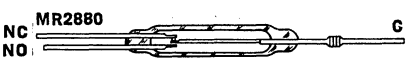
MR5203	3.17 (.125)	14.85 (.585)	52.58 (2.07)	21.59 (.850)	.300	100	3	200	.150	RH	15-35
MR5204	3.17 (.125)	14.85 (.585)	51.82 (2.04)	21.59 (.850)	.300	100	3	200	.150	RH	15-35
MR7603	3.17 (.125)	14.85 (.585)	52.58 (2.07)	21.59 (.850)	.300	100	4	250	.150	RH	15-35
MR8293	2.28 (.090)	14.22 (.560)	52.58 (2.07)	21.59 (.850)	.250	100	3	200	.150	RU	15-35



DRY STANDARD SPST/FORM A OFFSET GAP

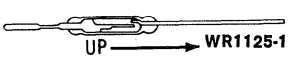
MR8901	4.83 (.190)	43.18 (1.70)	81.28 (3.20)	49.53 (1.95)	3.0	250	100	400	.500	W	60-100

Inrush Current Permitted



DRY STANDARD SPDT/FORM C

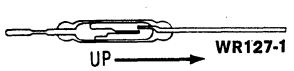
MR2880	5.54 (.218)	35.56 (1.40)	91.44 (3.60)	53.34 (2.10)	1.0	250	15	750	.100	RH	40-100



MERCURY WETTED SUB-MINIATURE SPST/FORM A OFFSET GAP

WR1125-1	2.54 (.100)	12.70 (.500)	41.14 (1.62)	19.05 (.750)	1.0	500	50	1500	.050	Hg	25-55
WR1125-20	2.54 (.100)	12.70 (.500)	41.14 (1.62)	NA	1.0	500	50	1500	.050	Hg	30-60

(MOUNTING POSITION — WITHIN 30° OF VERTICAL)



MERCURY WETTED MINIATURE SPST/FORM A OFFSET GAP

WR127-1	3.17 (.125)	17.52 (.690)	41.14 (1.62)	19.05 (.750)	1.0	500	50	1500	.050	Hg	25-55
WR127-20	3.17 (.125)	17.52 (.690)	53.98 (2.725)	NA	1.0	500	50	1500	.050	Hg	30-60

(MOUNTING POSITION — WITHIN 30° OF VERTICAL)

MERCURY WETTED MINIATURE SPDT/FORM C

WR1201-1	3.17 (.125)	16.00 (.630)	39.87 (1.57)	21.59 (.850)	1.0	500	50	1500	.050	Hg	40-80
WR1201-20	3.17 (.125)	16.00 (.630)	52.71 (2.075)	NA	1.0	500	50	1500	.050	Hg	45-85

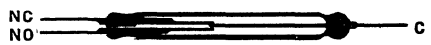
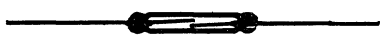
(MOUNTING POSITION — WITHIN 30° OF VERTICAL)

**RU — Ruthenium RH — Rhodium W — Tungsten Hg — Mercury Wetted

ADDITIONAL SWITCHES AVAILABLE. PLEASE CONTACT FACTORY FOR DETAILS

GORDOS CORPORATION

REED SWITCHES

Part Number	Maximum Glass Diameter mm (Inches)	Maximum Glass Length mm (Inches)	Maximum Uncut Switch Length mm (Inches)	Maximum Switching Current (Amps)	Maximum Switching Voltage (Vrms)	D.C. Contact Rating (Watts)	Minimum Voltage Breakdown (Vrms)	Maximum Initial Contact Resistance (Ohms)	**Contact Plating Material	Stock Ampere Turn Range
MR1517	5.4 (.212)	52.0 (2.04)	79.0 (3.11)	1.0	1500	30	3000	.080	Rh	75-95
MR1521	5.4 (.212)	52.0 (2.04)	79.0 (3.11)	2.5	250	80	800	.080	Rh Vap	75-95
MR1525	5.4 (.212)	52.0 (2.04)	79.0 (3.11)	1.3	250	60	800	.080	Rh	75-95
MR1526	5.4 (.212)	52.0 (2.04)	79.0 (3.11)	5.0	250	—	600	.100	GA32	80-100
										
MR1625	5.6 (.220)	52.0 (2.05)	80.0 (3.15)	1.000	220	30	500/400	.100	Rh	80-160
										
MR2125	2.3 (.090)	15.8 (.622)	59.3 (2.33)	0.500	100	10	250	.100	Rh	15-50
MR2715	2.6 (.102)	19.0 (.748)	55.0 (2.16)	0.500	350	8	600	.100	Rh	30-50
MR2725	2.6 (.102)	19.0 (.748)	55.0 (2.16)	0.500	220	10	400	.100	Rh	15-50
MR2736	2.6 (.102)	19.0 (.748)	55.0 (2.16)	1.500	240	20	500	.100	GA34	30-60
MR6517	5.6 (.220) 10.5 (.410)*	50.8 (2.00)	83.5 (3.29)	3.0	10,000	50	14,000	.250	W	<200

** Contact plating material:
Rh = Rhodium; Rh Vap = Rhodium Vaporized; W = Tungsten; GA32 = Ruthenium; GA34 = Rhodium.

HOW TO ORDER A REED SWITCH

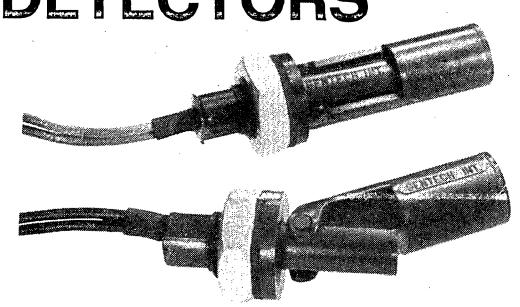
Gordos reed switches must be ordered by stating the REED SWITCH PART NUMBER (Example: MR5203) followed by the desired PULL-IN SENSITIVITY RANGE (AMPERE-TURN RANGE) (Example: 15-35 ampere turns). PULL-IN SENSITIVITY of a reed switch is measured in ampere-turns (AT). AT is the product of the current flowing in a coil and the number of turns of wire in that coil, measured at the point of "just operate" for the Reed Switch. It is very important to specify the desired AT range when ordering a Reed Switch.

There may be a delivery and price advantage to ordering a broader AT range (Example: delivery and price may be better for 15/35AT than for 15/20AT). Reed Switches are normally grouped in multiples of five ampere-turns within the stock ampere-turn range.

CUSTOM PRODUCTS

Gordos mercury switches, and custom products are produced by one manufacturing division with extensive experience in packaging its own products as well as Gordos magnetic reed switches. Together, these capabilities have permitted Gordos to provide applications engineering consultations, unique solutions, and custom products to leaders in the automotive, security, photocopy, and instrument industries for years.

FLUID LEVEL DETECTORS



DESIGN FEATURES

- Made from heat stabilized, glass filled nylon
- Switch rating up to 100 VA
- Normally open or normally closed action
- Easy to install
- Inexpensive
- Reed switch reliability

APPLICATIONS

- Low coolant level detection
- Fuel or oil level indication
- Boiler level control
- Chemical solution monitoring
- Domestic appliances

PART NUMBER

- FH4A-000 Metal nut; lead is .5 meters
- FH4A-003 Nylon nut; lead is .5 meters
- FH4A-004 Metal nut; specify lead length

OTHER PRODUCTS

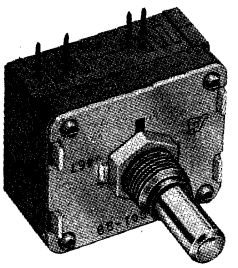
- Reed switch assemblies
- Mercury switch assemblies
- Reed relay assemblies
- Solid state relay assemblies
- Bus compatible I/O Interface Cards
- Proximity sensors

STANDARD GRIGSBY

SUB-MINIATURE P/REL

A GORDOS INTERNATIONAL Company

SUBMINIATURE PROGRAMMABLE ROTARY ENCODED LOGIC SWITCH



NOW AVAILABLE THROUGH YOUR LOCAL GORDOS AUTHORIZED DISTRIBUTOR

- Make before break
- Printed circuit or solder terminals
- Adjustable stop at the rear is available (please specify)

The compact subminiature programmable rotary encoded logic switch (P/REL) is now available in 16 and 32 position binary or gray code.

DUAL FLEX™ DETENT

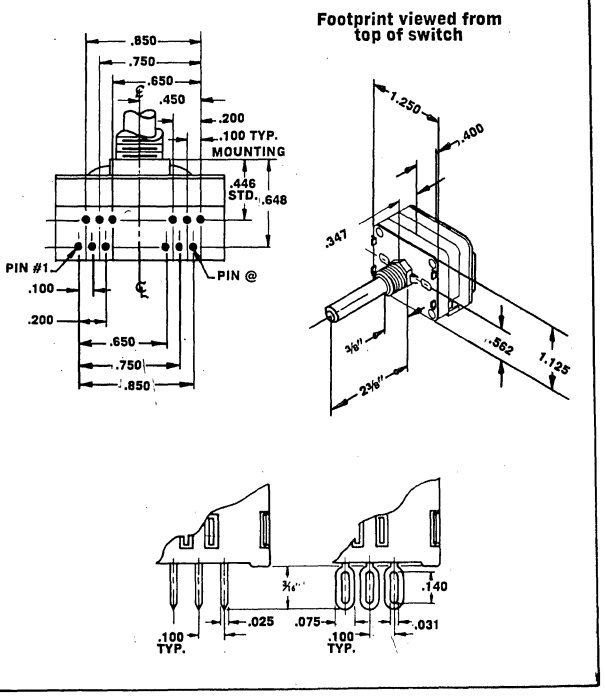
The Dual Flex detent has a dual ball starwheel drive to provide positive indexing and longer life, tactile feedback and resistance to teasing.

ELECTRICAL RATINGS

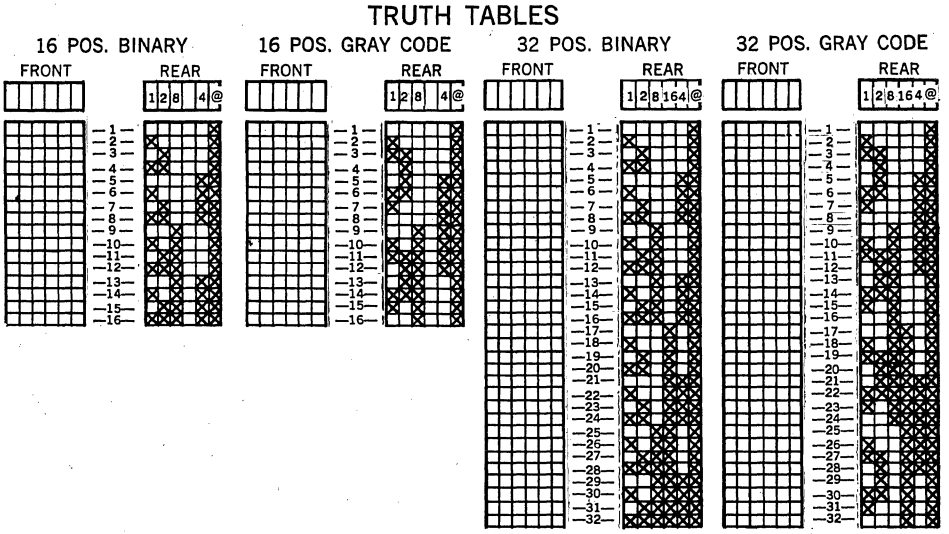
Current Carrying Capacity — .25 amp
Resistive Load Switching — .125 amp @ 115 AC
Contact Resistance — initial 0.1 ohm maximum
Insulation Resistance — 100 megohms
Dielectric Strength — 500 VAC minimum
Contact Life — 25K cycles of 720° minimum (50K cycles of 360° minimum)
Operating Force — 14 to 24 inch oz. standard
Temperature Ranges — −55°C to +85°C
Insulation — Molded Valox 310
Programmable Disc — Plated copper clad laminate
Contacts — Plated spring tempered material
Front Plate and Shaft — Cold rolled steel cadmium plated
Bushing — Die cast zinc or aluminum

Part Number	Description
D001-16-BP	16 Position Binary — P.C. Pins
D002-16-BS	16 Position Binary — Solder Lugs
D003-16-GP	16 Position Gray Code — P.C. Pins
D004-16-GS	16 Position Gray Code — Solder Lugs
D005-32-BP	32 Position Binary — P.C. Pins
D006-32-BS	32 Position Binary — Solder Lugs
D007-32-GP	32 Position Gray Code — P.C. Pins
D008-32-GS	32 Position Gray Code — Solder Lugs

OUTLINE DIMENSIONS



TRUTH TABLES

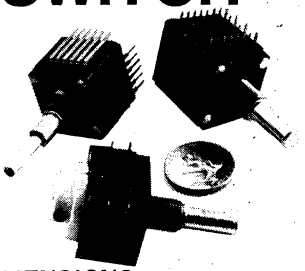


STANDARD GRIGSBY

MICROMINIATURE P/REL

A GORDOS INTERNATIONAL Company

MICROMINIATURE P/REL PROGRAMMABLE ROTARY ENCODED LOGIC SWITCH



DUAL FLEX™ DETENT

The Dual Flex detent has a dual ball starwheel drive to provide positive indexing and longer life, tactile feedback and resistance to teasing.

ELECTRICAL RATINGS

Current Carrying Capacity — 250 milliamps at 28 VDC resistive load
Contact Resistance — 75 milliohms max. over lifetime
Codes — Hexidecimal, B.C.D., and others
Dielectric Strength — 1,000 volts min.

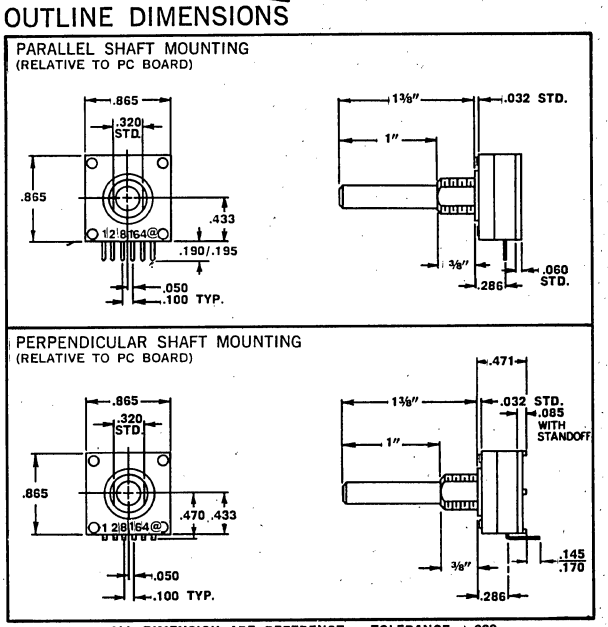
MECHANICAL SPECIFICATIONS

Life — 50,000 cycles min.
Operating Temperature Range — −55°C to +85°C
Shafts and Hardware — Shafts and hardware are steel, cadmium plated and chromate treated
Anti-Rotation Device — Flatted mounting bushing. .375" dia. x .320", double "D"

Part Number	Description
D101-08-BH	8 position Binary parallel shaft mounting
D102-08-CH	8 position Binary complement parallel shaft mounting
D103-08-BV	8 position Binary perpendicular shaft mounting
D104-08-CV	8 position Binary complement perpendicular shaft mounting
D105-10-BH	10 position Binary parallel shaft mounting
D106-10-CH	10 position Binary complement parallel shaft mounting
D107-10-BV	10 position Binary perpendicular shaft mounting
D108-10-CV	10 position Binary complement perpendicular shaft mounting
D109-12-BH	12 position Binary parallel shaft mounting
D110-12-CH	12 position Binary complement parallel shaft mounting
D111-12-BV	12 position Binary perpendicular shaft mounting
D112-12-CV	12 position Binary complement perpendicular shaft mounting
D113-16-BH	16 position Binary parallel shaft mounting
D114-16-CH	16 position Binary complement parallel shaft mounting
D115-16-BV	16 position Binary perpendicular shaft mounting
D116-16-CV	16 position Binary complement perpendicular shaft mounting
D117-18-BH	18 position Binary parallel shaft mounting
D118-18-CH	18 position Binary complement parallel shaft mounting
D119-18-BV	18 position Binary perpendicular shaft mounting
D120-18-CV	18 position Binary complement perpendicular shaft mounting
D121-20-BH	20 position Binary parallel shaft mounting
D122-20-CH	20 position Binary complement parallel shaft mounting
D123-20-BV	20 position Binary perpendicular shaft mounting
D124-20-CV	20 position Binary complement perpendicular shaft mounting
D125-24-BH	24 position Binary parallel shaft mounting
D126-24-CH	24 position Binary complement parallel shaft mounting
D127-24-BV	24 position Binary perpendicular shaft mounting
D128-24-CV	24 position Binary complement perpendicular shaft mounting
D129-28-BH	28 position Binary parallel shaft mounting
D130-28-CH	28 position Binary complement parallel shaft mounting
D131-28-BV	28 position Binary perpendicular shaft mounting
D132-28-CV	28 position Binary complement perpendicular shaft mounting

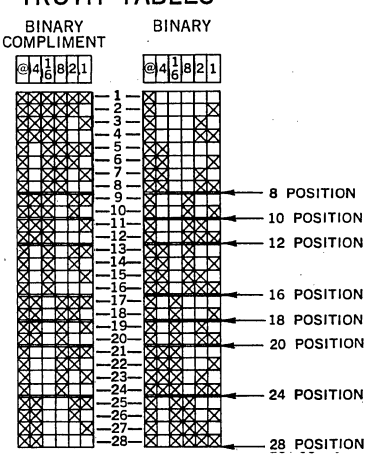
Note: All switches are continuous rotation.

OUTLINE DIMENSIONS



ALL DIMENSION ARE REFERENCE ... TOLERANCE ±.020.

TRUTH TABLES



D101 - 08 - B H

Part number

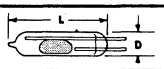
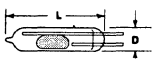
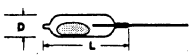
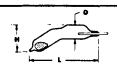
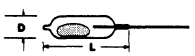
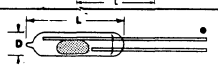
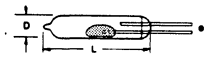
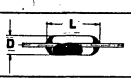
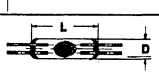
Positions

H = Parallel shaft mounting
V = Perpendicular shaft mounting

B = Binary
C = Binary complement

GORDOS CORPORATION

MERCURY TILT SWITCHES

	Switch Part No.	Contact Arrangement	AC Resistive Switching Current Ratings			Differential Angle Degrees		Inches (Millimeters)			Type of Contact*	Standard Mounting Clip Part No.	Remarks
			30	115	220	Max.	Min.	D	L	H			
	HG 213 LO	SPST	.3	.1	.05	5°	Typ 1°	.175 (4.45)	7/8" (22.23)	—	MDM	M-539	Low Angle
	HG 225 LO	SPST	.3	.1	.05	10°	—	.175 (4.45)	7/8" (22.23)	—	MWM	M-539	Platinum & Platinum Tipped Electrodes
	HG 251 LO	SPST	3	1	.5	2°	—	.325 (8.26)	1" (25.40)	—	MDM	M-514	Low Angle General Purpose Switch
	HG 252 LO	SPST	4	2	1	14°	—	.325 (8.26)	1" (25.40)	—	MWM	M-514	General Purpose Switch
	HG 259 LO	SPST	4	2	1	35°	25°	.325 (8.26)	1.187 (30.1)	.500 (12.7)	MDM	M-514	High Differential Angle
	HG 455 LO	SPST	15	10	4	5°	—	.435 (11.05)	1 1/16" (25.40)	—	MDM	M-59	Small 10A Switch
	HG 457 LO	SPST	20	10	5	32.5°	27.5°	.446 (11.30)	2.25 (57.15)	.875 (22.23)	MDM	M-56	High Differential Angle
	HG 520 LO	SPST	25	.1	.05	10°	—	.155 (3.94)	1/2" (12.70)	—	MDM	M-539	Precision Switch Subminiature
	HG 805 LO	SPST	1	.2	.1	1.4°	Typ 1°	.325 (8.26)	1 3/8" (34.93)	—	MWM	M-514	Thermostat Control Switch
	HG 2703	SPST	—	.5	—	—	15°	.22 (5.6)	.63 (16.0)	—	MDM	—	General Purpose Miniature
	HG 3703	SPST	—	—	1	—	10°	.30 (7.5)	.69 (17.5)	—	MDM	—	General Purpose Miniature
	HG 3704	SPST	—	—	.5	—	15°	.30 (7.5)	.69 (17.5)	—	MWM	—	Low Switching Voltages
	HG 3803	SPST	—	—	2	—	15°	(.30) (7.5)	.73 (18.5)	—	MDM	—	General Purpose Miniature
	HG 3903	SPDT	—	—	1	—	15°	.30 (7.5)	.91 (23.0)	—	MDM	—	Miniature SPDT
	HG 4703	SPST	—	—	2	—	15°	.37 (9.5)	.87 (22.0)	—	MDM	—	High Power

* Type of contact: **MWM** — Mercury to Wet Metal. **MDM** — Mercury to Dry Metal.

CUSTOM PRODUCTS

Gordos mercury switches, and custom products are produced by one manufacturing division with extensive experience in packaging its own products as well as Gordos magnetic reed switches. Together, these capabilities have permitted Gordos to provide applications engineering consultations, unique solutions, and custom products to leaders in the automotive, security, photocopy, and instrument industries for years.

GENERAL TECHNICAL DATA AND RELATED INFORMATION

General Features
The **"Green Devil"** line of mercury tilt switches feature silent operation, excellent bounce-free switching characteristics, and small size. Due to the fact that they are automatically produced in large volumes, their **cost is significantly less** than other techniques of tilt angle detection. The mercury switching medium is sealed in an inert atmosphere and has proven its reliability in millions of applications.

Differential Angle
The **differential angle** is measured from the position "just closed." It is the tilt angle required in order to move the mercury away from the electrodes so that the position "just opened" is achieved.

The **operating angle**, i.e. the angle by which the switch has to be tilted in order to assure operation, always has to be relatively larger. In general, 1.5 to 2 times the differential angle is sufficient.

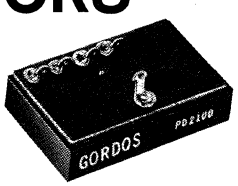
Contact Forms
Depending on the starting position, all switches with the exception of type **HG 3903**, can be used as normally open (Form A) or normally closed (Form B). Switch type **HG 3903** is a single pole — double throw (Form C).

Connecting Leads and Encapsulated Switches
The standard switches specified above have no connecting leads or wires — other than the terminals shown. However, all switches can be supplied with connecting leads as per customer specification. Highly flexible connecting leads with PVC insulation or any other suitable wire can be used. Our mercury switches normally require no further encapsulating. However, customer assembly procedures and methods will sometimes require protection of the glass body. In these cases we design and produce switches built into **metal** or **plastic tubes** and encapsulated with an **epoxy resin.**

Our engineers are ready to answer any questions you may have regarding the application or the installation of our Mercuty Tilt Switches.

LEVEL SENSORS

FOR ABSOLUTE LEVEL DETECTION OF RECREATIONAL VEHICLES, MOBILE HOMES, X-RAY TABLES, APPLIANCE INSTALLATIONS AND ANY OTHER APPLICATION WHERE LEVELING IS CRITICAL



Gordos mercury actuated sensors are compact; plastic encapsulated for complete environmental immunity; and exhibit all the qualities of fine instruments.

Consisting of a series of sensitive mercury tilt switches, these devices accurately reflect tilt or out of level conditions in 2 or 4 directions.

Three models permit a wide range of applications; the PD2100 and 2105 are one amp devices with sensitivities of less than 2°; the PD2110 will switch up to 10A.

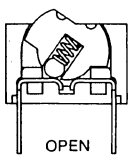
GORDOS CORPORATION/250 GLENWOOD AVE., BLOOMFIELD, NJ 07003 USA/TELEPHONE (201) 743-6800/TWX: 710-994-4787

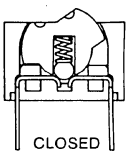
Grayhill INC.

DIP Switches

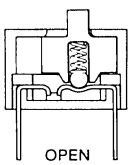
Another Difference from the Different DIP Switch Company . . .

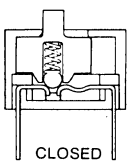
Exclusive Contact System:





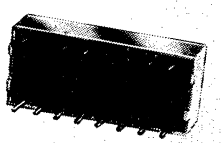
- Now available in Rockers *AND* Slide Actuators





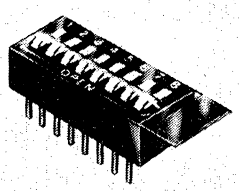
Unique spring-loaded ball contact system provides high contact pressure for reliable contact and shock and vibration immunity. It also provides exceptional mechanical and electrical life.

Complete Seal



After being wave soldered, your printed circuit boards can be vapor, spray or immersion cleaned without damaging switch contacts.

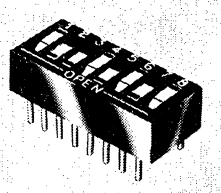
- Epoxy Potted Bottom Is Standard
- Top Seal Available At Minimum Additional Price



Military Qualified

Another difference from the different DIP Switch Company . . . Grayhill SPST Rocker DIP Switches are qualified to military specifications MS83504/1 and MS83504/2.

And more . . .



Grayhill can also provide position location markings, rigid protective covers, and cards of tape seal. Contact Grayhill.

Specifications—Series 76 and 78

For Series 79 Specifications, see Binary Code DIP Switch page.

RATING

Mechanical Life: (Operations per position): For Series 76—50,000; for Series 78—35,000.

Make and Break Current Rating: At 50 mA and 30 VDC, Series 76 Switches—35,000 operations; Series 78 Switches—25,000 operations. At 125 mA and 30 VDC, Series 76 Switches—25,000 operations; Series 78 Switches—15,000 operations.

Contact Resistance: 100 Milliohms Maximum after life (30 Milliohms initially), measured at 10 mA DC and 50 mV (open circuit).

Insulation Resistance: (at 100 VDC): Between Adjacent Closed Contacts: 1,000 Megohms Minimum after life, (5,000 Megohms initially). Across Open Switch Contacts: 1,000 Megohms Minimum after life, (5,000 Megohms initially).

Dielectric Strength: Between Adjacent Closed Contacts: 500 VAC after life (750 VAC initially). Across Open Switch Contacts: 500 VAC after life (750 VAC initially).

Current Carry Rating: With a maximum contact temperature rise of 20°C.: Series 78—5 Amps; Series 78—4 Amps.

MATERIALS AND FINISHES

Switch Cover, Rocker and Base: Polyester.

Shorting Bar (Ball): Brass, Gold plated .00001″ minimum over Nickel plate.

Base Contacts: Brass, Gold plated .00001″ minimum over Nickel plate.

Terminals: Brass, Tin plated .00005″ minimum over Nickel plate.

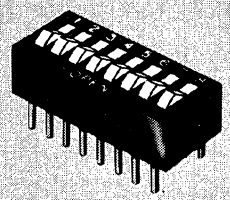
Potting Material: Epoxy.

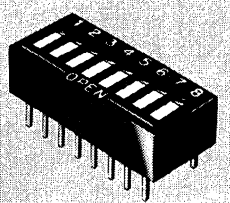
Optional Contact Plating: Gold thicknesses of .00003″ and .0001″ are also available on Series 78 Switches.

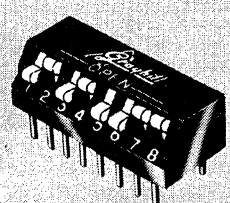
Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Grayhill INC.

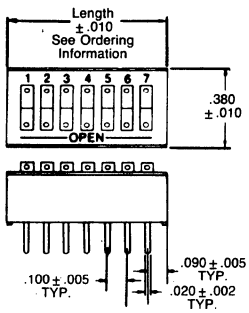
SPST Rocker DIP Switches—Series 76





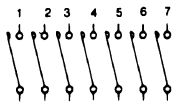


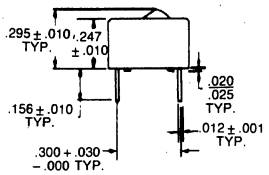
Raised and Recessed Rockers



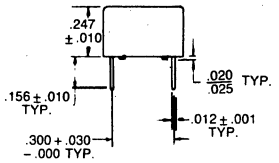
Typical Circuit Diagram

As viewed from top of switch.



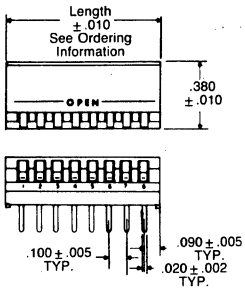


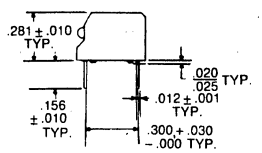
End view recessed rocker



Side Actuated The PIANO-DIP®

- Edge Mounting Provides Easy Access On Closely Racked PC Boards





ORDERING INFORMATION

Raised and Recessed Rockers

No. of Rockers	Length	Part No. Raised	Part No. Recessed	Unit Price
2	0.280	76SB02	76RSB02	$2.90
3	0.380	76SB03	76RSB03	3.00
4	0.480	76SB04	76RSB04	3.10
5	0.580	76SB05	76RSB05	3.20
6	0.680	76SB06	76RSB06	3.30
7	0.780	76SB07	76RSB07	3.35
8	0.880	76SB08	76RSB08	3.45
9	0.980	76SB09	76RSB09	3.55
10	1.080	76SB10	76RSB10	3.60
12	1.280	76SB12	76RSB12	3.80

Military Qualified

Military Number*	Grayhill Number	Military Number*	Grayhill Number	Unit Price
M83504/01-022	76MSB02	M83504/02-022	76MRSB02	$3.20
M83504/01-023	76MSB03	M83504/02-023	76MRSB03	3.30
M83504/01-024	76MSB04	M83504/02-024	76MRSB04	3.40
M83504/01-025	76MSB05	M83504/02-025	76MRSB05	3.50
M83504/01-026	76MSB06	M83504/02-026	76MRSB06	3.60
M83504/01-027	76MSB07	M83504/02-027	76MRSB07	3.65
M83504/01-028	76MSB08	M83504/02-028	76MRSB08	3.75
M83504/01-029	76MSB09	M83504/02-029	76MRSB09	3.85
M83504/01-030	76MSB10	M83504/02-030	76MRSB10	3.90
M83504/01-032	76MSB12	M83504/02-032	76MRSB12	4.10

To order top tape sealed switch, add suffix "S" to Grayhill part number (or "T" to Military Number); add $0.20 to unit price, and discount accordingly.

Contact GRAYHILL for information and prices on switches with the following Military Numbers: M83504/01-002 thru M83504/01-010, and M83504/02-002 thru M83504/02-010.

PIANO-DIP®

No. of Stations	Length	Part No. Sealed Bottom Only	Unit Price
4	0.480	76PSB04	$3.65
5	0.580	76PSB05	3.70
6	0.680	76PSB06	3.80
7	0.780	76PSB07	3.90
8	0.880	76PSB08	3.95
9	0.980	76PSB09	4.10
10	1.080	76PSB10	4.25

To order top tape seal, add suffix "S" to part number, add $0.30 to unit price and discount accordingly.

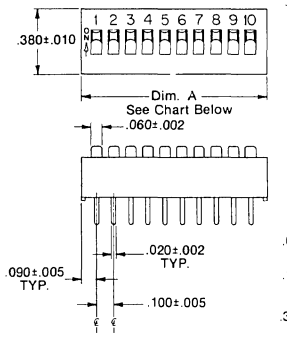
Discount Schedule

	Part Numbers 76SB, 76RSB 76MSB, 76MRSB	76PSB
1-9	Unit Price	Unit Price
10-24	Less 8%	Less 8%
25-49	Less 21%	Less 16%
50-99	Less 40%	Less 21%
100-499	Less 50%	Less 30%
500-999	Less 57%	Less 40%
1000 Up	Contact Your Local Distributor or Grayhill	

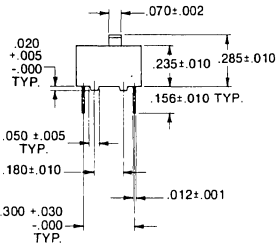
Prices and Discounts subject to change without notice.

Single Throw Slide DIP Switches—Series 78

Single Pole/Single Throw

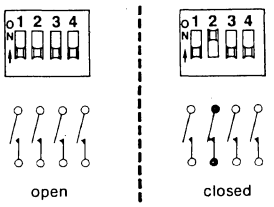


Drawing shown for raised slide actuator. For recessed actuator, eliminate projection above top surface and .060, .070 and .285 dimensions.

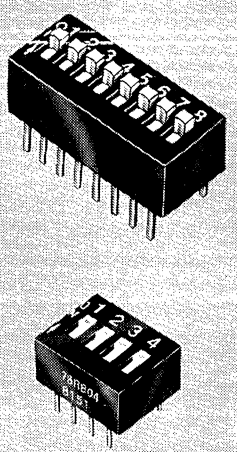


Typical Circuit Diagram

As viewed from top of switch.

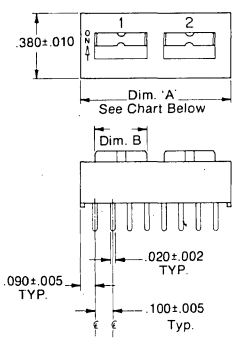


● indicates closed contact
○ indicates open contact

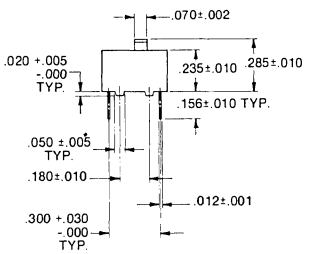


Two, Three, and Four Pole/Single Throw

Drawings show a 4PST switch; dimensions also apply to 2PST and 3PST switches.

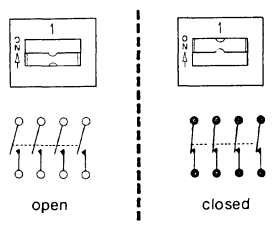


Dimension B is .100 for 2PST, .200 for 3PST, and .300 for 4PST; all at ±.002 tolerance.



Typical Circuit Diagram

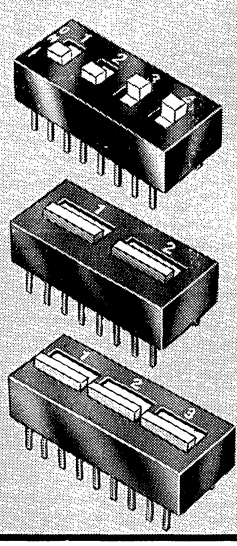
As viewed from top of switch



● indicates closed contact
○ indicates open contact

Circuitry diagrams shown are for 4PST. Circuitry is achieved in a similar fashion for 2PST and 3PST switches.

Note: Some switches of an earlier production version have externally tied actuators; drawings and dimensions may be found in Bulletin Number 328—contact GRAYHILL.



ORDERING INFORMATION

Last 2 digits in part number indicate number of stations in switch.

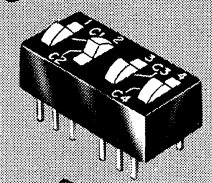
SPST Standard			SPST Raised Slide—Military			DPST		3PST		4 PST		
Part No. Raised	Part No. Recessed	Unit Price	Grayhill Part No.	Military Part No.	Unit Price	Part No.	Unit Price	Part No.	Unit Price	Part No.	Unit Price	Dim. A Length
78B02	78RB02	$2.61	78M02	M83504/04-022	$2.91	78F01	$3.56	–	–	–	–	.280
78B03	78RB03	2.70	78M03	M83504/04-023	3.00	–	–	78G01	3.74	–	–	.380
78B04	78RB04	2.79	78M04	M83504/04-024	3.09	78F02	3.78	–	–	78H01	3.78	.480
78B05	78RB05	2.88	78M05	M83504/04-025	3.18	–	–	–	–	–	–	.580
78B06	78RB06	2.97	78M06	M83504/04-026	3.27	78F03	3.96	78G02	3.96	–	–	.680
78B07	78RB07	3.02	78M07	M83504/04-027	3.32	–	–	–	–	–	–	.780
78B08	78RB08	3.11	78M08	M83504/04-028	3.41	78F04	4.19	–	–	78H02	4.19	.880
78B09	78RB09	3.20	78M09	M83504/04-029	3.50	–	–	78G03	4.23	–	–	.980
78B10	78RB10	3.24	78M10	M83504/04-030	3.54	78F05	4.37	–	–	–	–	1.080

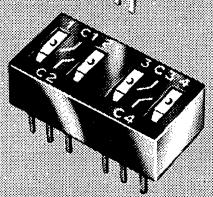
For top seal versions, add the suffix "S" to part number; add $0.20 to unit price and discount accordingly.

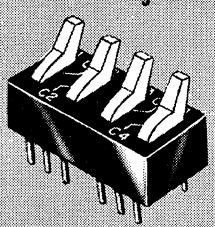
Discounts are the same as those indicated for 76SB at left.

Available Locally Through Your Grayhill Distributor

Grayhill INC.





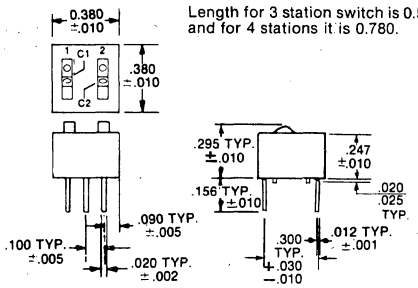


SPDT DIP Switches

Rockers and Toggles—Series 76

The DIP-C™

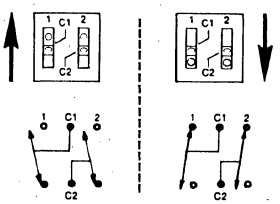
True Form "C" Switching.



Length for 3 station switch is 0.580 and for 4 stations it is 0.780.

Typical Circuit Diagram

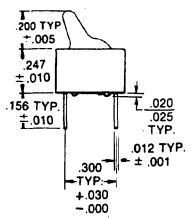
As viewed from top of switch



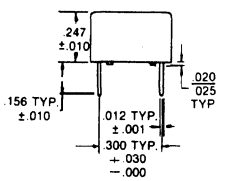
● indicates closed contact
○ indicates open contact

The TOGGLE-DIP™

For easy actuation in front panel applications.

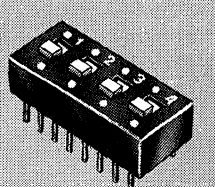


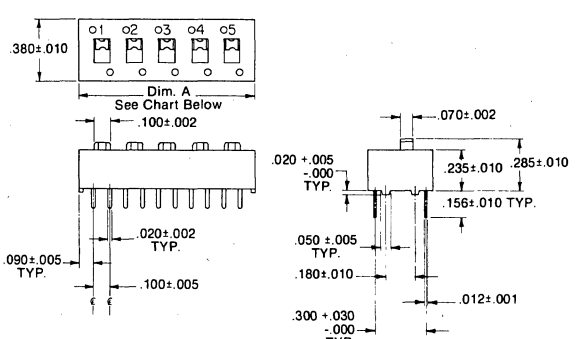
End view recessed rocker



Slide Actuated—Series 78

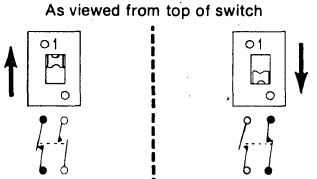
All Series 78 double throw switches have alternately opposed circuits which are actually 2 completely separate circuit paths. A single slide actuates both circuits thus providing double throw. True double-throw circuitry is achieved by tying selected terminals on the PC board for a common. The "on" position of each circuit is indicated by a dot on the cover. Note: Some switches of an earlier production version have externally tied actuators; drawings and dimensions may be found in Bulletin Number 328—contact Grayhill.





Typical Circuit Diagram

As viewed from top of switch



● indicates closed circuit
○ indicates open circuit

ORDERING INFORMATION

Rockers and Toggles

No. of Rockers	THE DIP-C Raised Part No.	THE DIP-C Recessed Part No.	TOGGLE-DIP Part No.	Unit Price
2	76SC02	76RSC02	76STC02	$3.70
3	76SC03	76RSC03	76STC03	3.95
4	76SC04	76RSC04	76STC04	4.20

Slide Actuated Switches

No. of Stations	Part No.	Price	Dim. A Length
1	78J01	$4.41	.280
2	78J02	4.59	.480
3	78J03	4.82	.680
4	78J04	5.04	.880
5	78J05	6.30	1.080

For Discount Schedule See Next Page

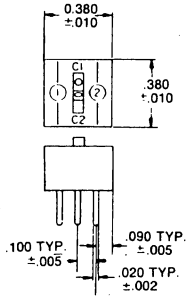
To order top seal versions, add suffix "S" to part number (not available on TOGGLE-DIP), add $0.20 to unit price, and discount accordingly.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

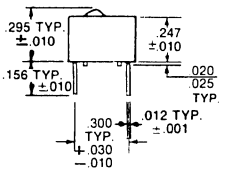
DPDT DIP Switches

Rockers and Toggles—Series 76

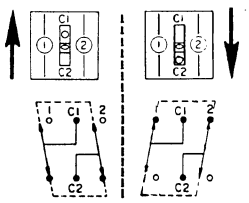
The DOUBLE-DIP™



Length of 2 station switch is 0.780

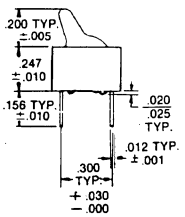


Typical Circuit Diagram
As viewed from top of switch

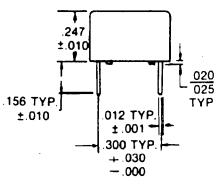


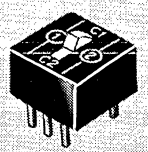
● indicates closed contact
○ indicates open contact

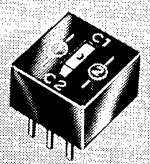
The TOGGLE DIP™

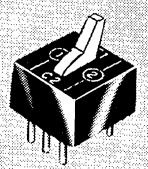


End view recessed rocker



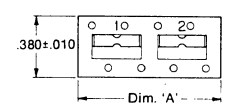




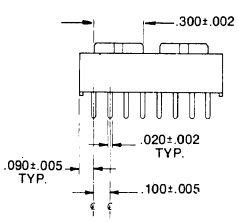


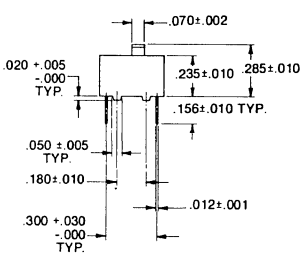
Slide Actuated—Series 78

All Series 78 double throw switches have alternately opposed circuits which are actually 2 completely separate circuit paths. A single slide actuates both circuits thus providing double throw. True double-throw circuitry is achieved by tying selected terminals on the PC board for a common. The "on" position of each circuit is indicated by a dot on the cover. Note: Some switches of an earlier production version have externally tied actuators; drawings and dimensions may be found in Bulletin Number 328—contact Grayhill.

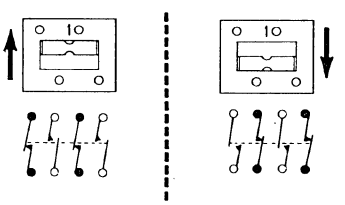


Dimension A is 0.480 for 1 station and 0.880 for 2 stations.

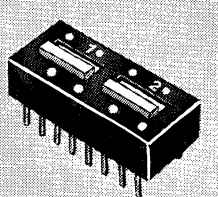




Typical Circuit Diagram
As viewed from top of switch



● indicates closed circuit
○ indicates open circuit



ORDERING INFORMATION

The DOUBLE DIP™			TOGGLE-DIP™		Slide Actuated	
No. of Rockers	Raised Part No.	Recessed Part No.	Part No.	Unit Price	Part No.	Price
1	76SD01	76RSD01	76STD01	$3.80	78K01	$6.48
2	76SD02	76RSD02	76STD02	4.30	78K02	7.02

To order top seal versions, add suffix "S" to part number (not available on TOGGLE-DIP), add $0.20 to unit price, and discount accordingly.

Discount Schedule

	Series 76	Series 78
1-9	Unit Price	Unit Price
10-24	Less 8%	Less 8%
25-49	Less 16%	Less 21%
50-99	Less 21%	Less 40%
100-499	Less 30%	Less 50%
500-999	Less 35%	Less 57%
1000 Up	Contact Grayhill	

Prices and discounts subject to change without notice.

Available Locally Through Your Grayhill Distributor

Grayhill INC

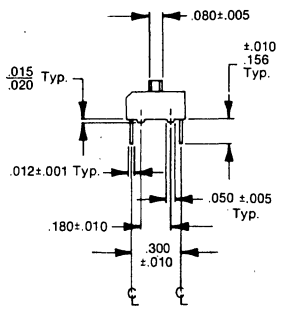
Linear Action DIP Switches

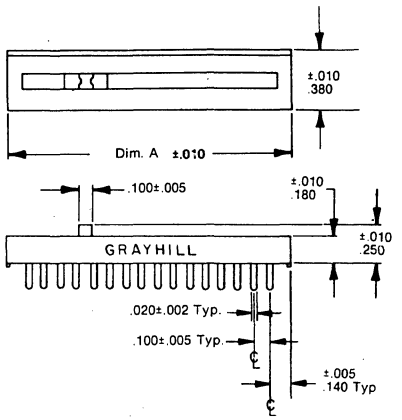
Tap Switches

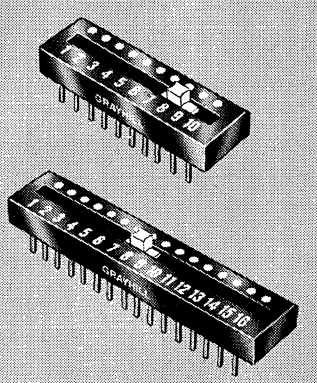
- Single Setting for Accurate Programming
- Choice of Isolated Circuits or Common Bus
- Choice of 10 or 16 Positions

Dimensions

Note: Drawing shows a 16 position switch, but dimensions also apply to a 10 position switch. Dimension A for 16 positions is 1.780", and for 10 positions it is 1.180".







1-of-10 Circuits Switch, and 1-of-16 Circuits Switch

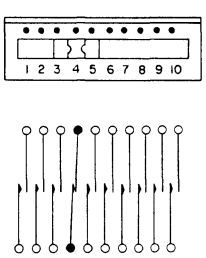
Isolated Circuits

Each position is a single isolated circuit, and is so indicated by the single dot above each position. The moveable contact is non-shorting.

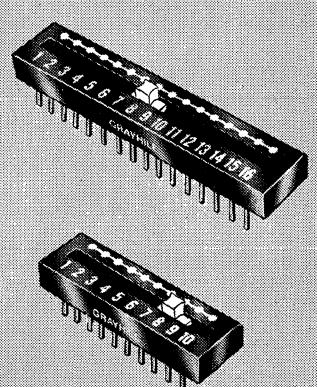
See next page for specifications and prices.

1-of-10 circuits ..... Part No. 79A10
1-of-16 circuits ..... Part No. 79A16

Typical Circuit Diagram



● indicates closed contact
O indicates open contact



SP/10 Position Tap Switch SP/16 Position Tap Switch

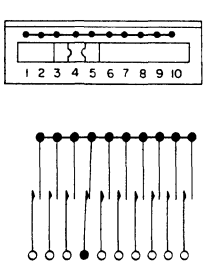
Common Bus

Moveable contact is non-shorting. All contacts on the side marked by connected dots are internally bussed for a common pole. Any terminal on that side may be selected as a common. If so desired, other terminals on that side may be clipped. The bussed contacts are indicated by dots and connecting line.

See next page for specifications and price.

SP/10 Position ..... Part No. 79C10
SP/16 Position ..... Part No. 79C16

Typical Circuit Diagram



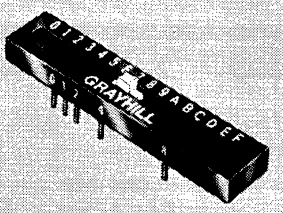
● indicates closed contact
O indicates open contact

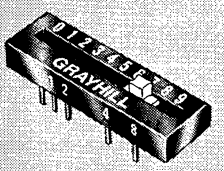
Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Binary Code DIP Switches

BCD and Hexadecimal Code Switches

- Includes "O" Output
- Reliable Switching
- 1000 Cycle Life—32,000 Detent Operations

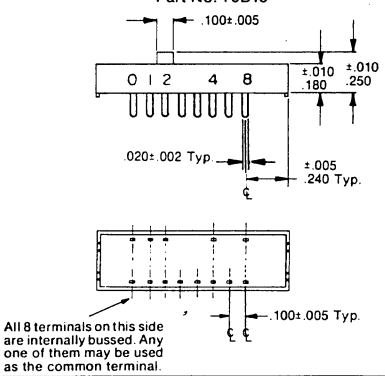




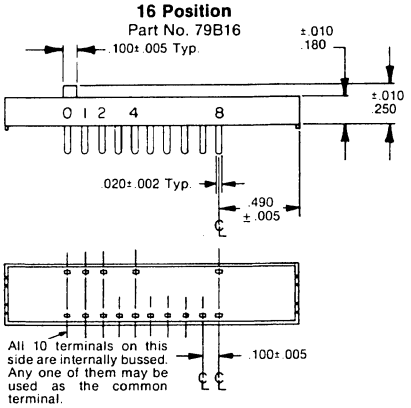
Dimensions

For complete dimensions see additional views on facing page.

10 Position
Part No. 79B10



16 Position
Part No. 79B16



Specifications

Ratings

Mechanical Life: 2,000 cycles minimum. Note: A cycle is one complete operation, back and forth thru all switch positions.

Make and Break Current Rating; 2,000 cycles at 10 mA, 30 mV DC; 1,000 cycles at 25 mA, 6 VDC; 1,000 cycles at 50 mA, 30 VDC.

Contact Resistance: 100 milliohms maximum after life, measured at 10 mA DC and 50 mV (open circuit). Initial values are 60 milliohms maximum for coded switches, and 50 milliohms for other Linear Action Switches.

Insulation Resistance (At 100 VDC): Between adjacent isolated contacts—1,000 Megohms minimum after life; (5,000 Megohms initially). Between adjacent open contacts 1,000 Megohms minimum after life. (5,000 Megohms initially).

Dielectric Strength Between adjacent isolated contacts: 500 VAC after life, (750 VAC initially). Across open contacts: 500 VAC after life, (750 VAC initially).

Current Carry Rating: 2 Amps with a maximum contact temperature rise of 20° C.

Note: These specifications are based on preliminary testing; additional ratings and test information are available upon request.

Materials and Finishes

Switch Cover, Slide, Base: Polyester, 94 VO rating.

Shorting Arm: Phosphor Bronze, Gold plated .00001 minimum over Nickel plated .00002 minimum.

Base Contacts: Brass, Gold plated .00001 minimum over Nickel plated .00002 minimum.

Terminals: Brass, Tin plated .00005 minimum over Nickel plated .00002 minimum.

Potting Material: Epoxy.

Code & Truth Table

BINARY CODES		16					10				
POSITIONS	0	●					●				
	1		●					●			
	2			●					●		
	3		●	●				●	●		
	4				●					●	
	5		●		●			●		●	
	6			●	●				●	●	
	7		●	●	●			●	●	●	
	8					●					●
	9		●			●		●			●
	A			●		●					
	B		●	●		●					
	C				●	●					
	D		●		●	●					
	E			●	●	●					
	F		●	●	●	●					
		0	1	2	4	8	0	1	2	4	8
TERMINAL LOCATIONS											

Ordering Information

Circuitry	Part Number	Unit Price
1-of-10 Circuits	79A10	$4.00
1-of-16 Circuits	79A16	4.65
Binary Code-10	79B10	4.00
Binary Code-16 (Hexadecimal)	79B16	4.65
SP/10 Position Tap	79C10	4.00
SP/16 Position Tap	79C16	4.65

Discount Schedule

1-9	Unit Price
10-24	8%
25-49	16%
50-99	21%
100-499	30%
500-999	35%

Prices and Discounts Subject to Change Without Notice.

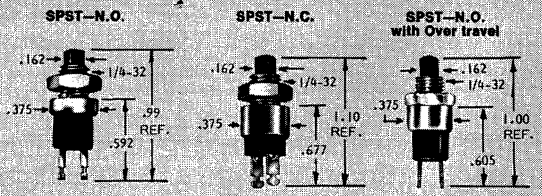
Available Locally Through Your Grayhill Distributor

Grayhill INC

Pushbutton Switches

1 Amp Butt Contact Pushbutton Switches

Life Expectancy — 1 Million Operations,
UL Listed Types Available



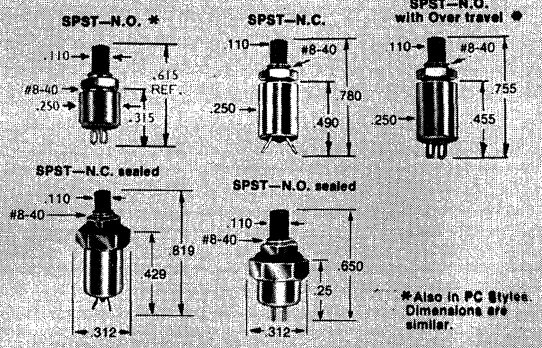
SPST—N.O.-Sealed
SPST—N.C.-Sealed
Dimensions approximately same as above.

RATING CRITERIA
Make and break 1 Amp

Part No.	Description	Circuitry	Operations at Rated Load	Part No.	Description		Operations at Rated Load
30-1	Momentary	SPST-N.O.	1,000,000	30-251	Sealed, SPST-N.O.		1,000,000
30-3				30-352	Sealed, SPST-N.C.		
30-2		SPST-N.C.	1,000,000	30-1UL	UL Listed	SPST-N.O.	6,000 at 5 Amp 115 VAC
30-6				30-3UL			
30-15	.020" Overtravel	SPST-N.O.	500,000	30-2UL		SPST-N.C.	
30-37				30-6UL			

1/4 Amp and 1/2 Amp Miniature Butt Contact Pushbutton Switches

Minimum of Space, Flux Cleaning Protection



*Also in PC Styles. Dimensions are similar.

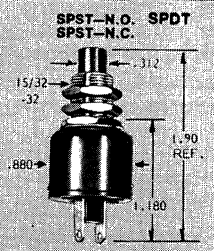
Part Number	Circuitry Momentary	Description	Operations at Rated Load	Rated Load
39-1	SPST—N.O.	Red Button	1,000,000	1/2 Amp, 115 VAC
39-3		Black Button		
39-601		Silver Contacts		150 mA, 5 VDC (20 mA, 20 VDC)
39-401		PC Mount		150 mA, 28 VDC
39-405		PC, No Nut		
39-351		Sealed	100,000	1/2 Amp, 115 VAC
39-12	SPST—N.O. .130" Overtravel	Red Button	100,000	1/2 Amp, 115 VAC
39-24		Black Button		
39-424		PC Mount	100,000	150 mA, 28 VDC
39-2	SPST—N.C.	Black Button	250,000	1/4 Amp, 115 VAC
39-352		Sealed	100,000	

See also Accessory Button Cap.

30102 ACCESSORY BUTTON CAP
Extends button surface to 0.25 dia. Available in Red, Black, Yellow or White. Adhesive required to mount. This cap fits 1 amp Butt Contact and part no. 39-1 and 39-2, 1/2 amp Miniature Butt contact switches.

10 Amp Snap Action Pushbutton Switches

Extremely Fast Make And Break, Audible Click
Life Expectancy—25,000 Operations



Make and break 10 Amp

Part No.	Circuitry Momentary Contact	Operations at Rated Load
2201	SPST-N.O.	25,000
7-7		

Make and break 10 Amp

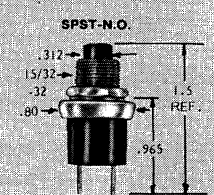
Part No.	Circuitry Momentary Contact	Operations at Rated Load
7-8	SPST-N.C.	25,000
2202		
7-26 RED	SPDT	25,000
7-26 BLK		

Common terminal of SPDT switch (not shown) extends overall length to 1.966.

10C105-1 BUTTON GUARD
Prevents Accidental Actuation 0.29 dia. by 0.41 deep. For 10 amp snap action, 1 amp wiping contact and DPST wiping contact switches.

1 Amp Wiping Contact Pushbutton Switches

Life Expectancy — 100,000 Operations,
UL Listed Types Available



7C1040-1 DECORATIVE MOUNTING NUT
77 Dia. .75 Across Flats and .12 Thick. For 10 amp snap action, 1 amp wiping contact and DPST wiping contact switches.

UNDERWRITERS LABORATORY LISTED

Make and break 1 Amp

Part No.	Action	Circuitry	Operations at Rated Load
4001	Momentary	SPST-N.O.	100,000
10-9			

Make and break 3 Amp

Part No.	Action	Circuitry	Operations at Rated Load
4001UL	Momentary	SPST-N.O.	6,000
10-9UL			

ORDERING INFORMATION

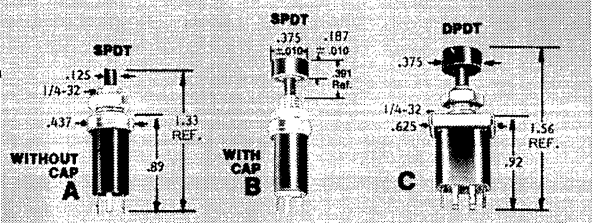
Part No.	Button Color	Unit Price	Part No.	Button Color	Unit Price	Part No.	Button Color	Unit Price	Part No.	Button Color	Unit Price	Part No.	Button Color	Unit Price
7-7	Blk	$5.88	30-1UL	Red	$1.47	30-251 RED	Red	$4.00	39-3	Blk	$2.21	39-405 RED	Red	$1.85
7-8	Red	6.30	30-2	Blk	1.65	30-251 BLK	Blk	4.00	39-12	Red	2.73	39-405 BLK	Blk	1.85
7-26 RED	Red	7.25	30-2UL	Blk	1.65	30-252 RED	Red	4.70	39-24	Blk	2.73	39-424 RED	Red	2.45
7-26	Blk	7.25	30-3	Blk	1.47	30-252 BLK	Blk	4.70	39-351 RED	Red	4.30	39-424 BLK	Blk	2.45
7C1040-1	—	0.32	30-3UL	Blk	1.47	30B1012-5	Red	0.23	39-351 BLK	Blk	4.30	39-601 RED	Red	1.60
10-9	Blk	2.05	30-6	Red	1.65	30B1012-8	Wht	0.23	39-352 RED	Red	4.95	39-601 BLK	Blk	1.60
10-9UL	Blk	2.05	30-6UL	Red	1.65	30B1012-9	Blk	0.23	39-352 BLK	Blk	4.95	2201	Red	5.88
10C1015-1	—	0.50	30-15	Red	1.83	39-1	Red	2.21	39-401 RED	Red	1.90	2202	Blk	6.30
30-1	Red	1.47	30-37	Blk	1.83	39-2	Blk	3.25	39-401 BLK	Blk	1.90	4001	Red	2.05
												4001UL	Red	2.05

For Discounts See Next Page.

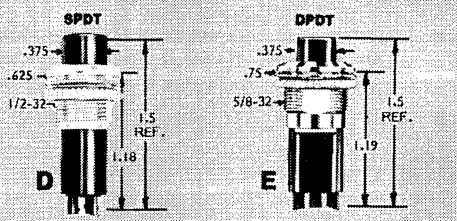
Pushbutton Switches

All Switches on this page and page at left have these qualifications . . .

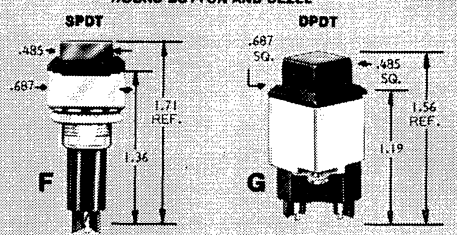
- **RATING CRITERIA:** See individual charts. 115 VAC resistive load.
- **CONTACT RESISTANCE:** 25 milliohms maximum on a new switch.
- **VOLTAGE BREAKDOWN:** 1,000 VAC between mutually insulated parts.
- **INSULATION RESISTANCE:** 1,000 megohms minimum.



DECORATIVE MOUNTING



ROUND BUTTON AND BEZEL



SQUARE BUTTON AND BEZEL

¼ Amp Wiping Contact Pushbutton Switches

Long Wipe Assures High Reliability With Life Expectancy To 250,000 Operations

Make and break ¼ Amp

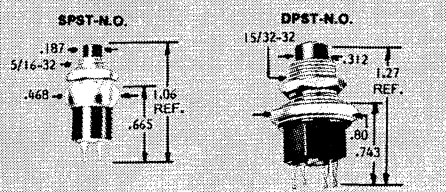
Part No.	Fig.	Momentary Circuitry	Operations at Rated Load
46-101 RED	A	SPDT	250,000
46-101 BLK			
46-102 RED(CAP)	B	SPDT	
46-102 BLK (CAP)			
46-200 RED	C	DPDT	250,000
46-200 BLK			

DECORATIVE Make and break ¼ Amp

Part No.	Fig.	Momentary Circuitry	Operations at Rated Load
46-05-05-502-0303	D	SPDT	250,000
46-05-05-502-0707			
46-05-08-502-0303	E	DPDT	
46-05-08-502-0707			
46-01-05-500-0303	F	SPDT	
46-01-05-500-0707			
46-01-08-500-0303	G	DPDT	
46-01-08-500-0707			

¼ Amp Wiping Contact Pushbutton Switches

Momentary Contact With Life Expectancy To 100,000 Operations



Make and break ¼ Amp

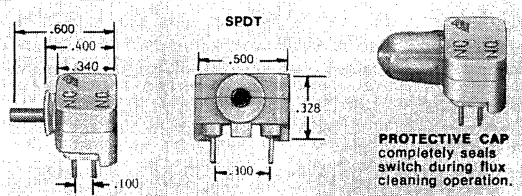
Part No.	Circuitry	Operations at Rated Load
23-1	SPST-N.O.	100,000
23-4		

Make and break ½ Amp

Part No.	Circuitry	Operations at Rated Load
35-1	DPST-N.O.	100,000
35-3		

PC Mount, ¼ Amp Butt Contact Switches

Side Actuated, PC Mounted, Sealed—500,000 Operations



Also available with .187 Diameter Flat Button.

Make and Break ¼ Amp

Part No.	Circuitry	Button
Switch With Protective Cap Assembled		
39-250 RED	SPDT (2 Circuits)	Small
39-250 BLK		
39-260 RED		.187 Dia.
39-260 BLK		Flat

Part No.	Circuitry	Button
Switch Without Protective Cap		
39-251 RED	SPDT (2 Circuits)	Small
39-251 BLK		
39-261 RED		.187 Dia.
39-261 BLK		Flat

ORDERING INFORMATION

Part No.	Button Color	Unit Price
23-1	Red	$2.00
23-4	Blk	2.00
35-1	Red	2.92
35-3	Blk	2.92

Protective Cap Only		
SHH1065	Red	0.10

Part No.	Button	Unit Price
39-250 RED	Small	$1.61
39-250 BLK		1.61
39-251 RED	Small	1.34
39-251 BLK		1.34
39-260 RED	Flat	1.61
39-260 BLK		1.61
39-261 RED	Flat	1.34
39-261 BLK		1.34

Part No.	Button Color	Unit Price
46-101 RED	Red	$2.15
46-101-BLK	Blk	2.15
46-102 RED(CAP)	Red	2.26
46-102 BLK (CAP)	Blk	2.26
46-200 RED	Red	4.57
46-200 BLK	Blk	4.57

Part No.	Button Color	Unit Price
46-05-05-502-0303	Red	$4.31
46-05-05-502-0707	Blk	4.31
46-05-08-502-0303	Red	5.71
46-05-08-502-0707	Blk	5.71
46-01-05-500-0303	Red	5.39
46-01-05-500-0707	Blk	5.39
46-01-08-500-0303	Red	6.79
46-01-08-500-0707	Blk	6.79

Discount Schedule

1-49 . . . . . Unit Price
50-99 . . . . . Less 15%
100-499 . . . . Less 25%
500-999 . . . . Less 36%
1000 UP Contact GRAYHILL

Prices and Discounts Subject to Change Without Notice.

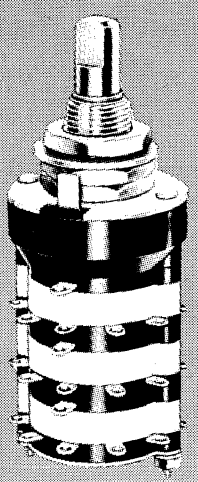
Available Locally Through Your Grayhill Distributor

Grayhill INC

1 Inch, 1 Amp, Rotary Switch

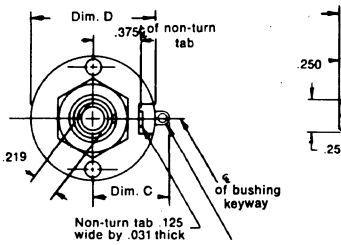
Our Most Popular Rotary Switch Family

- Available in standard and military styles
- Single or concentric shafts
- P.C. Mounting
- Add-a-pots
- Shaft and panel seals

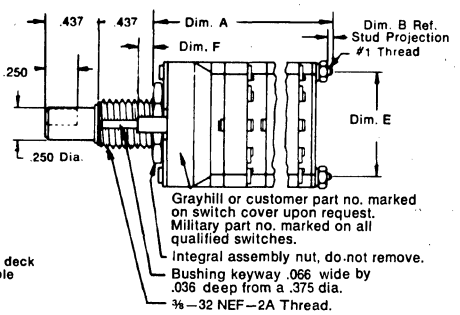


Standard
Or Military

DIMENSIONS



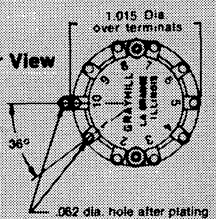
Common locations for a single pole per deck switch. For common location on multipole switches see circuit diagram.



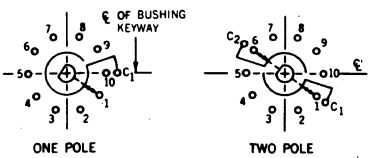
Grayhill or customer part no. marked on switch cover upon request. Military part no. marked on all qualified switches.
Integral assembly nut, do not remove.
Bushing keyway .066 wide by .036 deep from a .375 dia.
⅜—32 NEF—2A Thread.

Series 42
36° Angle of Throw

Rear View



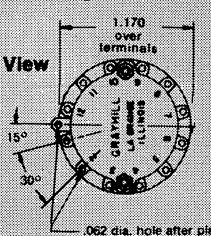
CIRCUIT DIAGRAMS

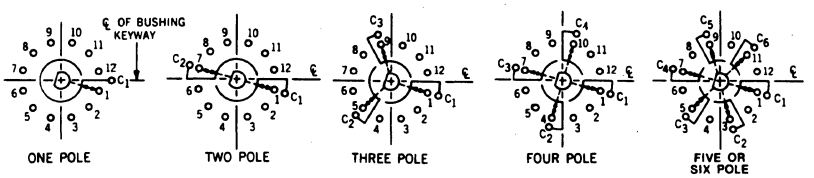


Dimensions	C	D	E	F
SERIES 42	.562	1,000	.830	.093
SERIES 44	.642	1,162	1.000	.121

Series 44
30° Angle of Throw

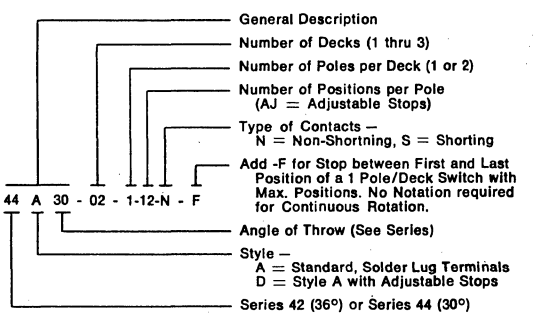
Rear View





ORDERING INFORMATION:

How to determine part number—Sample part number for a standard style, fixed stop, 2 deck, 1 pole per deck 12 positions per pole, 30° angle of throw rotary switch with non-shorting contacts.



For other angles of throw; 3 to 6 poles per deck; 4 thru 12 decks; military, sealed, UL listed, or PC mountable styles, contact factory.

Discount Schedule

1-9	Unit Price
10-24	Less 8%
25-49	Less 16%
50-99	Less 37%
100-499	Less 50%
500-UP	Contact your local distributor or Grayhill

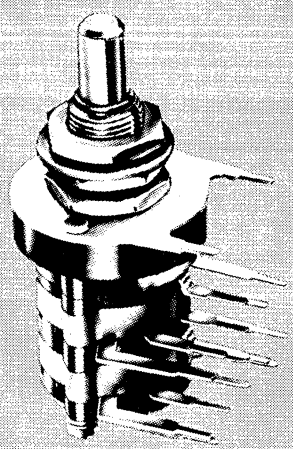
Prices and Discounts subject to change without notice.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

1 Inch, 1 Amp, Rotary Switch

With A Wide Range Of Variations And Options

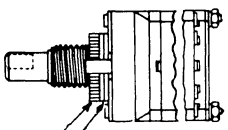
- 30°, 36°, 45°, or 90° angle of throw
- 1 thru 6 poles/deck
- 1 thru 12 decks
- Non-shorting or shorting contacts
- Adjustable stops (see below)



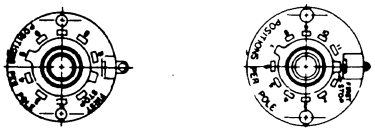
P.C. Mounting

ADJUSTABLE STOPS

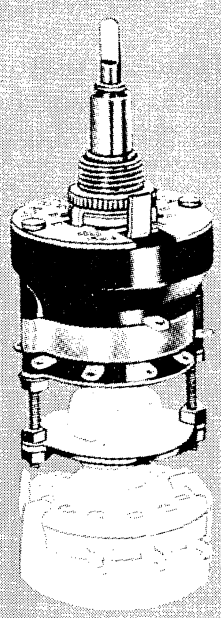
Adjustable stop switches permit the user to externally set the switch stops which limit its rotation. Adjustment is accomplished by removing the stop washers and relocating them. The knurled nut or the panel can be used to hold-in the stop washers. All other dimensions are the same as the standard style.



Adjustable stop washers.
Use of knurled nut is optional.



Series 44 is available with adjustable stops in 30° angle of throw only.



Add-A-Pot

SPECIFICATIONS

Rated: To make and break the following loads with 30° or 36° angle of throw: 1 amp., 115 VAC resistive; 1 amp., 6 to 28 VDC resistive; 0.25 amp., 115 VAC inductive; 0.02 amp., 115 VDC inductive; 0.10 amp., 6 to 28 VDC inductive; 0.10 amp., 115 VDC resistive. To carry 10 amps. continuously.

Contact Resistance: After 25,000 cycles of operation .020 ohms maximum.

Insulation Resistance: 50,000 megohms minimum (initially).

Voltage Breakdown: 1,000 VAC initially (500 VAC or better after most enviornmental tests).

Life Expectancy: 100,000 mechanical cycles of operation; details in catalog.

Stop Strength: 15 pound-inches standard, 12 pound-inches adjustable minimum.

Rotational Torque: 8-115 ounce-inches, depending on the number of poles per deck and the number of decks.

Contacts: Shorting or non-shorting wiping contacts with over 150 grams contact force.

Shaft Flat Orientation: Flat opposite contacting position of pole number one. (See circuit diagram.)

Specifications and circuit values for military styles along with additional characteristics available—contact Grayhill for complete engineering catalog.

PRICES

One Pole Per Deck — Fixed Stops

	SERIES 42A 36 AND 44A 30 (FIXED STOPS)									SERIES 44A 30	
No. of Decks	Number of Positions										
	2	3	4	5	6	7	8	9	10	11	12
1	$16.98	$17.35	$17.71	$18.08	$18.45	$18.82	$19.18	$19.55	$19.92	$20.29	$20.65
2	20.08	20.81	21.55	22.28	23.02	23.75	24.49	25.22	25.96	26.69	27.43
3	23.17	24.28	25.38	26.48	27.58	28.69	29.79	30.89	31.99	33.10	34.20

Two Poles Per Deck — Fixed Stops

SERIES 42A 36 AND 44A 30 (FIXED STOPS)					SERIES 44A 30
No. of Decks	Number of Positions				
	2	3	4	5	6
1	$18.57	$19.31	$20.04	$20.78	$21.51
2	23.27	24.74	26.21	27.68	29.15
3	27.96	30.17	32.37	34.58	36.78

Series 42 D 36 — Adjustable Stop

	No. of Positions	
No. of Decks	2-12 1 Pole	2-5 2 Pole
1	$19.92	$20.78
2	25.96	27.68
3	31.99	34.58

Series 44 D 30 — Adjustable Stop

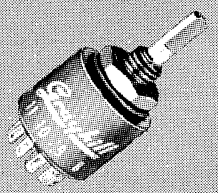
	No. of Positions	
No. of Decks	2-10 1 Pole	2-6 2 Pole
1	$20.65	$21.51
2	27.43	29.15
3	34.20	36.78

Available Locally Through Your Grayhill Distributor

Grayhill INC

½ Inch Diameter Single Deck

Outstanding Circuit Versatility And A Wide Range Of Options

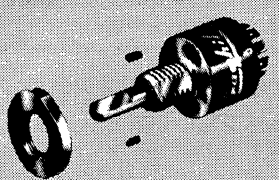


The most popular Series 50 and 51 rotary switches are fixed stop, with or without panel seals, solder lug or PC terminals. The drawing below (Figures 1 thru 4) show these combinations. The chart below lists the switch style that describes the combination and the appropriate drawing that illustrates the combination. The Series 50 is 36° angle of throw and 0.500″ diameter. The Series 51 is 22½° or 30° angle of throw and 0.562″ diameter. Many other options are available as described below.

STANDARD FEATURES OR OPTIONS

—Screwdriver Slotted Shafts
—Coded Versions
—Spring Return (Momentary Positions)
—Push-To-Turn or Pull-To-Turn†
—Keylock (Key Operated)
—RFI Grounding†
—Electrostatic or Electromagnetic Shielding†
—Intermix of Shorting and Non-Shorting Contacts†

†Indicates not available through distributors



ADJUSTABLE STOPS

Military Style Rotary Switches

The Series 50 and 51 Rotary Switches are also available with military type switch materials. Many types of the Series 50 are fully qualified to MIL-S-3786/20. Many types of the Series 51 are fully qualified to MIL-S-3786/35. These documents as well as the QPL (Qualified Products List) should be consulted for complete specification and ordering information. Contact GRAYHILL for additional assistance in specifying military styles Series 50 and 51 Rotary Switches.

45°, 60° or 90° Angles of Throw

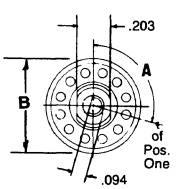
The Series 50 Rotary Switch is also available with 45° (8 position), 60° (6 position) or 90° (4 position) angles of throw. These angles of throw are available with 1 or 2 poles per deck, solder lug or PC mount terminals, with or without shaft and panel seal, fixed or adjustable stops and in standard or military types.

Adjustable Stops

Adjustable stop versions of the Series 50 and 51 Rotary Switches are readily available from local distributor stock. The adjustable stop versions are form, fit and function equivalents to their fixed stop counterparts. Adjustable stop Series 50 and 51 Rotary Switches can be provided in all angles of throw and with or without shaft and panel seal. Contact your local distributor or GRAYHILL for cross reference information between fixed and adjustable stop switches.

UNSEALED — FIXED STOPS

Shown on these two pages are the standard unsealed and sealed fixed stop version with solder lug or PC terminals.



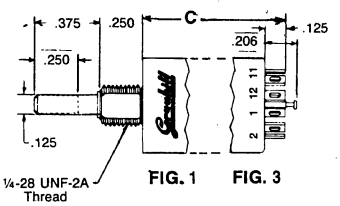


FIG. 1 FIG. 3

SEALED — FIXED STOPS

Seal does not alter dimensions when mounted

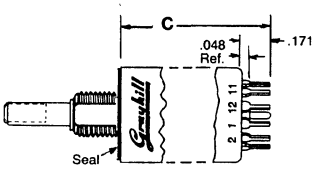


FIG. 2 FIG. 4

Type	Terminal	Switch Style	Applicable Figures	Dimension C
Unsealed	Solder Lug	A	1,3	.617
Fixed Stop	PC Terminal	P	1,4	.667
Sealed	Solder Lug	S	2,3	.617
Fixed Stop	PC Terminal	SP	2,4	.667

Series	51	51	50
Angle of Throw	22½°	30°	36°
Angle A	101°15″	105°	108°
Dimension B	.562	.562	.500

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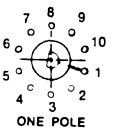
Rotary Switches

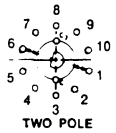
Circuit Diagrams

Switches are viewed from shaft end and shown in position 1.

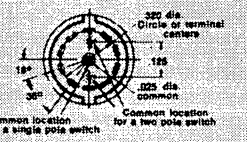
Common location for a single pole switch. Two pole commons are located as shown in circuit diagram on a .156 dia. Circle of centers; four pole commons are located as shown in circuit diagram on a .175 dia. circle of centers.

SERIES 50

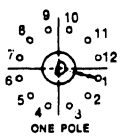


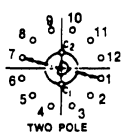


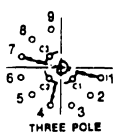
36° ANGLE OF THROW

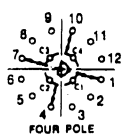


SERIES 51

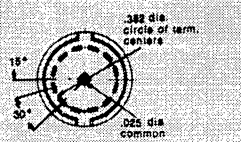




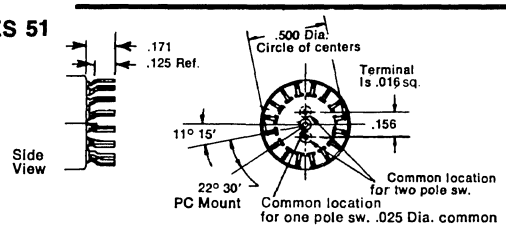


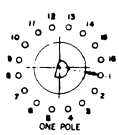


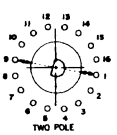
30° ANGLE OF THROW



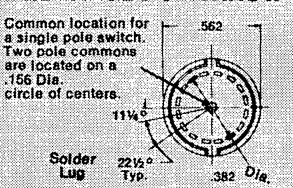
SERIES 51







22½° ANGLE OF THROW



SPECIFICATIONS

RATING:
Rated to make and break 200MA for 10,000 cycles of operation or 50MA for 25,000 cycles of operation, resistive load, 115VAC or 30VDC. For 22½° switch, rating is lower. For complete load life information, see GRAYHILL Rotary Switch catalog.

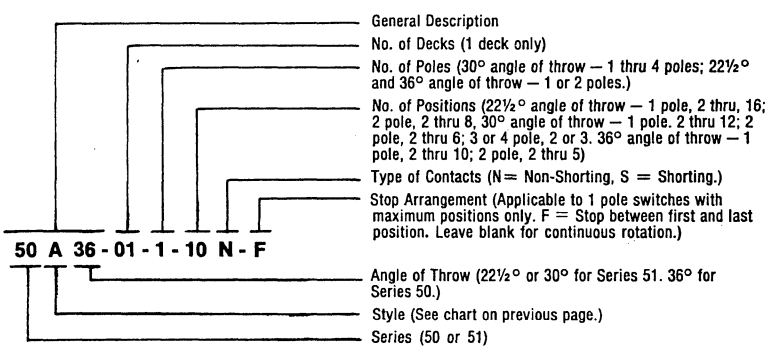
CONTACT RESISTANCE:
50 milliohms maximum (10 milliohms initially).

INSULATION RESISTANCE:
10,000 megohms minimum between mutually insulated parts (50,000 megohms initially).

VOLTAGE BREAKDOWN:
600VAC between mutually insulated parts; 400VAC for 22½° switch.

CARRY CURRENT:
6 amperes with a maximum contact temperature rise of 20°C.

HOW TO ORDER



Style A and P

No. of Poles	Non-Shorting			Shorting		
	Series 50 36°	Series 51 22½°	Series 51 30°	Series 50 36°	Series 51 22½°°	Series 51 30°
1	$ 9.50	$14.05	$10.35	$10.70	$15.20	$11.55
2	13.10	16.80	13.85	14.70	18.30	15.40
3	....	....	15.95	....	....	18.00
4	....	....	18.30	....	....	20.65

Style S (for Styles SP, add $.50)

No. of Poles	Non-Shorting			Shorting		
	Series 50 36°	Series 51 22½°	Series 51 30°	Series 50 36°	Series 51 22½°°	Series 51 30°
1	$10.50	$15.28	$11.39	$11.72	$16.44	$12.61
2	14.28	18.17	15.07	15.92	19.70	16.65
3	....	....	17.27	....	....	19.38
4	....	....	19.74	....	....	22.17

Discount Schedule

1-9	.....Unit Price
10-24	.....LESS 8%
25-49	.....LESS 16%
50-99	.....LESS 37%
100-499	.....LESS 50%
500 UP	. . Contact your local distributor or Grayhill

Prices and Discounts subject to change without notice

Available Locally Through Your Grayhill Distributor

Grayhill

1/2 Inch Diameter Single Deck

Grayhill Quality For As Little As $3.25*

SERIES 56

SERIES 55

SERIES 56

SERIES 55

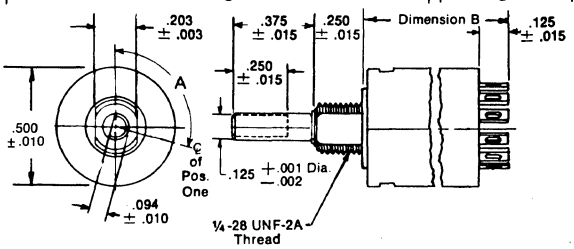
Great Variety Of Styles And Features:

- Shaft and Panel Seal
- Screwdriver Actuation
- PC Termination
- Adjustable Stops
- Extra Short Depth
- 30° or 36°, 1 or 2 Poles

*Standard Style, 1 Pole, 10 Position, Non-Shorting Switch in lots of 1000.

Dimensions See Choices and Limitations for applicable Figures.

Fig. 1



Stop pin holes can be seen in Fig. 3.

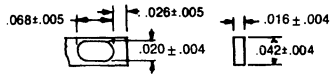
Angle Of Throw	30°	36°
Angle 'A'	105°	108°

Series	55	56
Dimension 'B'	.635 ± .020	.480 ± .020

Rear Views Shown With Circuit Diagrams

SOLDER LUG TERMINAL DETAIL

30° Angle Of Throw



36° Angle Of Throw

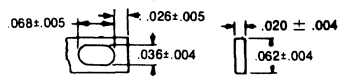
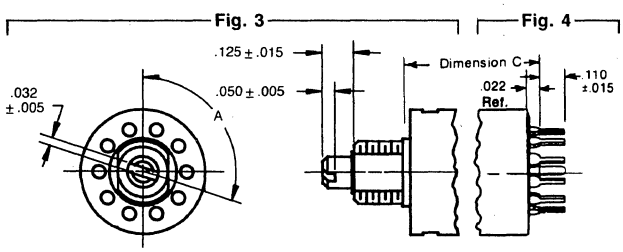


Fig. 3 Fig. 4



For additional dimensions, See Figure 1.

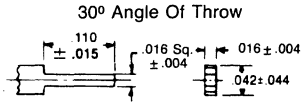
Angle Of Throw	30°	36°
Angle 'A'	105°	108°

Series	55	56
Dimension 'C'	.532 ± .020	.377 ± .020

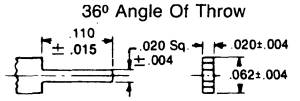
Rear Views Shown With Circuit Diagrams

PC TERMINAL DETAIL

30° Angle Of Throw

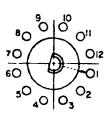


36° Angle Of Throw

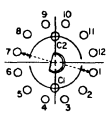


CIRCUIT DIAGRAMS

30° ANGLE OF THROW

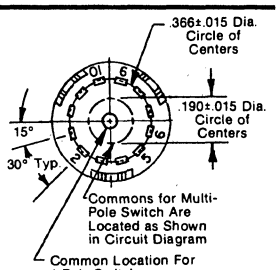


ONE POLE

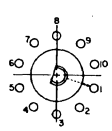


TWO POLE

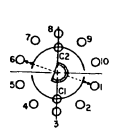
Note: Four pole switch is available by special order.



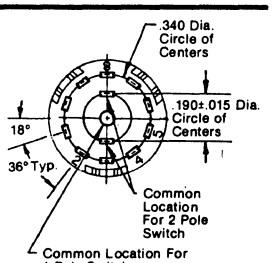
36° ANGLE OF THROW



ONE POLE



TWO POLE



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Rotary Switches

Specifications

RATING:
Rated to make and break 200 mA for 10,000 cycles of operation or 50 mA for 25,000 cycles of operation, resistive load, 115 VAC or 30 VDC. For complete load life information, see GRAYHILL Catalog Number One.

CONTACT RESISTANCE:
100 milliohms maximum (15 milliohms initially).

INSULATION RESISTANCE:
10,000 megohms minimum between mutually insulated parts (50,000 megohms initially).

VOLTAGE BREAKDOWN:
600VAC between mutually insulated parts.

CARRY CURRENT:
6 amperes with a maximum contact temperature rise of 20°C.

SHAFT AND PANEL SEAL
Panel is sealed by an "O" ring at the base of bushing. Shaft is sealed by an "O" ring inside the bushing. After the switch is mounted, seals do not alter the dimensions of the unsealed style.

ADJUSTABLE STOPS
Set and Reset Stops to Limit Rotation Form, Fit and Function Equivalent to Fixed Stop Counterparts

Adjustable Stop Switches: Two stop pins and an adhesive backed sticker or seal washer are provided. Stop pins can be located or reset as desired. Sticker or seal washer maintains stop pins in place. Sticker or seal washer can be removed to change stop pin location.

Choices And Limitations

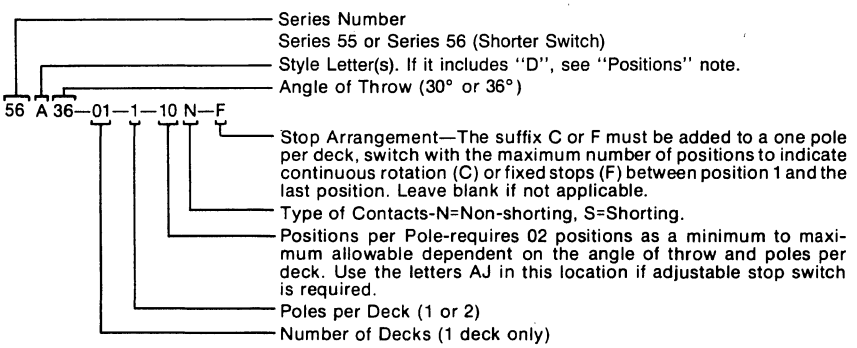
Style, Description, and Applicable Drawing Figures		Angle Of Throw	Stops	Terminals	Number of Poles		Number Of Positions/Pole
					Shorting	Non-Shorting	
A = Standard	1,2	30°	Fixed	Solder Lug	1	1	2 thru 12
S = Standard, Shaft/Panel Seal	1,2				2	2	2 thru 6
B = Screwdriver Slotted	3,2	36°			1	1	2 thru 10
BS = Slotted, Shaft/Panel Seal	3,2				2	2	2 thru 5
P = PC Mount	1,4	30°	Fixed	Printed Circuit	1	1	2 thru 12
SP = PC Mount, Shaft/Panel Seal	1,4				2	2	2 thru 6
BP = Screwdriver Slotted, PC Mount	3,4	36°			1	1	2 thru 10
BSP = Slotted, Sealed, PC Mount	3,4				2	2	2 thru 5
D = Adjustable Stops	1,2	30°	Adjustable	Solder lug	1	1	Adjustable (2 thru 12)
SD = Adj. Stops, Shaft/Panel Seal	1,2				2	2	Adjustable (2 thru 6)
BD = Adj. Stops, Screwdriver Slotted	3,2	36°			1	1	Adjustable (2 thru 10)
BSD = Slotted, Sealed, Adjustable	3,2				2	2	Adjustable (2 thru 5)
DP = Adj. Stops, PC Mount	1,4	30°	Adjustable	Printed Circuit	1	1	Adjustable (2 thru 12)
SDP = Adjustable, PC Mount, Sealed	1,4				2	2	Adjustable (2 thru 6)
BDP = Slotted, Adjustable, PC Mount	3,4	36°			1	1	Adjustable (2 thru 10)
BSDP = Slotted, Sealed, Adj., PC	3,4				2	2	Adjustable (2 thru 5)

ADDITIONAL OPTIONS (CONTACT GRAYHILL)

—KEYLOCK
—DIFFERENT SHAFT FLAT
—INTERMIXING OF SHORTING CONTACTS AND NON-SHORTING

HOW TO ORDER

Part number is descriptive and formed in the following manner:



PRICES

All Prices Are Unit Prices

Angles Of Throw	Poles	Shorting Non-Shorting	Switch Style A,B,D,BD	P,BP,DP,BDP	S,BS,SD,BSD	SP,BSP,SDP, BSDP
30°	1	N	$7.75	$8.00	$8.40	$8.65
		S	8.00	8.25	8.65	8.90
	2	N	8.60	8.85	9.25	9.50
		S	9.10	9.35	9.75	10.00
36°	1	N	7.50	7.75	8.15	8.40
		S	7.75	8.00	8.40	8.65
	2	N	8.35	8.60	9.00	9.25
		S	8.85	9.10	9.50	9.75

Discount Schedule

Quantity Range
1-9 ..... Unit Price
10-24 ..... Less 8%
25-49 ..... Less 16%
50-99 ..... Less 37%
100-499 ..... Less 50%
500 and up ..... Contact Your Local Sales Office Or GRAYHILL

PRICES AND DISCOUNTS SUBJECT TO CHANGE WITHOUT NOTICE.

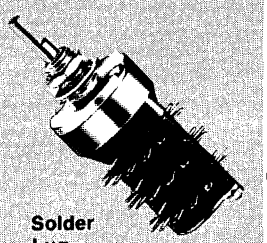
Available Locally Through Your Grayhill Distributor

Grayhill INC.

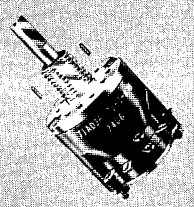
½ Inch Diameter, ¼ Amp

Value Engineered To Compete In Price And Outperform Open-Wafers

- 30° Or 36° Angle Of Throw
- Military Qualification
- 1/8″ or 1/4″ Shaft Diameter
- Solder Lug Or PC Mount
- 1 Thru 12 Decks; 1 To 6 Poles Per Deck



Solder Lug Terminals



Adjustable Stops

ADDITIONAL FEATURES

ADJUSTABLE STOPS—Stocked By Distributors

Number of positions per pole can be changed by removing and relocating stop pins in the switch front plate. Available in the single shaft versions with either .125″ or .250″ diameter, 30° or 36° angle of throw; and solder lug terminals or PC mount.

Non Adjustable Style	With Adjustable Stops Style Becomes
A	AD
B	BD
AF	ADF
BF	BDF

MILITARY QUALIFIED, MIL-S-3786/39

The Series 71 rotary switch qualification includes the 30° and 36° angles of throw in both shaft diameters, sealed and unsealed styles, in 1 thru 5 decks with solder lug terminals, and in 1 thru 4 operative decks with PC terminals. For more details, see GRAYHILL Engineering Catalog Number One.

Commercial Style	Military Style
A	MA
B	MB
AF	MAF
BF	MBF

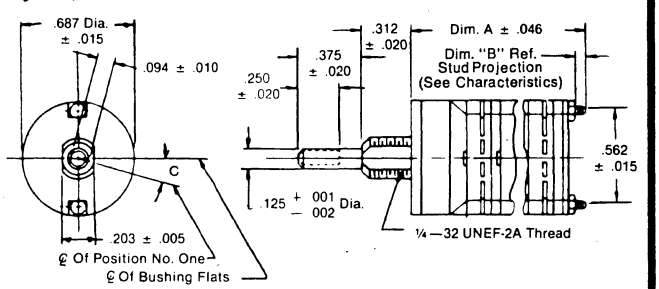
SHAFT AND PANEL SEAL

Shaft is sealed by "O" ring inside bushing. Panel is sealed "O" ring at base of bushing. Seals do not alter dimensions as shown in the drawings when switch is mounted. Panel seal is silicone rubber. Shaft seal is an "O" ring per MIL-P-5516B.

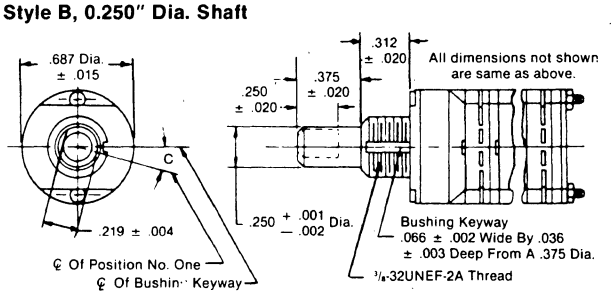
Non Sealed Style	With Seals Style Becomes	Military Style Becomes
A	AS	MAS
B	BS	MBS
AF	ASF	MASF
BF	BSF	MBSF

DIMENSIONS — SOLDER LUG TERMINALS

Style A, 0.125 Dia. Shaft



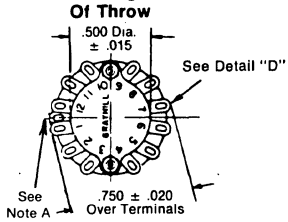
Style B, 0.250″ Dia. Shaft



Rear Views

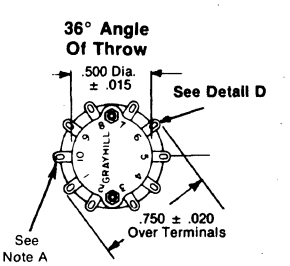
30° and 36° Angle of Throw may be Interposed on Either Shaft Diameter

30° Angle Of Throw



Note A: Common Location for a Single Pole Per Deck Switch. For Common Location on Multipole Switches See Circuit Diagram.

36° Angle Of Throw



Dimensions A & B

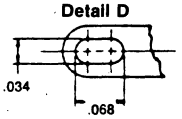
Extended studs are provided on switches of 6 or more decks for recommended double end mounting. See also military note under drawing for PC mountable styles.

No. of Decks	Dimension A: Mil. F Styles	Dimension A: Others	Dim. B
1	.761	.761	.031
2	.979	.979	.031
3	1.415	1.197	.031
4	1.633	1.415	.031
5	—	1.633	.031
6	—	2.131	.312
7	—	2.349	.312
8	—	2.567	.312
9	—	2.785	.312
10	—	3.003	.312
11	—	3.221	.312
12	—	3.439	.312

Dimension C

10 Position Switches	12 Position Switches
36°	15°

Detail D

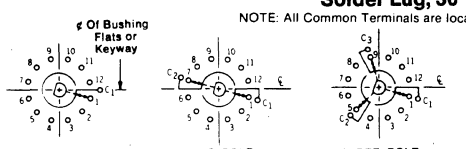


CIRCUIT DIAGRAMS

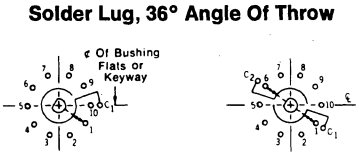
(Switch is viewed from Shaft End and shown in Position No. 1)

Solder Lug, 30° Angle Of Throw

NOTE: All Common Terminals are located above Base Terminals as shown.



Solder Lug, 36° Angle Of Throw

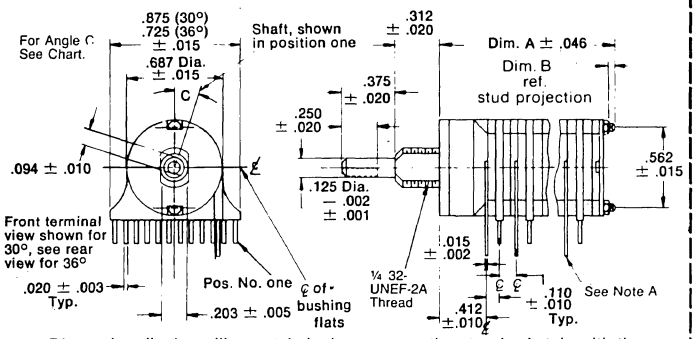


Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Multideck, Rotary Switches

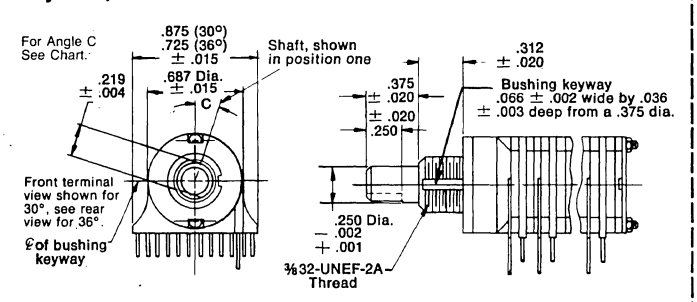
DIMENSIONS—PC BOARD MOUNTABLE

Style AF, 0.125" Dia. Shaft



Dimensionally the military style is the same as the standard style with the exception of the PC version of 3 or 4 decks; a spacer deck between decks 2 and 3 adds another deck length to the switch without increasing the number of operative decks. See chart.

Style BF, 0.250" Dia. Shaft

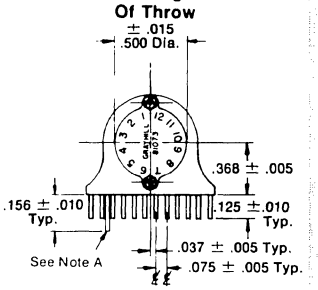


For other dimensions and military styles, see drawing above.

Rear Views

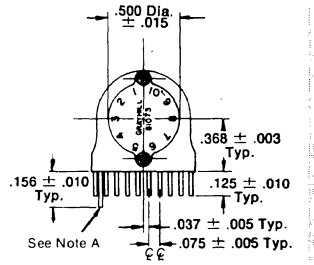
30° and 36° Angle of Throw may be interposed on either Shaft Diameter

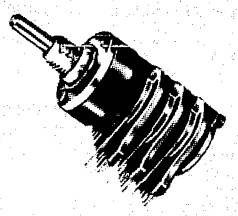
30° Angle Of Throw



Note A. Common Location for a Single Pole Per Deck Switch. For Common Location on Multipole Switches See Circuit Diagram

36° Angle Of Throw

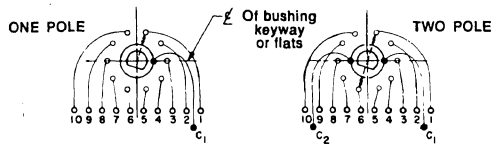




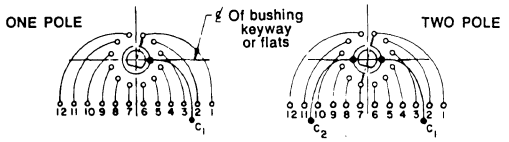
PC Mountable

CIRCUIT DIAGRAMS

36° Angle Of Throw



30° Angle Of Throw



SPECIFICATIONS

RATING:
Rated to make and break 400MA for 10,000 cycles of operation or 200MA for 25,000 cycles of operation, resistive load, 115VAC or 30VDC. Rated to make and break 250MA for 10,000 cycles of operation or 100MA for 25,000 cycles of operation, inductive load (250 Millihenries), 30VDC.

For complete load life information, see GRAYHILL Engineering Catalog Number One.

CONTACT RESISTANCE:
50 milliohms maximum (10 milliohms initially).

VOLTAGE BREAKDOWN:
500 VAC minimum between mutually insulated parts.

CARRY CURRENT:
4 amperes with a maximum contact temperature rise of 20°C.

INSULATION RESISTANCE:
10,000 megohms minimum between mutually insulated parts (50,000 megohms initially).

HOW TO ORDER

71 A 30 - 02 - 1 - 12 N - C

- Series 71, Style (as described on these pages), Angle of Throw (30° or 36°)
- No. of Decks (12 decks max., also see poles per deck limitation in price table.)
- No. of Poles per Deck (See circuit diagram for style and angle of throw limitations. Also limited to a maximum of 16 total poles per switch.
- No. of Positions (30° angle of throw solder lug—1 pole, 2 thru 12; 2 pole, 2 thru 6; 3 pole, 2 thru 4; 4 pole, 2 or 3; 5 or 6 pole, 2 only. 30° angle of throw PC mount—1 pole, 2 thru 12; 2 pole, 2 thru 6. 36° angle of throw—1 pole, 2 thru 10; 2 pole, 2 thru 5.)
- Type of Contacts (N=Non-Shorting. S=Shorting)
- Stop Arrangement (Applicable to 1 pole switches with maximum positions only. C=Continuous, F=Stop between first and last position.)

Prices on following page.

Available Locally Through Your Grayhill Distributor

Grayhill INC. Power Tap Rotary Switches—15 Amp

PRICES **SERIES 71**

71A30 71B30 71A36 71B36 71AF30 71BF30 71AF36 71BF36

Number of Decks	Poles/Deck and Positions/Pole 1 (2-12)	2 (2-6)	3 (2-4)	4 (2-3)	5 (2)	6 (2)
1	10.88	11.33	11.79	12.24	12.69	13.16
2	14.29	15.20	16.11	17.01	17.93	18.84
3	17.71	19.07	20.43	21.79	23.16	N.A.
4	21.11	22.93	24.75	26.56	N.A.	N.A.
5	24.52	26.80	29.07	N.A.	N.A.	N.A.
6	27.94	30.66	N.A.	N.A.	N.A.	N.A.
7	31.35	34.53	N.A.	N.A.	N.A.	N.A.
8	34.75	38.39	N.A.	N.A.	N.A.	N.A.
9	38.17	N.A.	N.A.	N.A.	N.A.	N.A.
10	41.58	N.A.	N.A.	N.A.	N.A.	N.A.
11	44.99	N.A.	N.A.	N.A.	N.A.	N.A.
12	48.40	N.A.	N.A.	N.A.	N.A.	N.A.

71MA30, 71MB30, 71MA36, 71MB36

Number of Decks	Poles/Deck and Positions/Pole 1 (2-12)	2 (2-6)	3 (2-4)	4 (2-3)	6 (2)
1	11.50	11.95	12.41	12.86	13.16
2	15.12	16.02	16.93	17.84	18.84
3	18.74	20.10	21.46	28.82	N.A.
4	22.35	24.17	25.99	27.80	N.A.
5	25.97	28.25	29.07	N.A.	N.A.

71MAF30 71MAF36 71MBF30 71MBF36

Number of Decks	1 (2-12)	2 (2-6)
1	12.58	13.03
2	17.45	18.36
3	22.32	23.68
4	27.18	29.00

Discount Schedule

1-9	UNIT PRICE
10-24	LESS 8%
25-49	LESS 16%
50-99	LESS 37%
100-499	LESS 50%
500 UP	Contact your local distributor or Grayhill

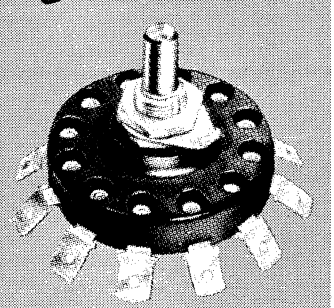
Shaft and Panel Seal, Style AS, ASF, BS, BSF, MAS, MASF, MBS, or MBSF—Add $1.13 to the price of a similar Style A, AF, B, BF, MA, MAF, MB or MBF rotary switch.

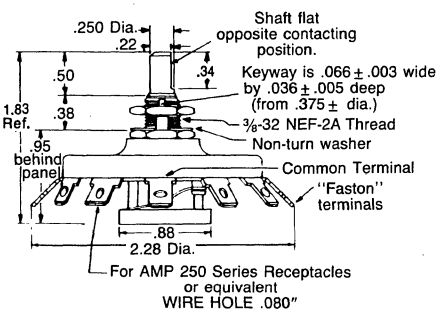
Adjustable Stops, Style AD, ADF, BD or BDF—Add $0.57 to the cost of a similar Style A, AF, B, or BF rotary switch.

NOTE: Number of Positions does not affect price.

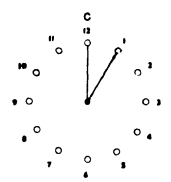
PRICES AND DISCOUNTS SUBJECT TO CHANGE WITHOUT NOTICE.

Grayhill INC. 15 Amp, UL Listed Rotary Switches





30° Angle of Throw
1 Pole, 2 to 11 Positions
'Faston' Terminals



CIRCUIT DIAGRAM
Drawings and Spec. For Ref. Only

SPECIFICATIONS

RATING:

Series 19 switches are UL listed at:
15 amps, 120 VAC, non-inductive load. 1 amp, 120 VDC, non-inductive load.

This rating is based on the following criteria:
Overload — 50 operations at 125% rated AC load and 150% rated DC load.

Endurance — 6000 operations at rated load with 900 VAC dielectric strength before and after test.

Temperature Rise — Not to exceed 30°C when carrying rated AC load after endurance test.

Contacts will carry 20 amps at 115 volts AC with 30°C maximum temperature rise.

CONTACT RESISTANCE: (Measured at 2 VDC and approximately 100MA) for new switch approximately 10 milliohms.

INSULATION RESISTANCE: Approximately 100,000 megohms. Between mutually insulated parts.

VOLTAGE BREAKDOWN: Approximately 2500 VAC. Between mutually insulated parts.

HOW TO ORDER

Part Number 19101-* UL (*Indicates No. of Positions—02, 03, 04 etc.)

Number of Positions	02	03	04	05	06	07	08	09	10	11
PRICES	$11.75	$12.38	$13 01	$13.64	$14.27	$14.90	$15.53	$16.16	$16.79	$17.43

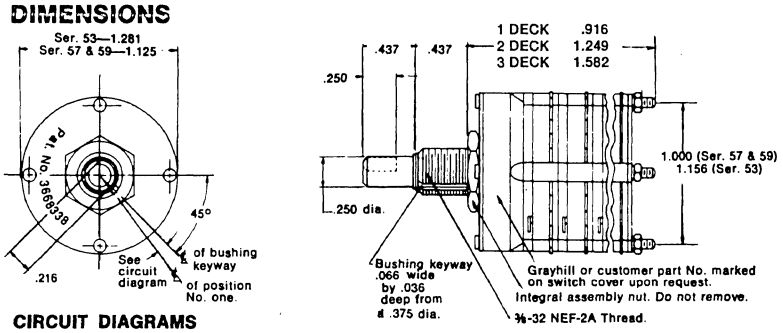
ALL PRICES SUBJECT TO DISCOUNT SCHEDULE ABOVE. PRICES AND DISCOUNTS SUBJECT TO CHANGE WITHOUT NOTICE.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

16, 20, and 24 Position Rotary Switches

Provides Logic Level To ½ AMP Switching Capability

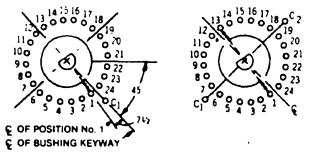
DIMENSIONS



CIRCUIT DIAGRAMS

SERIES 53 —

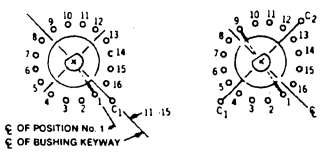
15° ANGLE OF THROW (24 POSITIONS)



ONE POLE TWO POLE

SERIES 57 —

22½° ANGLE OF THROW (16 POSITIONS)

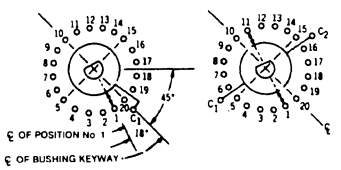


ONE POLE TWO POLE

MOUNTING HARDWARE: Includes two mounting nuts, one internal tooth lockwasher and one non-turn washer.

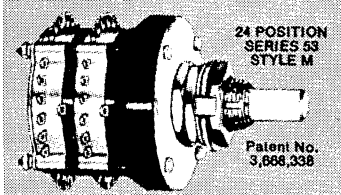
SERIES 59 —

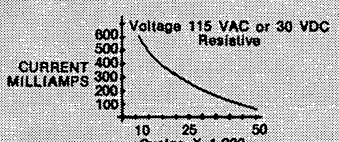
18° ANGLE OF THROW (20 POSITIONS)

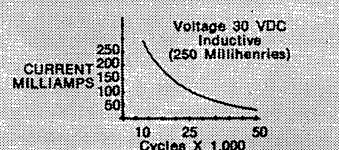


ONE POLE TWO POLE

Make And Break More Circuits In Less Space.







SPECIFICATIONS

Voltage: 115 VAC or 30 VDC, resistive load; 30 VDC inductive load.

Contact Resistance: 50 milliohms maximum (15 milliohms initially).

Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

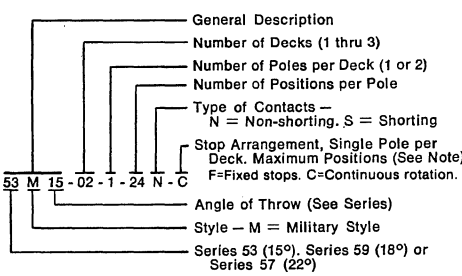
Voltage Breakdown: 500 VAC minimum between mutually insulated parts. These switches will carry 4 amperes with a maximum contact temperature rise of 20°C.

Chart shown for non-shorting contacts (break before make).

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the curves on the right was measured at sea level 25°C and 68% relative humidity with the above life limiting criteria.

ORDERING INFORMATION

How to determine part number. Suffix "C" or "F" is required for a complete part number when ordering single pole/deck switches with maximum number of positions. Sample part number for a 2 deck, 1 pole/deck, 24 position, Style M, 15° angle of throw, non-shorting contact switch without stops:



For 3 to 12 poles per deck; 4 thru 12 decks; military qualified, sealed styles, contact factory.

Poles/Deck and Positions/Pole

1 Pole	Series No.	2 Pole
2-24	53	2-12
2-20	59	2-10
2-16	57	2-8

Prices

Number Of Decks	1 Pole	2 Pole
1	$28.56	$29.93
2	38.66	41.39
3	48.74	52.85

Discount Schedule

1-9	Unit Price
10-24	Less 8%
25-49	Less 16%
50-99	Less 37%
100-499	Less 50%
500 UP	Contact GRAYHILL

Prices and Discounts Subject to Change Without Notice.

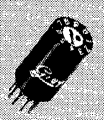
Available Locally Through Your Grayhill Distributor

Grayhill INC

0.3" Diameter Rotary Switches

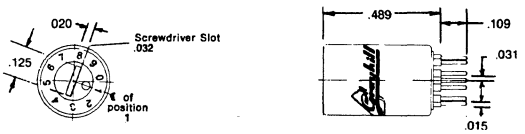
Designed As The World's Smallest Rotary Switch

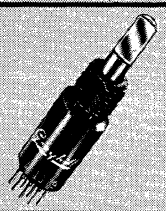
- 10 Position, 1 or 2 Poles
- Rated to make and break logic loads for a minimum of 15,000 cycles of operation
- Non-Shorting Wiping Contacts



Style AP Screwdriver Actuated Style AF

All Dimensions Not Shown and Front View Same as Style AP

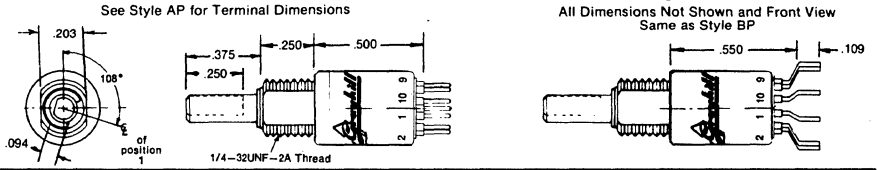




Style BP Shaft Actuated Style BF

See Style AP for Terminal Dimensions

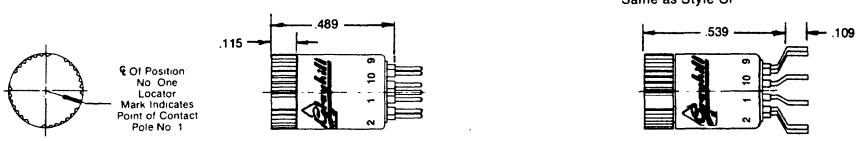
All Dimensions Not Shown and Front View Same as Style BP



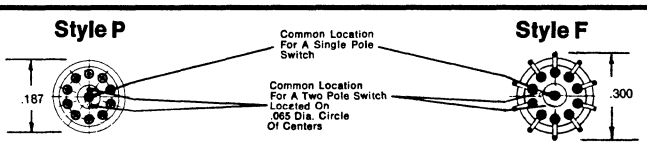
Style CP Integral Knob Actuated Style CF

See Style AP for Terminal Dimensions

All Dimensions Not Shown and Front View Same as Style CP

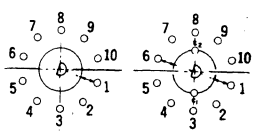


REAR VIEWS



CIRCUIT DIAGRAM

(Switch is viewed from shaft end and shown in position 1.)



SPECIFICATIONS

Voltage: 115 VAC or 30 VDC, resistive load.

Contact Resistance: 50 milliohms maximum. (15 milliohms initially).

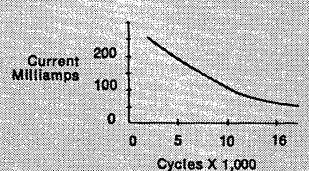
Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

Voltage Breakdown: 500 VAC minimum between mutually insulated parts.

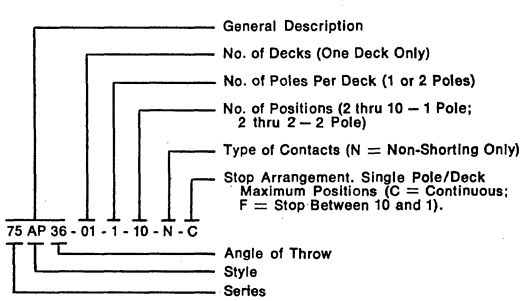
Chart shown for non-shorting contacts (break before make).

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the curve was measured at sea level, 25°C. and 68% relative humidity with the above life limiting criteria.

RATING:
Life Expectancy:



ORDERING INFORMATION



PRICES

Style	Unit Price 1 Pole/Deck	Unit Price 2 Pole/Deck
AF or CF	$11.91	$14.77
AP or CP	11.55	13.81
BF	13.57	16.41
BP	13.19	15.45

Discount Schedule

1-9	.....Unit Price
10-24	.....Less 8%
25-49	.....Less 16%
50-99	.....Less 37%
100-499	.....Less 50%
500-UP	... Contact your local distributor or Grayhill

PRICES AND DISCOUNTS SUBJECT TO CHANGE WITHOUT NOTICE.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

HAMLIN INC

LAKE and GROVE STREETS · LAKE MILLS, WISCONSIN 53551
PHONE: SALES 414/648-2361 · TWX 910-260-3740

REED SWITCHES & SENSORS • REED, HG & MOS RELAYS • LIQUID CRYSTAL DISPLAYS

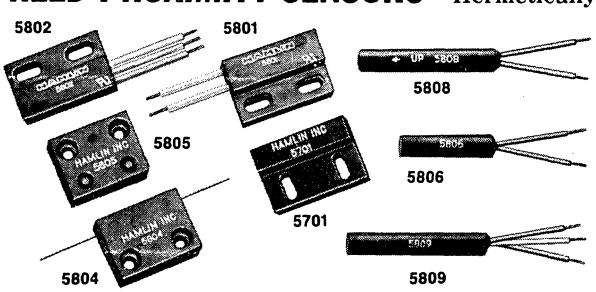
MAGNETIC REED SWITCHES

Micro-miniature ● Tiny ● Sub-miniature ● Compact ● Mercury-wetted
High voltage ● High current

Switch Model No.	Form	Max. DC Contact Rating	Max. Amps	Max. DC Volts	Ampere Turn Pull-In Range	Overall Length Nominal Inches	Glass Length Max. Inches	Glass Diameter Max. Inches	Magnet	Special Features	List Price
HAMILIN DRY REED FORM C MAGNETIC REED SWITCHES											
MDRR-DT-175	C	3W	.240	28	20-35	2.076	.562	.105	H-33	3W Low Profile Form C	$3.88
MRH-DT-175	C	3W	.250	28	20-35	2.124	.610	.130	H-33	Instrument Grade Form C	4.00
MRG-DT-175	C	3W	.250	28	20-35	2.125	.610	.130	H-33	Mod. Current & Voltage	3.45
MLC-DT-186	C	3W	.110	28	20-40	2.125	.610	.130	H-33	Economy Form C - Sub-Minature	2.80
DLC-DT-327	C	10W	.500	200	40-70	3.375	1.562	.218	H-32	Economy Form C - Standard	2.25
DRR-DTH-445	C	10W	.500	250	65-80	3.375	1.562	.218	H-34	High Breakdown Form C	2.55
DRT-DTH-445	C	20W	1.500	500	65-80	3.375	1.562	.218	H-34	Inductive Loads	5.30
HAMILIN DRY REED FORM A MAGNETIC REED SWITCHES											
MMRR-2-185	A	.3W	.010	28	22.5-37.5	2.000	.375	.090	H-31	"Grain of Wheat" Size	2.50
MINI-2S-115	A	3W	.110	28	12.5-27.5	1.235	.500	.070	H-31	The Mini-Reed	1.60
MDRR-4-185	A	10W	.500	100	22.5-37.5	1.235	.600	.105	H-33	Low Profile Form A	.95
MSRR-2-185	A	10W	.500	200	22.5-37.5	2.230	.800	.090	H-33	Mod. Current & Voltage	1.00
MRR-2-185	A	10W	.500	200	22.5-37.5	2.230	.800	.130	H-33	Mod. Current & Voltage	1.05
MRR-5-196	A	10W	.500	500	22.5-42.5	2.230	.800	.130	H-33	Breakdown Voltage to 1000 VDC	3.55
MDSR-4-185	A	10W	.500	100	22.5-37.5	1.590	.600	.090	H-33	.090 Dia. Low Profile	.95
MARR-2-185	A	10W	.500	100	22.5-37.5	2.230	.800	.105	H-33	.105 Dia. High Reliability	.95
MARC-2-186	A	10W	.500	100	20-40	2.230	.800	.105	H-33	Economy Form A	.89
MARH-2-185	A	10W	.500	200	22.5-37.5	2.230	.800	.105	H-33	Instrument Grade - Prem. Per.	1.20
MARR-5-196	A	10W	.500	500	22.5-42.5	1.775	.800	.105	H-33	Breakdown Voltage to 1000 VDC	3.55
SRR-2-425	A	15W	1.000	400	62.5-77.5	3.375	1.425	.195	H-32	Mod. Current & Voltage	2.45
DRR-1-425	A	15W	1.000	400	62.5-77.5	3.250	2.000	.207	H-34	Mod. Current & Voltage	1.76
DRR-5-425	A	25W	1.000	1000	62.5-77.5	3.250	2.000	.207	H-34	Breakdown Voltage to 1500 VDC	3.00
DRT-5-425	A	50W	3.000	1000	62.5-77.5	3.250	2.000	.207	H-34	Inductive Load Type Contact	5.00
HAMLIN MERCURY-WETTED MAGNETIC REED SWITCHES											
MDC-1-387	A	50W	2.000	500	40-80	2.250	.610	.130	H-33	Tiny Size, Mercury Wetted	2.50
MDC-DT-420	C	28W	.500	200	40-70	1.600	.625	.132	H-32	Form C, Mercury, Wetted	9.25
HAMLIN HIGH VOLTAGE MAGNETIC REED SWITCHES											
DRVT-10-658	A	50W	.004	7500	90-140	3.250	1.950	.218	H-34	Breakdown Voltage to 10,000 VDC	6.00
HAMLIN HIGH CURRENT MAGNETIC REED SWITCHES											
SRT-2-455	A	100VA	1.000	28 VDC 110 VAC	67.5-82.5	3.375	1.610	.195	H-32	High Power Inductive Loads	3.45
DRR-129-425	A	100W	3.000	250	62.5-77.5	3.250	2.000	.207	H-34	Ideal High Current Loads	3.75

MAGNETICALLY ACTUATED REED PROXIMITY SENSORS

High Reliability and Long Life
Hermetically Sealed.



ORDERING/PRICING INFORMATION

Sensor Number	Contact Form	Contact Ratings				Minimum Breakdown Voltage (VDC)
		Watts	VDC	VAC	AMPS	
5801	A	10	200	240	.5	400
5802	C	3	28	120	.25	200
5804	A	10	100	120	.5	200
5806	A	10	100	120	.5	200
5807	A	10	100	120	.5	200
5808	A	50	500	240	2.0	1000
5809	C	3	28	120	.25	200
5811	A	50	100	120	1.0	225
5812	A	10	200	240	.5	400
5901	A	1.5	—	240	1.5	400

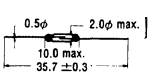
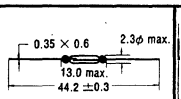
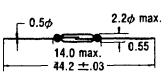
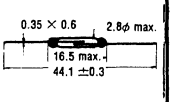
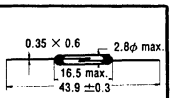
ACTUATION DISTANCES OF MAGNETIC ACTUATORS

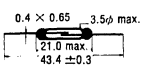
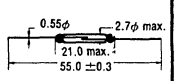
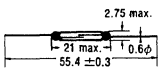
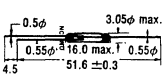
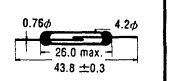
ACTUATOR	USE WITH SENSOR	SIDE OPERATING MODE		END OPERATING MODE	
		ON	OFF	ON	OFF
5701	5801	.400	1.00	—	—
	5802	.250	1.00	—	—
	5806	.400	1.00	.200	.750
	5807	.450	1.10	.200	.750
	5808	.150	.750	.100	.500
	5809	.250	.900	.150	.750
	5811	.250	.750	—	—
	5901	.400	1.00	—	—
5805	5804	.400	1.00	—	—
	5806	.350	1.00	.200	.750
	5807	.350	1.10	.200	.750
	5808	.050	.750	.050	.500
	5809	.150	.900	.100	.750
5810	5806	.350	1.00	.150	.750
	5807	.400	1.10	.150	.750
	5808	.100	.750	.050	.500
	5809	.200	.900	.100	.750
	5811	.250	.750	—	—

HASCO COMPONENTS INC. / REED SWITCHES

OKI electric industry company, ltd.

Specifications

						
		ORD-211	**ORD-221**	**ORD-228**	**ORD-225**	**ORD-226**
Electrical Characteristics	Contact	1A	1A (offset)	1A	1A	1A
	Pull-in [AT]	10 ~ 50	10 ~ 55	10 ~ 50	10 ~ 60	15 ~ 45
	Drop-out [AT]	5 min.	5 min.	5 min.	1 min.	RLS/OP >0.8
	Contact resistance (Initial) [mΩ]	150 max.	150 max.	150 max.	150 max.	150 max.
	Breakdown voltage [DCV]	150 min.	200 min.	200 min.	250 min.	150 min.
	Insulation resistance [Ω]	10^9 min.	10^9 min.	10^9 min.	10^{10} min.	10^9 min.
	Electrostatic capacitance [PF]	0.2 max.	0.3 max.	0.3 max.	0.3 max.	0.3 max.
	Contact capacity [VA]	1.0	10	10	10	10
	Maximum conductive current [A]	0.3	1.0	1.0	1.0	0.5
	Maximum voltage [V]	24	100	100	100	100
Operating Characteristics	Operate time [ms]	0.3 max.	0.3 max.	0.3 max.	0.4 max.	0.3 max.
	Bounce time [ms]	0.3 max.	0.3 max.	0.3 max.	0.4 max.	1.0 max.
	Release time [ms]	0.05 max.	0.05 max.	0.05 max.	0.05 max.	0.1 max.
	Resonant frequency [Hz]	8600 ±500	2750 ±250	5300 ±300	3700 ±300	4200 ±200
	Maximum operating frequency [Hz]	500	500	500	500	500
Standard Coil	Coil resistance [Ω]	600	450	450	450	450
	No. of turns [T]	5000	5000	5000	5000	5000
	Dimensions [mm]	2.0 x 10	2.9 x 15	2.9 x 15	2.9 x 15	2.9 x 15
	Type No.	8	6	6	6	6
Features (Contact material)		Ultra-miniature (Rh)	Miniature offset (Rh)	General purpose miniature (Rh)	General purpose miniature (Rh)	Drop-out / Pull-in >0.8 (Rh)

						
		ORD-234	**ORD-229**	**ORD-2210**	**ORT-233**	**ORD-2211**
Electrical Characteristics	Contact	1A	1A	1A	1C	1A
	Pull-in [AT]	20 ~ 60	10 ~ 60	20 ~ 60	15 ~ 45	20 ~ 60
	Drop-out [AT]	10 min.	5 min.	10 min.	10 min.	10 min.
	Contact resistance (Initial) [mΩ]	150 max.	150 max.	150 max.	150 max.	100 max.
	Breakdown voltage [DCV]	300 min.	700 min.	300 min.	200 min.	200 min.
	Insulation resistance [Ω]	10^{10} min.	10^{10} min.	10^{10} min.	10^9 min.	10^9
	Electrostatic capacitance [PF]	0.5 max.	0.2 max.	0.5 max.	1.5 max.	0.3 max.
	Contact capacity [VA]	10	20	70	3	30W max.
	Maximum conductive current [A]	2.0	2.0	2.5	0.5	0.5; In-rush 3
	Maximum voltage [V]	200	250	100	30	100
Operating Characteristics	Operate time [ms]	0.5 max.	0.5 max.	0.5 max.	1.0 max.	0.6 max.
	Bounce time [ms]	0.5 max.	0.5 max.	0.5 max.	(NC) 1.0 max. (NO) 1.5 max.	0.4 max.
	Release time [ms]	0.05 max.	0.1 max.	0.1 max.	0.5 max.	0.05 max.
	Resonant frequency [Hz]	2200 ±300	2200 ±300	2350 ±250	6000 ±4000	4600 ±500
	Maximum operating frequency [Hz]	500	500	500	200	500
	Shock resistance [G]					30 (11 ms)
	Vibration [G]					20
	Tensile strength [Kg]					2.0
	Operating temperature [°C]					−40 ~ +80
Standard Coil	Coil resistance [Ω]	500	500	500	570	450
	No. of turns [T]	5000	5000	5000	5000	5000
	Dimensions [mm]	3.6 x 20	2.8 x 18	3.6 x 20	3.6 x 10	2.9 x 15
	Type No.	3	7	3	10	6
Features (Contact material)		Long life (Rh)	High breakdown voltage (Rh)	High power (Rh)	Miniature transfer (Rh)	High inrush

High Reliability Supported by Unique Technology

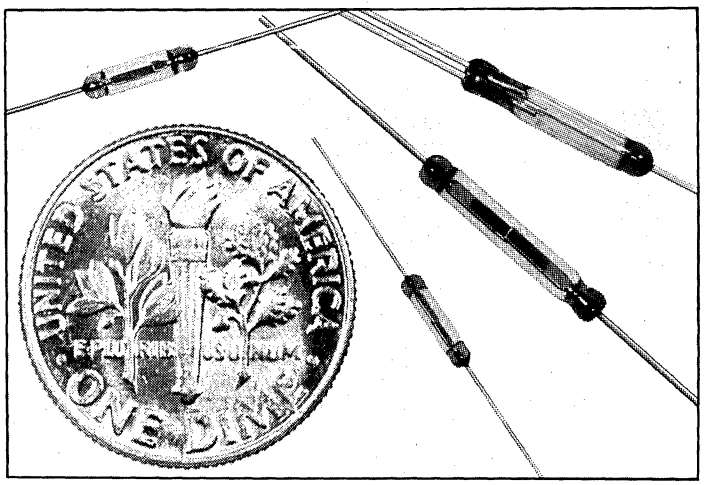
Flux Scanning Method:

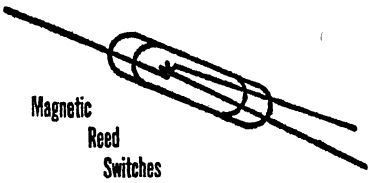
In spite of severe control of the sealing process, there is a slight probability that foreign matter such as magnetic particles may enter the glass. After extensive study in the detection of micro impurities, OKI has adopted the highly reliable flux scanning method. In flux scanning, external magnetism is moved so that foreign matter near the reed is forced to jump to the contact part. The contact resistance then measured is used as the standard for the selection of characteristics. We have thus succeeded in remarkably improving the reliability of reed switches by replacing conventional visual checking with the latest flux scanning method.

EXCLUSIVE AGENT FOR OKI REED SWITCHES IN USA AND CANADA

HASCO COMPONENTS, INC. / 214-22 WATERS EDGE DRIVE, BAYSIDE, NY 11360 / (212) 428-5155 TWX: 710-582-5750

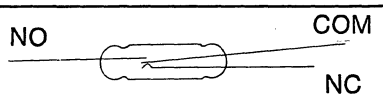
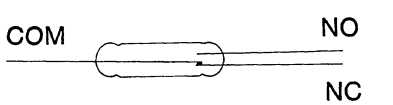
HERMETIC SWITCH





MANUFACTURERS OF

THE WORLD'S SMALLEST REED SWITCHES

Model	Form	Max D C. Watts	Max D C. Amps	Max D C. Volts	Stock Amp-Turn Pull-In Range	Overall Length Inches	Max Glass Diameter Inches	Max Glass Length Inches	Special Features
THE WORLD'S SMALLEST									
HSR-003	A	0.1	.01	10	5-25	1.050	.055	.210	AVAILABLE IN HI-REL AND COMMERCIAL GRADES
HSR-005	A	0.1	.01	10	5-40	1.000	.055	.260	
HSR-067	A	4	.20	30	10-35	1.240	.070	.460	
HSR-370	C	3	.10	28	15-35	1.490	.072	.485	
MINIATURE FORM C									
HSR-301	C	4	.20	100	15-40	1.930	.093	.580	
HSR-3015	C	4	.20	100	15-40	1.930	.103	.580	
HSR-302	C	4	.20	100	15-40	1.930	.120	.580	
HSR-505	C	3	.10	28	15-35	1.500	.075 .095 Oval	.465	
HSR-510	C	3	.25	100	15-40	2.000	.105	.590	
HSR-520	C	3	.25	100	15-40	2.000	.125	.600	
HIGH POWER									
HSR-V200	A	200	3.0	7500	50-150	3.230	.210	2.100	200 WATT SWITCHING
HIGH VOLTAGE									
HSR-V10K	A	50	3.00	7500	50-150	3.230	.210	2.100	10,000 VDC DIELECTRIC

ASK FOR CATALOG AND SPECIFICATION SHEETS ON COMPLETE REED SWITCH PRODUCT LINE INCLUDING OVER 25 STANDARD MODELS

HERMETIC SWITCH, INC.

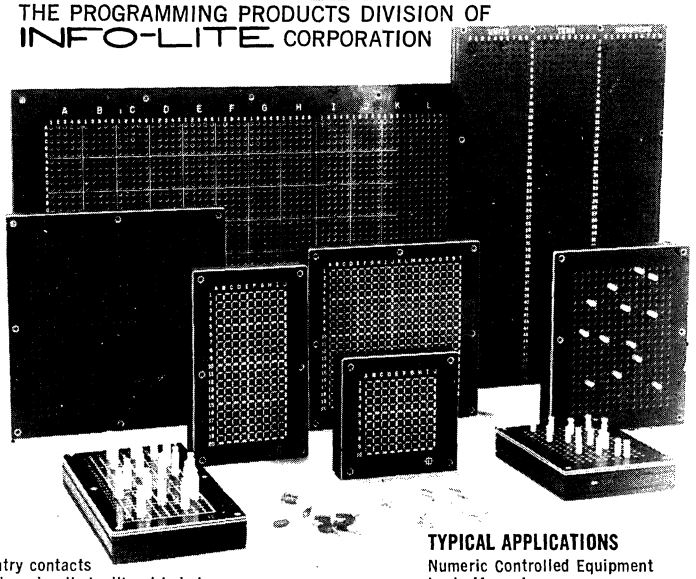
P.O. BOX 1325, HIGHWAY 92 SOUTH / CHICKASHA, OKLAHOMA 73018 / TELEPHONE (405) 224-4046
TELEX 796125 HERMETIC CKSA

CROSSPOINT

THE PROGRAMMING PRODUCTS DIVISION OF
INFO-LITE CORPORATION

PROGRAMMING PRODUCTS

MATRIX PINBOARDS



INFO-LITE has developed a most convenient, compact and economical system for reliable programming and switching • The Matrix Program Board allows a wide variety of switching/programming functions to be performed by simply inserting programming pins (shorting or diode type) into a 2 to 10 deck contact matrix • No accessorise such as "read" "write" equipment are required • Matrix Board features have lead them to be favored over such devices at patchboards, card readers, toggle and thumbwheel switches, mag/punched tape and electronic memories • The two basic uses for Matrix Program Boards are: (1) Cordless patching (input-output switching), using shorting pins; (2) Programmable diode matrices (logic memories), using diode pins • Units with up to 100 x 100 crosspoints can be supplied to meet your requirements, whether for prototype or production quantities.

See Data Sheet MB3 for detailed specifications.

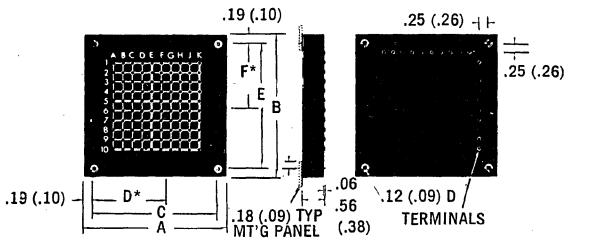
FEATURES

- Reliable closed entry contacts
- Rugged programming pins that will not beind
- Rapid and convenient method of programming/switching
- Permits insertion of components into network without soldering
- Replaces costly complex switching hardware
- Attractive and compact package
- Low capacitance for high frequency applications
- Ease of visual program checking

TYPICAL APPLICATIONS

Numeric Controlled Equipment
Logic Memories
Power Distributors
Circuit/Component Test Programmers
Lighting Systems
Code Generators
Programmable Diode Matrices
Communications Distributors
Status Indicators
Data Logging
Vending Machine Control
Thermo-Couple Selectors
Batching Programmers
Function Generators
Sequence Programmers
Pulse Code Programmers

STANDARD SPECIFICATIONS & STOCK MATRICES FOR 1000 & 2000 SERIES



* ADDITIONAL MOUNTING HOLE POSITION

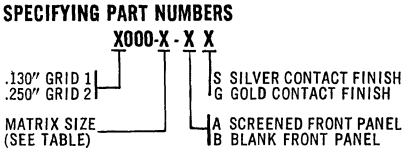
Matrix Size	Dash #	2000 Series — .250" Grid						1000 Series — .130" Grid					
		A	B	C	D	E	F	A	B	C	D	E	F
10 x 10	—1	3.63	3.63	3.25	—	3.25	—	2.02	2.02	1.82	—	1.82	—
10 x 15	—2	3.63	4.93	3.25	—	4.50	—	2.02	2.67	1.82	—	2.47	—
10 x 20	—3	3.63	6.12	3.25	—	5.75	2.75	2.02	3.32	1.82	—	3.12	—
10 x 25	—4	3.63	7.38	3.25	—	7.00	3.50	2.02	3.97	1.82	—	3.77	1.82
10 x 50	—5	3.63	13.62	3.25	—	13.25	4.50	2.02	7.22	1.82	—	7.02	3.51
20 x 20	—8	6.12	6.12	5.75	2.75	5.75	2.75	3.32	3.32	3.12	—	3.12	—
25 x 25	—9	7.38	7.38	7.00	3.50	7.00	3.50	3.97	3.97	3.77	1.82	3.77	1.82
50 x 50	—10	14.4	14.1	14.0	7.00	13.75	7.00	(Currently not available)					

STANDARD SPECIFICATIONS

1 — Contact Type: Closed Entry
2 — Contact Material: Be-Cu, Alloy 25
3 — Contact Finish: a - .0002" Ag over Cu Flash
b - .00002" Min. Au over Ni Flash
4 — Contact Support Material: Silicone Rubber
5 — Contact Resistance: .040 Ohm, typ.
6 — Contact Capacitance: 1 uuf [2 uuf]/in. at 1 MHz, typ.
7 — Bussing: 1st (top) Deck Vertical; 2nd Deck Horizontal
8 — Breakdown Voltage: 1000 VRMS
9 — Current Rating: 5 [2] Amps standard; 10 [4] Amps available
10 — Terminals: Combination Taper Pin Socket/Solder Cup [Solder Cup]
11 — Panel Material: Black XX Grade Phenolic
12 — Panel Marking: Alpha-Numeric/Grid, White Epoxy Ink Screened

NOTE: Values in brackets [ ] are for 1000 Series if two values are given.

SPECIFYING PART NUMBERS

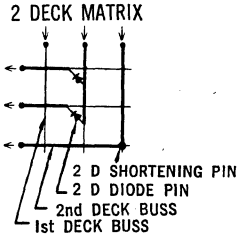


EXAMPLE: A 20 x 20, .250" grid matrix with silver contacts and blank front panel would have Part Number 2000-8-BS. U.S. Patent No. 3,631-374

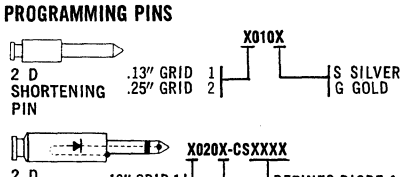
Programming Pins Diode Pins 1000 Series (.13" Grid)	Specifications Diode	Anode To†
1020S-CS0001/-CS0002	1N4151	Tip/Sleeve
1020G-CS0003/-CS0004	1N4151	Tip/Sleeve
2000 Series (.25" Grid)	†On Std. Matrices Tip makes W/2nd Deck.	
2020S-CS0006/CS0007	1N270	Tip/Sleeve
2020S-CS0010/CS0011	1N4151	Tip/Sleeve
2020G-CS0012/CS0025	1N4151	Sleeve/Tip
2020S-CS0014/CS0024	1N4004	Sleeve/Tip
Shorting Pins 1010G & 2010G		

† Sold in multiples of 25 pieces.

SCHEMATIC



PROGRAMMING PINS



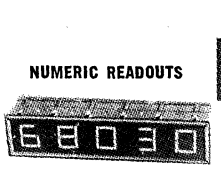
* Diode orientation shown: Anode to Sleeve (1st Deck)

SPECIAL SWITCHING/PROGRAMMING PRODUCTS

CROSSPOINT's advanced manual and electronic programming products cover a selection ranging from simple switches to complex electronic networks. The manual devices combine the ease of a switch with the versatility of a patchboard system. The electronic systems include a wide range of ROM, PROM, EPROM and EROM hardware with software to meet a broad spectrum of customer applications.

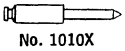
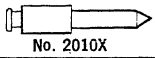
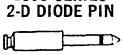
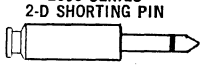
OTHER INFO-LITE PRODUCTS

NUMERIC READOUTS



LIGHTED INDICATORS

STANDARD PROGRAMMING PINS

1000 SERIES 2-D SHORTING PIN	2000 SERIES 2-D DIODE PIN
 No. 1010X	 No. 2010X
1000 SERIES 2-D DIODE PIN	**2000 SERIES 2-D SHORTING PIN**
 No. 1020X-CSXXXX	 No. 2020X-CSXXXX

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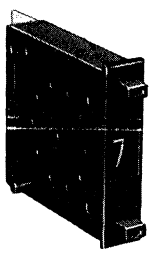
THUMBWHEEL SWITCHES

IMLEC

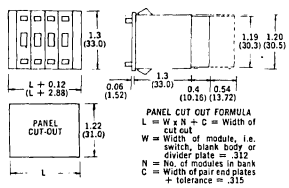


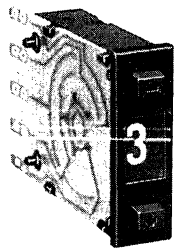
MODEL II IMLEC INDEXER PUSHBUTTON FRONT MOUNT

The Imlec Indexer is a bi-directional push indexing front mount switch, 5/16" in width. Identical in size to our popular MF switches. With snap together banking and snap-in panel mounting. Pushbuttons above and below the legend allow the user to add or subtract from the count.

These 10 or 16-position switches are available in all popular codes.

DIMENSIONS IN INCHES (IN MILLIMETERS)



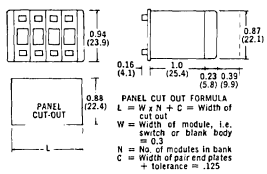


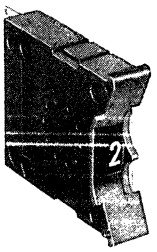
MODEL MI MINI INDEXER PUSHBUTTON FRONT MOUNT

The Mini Indexer is a bi-directional push indexing front mount switch. 0.30" in width. Similar to our Imlec Indexer but smaller in size. Features snap together banking and snap-in panel mounting. Pushbuttons above and below the legend allow the user to add or subtract from the count.

Available in most popular 10-position codes.

DIMENSIONS IN INCHES (IN MILLIMETERS)



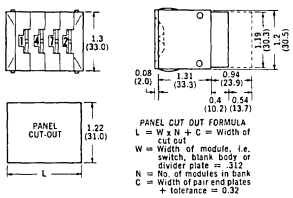


MODEL MF MINIATURE FRONT MOUNT

The MF is our most popular, low cost, 5/16" wide Thumbwheel Switch. Slim, attractive, snap-in panel mounting requires no panel mounting hardware.

Available in all popular 10 and 16-position codes. Matte black finish on high impact moldings, with white legend on black wheel standard.

DIMENSIONS IN INCHES (IN MILLIMETERS)

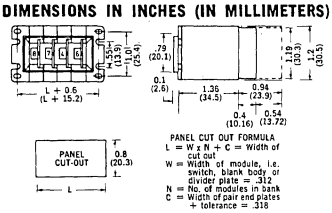


MODEL TR THIN REAR MOUNT

For applications that require a lot of switch in a small space, these 5/16" wide TR switches are ideal. Rear mount counterpart to our popular MF front mount switches.

Available in most 10-position codes including Decimal, BCD, BCD plus Complement and Complement only.

DIMENSIONS IN INCHES (IN MILLIMETERS)

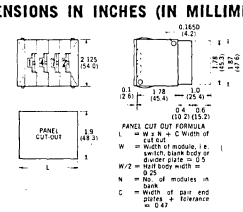


MODEL IF INTERMEDIATE FRONT MOUNT

A rugged front mount switch with large digits, 1/2" wide module. Snap-in front mounting hardware. Available in most popular 10 and 16-position codes.

Matte black finish with white legends on black wheel standard. Gloss fnish, other wheel colors and legends available.

DIMENSIONS IN INCHES (IN MILLIMETERS)

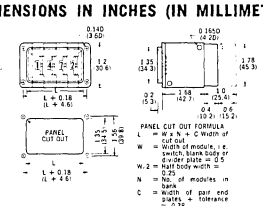


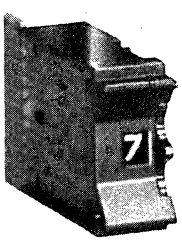
MODEL IR INTERMEDIATE REAR MOUNT

Rugged rear mount counterpart to our IF model, with large readable digits, 1/2" wide module. Available in most popular 10 and 16-position codes.

Matte black finish with white legends on black wheel standard. Gray bodies, gloss finish, other wheel colors and legends available.

DIMENSIONS IN INCHES (IN MILLIMETERS)

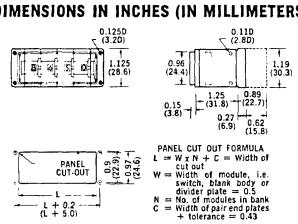




MODEL MR MINIATURE REAR MOUNT

Popular rear mount switch, 1/2" wide module but lower profile than IR model. Available in matte black in most popular 10-position codes including Decimal, BCD, and BCD plus Complements.

DIMENSIONS IN INCHES (IN MILLIMETERS)



Voltage: 200 volts max DC (within power rating) or RMS.

Power: 24 watts max per switch with 12 watts max per energized output.

Insulation Resistance: 1000 megohms between adjacent contacts at 25°C and 20% relative humidity.

Contact Resistance: 0.1 ohms initial and 0.2 ohms after life test at 25°C.

Dielectric Strength: 500 VAC.

Moldings: High impact acetate body in matte black, gloss black or gray finish; wheels are polycarbonate in black with white legends standard, white with black legends for lighted versions, other colors available.

Contact Material: Stator has 0.0001" hard gold over 1 oz. copper on glass fibre as MIL-P-13949GF. Rotor has silver/gold alloy on beryllium copper.

Life: 1,000,000 detents minimum either direction.

Stops: Stops to limit switch to any position.

Panel Thickness: 1/16" to 5/32".

Operating Temperature: −20°C to 70°C. Storage temperature: −40°C to 70°C.

Shock: 100 G's, 6 MS.

Vibration: 15 G's to 70-2000 Hz.

Humidity: 96 HRS, 95% relative.

Options and Accessories Available: Extended Boards for diode suppression; Termination Pins; Stopping; Blank Bodies, Half Bodies; End Plates Divider Plates; Connectors; External LED Lighting; Sealing, etc.

SPECIFICATIONS

ALL MODELS

Contact Current: Contacts rated 2 amps @ 115 VAC or 28 VDC non-switching; 0.5 amps @ 28 VAC or DC switching. Minimum recommended switching current 10 microamps @ 20 millivolts.

HOW TO ORDER

CODE NO.	DESCRIPTION	II	MI	MF	TR	MR	IF	IR
-12	10 pos. Decimal	II-12	MI-12	MF-12	TR-12	MR-12	IF-12	IR-12
-12A	10 pos. Decimal Ext. Board	II-12A	MI-12A	MF-12A	TR-12A	—	IF-12A	IR-12A
-13	10 pos. Decimal 2 pole	II-13	—	MF-13	TR-13	MR-13	IF-13	IR-13
-18	10 pos. BCD Complement Only	II-18	MI-18	MF-18	TR-18	—	—	—
-18A	10 pos. BCD Complement Only Ext. Board	II-18A	MI-18A	MF-18A	TR-18A	—	—	—
-21	10 pos. BCD	II-21	MI-21	MF-21	TR-21	MR-21	IF-21	IR-21
-21A	10 pos. BCD Ext. Board	II-21A	MI-21A	MF-21A	TR-21A	MR-21A	IF-21A	IR-21A
-22	10 pos. BCD and Complement	II-22	—	MF-22	TR-22	MR-22	IF-22	IR-22
-22A	10 pos. BCD and Complement Ext. Board	II-22A	—	MF-22A	TR-22A	MR-22A	IF-22A	IR-22A
-55	16 pos. Decimal 0-15 or 0-F	II-55	—	MF-55	—	—	IF-55	IR-55
-56	16 pos. BCD 0-15 or 0-F	II-56	—	MF-56	—	—	IF-56	IR-56
-57	16 pos. BCD and Comp. 0-15 or 0-F	II-57	—	MF-57	—	—	IF-57	IR-57
-57A	16 pos. BCD and Comp. 0-15 or 0-F Ext. Board	II-57A	—	MF-57A	—	—	IF-57A	IR-57A
-EP	End Plates, Pair	II-EP	MI-EP	MB-EP	TR-EP	MR-EP	IF-EP	IR-EP
-BB	Blank Body	II-BB	MI-BB	MF-BB	TR-BB	MR-BB	IF-BB	IR-BB
-DP	Divider Plate	—	—	MF-DP	TR-DP	MR-DP	IF-DP	IR-DP
-BBH	Blank Body with Decimal Point	II-BBH	MI-BBH	MF-BBH	TR-BBH	MR-BBH	IF-BBH	IR-BBH
-CN	Connector 10 position only	MCN-10	—	MCN-10	MCN-10	—	ICN-10	ICN-10
-HB	Half Body	—	—	—	—	—	IF-HB	IR-HB
IH	Banking Hardwade (insert no. of modules)	—	—	—	—	IH-( )	IH-( )	IH-( )
MFH	Banking Hardwade (insert no. of modules)	—	—	MFH-( )	MFH-( )	—	—	—

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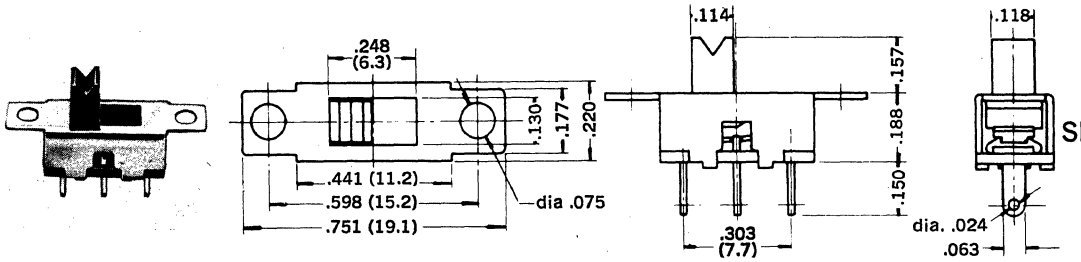
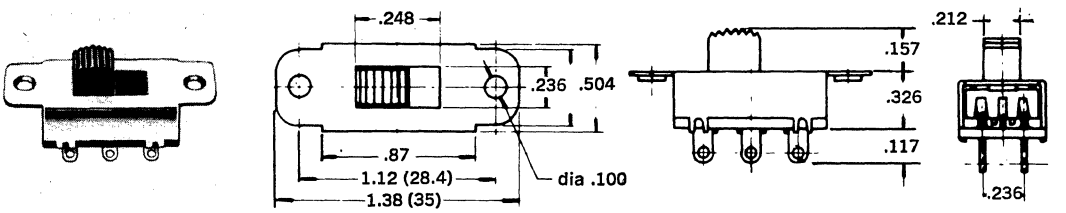
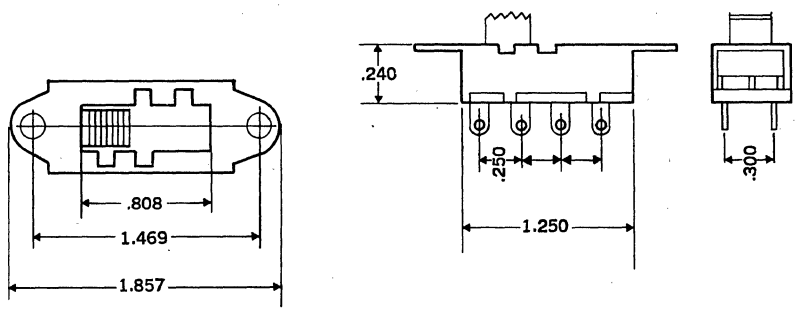


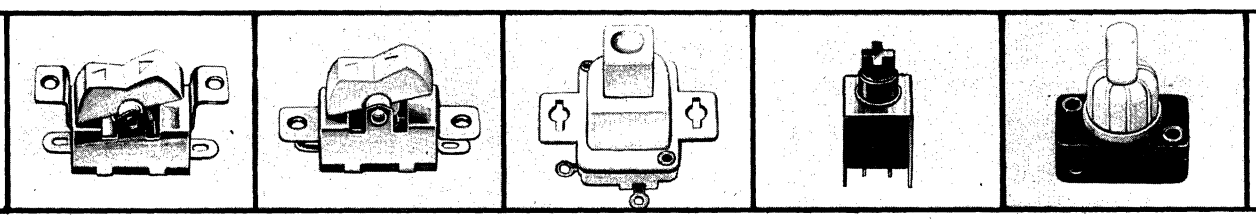
103 SPDT
MINIATURE
SLIDE SWITCH



108 DPDT
CENTER OFF

DPTT
SLIDE SWITCH
4, 6, 8, 11 & 13 amp





ALSO AVAILABLE ARE ROCKER SWITCHES, PUSH BUTTON SWITCHES, AND KEYBOARD SWITCHES

CUSTOM DESIGNS ARE WELCOME, CHALLENGE OUR DESIGN STAFF

ALL DIMENSIONS SHOWN ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTIFICATION.

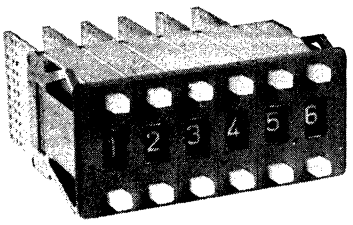
CALL FACTORY FOR COMPLETE DETAILS ON PRODUCTS AVAILABLE AND SPECIFICATIONS.

Thumbwheel Codicount and Multicount

INTERSWITCH
ONE OF THE PURDY GROUP OF COMPANIES

770 AIRPORT BLVD., BURLINGAME, CA 94010 • TEL (415) 347-8217 • TWX 910-374-2353 OR 910-375-2012

New Type D



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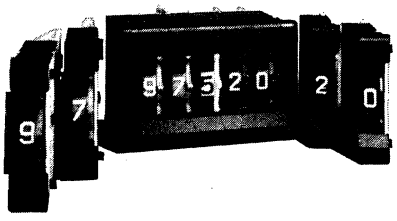
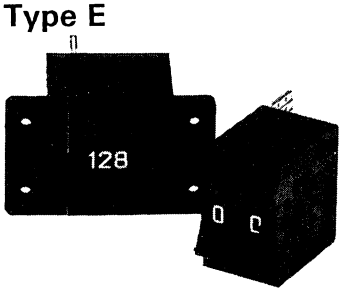


Type E



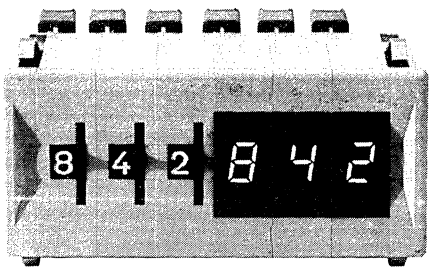
Thumbwheel Switches

Our thumbwheel switches are designed to give the logic and package designer maximum flexibility through an almost unlimited choice of electrical/mechanical configurations, switching logic, terminations, and circuit capacity. Interswitch offers more than 25 different codes including decimal, BCD, hexadecimal, seven segment code, voltage dividers, and resistance decades. Numerous options are available such as long PC boards (for mounting components), colored wheels, stops, and custom markings on housings, spacers and thumbwheels.

Available Switches

Series	A	B	D	E	G	H	L	M	N	P	R	S	U	V	Z
Front Mounting		●	●		●	●		●			●	●	●	●	●
Rear Mounting	●			●			●		●	●					
Width in mm	11	12,5	7,62	16	20	10	8	8	7	10	20	10	8	8	7,62
Height in mm	39	58	24	18	76	33	18	33	18	24	33	33	33	26,5	15
Mounting Depth in mm	53,5	57	33,5	31,5	79	38	31,5	38	31,5	38	38	38	38	34,5	24
Spacer 2,54 mm			●												
Spacer 2,7 mm						●				●		●			

Codicount Displays

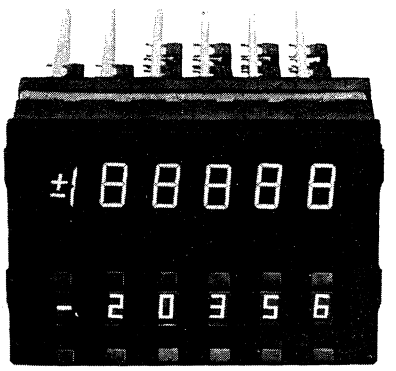


Our highly reliable, compact Codicount LED display modules are easily assembled into multi-decade blocks incorporating the Interswitch thumbwheel series, or used by themselves as output devices.

General Information

- 8 series over 50 models
- TTL or CMOS logic
- 5 to 24V supply voltage
- 9 to 45 mm digit heights
- red or green LED's
- seven segment and sign/overflow displays
- modules are available with direct, decimal, BCD, inverted or counter inputs, memory, and BCD outputs

Multicount Switches



Our versatile Multicount line of seven segment displays with integral decade switches saves valuable panel space and simplifies mounting and wiring.

General Information

- 6 types
- TTL or CMOS logic
- 5V (TTL) or 12V (CMOS) supply voltage
- 9 mm character height
- available functions include decoders w/latch, integral comparators, and pre-setable up-down counters

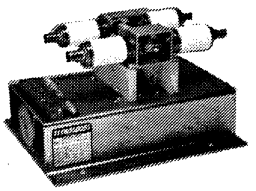
PLEASE CALL OR WRITE FOR COMPLETE ENGINEERING BULLETINS

vacuum contactors

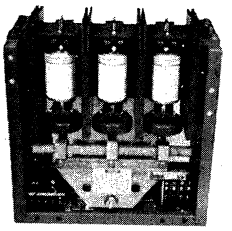
Vacuum Contactors are used to control large amounts of DC power and RF currents with ratings up to 50 kv and currents up to 600 Amperes continuous. These contactors are recommended wherever high voltage capability, small size, and high speed operation with a long and low maintenance life are important. Applications include primary control of power supplies, industrial motors, and induction heating equipment, RF system tap changing, and fault protection of high power transmitters. The 16 page catalog provides complete specifications with a variety of specific applications for 3-pole, high voltage AC and DC, RF contactors and overcurrent relays actuated by solenoid, air or motor drives.

RP101, 103

RP900-901



RT22



RP130, RP170

RP157

GENERAL PURPOSE

Model Number	Test Voltage (Pk KV)	Operate Voltage (Pk KV)	Continuous Current (Amps)	Max. Interrupt AC Current (Amps RMS)	Max. Interrupt DC Power (KW)	Capacitor Discharge Decaying to 0 in 200 μs	Contact Arrangement	Actuator Voltage (Volts)	Time to Close (Ms)	Break Time (Ms)	Weight (Lbs.)
RP101F4903D21B20 RP101F4904D21B20	50	30	200 DC	2000	500 (10 A Max.)	50 K Amps	N/O N/C	115 60 Hz	60	50	8¾
RP101F4304D26B20	50	30	200 DC	2000	500 (10 A Max.)	50 K Amps	N/C	100 DC	55	42	8¾
RP103F4304D26B20			200 RMS	2000	N/A	50 K Amps					
RP103F4903D21B20 RP103F4904W21B20	50	30	200 RMS	2000	N/A	50 K Amps	N/O N/C	115 60 Hz	60 30	50 60	8¾
RP901K4903D21B30 RP901K4904D21B30	70	50	400 DC	4000	500 (10 A Max.)	100 K Amps	N/O N/C	115 60 Hz	60 30	50 60	15
RP901K4601D26B30 RP901K4602D26B30	70	50	400 DC	4000	500 (10 A Max.)	100 K Amps	N/O N/C	100 DC	34 60	11 25	15
RP900K4903D21B30 RP900K4904D21B30	70	50	400 RMS	4000 at 13 KV RMS	N/A	100 K Amps	N/O N/C	115 60 Hz	60 30	50 60	15
RT1G4201C21A10 RT1G4202C21A10	35	20	100	500	100	1 K Amps	N/O N/C	115 AC	60	25 30	2
RT5C4202A21A10	25	15	50	100	50	0.5 K Amps	N/C	115 AC	60	30	1.5

RF

Unit	Pk. Operate Voltage 32 MHz	Contact Current 32 MHz RMS	Contact Resistance Ohms Max.	Contact Capacitance pF	Contact Inductance Nh	Contact Arrangement	Open Time	Close Time	Pull-in Current RMS	Hold Current RMS	Hold Power Watts	Actuating Voltage or Air Pressure	Approx. Weight	Life	Auxiliary Contacts Ratings Volt RMS Current RMS
RT224070A31NB (Solenoid Operated)	5*	25	.0005	2.5	n/a	Latching	<300 Ms.	<300 Ms.	.3	n/a	n/a	230 VAC	12 lbs.	$2.5x10^5$	Form C 230/15
RP233D1585 (Air Operated)	25	35	.0005	2	25	N/O	<200 Ms.	n/a	n/a	n/a	n/a	40 ±5 psig	12 oz.	$1x10^5$	n/a

*Higher voltage ratings available at lower frequencies.

3-PHASE

Model Number	Operate Voltage V (RMS)	Continuous Current 60 Hz	Interrupt Current Amps RMS	Mechanical Life (Min.)	Actuator Voltage	Approx. Pull-in Current Amps Max.	Approx. Hold Current Amps Max.	Interrupt Time	Auxiliary Contacts	Approx. Weight
RP151B4541X46R20	600	200	2000	$1x10^6$	26.5 VDC 100 VDC	3.5 1.1	.5 .07	Less than 2 Cycles	2 SPDT 230 VAC/10A	16 lbs.
RP1574549X41TX0 (60 Hz) RP1574549X4KTX0 (50 Hz)	1500	300	3000	$1x10^6$	115 VAC	15	1.5	Less than 2 Cycles	4 PDT 230 VAC/5A	25 lbs.
RP1574544X44TX0 RP1574544X45TX0 RP1574544X46TX0	1500	300	3000	$1x10^6$	26.5 VDC 48 VDC 100 VDC	24.4 11.3 5.9	.30 .14 .08	Less than 2 Cycles	115 VAC/5A	25 lbs.
RP170-2300	7200	450	4500	$1x10^6$	115/230* VAC	3.5	.5	Less than 2 Cycles	SPST 3 NC/4 NO 600 VAC/10A	85 lbs.
RP130-2330	1500				115 VAC*	5.1	.9			25 lbs.

WRITE FOR OUR VACUUM CONTACTOR CATALOG NO. C403.

* 110 VDC Option Available

ITT JENNINGS Dept. EM, 970 McLaughlin Ave. • San Jose, CA 95122 • (408) 292-4025

DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum interrupters

Industrial Vacuum Interrupters from ITT Jennings offer many advantages over air, oil or hermetically sealed alternatives. They are generally smaller, less expensive to install and maintain, faster, and can be used in hazardous or corrosive environments because of the vacuum sealed contacts. They are especially recommended where dust, high humidity or high altitudes make dielectric strength difficult to maintain.

Specific applications in motor control utilize the models RP130, RP170, or RP157 where low "chop" currents are needed to protect motor windings, and limit switching transients. They are also ideal for mining and heavy industrial equipment applications to 7.2 kV.

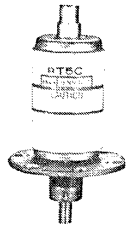
Other ITT Jennings Industrial Vacuum Interrupters are used for switching dust percipitator plates where voltages to 75 kVDC must be controlled in hazardous environments, and to control RF induction, dielectric and arc furnaces. They are also recommended for RF applications such as high power transmitter band switching, coil tap, and filter network switching.

Special Purpose Vacuum Interrupters are used for applications requiring high voltage and current capabilities. They are recommended for high power communications systems for overload circuit breakers, remote control antenna selection, tuning relays, transmission line switching, rapid action crowbar protection, auto grounding for DC power supplies and high voltage pulse network selection switches. These interrupters are also used for coil tap changing, in RF induction and dielectric heating units, in primary and secondary control of large industrial equipment, high voltage capacitor charging and discharging circuits, transient pulse generation, and for safety grounding in high capacitance circuits.

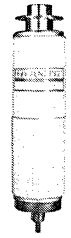
RP157-1
RP151B
RP130

RP951B

RT1



RT5C



RT8

RT22

RF20B

RP233B

VACUUM INTERRUPTERS — INDUSTRIAL

	ELECTRICAL						MECHANICAL					
Model Number	Line to Line Max. Voltage @50/60 Hz KV, (RMS)	50/60 Hz Withstand Voltage KV, RMS	Full Wave Impulse Withstand Voltage KV, Crest	Continuous Current Amps, RMS	Interrupt Current Amps, RMS	Momentary Close & Latch Current Amps, RMS	Contact Stroke Inches	Contact Opening/ Closing Velocity Ft./Sec.	Contact Opening Force from 1 Atmos. Lbs.	Weight Lbs./Oz. Nom.	Moving Part Weight Lbs. Nom.	Mechanical Life @ Rated Current Operation x 10^4
RP130*	1.5	6.5	30	450	4500	28,000	.09	1.1/2.5	12	.8	.3	100
RP157-1*	5	11.5	45	300	4500	28,000	.110	2.5/2.0	10	1.1	.4	200
RP170*	7.2	20	60	450	4500	55,000	.187	2.5/2.0	16.5	2.7	.6	100**
RP151B	5	21	60	200	2000	20,000	.160	1.0/1.0	2.5	2.0	.25	25
RP951B	5	27	60	600	4000	20,000	.25	2.5/2.0	15	7.0	1.5	50

* Chop Current is less than 1.5 amps in a 30 amp circuit with an impedance of 1000 Ohms.
** Consult factory for extended life to 250 x 10^4 operations.

VACUUM INTERRUPTERS — SPECIAL PURPOSE

	ELECTRICAL									MECHANICAL						
Model Number	Line to Voltage, KV Peak				50/60 Hz Withstand Voltage KV, RMS	Continuous Current Amps				Contact Resistance μOhms, Max.	Contact Stroke Inches	Contact Opening/ Closing Velocity (FpS)	Force Required for Specified Gap Lbs.	Added Contact Force, Lbs. for Max. Current Rating	Weight Lbs. Max.	Mechanical Life @ Full Gap Ops. x 10^4
	DC	300 kHz	10 MHz	30 MHz		DC	300 kHz	10 MHz	30 MHz							
RT1		30	25	18	50		90	25	15	300	.09	1.0	10	30	2	10
RT1G	30				50	200				300	.09	1.0	10	30	2	10
RT5C		15	12	9	25		30	22	18	10	.156	1.0	15	30	1	10
RT8		50	30	25	50		80	40	35	150	.16	1.0	10	30	3	10
RT8A	40				60	300				300	.16	1.0	10	30	4	10
RT22		22	15	10	25		40	25	20	1.0	.07	1.0	14	10	1	25
RF20B		40	30	20	40		400	220	100	0.4	.10	N/A	15	24	3	100
RP233B		40	35	25	40		50	45	35	0.4	.13	1.0	6	10	1	10

SEND FOR 20 PAGE VACUUM INTERRUPTER CATALOG.

ITT JENNINGS Dept. EM, 970 McLaughlin Ave. • San Jose, CA 95122 • (408) 292-4025

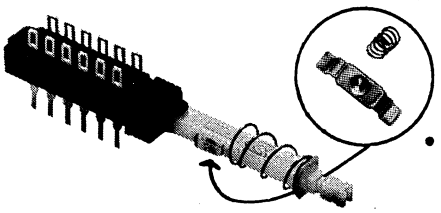
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

MODULAR PUSH BUTTON SWITCHES

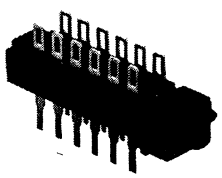
"Creative Switchmakers" for Home Entertainment Products and Test Equipment

If it's a better switch you need . . . better switch to Schadow!

better switch... here's why...



HAND WIRING AND FLO-SOLDERING CONNECTIONS ARE STANDARD
- Solder lugs on top for hand wiring
- PC spikes at bottom for flo-soldering



SUPERIOR MODULAR CONSTRUCTION
- Ease of maintenance . . . switch plunger with sliding contacts is removable from the front without disturbing electrical connections

INDIVIDUAL COIL SPRING LOADED MOVING CONTACTS
- The coil spring-loaded contoured moving contacts have been designed to provide balanced contact pressure for optimum surface to surface interface with the fixed contacts . . . assuring reliable performance in low voltage (dry circuit) applications
- Long term low contact resistance
- Constant coil spring tension at the contact points provides positive self-cleaning action

MODULE ADVANTAGES
- Enclosed housing protects inner contact area from dust and foreign intrusions
- Fixed terminals are "staked" in position, providing an extra seal to help prevent wicking of solder or flux
- Molded PC Board Standoffs, front and back, on bottom side, assure parallel mounting

TECHNICAL DATA

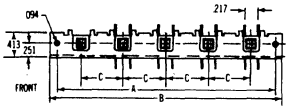
Contact Resistance .....4-6 mOhms after 25,000 cycles .....6-20 mOhms
Lifetime Expectation Interlocked (50,000) Momentary, Push Push (100,000) cycles
Material of Construction
Fixed contact. Brass/Silver Plated .....0002"
Moving contact .....Bimetal Brass/Silver .0004"
Plunger Material....Polycarbonate V-0 rated or Delrin
Contacts .....Non-shorting
Housing Material.....Polycarbonate V-0 rated or Glass Reinforced Nylon
Terminal Board Material .....High Grade Paper Phenolic or V-0 rated material.....Series F
Key pressure with 2PDT .....28 oz.
Key pressure with 4PDT .....32 oz.
Key pressure with 6PDT .....35 oz.
Key pressure with 8PDT .....42 oz.
Key pressure with 10PDT .....46 oz.
Key pressure with Power Switch .....42 oz.

NOTE: Lighter key pressures available, contact factory for details.

NOTE: For switching applications requiring flame retardant materials, contact factory.

CHASSIS DIMENSIONS FOR SERIES F

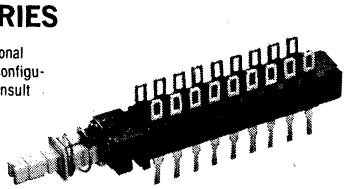
NOTE: Maximum stations to be grouped in one interlocking action. 10mm-10/12.5mm-23/15mm-23/17.5mm-23/20mm-19



No. of Stations	C Dim. 10mm (.394) A MTG. O - ALL	B MTG. O - ALL	C Dim. 12.5mm (.492) A MTG. O - ALL	B MTG. O - ALL	C Dim. 15mm (.590) A MTG. O - ALL	B MTG. O - ALL	C Dim. 17.5mm (.689) A MTG. O - ALL	B MTG. O - ALL	C Dim. 20mm (.787) A MTG. O - ALL	B MTG. O - ALL
2	1.181	1.575	1.201	1.811	1.378	1.969	1.476	2.165	1.811	2.362
3	1.575	1.969	1.693	2.185	1.969	2.560	2.165	2.854	2.362	3.150
4	1.969	2.362	2.185	2.677	2.560	3.150	2.854	3.543	3.150	3.937
5	2.362	2.756	2.677	3.169	3.150	3.740	3.543	4.232	3.937	4.724
6	2.756	3.150	3.169	3.661	3.740	4.331	4.232	4.921	4.724	5.512
7	3.150	3.543	3.661	4.154	4.331	4.921	4.921	5.610	5.512	6.299
8	3.543	3.937	4.154	4.646	4.921	5.512	5.610	6.299	6.299	7.087
9	3.937	4.331	4.646	5.138	5.512	6.102	6.299	6.988	7.087	7.874
10	4.331	4.724	5.138	5.630	6.102	6.693	6.988	7.677	7.874	8.661
11	4.724	5.118	5.630	6.122	6.693	7.283	7.677	8.366	8.661	9.005
12	5.118	5.512	6.122	6.614	7.283	7.874	8.366	9.055	9.449	9.843
13	5.512	5.906	6.614	7.106	7.874	8.465	9.055	9.646	10.236	10.630
14	5.906	6.299	7.106	7.598	8.465	9.055	9.646	10.236	11.024	11.417
15	6.299	6.693	7.598	8.091	9.055	9.646	10.236	10.827	11.811	12.205
16	6.693	7.087	8.091	8.583	9.646	10.236	10.827	11.417	12.598	12.992
17	7.087	7.480	8.583	9.075	10.236	10.827	11.417	12.008	12.992	13.386
18	7.480	7.874	9.075	9.567	10.827	11.417	12.008	12.598	13.780	14.173
19	7.874	8.268	9.567	10.059	11.417	12.008	12.598	13.189	14.567	14.961
20	8.268	8.661	10.059	10.551	12.008	12.598	13.189	13.780	14.370	14.961
21	8.661	9.055	10.551	11.043	12.598	13.189	13.780	14.370	14.961	15.551
22	9.055	9.449	11.043	11.535	13.189	13.780	14.370	14.961	15.551	16.142
23	9.449	9.843	11.535	12.028	13.780	14.370	14.961	15.551	16.142	16.732
24	9.843	10.236	12.028	12.520	14.370	14.961	15.551	16.142	16.732	17.323
25	10.236	10.630	12.520	13.012	14.961	15.551	16.142	16.732	17.323	
26	10.630	11.024	13.012	13.504	15.551	16.142	16.732	17.323		
27	11.024	11.417	13.504	13.996	16.142	16.732	17.323			
28	11.417	11.811	13.996	14.488	16.732	17.323				
29	11.811	12.205	14.488	14.980	17.323					
30	12.205	12.598	14.980	15.472						
31	12.598	12.992	15.472	15.965						
32	12.992	13.386	15.965	16.457						
33	13.386	13.780	16.457	16.949						
34	13.780	14.173	16.949							
35	14.173	14.567								
36	14.567	14.961								
37	14.961	15.354								
38	15.354	15.748								
39	15.748	16.142								
40	16.142	16.535								
41	16.535	16.929								
42	16.929	17.323								
43	17.323									

F SERIES

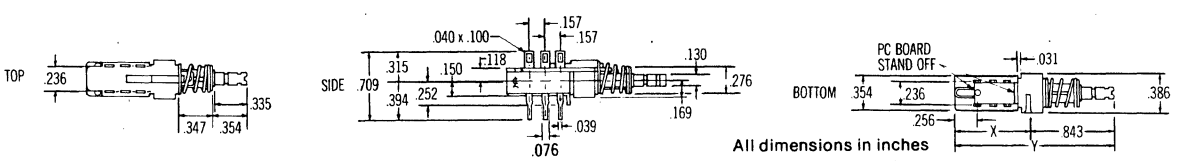
For additional terminal configurations consult factory.



F-6U
6P DT

MODULE DIMENSIONS

	X	Y
2PDT	.827	1.670
4PDT	1.300	2.143
6PDT	1.772	2.615
8PDT	2.244	3.087
10PDT	2.716	3.559
16PDT		



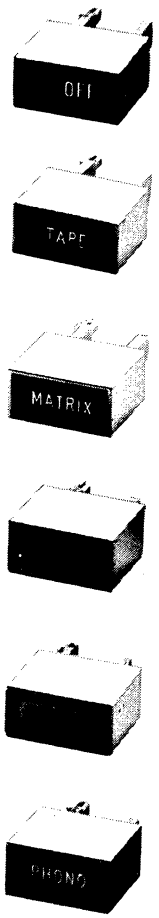
All dimensions in inches

ITT ITT Schadow inc

Dept. EM, 8081 Wallace Road, Eden Prairie, MN 55344 • (612) 934-4400
TWX 910-576-2469 • TELEX: 29-0556
Manufacturing facilities in
Minneapolis, Minnesota; Einbeck, W. Germany; W. Berlin, Cucq, Dole, France and Singapore
In Canada: ITT Components, 4001 Chesswood Drive, Downsview, Ontario M3J 2R8
(416) 630-7971 • TELEX: 06-22703

NEED GRAPHICS?

Several examples are shown below. Your specific requirements quoted on request. (Graphics pictured on FA 100 push buttons)



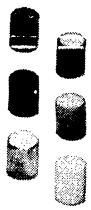
right on the button . . .

standard buttons for Series F and G Switches

Rectangular buttons also can be snapped on vertically to provide more selection of larger buttons on smaller chassis spacing. Standard colors shown . . . other colors to match or contrast with your equipment available on special order.

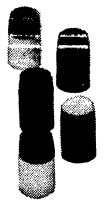
Rectangular buttons also can be snapped on vertically to provide more selection of larger buttons on smaller chassis spacing. Standard colors shown . . . other colors to match or contrast with your equipment available on special order.

FG
Diameter: .346"
Length: .413"
Standard Minimum Spacing: 10mm
Colors: Black, White, Grey, Red, Green, Chrome

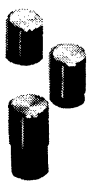


F-2C0
Diameter: .394"
Length: .433"
Standard Minimum Spacing: 12.5mm
Colors: Chrome/ Black, Black/ Black

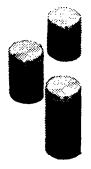
FZ
Diameter: .394"
Length: .642"
Standard Minimum Spacing: 12.5mm
Colors: Black/Black, White/Black, White/Red, Red/Black, Red/Grey



F1.12 - H-3
F1.15 - H-3
F1.21 - H-3
Diameters: .433", .433", .433"
Lengths: .472", .591", .827"
Cap Depth: .472"
Standard Minimum Spacing: 12.5mm
Colors: Black/ Metal Cap

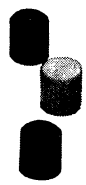


F1.12 - H-4
F1.15 - H-4
F1.21 - H-4
Diameters: .394", .394", .394"
Lengths: .472", .591", .827"
Cap Depth: .079"
Standard Minimum Spacing: 12.5mm
Colors: Black/ Metal Cap



F1.12 - H-5
F1.15 - H-5
F1.21 - H-5
Diameters: .480", .480", .480"
Lengths: .571", .689", .925"
Cap Depth: .571"
Standard Minimum Spacing: 12.5mm
Colors: Black/ Chrome

FGK
Diameter: .473"
Length: .492"
Standard Minimum Spacing: 12.5mm
Colors: Red, White, Black, Grey, Green

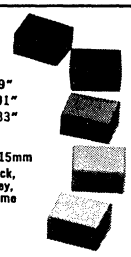


FSC
Width: .386"
Height: .217"
Length: .441"
Standard Minimum Spacing: 10mm
Colors: White, Black, Grey

FSD
Width: .484"
Height: .276"
Length: .413"
Standard Minimum Spacing: 12.5mm
Colors: Black, White, Grey

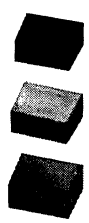
FU12
Width: .470"
Height: .216"
Length: .440"
Standard Minimum Spacing: 12.5mm
Colors: Black, White, Grey, Red

FSB
Width: .579"
Height: .291"
Length: .433"
Standard Minimum Spacing: 15mm
Colors: Black, White, Grey, Red, Chrome



FE
Width: .681"
Height: .236"
Length: .472"
Standard Minimum Spacing: 17.5mm
Colors: Black, White, Grey.

FSA
Width: .677"
Height: .315"
Length: .512"
Standard Minimum Spacing: 17.5mm
Colors: Black, White, Grey
Inserts: Silver or Gold

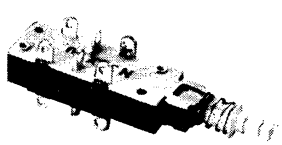


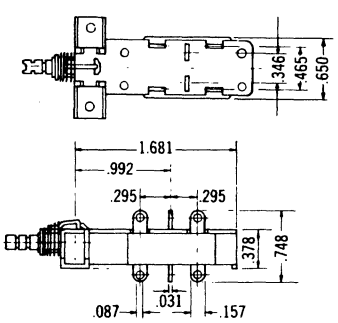
FA
Width: .772"
Height: .394"
Length: .453"
Standard Minimum Spacing: 20mm
Colors: Black, White, Grey,

04-7060-00
Width: .487"
Height: .487"
Length: .590"
Cap Depth: .480"
Standard Minimum Spacing: 12.5mm
Colors: Spun-Finish Chrome

N30 TV-5 rated power switches

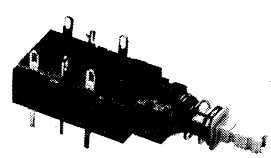
(Also available with 2PDT low voltage auxiliary contacts) UL, CSA, VDE Approved.

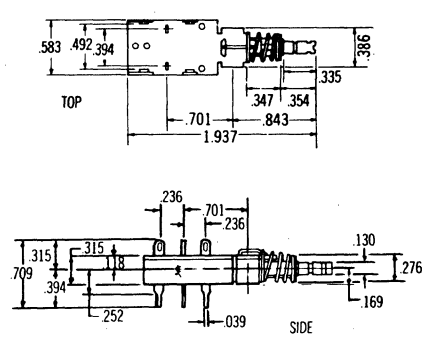




Series NE 15/F line switches

(Also available with 2PDT low voltage auxiliary contacts) UL, CSA, VDE Approved, 4 AMP 250 VAC.





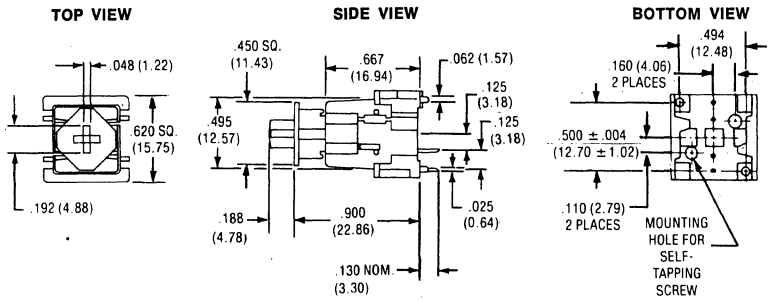
ITT ITT Schadow inc

DC50 Series Key Switches (Full Travel)

The DC50 Series exceptional reliability and outstanding performance is achieved through ITT Schadow's patented diaphragm process which sandwiches two gold-plated contacts between Mylar* and stainless steel to permanently protect them from damage and environmental contamination.

- Modular construction
- Tease-proof action
- Tactile feedback
- Contact bounce less than 2 milliseconds
- Membrane contact

(0° KEYSTEM EXAMPLE)

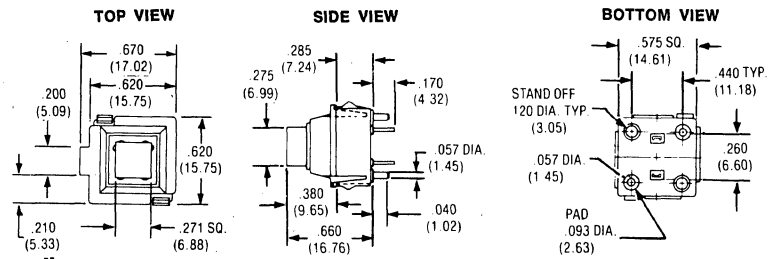


DC60 Series Key Switches (Full Travel)

The ITT Schadow DC60 Series Key Switches are value engineered to achieve the highest possible performance at a much lower cost than conventional mechanical switches.

- Choice of 3 low profile
- Trifurcated gold-inlayed contacts
- Snap fit sub panel mounting
- Tactile feedback
- Variety of actuation forces
- Momentary or push push action
- 61-01 complies with European D.I.N. specifications
- Modular construction

(DC61-01 EXAMPLE)

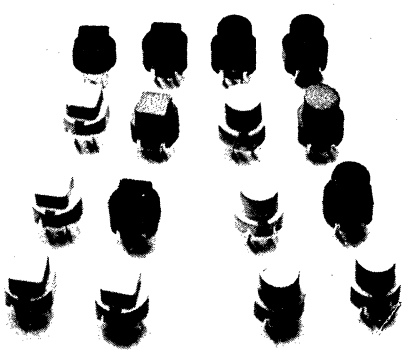


D.I.N. Compliance

ITT Schadow's DC61-01 and DC61-02 Full Travel Key Switches are among the lowest profile module Key Switches ever built. This low profile conforms to strict European health and safety regulations by complying to their D.I.N. standard. So if you are now selling or ever plan to sell to the European market, you owe it to yourself to take a look at these low profile switches.

D6 Series Key Switches

The D6 is a single pole, single throw normally open key switch specially designed for digital electronic control. Its small size enables keyboard design with minimum center spacing of .500 (12.70mm). The commoned terminals offer the possibility of X. Y coding by using a single sided printed Circuit Board.
Built-in buttons (square or round) are available in several colors and have been designed to fit directly onto front panels. The total travel of .031 (0.80mm) combined with the snap effect provide the user with a smooth, gentle yet positive tactile feedback.

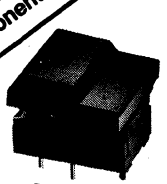


- Tactile feedback
- Three package styles
- Eight colors
- Commoned terminals
- Small size .500 (12.70mm)
- Low cost

ELECTRICAL DATA

Electrical diagram SPST NO		Electrical diagram SPST NO	
Contact resistance	≤20 mΩ	Contact bounce	3 ms
Breaking capacity	10 mA/35 VDC	Life (nominal current and voltage)	500,000 Cycles
Insulation resistance	100,000 MΩ	Temperature range	−20°C to +65°C
Dielectric strength	500 V	Climatic category	21 days
Inter-terminal capacity	1 pF	Solderability	235°C during 5 seconds

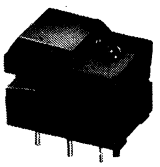
digitast modular electronic switch input component



digitast

SR 12.3mm wide x 17.1mm

ST 17.3mm wide x 17.1mm (pictured)

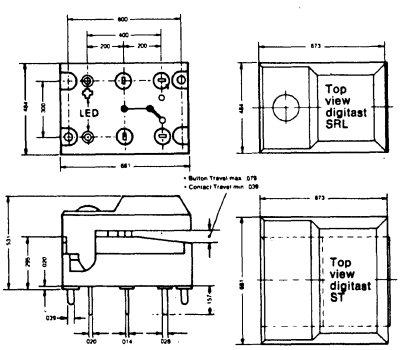


digitast

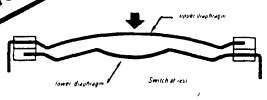
SRL (LED factory or customer installed) 12.3mm wide x 17.1mm (pictured)

STL (LED factory or customer installed) 17.3mm wide x 17.1mm

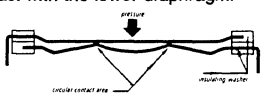
Digitast for use with DIP packages, consistent tactile feel, SPDT momentary spring loaded contact, less than 1 ms contact bounce, 24v 10ma or 60v 100ma ratings. Mechanical life greater than 1 million operations. Available with built in LED. PCB mounting. Hot stamped graphics available.



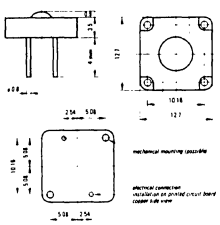
low cost
3 point contact
highest integrity
disc switch
modular electronic components

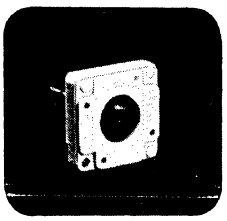


The Disc switch is built around two contact diaphragms separated by an insulating material. The profile of each of these two diaphragms is such that, under the action of applied pressure on the upper dome, it is momentarily collapsed, making instant positive, 3 point contact with the lower diaphragm.

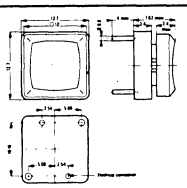


- High Reliability...10 X 10^6
- Self Cleaning
- Broad Range of Switching Power...from a few milliwatts to 30 watts.
- Low Bounce (less than 100 microseconds)

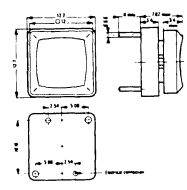


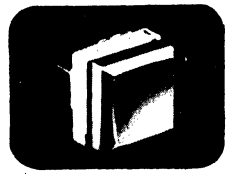


MD Disc module: Extra-flat momentary contact module. Shorter stroke configuration installable directly on printed circuit board. Enables you to design your own keyboard adapted to your own specific needs.



ED Push button switch assembly with a momentary action contact and incorporating the unique design disc switch. The switch is designed for direct insertion into printed circuit boards. Two principal advantages of the MDP switch are the short stroke (only 0.5 mm) and the crisp tactile feel.





MDP Push button switch assembly with a momentary action contact and incorporating the unique design disc switch. The switch is designed for direct insertion into printed circuit boards. Two principal advantages of the MDP switch are the short stroke (only 0.5mm) and the crisp tactile feel. Contact arrangement: single, normally open contact with momentary action. TERMINALS: tinned terminals — 0.8mm dia. x 4mm long. SOLDERING: Since the disc switch is completely sealed, it can be flow soldered. PUSH BUTTONS AND KEYS: dimensions (mm) 12.7 x 12.7 x 3.4 (7.62 with key). STANDARD COLORS: red, blue, light grey, dark grey.

PUSH BUTTON SWITCH SERIES

Option Guide: To allow quick option selection at a glance.

LT Series Light Touch Push Buttons: The Light Touch Series of push button switches offers all the reliability and versatility of the F Series switch system with dramatically lower actuation forces.

F Series Miniature Push Button: The F Series miniature push button switch forms a versatile system of modules designed for reliable performance in low voltage (dry circuit) applications.

F Series Power Switches: F Series power switches form an integral or stand alone option to our standard F Series. All mechanical functions performed by the F Series are available in the power switch offering with the exception of lockout.

F Series Options:
- Panel Mount, ZF and FPM
- Lampless status indicators
- Illuminated buttons
- Non-illuminated buttons

KEY SWITCH SERIES (Low Travel)

Digitast Series: The Digitast Series key switch is specially designed for use with dual in-line packages, yet offers a wide variety of options.

REK Series: The REK Series key switch is designed for switching low current loads utilizing a patented contact system resulting in high reliability and long operating life.

Disc Series: The Disc Series key switch is built around two contact diaphragms separated by an insulating material designed for instant contact with the advantage of being a self-cleaning contact with tactile feed back.

D6 Series: The D6 Series key switch is a single pole, single throw key switch designed for digital electronic control allowing keyboard design with a minimum center spacing of .500 (12.70).

KEY SWITCH SERIES (Full Travel)

DC50 Series: The DC50 Series exceptional reliability and outstanding performance is achieved through ITT Schadow's patented diaphragm process which sandwiches two gold-plated contacts between mylar and stainless steel to permanently protect them from damage and environmental contamination.

DC60 Series: The DC60 Series key switches are value engineered to achieve the highest possible performance at a much lower cost than conventional mechanical switches.

ROTARY SWITCH SERIES (Closed Deck)

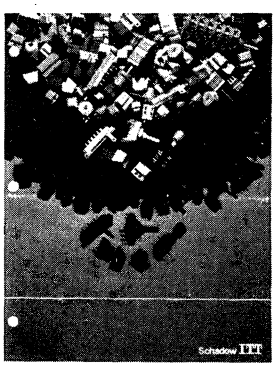
RT-A Series: The RT-A Series rotary switch is a PC or panel mounted switch with the shaft perpendicular to the PC Board for mounting with components such as displays and indicators.

RBP-12 Series: The RBP-12 Series rotary switch is designed with index and contacts contained within a single molded plastic case with many contact variations available.

MIL Series: The MIL Series rotary switch is a totally sealed miniature rotary that can be custom built to fit almost any packaging requirement.

ROTARY SWITCH SERIES (Open Deck)

MA/MAY/MAO/MO Series — SZ/SZY/SZO/SZV Series: The MA and SZ Series low current rotary switches can be ordered with multiple contact styles in silver, silver plated or gold.



Please write to your nearest Sales Office or Distributor, or to ITT Schadow for a free copy of the 1983 ITT Schadow product catalog. This catalog covers the following switch series . . .

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ITT ITT Schadow inc

Dept. EM, 8081 Wallace Road, Eden Prairie, MN 55344 • (612) 934-4400
TWX 910-576-2469 • TELEX 29-0556

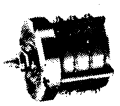
Manufacturing facilities in
Minneapolis, Minnesota; Einbeck, W. Germany; W. Berlin, CUCQ and Dole, France; and Singapore
In Canada: ITT Components, 4001 Chesswood Drive, Downsview, Ontario M3J 2R8
(416) 630-7971 • TELEX: 06-22703

Series "A" Miniature Rotary Selector Switches

QPL MIL-S-3786

- TOTALLY ENCLOSED
- EXPLOSION PROOF

Series A-15 — 15°

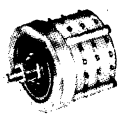


ELECTRICAL RATING:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

A15-1 Series 1 pole/deck
A15-2 Series 2 pole/deck
A15-3 Series 3 pole/deck
A15-4 Series 4 pole/deck
A15-6 Series 6 pole/deck

Max. Positions: 24
Body Diameter: 2″

Series A-20 — 20°

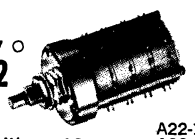


ELECTRICAL RATING:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

Max. Positions: 18
Body Diameter: 2″

Available only in single pole per deck construction.

Series A-22 — 22½°

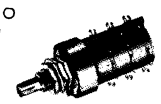


ELECTRICAL RATING:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

A22-1 Series 1 pole/deck
A22-2 Series 2 pole/deck
A22-4 Series 4 pole/deck

Max. Positions: 16
Body Diameter: 1.5″

Series A-30 — 30°



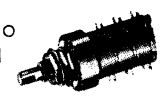
ELECTRICAL RATING:
2 amps 115 v ac Res.
1 amp 28 v dc Res.
0.5 amp 28 v dc Ind.

A30-1 Series 1 pole/deck
A30-2 Series 2 pole/deck
A30-3 Series 3 pole/deck
A30-4 Series 4 pole/deck
A30-6 Series 6 pole/deck

Max. Positions: 12
Body Diameter: 1.036″

"M" Series
See MIL-S-3786/4

Series A-36 — 36°



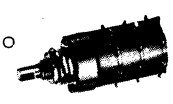
ELECTRICAL RATING:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

A36-1 Series 1 pole/deck
A36-2 Series 2 pole/deck

Max. Positions: 10
Body Diameter: 1.036″

"M" Series
See MIL-S-3786/4

Series A-45 — 45°



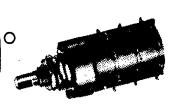
ELECTRICAL RATING:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.

A45-1 Series 1 pole/deck
A45-2 Series 2 pole/deck

Max. Positions: 8
Body Diameter: 1.036″

"M" Series
See MIL-S-3786/4

Series A-60 — 60°



ELECTRICAL RATING:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

Available only in single pole per deck construction.

Max. Positions: 6
Body Diameter: 1.036″

"M" Series See MIL-S-3786/4

Series A-90 — 90°

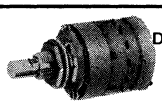
ELECTRICAL RATING:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.

Available only in single pole per deck construction.

Max. Positions: 4
Body Diameter: 1.036″

"M" Series See MIL-S-3786/4

Series	Index
AA30	— 30°
AA36	— 36°
AA45	— 45°



Directly interchangeable with "A" Series above.

ADJUSTABLE STOPS

Max. Positions: AA30-12 AA36-10 AA45-8
Body Dia.: 1.036″ Meets MIL-S-3786

JANCO CORPORATION

Series "B" Micro-Miniature Rotary Selector Switches

QPL MIL-S-3786

- TOTALLY ENCLOSED
- EXPLOSION PROOF
- UNITIZED CONSTRUCTION

All switches offer maximum protection against radio frequency interference.

Body Diameter: .623″

Electrical Rating Continuous:
8 amps at 28 v dc

Switching Rate:
0 to 0.25 amp resistive
0 to 28 v dc
0 to 0.25 amp resistive
0 to 115 v ac
0 to 0.12 amp inductive
0 to 28 v dc

Torque: 5 to 9½ ounces

Contact Resistance:
.005 ohms average

Insulation Resistance:
100,000 megohms minimum at 100 volts
10,000 megohms minimum at 500 volts

Designed and Built to meet the environmental and functional requirements of MIL-S-3786

Series B-30 — 30°

B30-1 Series 1 pole/deck
B30-2 Series 2 pole/deck
B30-3 Series 3 pole/deck

Max. Positions: 12
Body Diameter: .623″

"M" Series
See MIL-S-3786/13

Series B-36 — 36°

B36-1 Series 1 pole/deck
B36-2 Series 2 pole/deck

Max. Positions: 10
Body Diameter: .623″

"M" Series
See MIL-S-3786/13

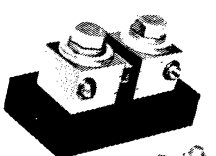
Series B-45 — 45°

B45-1 Series 1 pole/deck
B45-2 Series 2 pole/deck

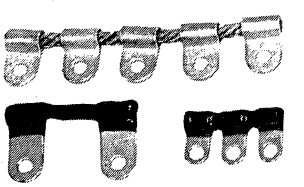
Max. Positions: 8
Body Diameter: .623″

"M" Series
See MIL-S-3786/13

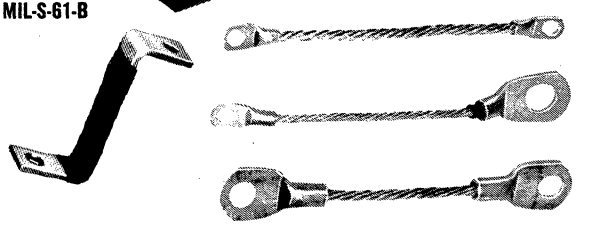
ELECTRICAL HARDWARE PRODUCTS FOR AIRCRAFT



EXTERNAL AMMETER SHUNTS MIL-S-61-B



FLEXIBLE BUS ASSEMBLIES



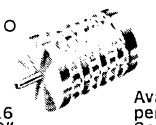
BUS BARS

BONDING JUMPERS

JANCO CORPORATION
Box 3038 • 3111 Winona Ave., Burbank, CA 91504 • (213) 846-1800 • TWX 910-498-2701

Series "C" Rotary Selector Switches

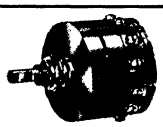
Series C-22 — 22½°



Max. Positions: 16
Body Diameter: 3″

ELECTRICAL RATING:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
6 amps 28 v dc Ind.
Available only in single pole per deck construction.
Screw terminals only.

Series C-30 — 30°



Max. Positions: 11 plus off
Body Diameter: 2.180″

ELECTRICAL RATING:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
C30-1 Series 1 pole/deck
C30-3 Series 3 pole/deck
Screw terminals only.

Series C-36 — 36°

Max. Positions: 9 plus off
Body Diameter: 2.375″

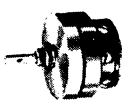
ELECTRICAL RATING:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
Available only in single pole per deck construction.
Screw terminals only.

Series C-45 — 45°

Max. Positions: 7 plus off
Body Diameter: 1.93″

ELECTRICAL RATING:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
C45-1 Series 1 pole/deck
C45-2 Series 2 pole/deck
Screw terminals only.

Series C-90 — 90°



Max. Positions: 4
Body Diameter: 2.12″
Screw terminals only.

ELECTRICAL RATING:
1 pole construction:
15 amps Res. 115 v ac
15 amps Res. 28 v dc
10 amps Ind. 28 v dc
2 pole construction
7.5 amps Res. 115 v ac
7.5 amps Res. 28 v dc
5 amps Ind. 28 v dc
C90-1 Series 1pole/deck
C90 Series 2 pole/deck

GENERAL SPECIFICATIONS

All switches offer maximum protection against radio frequency interference.

ELECTRICAL RATING:
Carry 10 amps continuous.
Make and Break — see individual switch data.

VOLTAGE DROP:
0.1 volt or less at rated amperage.
Initial Contact Resistance: .003 ohm.

LIFE:
10,000 double cycles make and break rated amperage.

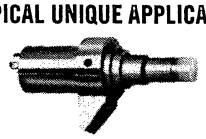
TORQUE:
1 to 3 inch lbs.

SWITCHES DESIGNED AND BUILT IN ACCORDANCE WITH THE FOLLOWING SPECS.:
MIL-S-6807 (rotary switches enclosed)
MIL-S-3786 (rotary switches)
MIL-E-5272 (environmental testing)

ON MOST OF THE SWITCHES LISTED, THE FOLLOWING FEATURES ARE AVAILABLE:

- O-ring Shaft and Panel Seal
- Combination of Decks
- Bridging contacts
- Momentary positions
- Isolated positions
- Adjustable stops
- Solenoid driven
- Keylock
- Gang switches
- Concentric shaft switches

TYPICAL UNIQUE APPLICATIONS OF JANCO ROTARY SWITCHES



DOUBLE MOMENTARY ACTION
Push button switch designed for grip stick applications. Actuation to first momentary detented position closes first circuit. Second detented position completes second circuit.

FEATURES UNIQUE ON-OFF OPERATION
Actuated by pulling knob out and rotating to "on" positions. While in "on" positions, circuitry cannot be shut off until knob is returned to "off" position and depressed.

MASTER COMMUNICATIONS SWITCH
Provides standard coded outputs and offers unique switching functions by longitudinal shaft movement. Momentary or maintained contact positions actuated by pulling shaft.

JET ENGINE START SWITCH
Knob is depressed and contacts are held in by the solenoid. After jet engine reaches desired RPM, system removes power disengaging solenoid. Lighted knob indicates function.

JANCO CORPORATION

Since 1947

Series "D" Pushbutton Rotary Switches

QPL MIL-S-22710

FEATURES: • Totally enclosed, explosion proof. • Printed-circuit construction. • Black or white numbers on black or white background indicate switch positions (black numbers on white background for lighted switches). • All standard codes available. Available in 8, 10, 12 or 16 positions. • Plastic covered buttons, available in black, red, green, yellow, white or blue.

Series	Indexing	No. of Positions
D45U	45°	8
D36U	36°	10
D30U	30°	12
D22B, D22U	22½°	16
D45B	45°	8
D36B	36°	10
D30B	30°	12
DA45U	45°	8
DA36U	36°	10
DA30U	30°	12

MAKE AND BREAK
.125 amp res. at 28 v dc and 115 v ac
.05 amp ind. at 28 vdc

PUSH FORCE:
55 oz. max.

CONTACT RESISTANCE:
Initial .100 ohms
After life .160 ohms

LIFE:
50,000 cycles
Cycle consists of 720° rotation

INSULATION RESISTANCE:
5,000 megohms

ALTITUDE:
70,000 ft.

TEMPERATURE RANGE:
−65°C to +85°C

PLUNGER TRAVEL:
.180 approx.

DIELECTRIC STRENGTH:
750 volts RMS

WEIGHT:
½ oz. approx.

Series "E" Rotary Selector Switches PRINTED CIRCUIT

Series	Indexing	No. of Positions
MINIATURE EA45	45°	8
EA36	36°	10
EA30	30°	12
EA22	22°	16
MICRO-MINIATURE EB45	45°	8
EB36	36°	10
EB30	30°	12
MINIATURE EC45	45°	8
EC36	36°	10
EC30	30°	12
EC22	22°	16
EC18	18°	20
EC15	15°	24

- Totally enclosed, explosion proof.
- Printed circuit construction.
- Make and break:
  .125 amp Res. @ 28 v dc
  .125 amp Res. @ 115 v ac
  .05 amp Ind. @ 28 v dc
- All standard codes available.
- Current carrying capacity, 3 amps continuous.
- Will meet or exceed the environmental requirements of MIL-S-3786 and MIL-S-22710.

JANCO CORPORATION
Box 3038 • 3111 Winona Ave., Burbank, CA 91504 • (213) 846-1800 • TWX 910-498-2701

LEDEX PUSH BUTTON CONTROLS

When your product demands the best switch the industry has to offer, examine the good looks and fine touch of a long lasting Ledex push button switch.

You can combine logic level switching (10 mA/5VDC) and high current switching (6A/250VAC) on one ganged switch.

You can get more interrelated options than any other similar switch available today—momentary, push/push, reciprocal release, master release, interlock, and emergency "all off" as required.

You can also get the most reliable delivery scheduling in the industry.

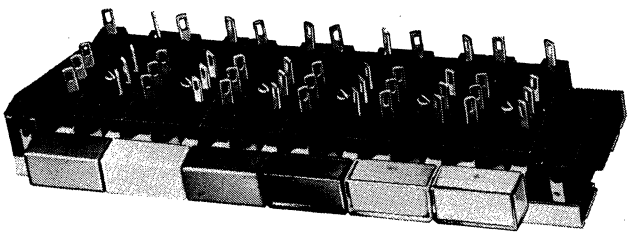
Test a pre-production prototype. Ask for our Push-Button catalogs.

SPECIFICATIONS

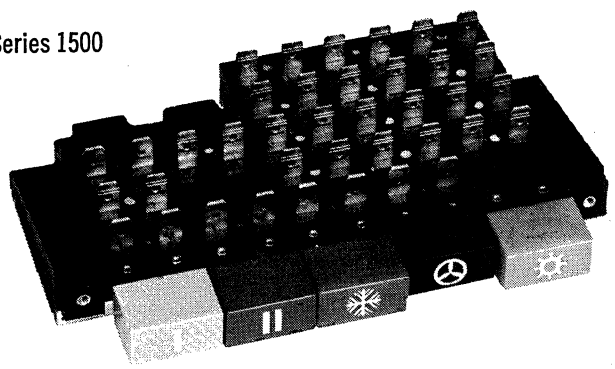
Series	1400	1500	75	1800
Module Capacity	1-20 per frame	1-15 per frame	Single Unit	1-20 per frame
Rating	4A/125VAC 2A/250VAC	16A/250VAC	4A/250VAC	10mA/5VDC 6A/250VAC
Contact material	Silver (STD.) Gold (Optional)	Silver plated brass	Copper/Silver alloy	Silver plated brass
Terminals	Solder or P.C.	Spade	Solder	Solder or P.C.
Illumination	6, 12, 24V lamps	Nonilluminated	6, 12, 24V lamps	2, 12, 24V lamps Single or dual
Cap size	3/8" x 3/4" 3/4" x 3/4"	.49" x .97"	.709" dia. .709" x .709" .709" x .945"	3/8" x 3/4" 7/16" x 3/4" 3/4" x 3/4"
Cap Colors	Red, Yellow Green, Blue Black, Grey White, Clear	Red, Yellow Green, Blue Black, White Light & Dark Grey	Red, Yellow Green, Blue Clear	Red, Yellow Green, Blue Black, Grey White, Clear, split screens
Legends	Hot stamp Engraved Film inserts	Hot stamp Engraved	Film insert	Hot stamp Engraved Film inserts
Function	Momentary Push/push Reciprocal release Master release Reciprocal + Master release Interlock	Momentary Push/push Reciprocal release Master release Reciprocal + Master release Interlock	Momentary Push/push Keylock	Momentary Push/push Reciprocal release Master release Reciprocal + Master release Interlock
Switching per module	2P2T Non-shorting	1NO 3NC thru 4NO 1NC Non-shorting	1P2T thru 3P2T Non-shorting	Lo-level to 4P2T Hi-level to 1NO 2NC

License rights by RAFI of West Germany

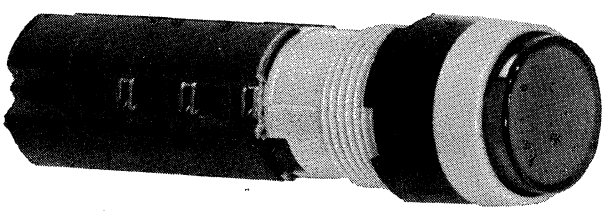
Series 1400



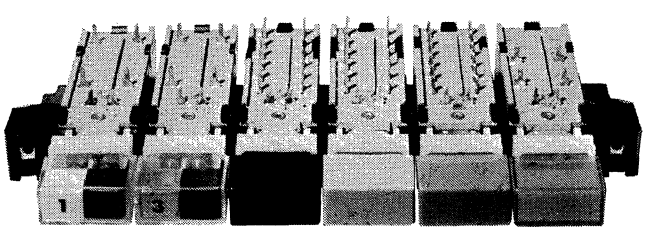
Series 1500



Series 75 (Key switches also)

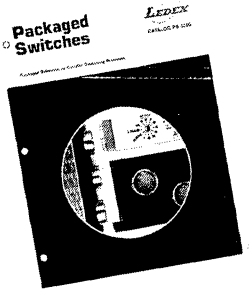


Series 1800



LEDEX
P.O. Box 427
Vandalia, Ohio 45377 U.S.A.
Phone: 513-898-3621

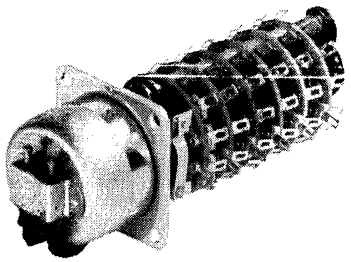
STEPPING SWITCHES/CIRCUIT SELECTORS



This catalog provides design guidelines for specifying and using hermetically sealed switches where high reliability requirements or harsh environmental conditions are factors that the designer must consider in the application.

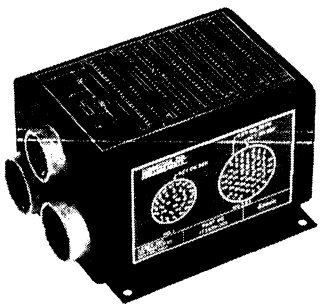
Several stock models, including compact 5 pole 2 throw, 49 pole 2 throw, and 39 pole 3 throw switches, are available for immediate delivery. Circuit diagrams and various switch control methods are given for each of the ten stock models shown.

Custom engineered programmers, variable intervalometers, controllers and management systems are provided as examples of how packaged switches can be tailored to meet a wide range of exacting requirements.



Ledex Stepping Switches
Used for relays, transfer switching, remote control of predetermined circuit patterns, remote sequencing of complex switching arrangements, or in programming checkout and sequential operations. They are known best for their ability to perform multiple switching functions reliably, in limited space, and under severe operating and environmental conditions. Available in open construction, prewired modules or as packaged control solutions.

Write for our catalog.



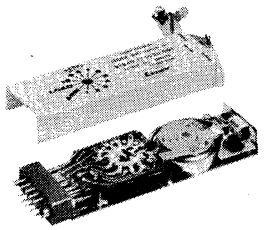
Ledex Hermetically Sealed Switches
Engineered to withstand severe shock and vibration, such as encountered in aircraft, missile and military applications, and to provide added switching reliability in adverse environments. Used extensively in aerospace and underwater guidance controls, as mode selectors, in rocket firing devices, and in a variety of military control functions that demand a high degree of reliability. There are 13 models available from the shelf.

Write for our catalog.

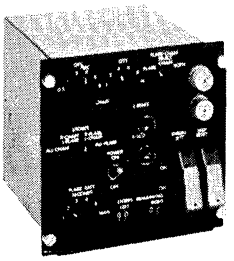
LEDEX PACKAGED CONTROL SOLUTIONS

Here are examples of Ledex Stepping Switches designed into compact, reliable control packages that combine the best characteristics of solid state and electromechanical technologies.

Whether your problem involves armament controls or commercial control functions, there's a good chance Ledex has already solved a similar problem. Our Packaged Switches Catalog shows several more detailed examples and also includes specifications for 13 hermetically sealed switches available from the shelf.



Miniaturized Armament Control Intervalometer
Flat, compact, 12-position stepping switch measures only ½" x 1¼" x 4¼", fires 19 rockets, sequentially in pairs. It includes a Ledex pulser to control time intervals over mil-spec. temperature and voltage ranges.



Dual Channel Flare/Chaff Dispenser Programmer
An all electronic dispenser, except for mechanical counters, allows programming of rate and quantity for flare or chaff dispensing by independent or simultaneous channel operation. Output pulses of up to 10 amperes per channel drive the electromechanical distributor switches located elsewhere in the aircraft. This state of the art experience can also be put to use in commercial applications as well as military. Let us interface your requirements with a "black box" solution.

Universal Stores Dispenser Intervals Variable on Digital Basis
All solid state and among the most flexible of Ledex intervalometer designs, this one permits the pilot to vary release intervals to any rate ranging from 30 ms to 9.99 seconds in increments of 10 ms. It includes a stepping switch to distribute sequential fire commands. Timing tolerance is ±10% over a voltage range of 22 to 32 volts and temperature to −55°C to +85°C. The package includes built-in suppression to protect solid state circuitry when switching inductive loads.

For engineering assistance and technical literature, write or phone:

P.O. Box 427
Vandalia, Ohio 45377 U.S.A
Phone: 513-898-3621

LANDIS & GYR

SAIA

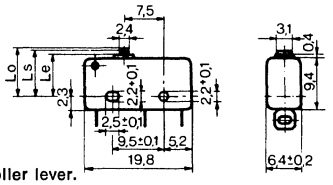
4 WESTCHESTER PLAZA, ELMSFORD, N.Y. 10523 • (914) 592-4400

PRECISION SNAP-ACTION SWITCHES

Request Catalog 13/12 for full information

. . . a variety of types with numerous ranges and variants for applications in electrical appliances . . . air conditioning . . . heating controls . . . office machines . . . vending machines . . . electrical instruments . . . recorders and phonographs . . . vehicles . . . tested and listed/approved by UL, CSA and most European test organizations. The test voltage and current values shown are based on international standards established by international test specification CEE 24.

SERIES XC SUBMINIATURE SWITCH

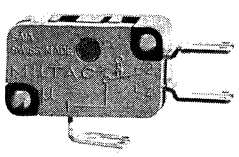


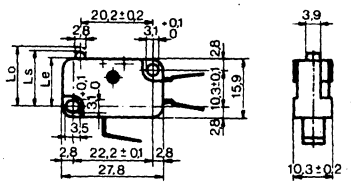
Actuation: (1) straight lever, (2) roller lever.
Housing Material: Special polyester resin moulding compound. Self extinguishing to UL 94. Maximum anti-creep characteristics — KB600.

- Specially small size, complying with int'l std (DIN41635, Form B)
- Wide choice of characteristics, terminals, actuating levers
- Tension-spring snap-action mechanism for longest possible mechanical life
- High-grade, anti-creep thermosetting moulding material for case components, preventing electrical breakdown
- Plunger can be pressed flush with case, thereby simplifying actuation
- Special fixing for actuating lever
- Ambient to 140°C

Basic Type	Basic Characteristics	Operating Force (max.) Newtons (ounces)	Differential Travel (max.) mm (in.)	Mech. Life Expectancy (millions of operations)	AC Rating, as VDE 0630	Terminals and Connection Types	Approvals/ Listings
XC	For most applications; high mech. life	1.70 (6.0)	0.1 (0.039)	10	5(1)A 250VAC	Soldering tags, plug connectors, PC terminals	(XC, XCC): UL, CSA, VDE, SEV, SEMCO, NEMCO, DEMCO
XCF	High elec. rating; switching security for control of motors	3.00 (10.7)	0.1 (0.039)	1	10(2)A 250VAC	SPDT (changeover), SPST (normally open, normally closed)	
XCC	Low oper. force; very high mech. life	0.60 (2.14)	0.1 (0.039)	50	2(0.5)A 250VAC		
XCH	Lowest oper. force; very high mech. life	0.35 (1.2)	0.1 (0.039)	50	10(0.1)A 250VAC		

SERIES XG STANDARD ECONOMY SWITCH





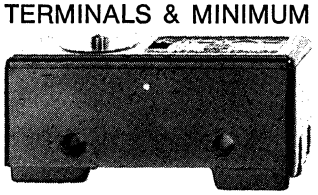
Actuation: (1) straight lever, (2) simulated roller lever, (3) bent lever, (4) roller lever
Housing Material: Thermoplastic type 181. Creep resistance KB250, test solution F.

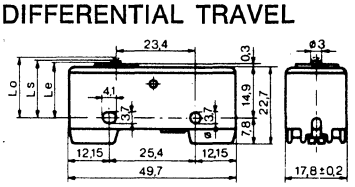
- Complies fully with international standards (DIN41635, Form A)
- Highest mechanical life (up to 100 Mio operations)
- High contact pressure, serrated contact surface, and contact wiping assures proper contact
- Electrical rating up to 16 A 250 VAC. With AgCdO-contacts 6 (2) A, 380 VAC available

XGK	For most applications; high mech. life	1.50 (5.4)	0.35 (0.014)	30	10(3)A 250VAC	Plug, solder, lug, screw, twin plug, short solder terminals	UL, CSA, VDE, SEV, SEMCO, DEMCO, NEMCO, UTE, BS
XG	High elec. rating. Best switching security at low voltage	3.20 (11.4)	0.35 (0.014)	5	16(3)A 250VAC		
XGA		3.20 (11.4)	0.15 (0.006)	5	16(3)A 250VAC	SPDT (changeover), SPST (normally open, normally closed)	
XGB	High mech. life, mean oper. force	1.50 5.4)	0.15 (0.006)	30	10(3)A 250VAC		
XGC	Low oper. force; very high mech. life	0.80 (2.9)	0.15 (0.006)	50	6(2)A 250VAC		
XGH	Lowest oper. force; very high mech. life	0.45 (1.6)	0.35 (0.014)	50	6(2)A 250VAC		

- High grade, anti-creep thermosetting plastic for case and lid
- Plunger may be depressed flush with case for ease of operation
- Ambient to 150°C

SERIES XO BASIC SWITCH WITH HEAVY-DUTY TERMINALS & MINIMUM DIFFERENTIAL TRAVEL





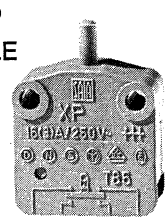
Actuation: (1) pin plunger, (2) short leaf-spring lever, (3) long leaf-spring lever, (4) leaf-spring lever with roller, (5) straight lever, (6) bent lever, (7) roller lever.
Housing Material: Thermosetting plastic type 181. Creep resistance KB250, test solution F.

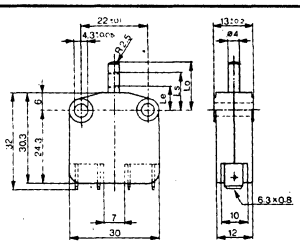
- Wide choice of actuating levers and terminal forms

XO	Rating of 16(3)A/380 VAC; min. differential travel, massive terminals and numerous variations of actuating member	4.50 (16.0)	0.08) (0.003)	10	16(3)A 380VAC 20(4)A 380VAC (opt.)	Screw terminals, flat plug, solder connectors, screw connectors SPDT (changeover)	VDE, SEV, UL, CSA, SEMCO, DEMCO, NEMCO

- Extreme constancy of operating position
- Complies fully with international standards
- High grade, anti-creep, thermosetting plastic for the case
- Serrated contact surface and contact wiping assure ideal contact
- Heavy-duty screw terminals
- Extremely small differential travel from 0.005 mm (0.0002 in.) up to 0.08mm (0.003 in.)
- Ambient to 120°C (standard)

SERIES XP MONOSTABLE SWITCH





Actuation: (1) pin plunger, (2) short leaf-spring lever, (3) long leaf-spring lever, (4) leaf-spring with roller, (5) straight lever, (6) bent lever, (7) roller lever, (8) straight reversing lever, (9) reversing lever with roller, (10) reversing lever with swivel roller, (11) pin plunger, (12) roller plunger.
Housing Material: Thermosetting plastic type 181. Creep resistance KB250, test solution F.

Unlike the above switches, series XP is of the push type, with slow-moving contact

XP	Monostable switch w/o snap-action. Contact gap exceeds 3mm (0.118 in.)	3.0 (10.7)	—	1	16(3)A 250VAC	Screw terminals, flat plug connectors, solder connectors, screw connectors with reduced base SPDT (changeover)	UL, CSA, SEV, VDE, IMQ, DEMCO, NEMCO, SEMCO, Belgium, Finland

- Push switch (without snap-action mechanism) mainly for applications, as door switch in domestic appliances, in copying and vending machines
- Particularly long over-travel, simplifying actuation of switch
- Rating of 16 A, 250 VAC
- Gap of more than 3 mm (0.118 in.) suits it for use as isolating switch
- Ambient to 140°C

MICRO SWITCH

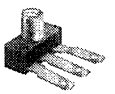
TABLE OF CONTENTS

The products described in the following pages are representative of the thousands of position sensing and manual control products manufactured and distributed by MICRO SWITCH. For comprehensive catalogs write MICRO SWITCH, Freeport, Illinois 61032, Dept. 720E. Or, call (815) 235-6600. For application assistance, contact a nearby MICRO SWITCH Sales Office. See listing in this Directory. For off-the-shelf products, see your local MICRO SWITCH Authorized Distributor listed on pages 49 & 50.

POSITION SENSORS

Hall effect position sensors

Hall effect sensors are operated by the magnetic flux from a permanent magnet or an electromagnet. The sensing element is a Hall sensor with a trigger and amplifier integrated on a silicon chip. These integrated circuits have been performance tested to over 19 billion operations. Operating speeds can exceed 100 kHz.



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6SS ..... page 2
8SS ..... page 2
9SS Linear output sensor ..... page 3
SR threaded sensors ..... page 3
AV vane sensors ..... page 4
Application information ..... page 5
MG magnets ..... page 6

XL solid state switches page 8

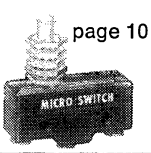
XL mechanically operated Hall effect switches combine mechanical switch operating and mounting convenience with solid state reliability. The mounting dimensions and mechanical characteristics are similar to the popular V3 snap-action switch.

ES current sensors page 9

ES current sensors are used in circuits to sense short circuits or other overcurrent conditions. They produce a digital signal as the current being monitored exceeds a specified value.

Z and A standard switches page 10

Standard size switches. Ratings to 25 amps. High precision-long life. Wide choice of actuators and terminals. Use for general purpose applications.

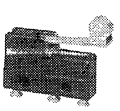


SX subminiature switches page 15

Smallest snap-action switches from MICRO SWITCH. Rated to 7 amperes. Choice of actuators and terminal styles. Use where the smallest and least weight, snap acting switch is essential.

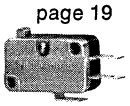
SM subminiature switches page 17

Slightly larger than SX switches. Rated to 11 amperes. Choice of contacts, actuators and terminal styles. Use for communications/office equipment and other smaller application needs.



V3 miniature switches page 19

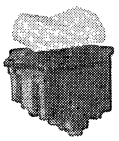
Standard or low operating forces. Rated to 15 amperes. Use for appliance-vending machine and similar applications.



MANUAL SWITCHES

TP sealed rockers page 21

Sealed rocker toggle series. Standard size 1, 2 and 4 poles. Various actuators, termination and circuitry. Military and UL listings.



TK industrial toggles page 22

Sealed toggle series. Standard size. 1, 2 and 4 poles. Various actuators, termination, and circuitry. UL listings.

TL sealed toggles ..... page 23

As above but mil. listed.

TS standard toggles page 24

Standard size toggles, 1 or 2 pole. Various actions, circuitry and termination. Use where a lower cost standard size toggle is required.

AT toggle assemblies page 25

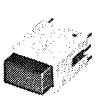
Toggle switch assemblies using basic switches. Wide variety of ratings, contacts, actuators, terminals, and sealing. Mil listings available.

AML advanced manual line page 26

AML provides a choice of solid state, electronic, or power controls with pushbutton, rocker, paddle or keylock actuation. Incandescent, LED or neon lighting illuminate a wide variety of display options. Single level termination with all common types available. Choice of snap-in front mount, strip or matrix mount.

MML miniature manual line page 37

MML miniature pushbuttons provide a choice of solid state, electronic or power duty controls. Plus incandescent or LED illumination with printed wiring board or snap in panel mounting. Operating modes include momentary, two level alternate action or multi-switch interlock.



Other MICRO SWITCH Products ..... page 47
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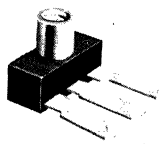
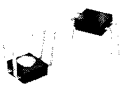
SS Miniature magnetically operated position sensors



.29H x .40W x .20D plus term.

5SS



.21 sq. plus term.

6SS

.30 sq. plus term.

8SS

FEATURES

- *Hall effect sensing*
- *Single digital output . . . current sinking or sourcing*
- *3 pin solder/quick-connect terminals . . . easy wiring as remote sensor*
- *Internally threaded flux concentrator . . . also used as mounting means*
- *4.5 to 5.5VDC or 6 to 16VDC supply voltages*

FEATURES

- *Hall effect sensing*
- *Dual digital outputs . . . current sinking or sourcing*
- *4 pin dual-in-line terminals . . . printed circuit board or standard DIP socket mounting*
- *Optional flux concentrator*
- *4.5 to 5.5VDC or 6 to 16VDC supply voltages*
- *Linear output sensor available . . . 4 to 10VDC supply voltage*

FEATURES

- *Hall effect sensing*
- *Single digital output . . . current sinking or sourcing*
- *3 pin in-line printed circuit board terminals . . . standard .100" mounting centers*
- *Smallest ceramic package . . . 0.3" square*
- *4.5 to 5.5VDC or 6 to 16VDC supply voltages*
- *Standard or precision magnetic characteristics*

SS ORDER GUIDE

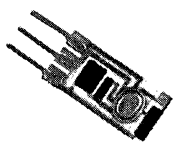
Supply Voltage (VDC)	Supply Current (mA max.)	Type	Current per Output	Operating Temperature °C	Magnetic Characteristics 25°C Typical			Catalog Listing
					Op. Gauss	Rel. Gauss	Dif. Gauss	
4.5 to 5.5	3.4	Source	10mA	0 to 70	100	−50	150	8SS9
	4.0			0 to 70	430	260	170	6SS2
				0 to 70	350	215	135	6SS4*
			20mA	0 to 70	245	150	95	5SS16
		Sink	4mA	0 to 70	430	260	170	65SS2
				0 to 70	350	215	135	65SS4*
			8mA	0 to 70	245	150	95	55SS16
				−40 to 100	100	−50	150	8SS1
				0 to 70	100	−50	150	8SS1E
	6.0		20mA	0 to 70	400	300	100	8SS7
				0 to 70	400	300	100	8SS7E
6 to 16	13.0	Source	10mA	−40 to 150	400	300	100	612SS2
				−40 to 150	330	245	85	612SS4*
			20mA	−40 to 150	230	170	60	512SS16
		Sink	10mA	−40 to 150	400	300	100	613SS2
				−40 to 150	330	245	85	613SS4*
				−40 to 150	60	−60	120	617SS2
				−40 to 150	50	−50	100	617SS4*
			20mA	−40 to 150	230	170	60	513SS16
				−40 to 150	35	−35	70	517SS16
				−40 to 150	400	300	100	8SS3
				0 to 70	400	300	100	8SS3E
				−40 to 150	60	−60	120	8SS5
				0 to 70	60	−60	120	8SS5E
4 to 10	3.5 Typ.	Linear: Differential outputs		−40 to 150	Sensitivity (−400 to +400 gauss) 0.75 to 1.06mV/gauss			634SS2

*With flux concentrator.

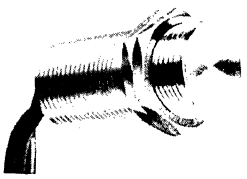
MICRO SWITCH, a Honeywell division

For more information, see Catalog 20, Solid State Sensors.

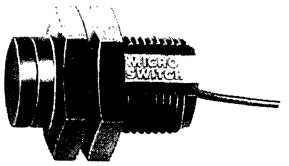
Magnetically operated position sensors 9SS LOHET™/SR



.60 H x .30 W x .07 D
9SS



15/32 thread x 1.00 L
103SR



M14 x 1 thread x 1.00 L
200SR

FEATURES
- *Hall effect sensing*
- *Single linear output*
- *3 pin in-line printed circuit board terminals . . . standard. 100" mounting centers*
- *Thin ceramic package*
- *4.5 to 8 VDC or 8 to 16 VDC supply voltages*
- *Laser trimmed thick film resistors . . . minimize sensitivity variations, compensate for temperature variations*
- *Tight specifications on output as function of magnetic induction*

FEATURES
- *Hall effect sensing*
- *Single output . . . digital current sinking or sourcing*
- *Sealed threaded aluminum bushing housing . . . meets NEMA 3, 3R, 3S, 4, 4X, 6, 12 and 13*
- *20 gage, 6 inch stranded leadwires . . . color coded, teflon insulated*
- *Adjustable mounting*
- *4.5 to 5.5 VDC or 6 to 16 VDC supply voltages*
- *Linear output available*

For more information, see Catalog 20, Solid State Sensors.

FEATURES
- *Hall effect sensing*
- *Single output . . . digital current sinking*
- *Threaded thermoplastic bushing housing*
- *22 gage, 6 inch stranded leadwires . . . colo" coded, teflon insulated*
- *Adjustable mounting*
- *4.5 to 5.5 VDC or 6 to 16 VDC supply voltages*
- *0 to 100 kHz operating speed . . . no minimum*

9SS ORDER GUIDE

Supply Voltage (VDC)	Output Type	Supply Current (mA max.)	Span (−400 to +400 gauss)	Null (Offset at 0 gauss)	Sensitivity (mV/gauss)	Linearity (% span)	Null Shift (Max. %)	Catalog Listing
8 to 16 (Performance at 12 VDC)	Ratiometric 2	15.0	6.0V ① ②	6.0 ±0.6V ① ②	7.5 ±0.2 ① ②	±1.5 ① ②	−40 to 150°C ±5	91SS12-2
8 to 16	Regulated 3	15.0	3.0V ① ③	3.0 ±0.6V ① ③	3.75 ±0.1 ① ③	±5.0 ① ③	−40 to 150°C ±7	92SS12-2
4.5 to 8 (Performance at 5 VDC)	Unregulated 4	15.0	1.5V ④ ⑤	2.25 ±0.5V ④ ⑤	1.875 ±0.1 ④ ⑤	±2.5 ⑤	0 to 85°C ±5	93SS12-2

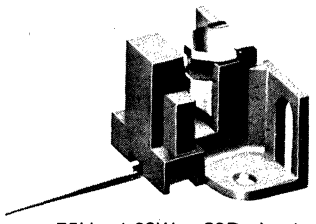
① At 25°C, 2200 Ohm load. ② Span, null, sensitivity vary in proportion to supply voltage over range of 12 ±4 VDC.
③ Characteristics apply over supply voltage range of 8 to 16 VDC.
④ Span, null, sensitivity approximately proportional to supply voltage over range of 4.5 to 8 VDC. ⑤ At 25°C, 1000 Ohm load.

SR ORDER GUIDE

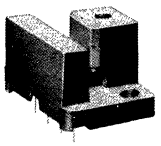
Supply Voltage (VDC)	Supply Current (mA max.)	Type	Current per Output	Operating Temperature °C	Magnetic Characteristics 25°C Typical			Catalog Listing
					Op. Gauss	Rel. Gauss	Dif. Gauss	
4.5 to 5.5	3.0	Sink	8 mA	−40 to 100	400	300	100	205SR1-A
					100	−50	150	208SR1-A
	4.0	Source	20 mA	0 to 70	350	215	135	103SR11A-1
		Sink	8 mA		350	215	135	103SR5A-1
6 to 16	10.0	Sink	20 mA	−40 to 100	400	300	100	213SR1-A
					60	−60	120	217SR1-A
	13.0	Source			330	245	85	103SR12A-1
		Sink			330	245	85	103SR13A-1
					50	−50	100	103SR17A-1
4 to 10	3.5 Typ.	Linear			Sensitivity (−400 to +400 gauss) 0.75 to 1.06 mV/gauss			103SR3F-5

MICRO SWITCH, a Honeywell division

AV Vane operated position sensors



.75H x 1.23W x .58D plus term.
1AV



.43H x .75W x .52D plus term.
3AV/4AV

Principle of operation

AV vane sensors are operated by passing a ferrous vane through the gap between the Hall sensor and the magnet, shunting the magnetic flux away from the sensor.* AV's can be used as limit switches by operating with a single large vane; as tachometer sensors by using a toothed wheel; or, as machinery synchronizing elements by using cams or sectors. 1AV and 4AV Series have many features in common, such as:

- *Operation by a low cost, easy to fabricate ferrous vane*
- *Magnet and sensor incorporated in same rugged package*
- *Sealed construction . . . unaffected by dust or dirt*
- *0 to 100kHz operating speed . . . no minimum speed of operation*
- *On and Off times programmable by vane dimensioning*
- *Precision mechanical operating characteristics*

*See Catalog 20 for vane actuation information.

FEATURES

- *Hall effect sensor*
- *Single digital output . . . current sinking or sourcing*
- *Versatile mounting*
- *3 pin solder/quick-connect terminals or leadwires*
- *6 to 16VDC power supply*
- *Lower operating force*
- *UL Recognized housing and leadwires*

For more information, see Catalog 20, Solid State Sensors.

FEATURES

- *Hall effect sensor*
- *Dual digital outputs . . . current sinking*
- *Small size*
- *4 pin in-line printed circuit board terminals or leadwires*
- *Closely controlled differential to predict pulse width*
- *4.5 to 5.5VDC or 6 to 16VDC power supply*
- *Connector block available*

AV ORDER GUIDE

Supply Voltage (VDC)	Supply Current (mA max.)	Type	Current per Output	Operating Temperature °C	Termination	Catalog Listing w/o Conn.	Catalog Listing w/Conn.
4.5 to 5.5	7.0	Sink	4 mA	−40 to 85	PC Board	3AV1C	
				−40 to 125		4AV11C	4AV11C-T1
			8 mA	−40 to 85	Leadwires	3AV2C	
				−40 to 125		4AV12C	
6 to 16	13.0	Sink	10 mA	−40 to 85	PC Board	3AV1A	
				−40 to 125		4AV11A	4AV11A-T1
		Source	20 mA	−40 to 125	Leadwires	1AV2B	
					Solder/Q.C.	1AV3B	
		Sink	20 mA	−40 to 125	Leadwires	1AV2A	
					Solder/Q.C.	1AV3A	
				−40 to 85	PC Board	3AV2A	
				−40 to 125		4AV12A	

Application information

DETERMINING MAGNETIC OPERATING CHARACTERISTICS

Magnetic sensing characteristics of Hall effect devices are specified within particular ranges. For example, assume an application with a temperature range of −40° to 100°C using a 513SS16. Referring to the table on page 2, the operate point may be up to 330 gauss and the release point may be 85 to 305 gauss. To insure reliable operation, **at least** 330 gauss must be presented to the sensor. The gauss level must then be reduced below 85 gauss to insure that the sensor will release. Therefore, it is necessary to know the flux density (gauss) measured at the chip to be able to 1) select a device with the best magnetic characteristics for your application; 2) select the best magnet; and 3) verify the desired mechanical characteristics.

The Calibrated Hall Element is used to determine the flux density produced at the sensor by the magnet. The package as well as the sensitive area is identical in size and location to the actual device. The output voltage of the Hall element, as a function of magnetic flux density, is linear, providing an electrical output which is proportional to flux density. A millivoltmeter with a one megohm input impedance should be used to measure the output. A Calibration Curve is furnished with each element, showing the Hall voltage versus flux density. When the magnetic field decreases, the output voltage decreases in a like manner. Referring to the calibration curve, a reading on the voltmeter is easily converted to gauss. Mechanical characteristics can be verified by first plotting a gauss versus distance graph. By comparing the curve to the magnetic characteristics of the sensor the possible mechanical ranges of operate point and release point can be determined.

Once the operating limits of the magnet and sensor combination have been established, feeler gages, etc., may be used during installation to insure that the correct gap is maintained.

CALIBRATED HALL ELEMENTS

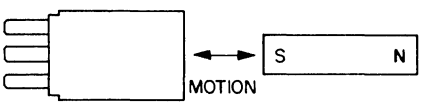
Magnetic characteristics for Hall effect devices are specified within particular ranges. To insure that all devices will operate and release in your application, gauss levels should be verified. Calibrated Hall Elements are available to measure the gauss levels produced in your application. These elements are available in packages similar to the corresponding Hall sensor. The elements are intended for laboratory use only.

METHODS OF ACTUATION

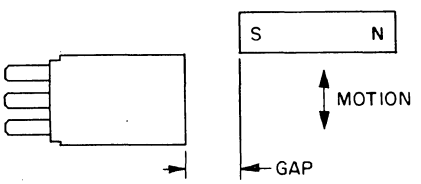
There are many ways to apply MICRO SWITCH solid state sensors. Some of the more common sensing methods are described. Further information is as near as your telephone. Just call your nearest MICRO SWITCH sales office, and one of our trained field engineers will be happy to discuss your application with you.

If you need more information, the handbook Hall Effect Transducers, How to apply them as sensors, is available from MICRO SWITCH. It is intended to assist you in understanding and applying Hall effect devices.

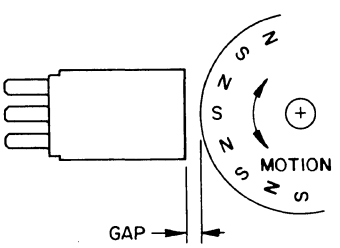
Head-on
The target is centered over the point of maximum sensitivity and is moved "head-on" to the sensor, then backed off.



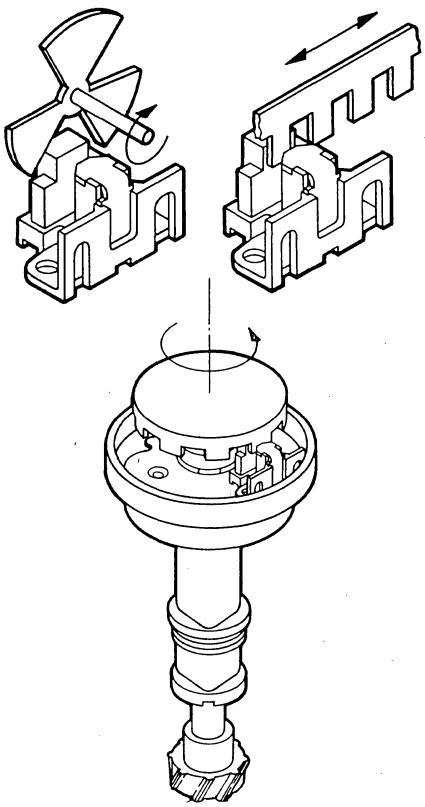
Slide-by
The target is moved across the face of the sensor at a specified distance.



Rotary
A rotating target, such as a ring magnet, provides an alternating pattern of On-Off actuation.



Vane
The target, a ferrous metal vane, slides through (or rotates through) the gap between magnet and sensor.



CALIBRATED HALL ELEMENT ORDER GUIDE

Supply Voltage	Supply Current	Output Voltage	Sensitivity	Use With Series	Catalog Listing
5 VDC	10mA max.	0 to 10mV @ 0 gauss	0.031mV/gauss	6SS..2	632SS2
			0.038mV/gauss	6SS..4	632SS4
			0.054mV/gauss	5SS..	532SS11
	5mA max.	−11 to +5mV @ 0 gauss	0.034mV/gauss	8SS.. 9SS.. 200SR....	732SS21-1*
	15mA max.	0 to 10mV @ 0 gauss	0.031mV/gauss	103SR.... 400SR....	103SR2-3

*Actual magnetic field strength seen by the Hall effect chip can vary. Distance from sensing surface of chip can vary by ± .003" (0,08mm).

MICRO SWITCH, a Honeywell division

Application information

ABSOLUTE MAXIMUM RATINGS (HALL EFFECT SENSORS)*

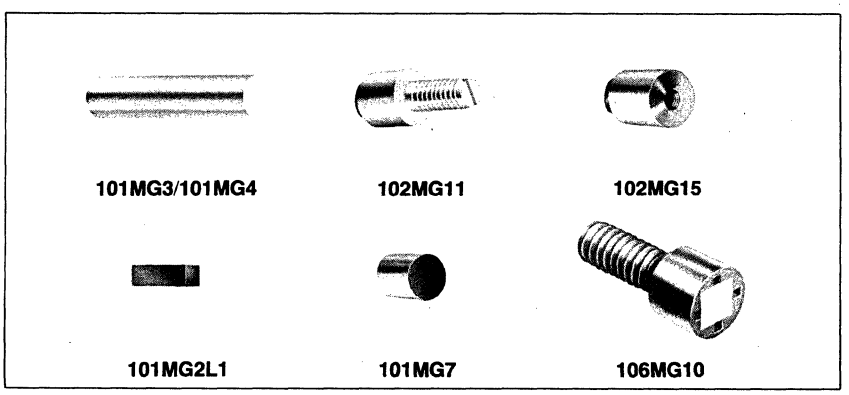
Parameters	Type	4.5 to 5.5 VDC Circuit		6 To 16 VDC Circuit	
Supply Voltage	N/A	−1.2 to +10 VDC		−1.2 to +20 VDC	
Voltage Externally Applied to Output	Sink	+10 VDC max. (OFF only) −0.5 VDC min. (ON or OFF)		+20 VDC max. (OFF only) −0.5 VDC min. (ON or OFF)	
	Source	+6.5 VDC max. (ON or OFF) −0.5 VDC min. (ON)		+6.5 VDC max. (OFF only) (Vs + 4) VDC (ON)	
Output Current		Single	Dual	Single	Dual
	Sink	20mA	10mA/output	40mA	20mA/output
	Source	40mA	20mA/output	20mA	20mA/output
Switching Time (μ sec max.)		Rise	Fall	Rise	Fall
	Sink	2.0	1.0	1.5	0.5
	Source	1.0	1.0	0.5	2.0
Temperature	N/A	−40°C to +100°C		−40°C to +150°C	
Magnetic Flux	N/A	No limit. Circuit cannot be damaged by magnetic overdrive.			

*Performance at maximum ratings cannot be guaranteed. However, Hall effect sensors will not be damaged unless these ratings are exceeded. Preferred operating characteristics are included in product Order Guides.

MG Magnets

MICRO SWITCH does not manufacture magnets. However, we do supply bar and ring magnets for operating our Hall effect sensors. The most common form of magnet used to operate a Hall effect sensor is the bar magnet. The magnet should provide at least 10% flux overdrive above "Max. Operate", when at minimum distance from the sensing surface.

For magnetic curves, see Catalog 20, Solid State Sensors. Or, contact MICRO SWITCH.

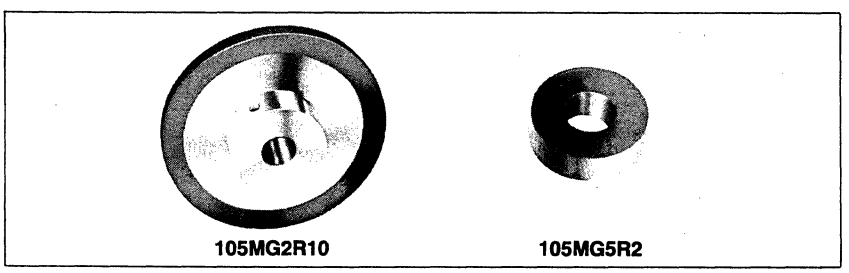


MG ORDER GUIDE

Bar Magnets

Outside Diameter	Length	Catalog Listing
6,3/0.25	31,7/1.25	101MG3
6,3/0.25	31,7/1.25	101MG4*
6,3/0.25	6,3/0.25	101MG7
3,2/0.125	9,5/0.375	101MG2L1
7,9/0.31	17,0/0.67	102MG11
7,9/0.31	12,2/0.48	102MG15
2,0/.078	2,0/.078	103MG5**
10,2/0.40	23,6/0.93	106MG10

*Reference magnet, calibrated to close tolerances. Useful for in-house inspection.
**125 pieces per tube. Poles not marked. Not illustrated.



Ring magnets are magnetized on the outside diameter with both North and South poles. Each pole pair (N and S) produces one pulse with standard Hall devices.

Ring Magnets

Outside Diameter	# Pole Pairs	Catalog Listing
44,4/1.75	10	105MG2R10
15,9/0.625	2	105MG5R2
15,9/0.625	4	105MG5R4

MICRO SWITCH, a Honeywell division

Application information

CURRENT SINKING AND CURRENT SOURCING

Two types of output circuits are common to solid state circuitry . . . current sinking and current sourcing. The names are derived from the location of the load in the output circuit.

Current sourcing (open emitter): The load is connected between the output and ground. The load is isolated from the supply voltage when the sensor is Off. When the sensor turns On, current flows from the power supply through the sensor, into the load. The sensor supplies a "source" of power to the load. A current sourcing output is Normally Low and goes High when the sensor is On.

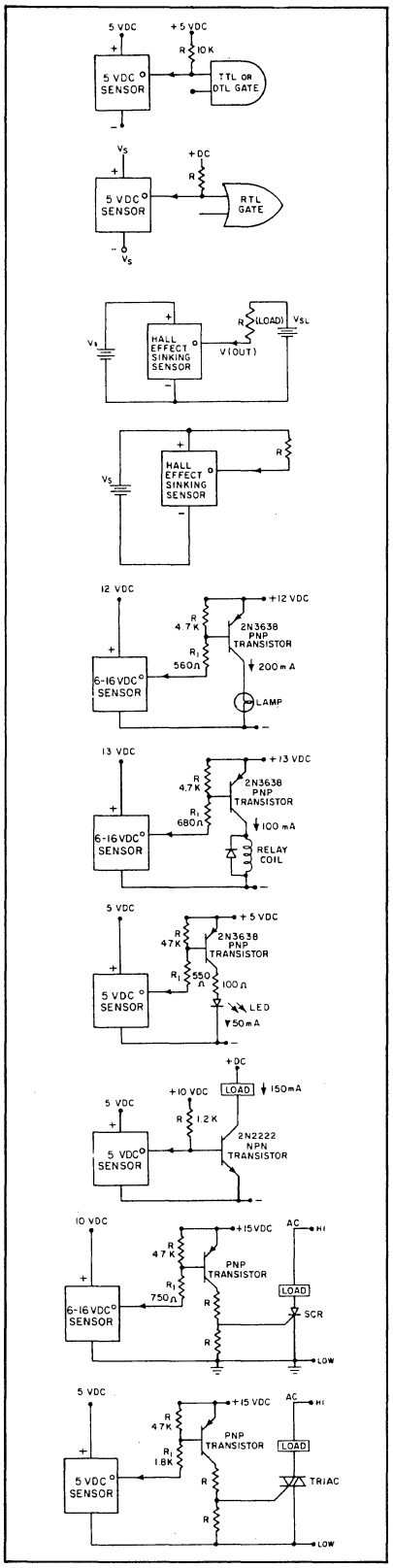
Current sinking (open collector): The load is connected between the power supply and the sensor. In this circuit, the load is isolated from ground when the sensor is Off. When the sensor turns On, the circuit is complete and current flows from the supply through the load, through the sensor and then to ground. The sensor switches, or "sinks" the output current to ground. A current sinking output is Normally High and goes Low when the sensor is On.

INTERFACING FOR MICRO SWITCH HALL EFFECT SENSORS

The schematics shown are typical of the outputs with which MICRO SWITCH Hall effect sensors can be interfaced. Values shown are representative only.

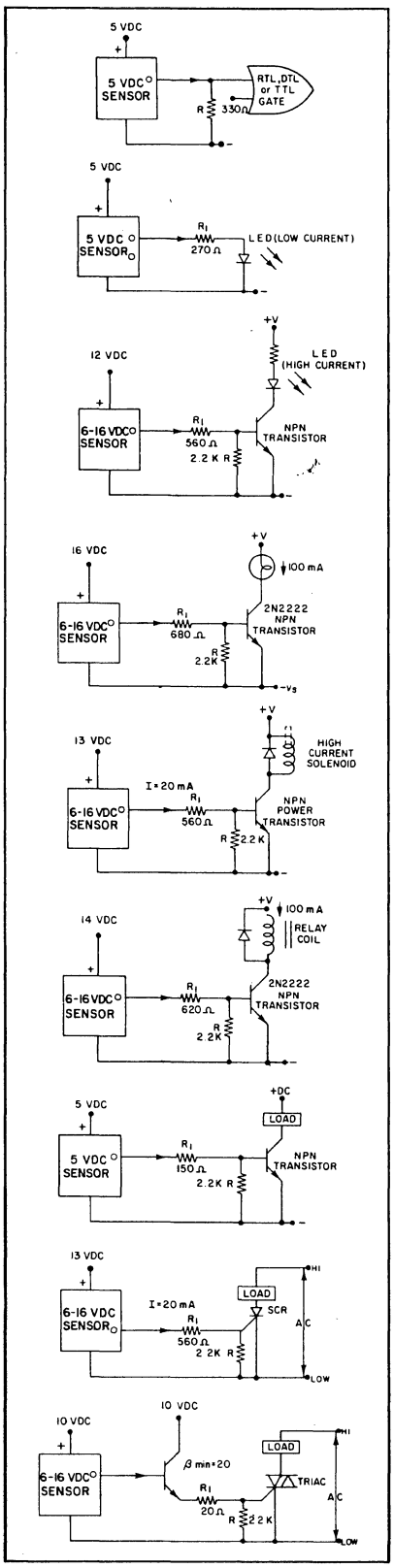
CURRENT SINKING OUTPUTS

(Current flow through load into sensor). Output terminal is open collector. In the unoperated condition (I_L = 0), the output voltage is normally High.



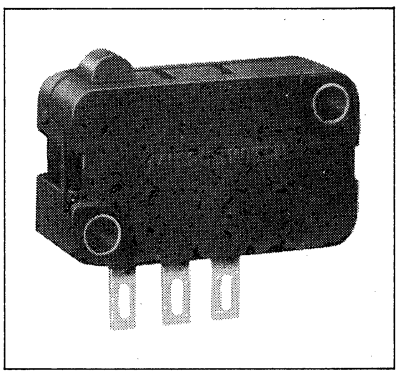
CURRENT SOURCING OUTPUTS

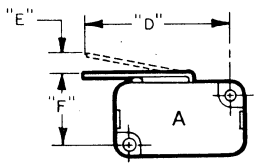
(Current flow from sensor through the load). Output terminal is open emitter. In the unoperated condition (I_L = 0), the output voltage is normally Low.

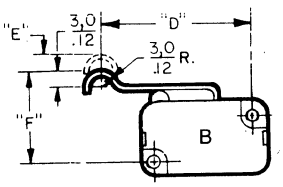


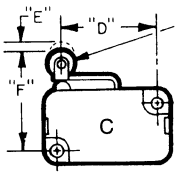
MICRO SWITCH, a Honeywell division

XL Mechanically operated solid state switches









4,8/19 DIA
X 4,8/.19 WIDE
OIL BRONZE
ROLLER
(CONCENTRICITY
0,13/.005 TIR)

FEATURES

- *Hall effect sensor, operated by magnet in plunger*
- *3 pin solder/quick-connect terminals . . . terminal housing available that uses AMP .110" push-on terminals*
- *Single output . . . digital current sinking, Normally High or Normally Low*
- *Low operating forces . . . as little as .15 oz. with lever*
- *Variety of actuator versions . . . uses all standard MICRO SWITCH V3 levers**
- *Same mounting centers as V3 snap-action switch*
- *4.5 to 5.5 VDC or 6 to 16 VDC supply voltages*

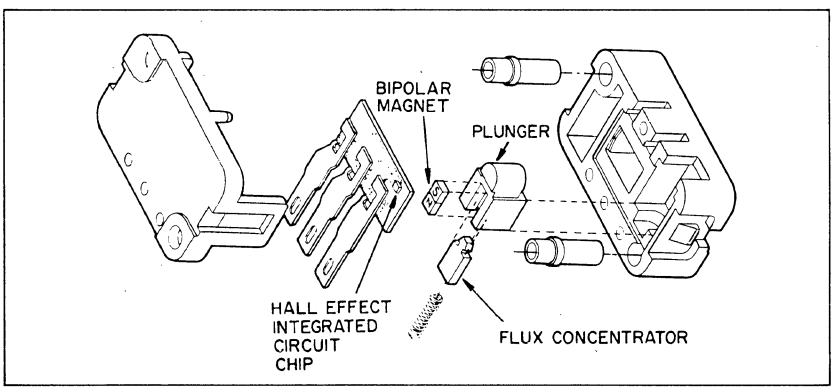
*See Catalog 10, Basic Switches

XL mechanically operated Hall effect switches combine mechanical switch operating and mounting convenience with solid state reliability. The mounting dimensions and mechanical characteristics are similar to the popular V3 snap-action switch. Over 500 actuators are possible, including pin plunger, straight levers, simulated roller levers, and roller levers.

XL ELECTRICAL SPECIFICATIONS

Supply Voltage (VDC)	Supply Current (mA max.)	Type	Current per Output	Series
4.5 to 5.5	4.0	Sink	8mA	37XL
6 to 16	13.0		20mA	47XL

EXPLODED VIEW



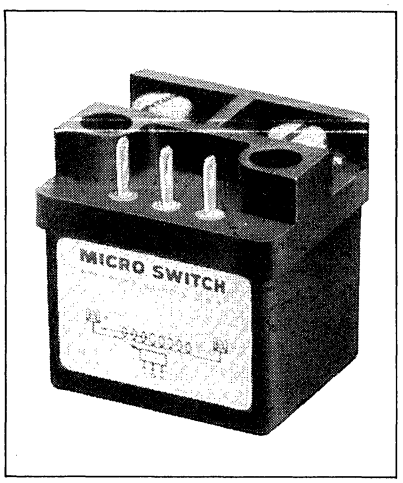
XL ORDER GUIDE AND OPERATING CHARACTERISTICS

Dimension "D"	Lever Style*	"E" Pretravel (Max.)	"F" Operating Point**	Overtravel (Min.)	Differential Travel (Max.)	Operating Force		Catalog Listings	
						Ounces	Newtons	5 VDC Type Sinking	6-16 VDC Type Sinking
—	None	1,65mm .065 in.	14,22mm .560 in.	0,76mm .030 in.	0,18mm .007 in.	.35 ± .15	0,10 ± ,04	37XL11-01	47XL11-01
—						1.25 ± .15	0,35 ± ,04	37XL11-02	47XL11-02
						3.00 ± .70	0,83 ± 0,19	37XL11-03	47XL11-03
21,84mm .860 in.	A	1,78mm .070 in.	14,86mm .585 in.	0,51mm .020 in.	0,25mm .010 in.	.40 ± .20	0,11 ± ,06	37XL11XA-11	47XL11XA-11
						1.40 ± .35	0,39 ± ,09	37XL11XA-12	47XL11XA-12
						3.2 ± .70	0,89 ± 0,19	37XL11XA-13	47XL11XA-13
35,56mm 1.400 in.	A	4,44mm .175 in.	14,22mm .560 in.	0,96mm .035 in.	0,38mm .015 in.	‡.20(+.15, −.07)	0,06(+,04, −,02)	37XL11XA-21	47XL11XA-21
						.70 ± .25	0,04 ± ,07	37XL11XA-22	47XL11XA-22
						1.4 ± .35	0,39 ± ,09	37XL11XA-23	47XL11XA-23
59,44mm 2.340 in.	A	6,60mm .260 in.	13,34mm .525 in.	2,03mm .080 in.	0,76mm .030 in.	‡.10 ± .07	0,03 ± ,02	37XL11XA-31	47XL11XA-31
						.35 ± .20	0,10 ± ,06	37XL11XA-32	47XL11XA-32
						.70 ± .35	0,04 ± ,09	37XL11XA-33	47XL11XA-33
32,64mm 1.285 in.	B	4,44mm .175 in.	17,40mm .685 in.	0,76mm .030 in.	0,38mm .015 in.	‡.20(+.15, −.07)	0,06(+,04, −,02)	37XL11XB-11	47XL11XB-11
						.70 ± .25	0,04 ± ,07	37XL11XB-12	47XL11XB-12
						1.4 ± .35	0,39 ± ,09	37XL11XB-13	47XL11XB-13
20,57mm .810 in.	C	1,90mm .075 in.	20,19mm .795 in.	0,51mm .020 in.	0,25mm .010 in.	.40 ± .20	0,11 ± ,06	37XL11XC-01	47XL11XC-01
						1.4 ± .35	0,39 ± ,09	37XL11XC-02	47XL11XC-02
						3.2 ± .70	0,89 ± ,19	37XL11XC-03	47XL11XC-03

*Typical values. Contact sales office for information on tolerances.
**Other lever styles available. Contact sales office.
‡Lever may not be self-returning.

NOTE: The output transistors of the listings shown are "normally open", i.e., they are not conducting with plunger in free position. To order devices which are "normally closed" (conducting with plunger in free position), substitute 12 for 11 immediately after the XL in the catalog listing. Example: 37XL12XA-1.

Current sensors ES



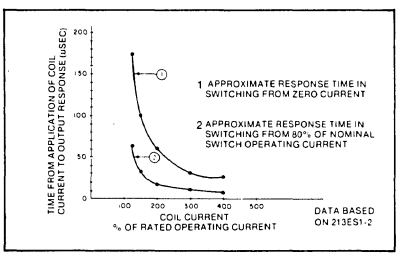
FEATURES

- *Hall effect sensing*
- *Monitors circuit current levels*
- *Fast, reliable indication of presence or absence of current*
- *Digital output signals overcurrent condition*
- *Automatic reset*
- *Operated by magnetic flux produced by current flowing through coil*
- *Very low coil resistance*
- *1500 VAC isolation between coil and Hall sensor*
- *Single 20mA current sinking output . . . 3 pin solder/quick-connect terminals*
- *6 to 16 VDC supply voltage*
- *UL Recognized component*

ES current sensors are used in circuits to sense short circuits or other overcurrent conditions. They produce a digital signal as the current being monitored exceeds a specified value. This signal enables a "circuit breaker" to open the line. The sensors are also used in sequencing and monitoring applications to insure that correct current levels exist.

The ES current sensor is operated by the magnetic flux produced by current flowing through a coil in the device. When coil current exceeds the specified value, the Hall sensor changes state. In DC circuits the output remains ON until coil current is reduced below the release level. For use in AC circuits, contact MICRO SWITCH. The 1500 volt dielectric between the coil and Hall sensor provides isolation between high and low voltage circuits.

RESPONSE TIME VS COIL CURRENT



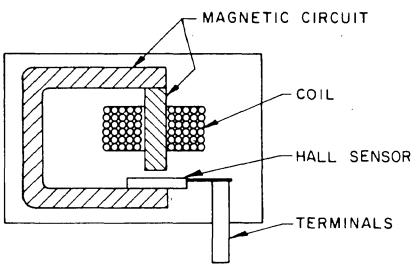
Data shown on the graph is based on the 213ES1-2. Devices with higher coil current ratings produce quicker response times. Lower rated devices produce slightly slower response times. If response time is critical, contact MICRO SWITCH for application assistance.

Operating Characteristics of Hall Sensor

Supply Voltage (VDC)	Supply Current (mA max.)	Current per Output
6 to 16	13.0	20mA max.

Operate current: The required current flow between power terminals which will cause the sensor to change state (operate and release).

Coil resistance: The maximum resistance between input terminals at 25°C.



ES ORDER GUIDE

DC Current — Amps*						Thermal Resistance		
Operate**	Minimum Release	Maximum Continuous ①	Maximum Continuous ②	Temperature Stability ± Amps/°C	Max. Coil Resistance	Coil to Air	Coil to Heat Sink	Catalog Listing
0.5 ± .03	0.2	2.5	1.5	.0007	350mΩ	21°C/watt	7°C/watt	213ES1-0.5
1.0 ± .07	0.4	7.0	3.5	.0015	64mΩ	21°C/watt	7°C/watt	213ES1-1
2.0 ± .14	0.8	10	5	.008	30mΩ	21°C/watt	7°C/watt	213ES1-2
5.0 ± .40	2.0	22	12	.016	6mΩ	21°C/watt	7°C/watt	213ES1-5
10 ± .80	4.0	33	19	.024	2.6mΩ	21°C/watt	7°C/watt	213ES1-10
20 ± 1.8	8.0	44	25	.062	1.5mΩ	21°C/watt	7°C/watt	213ES1-20
30 ± 2.7	12.0	54	31	.084	1mΩ	21°C/watt	7°C/watt	213ES1-30

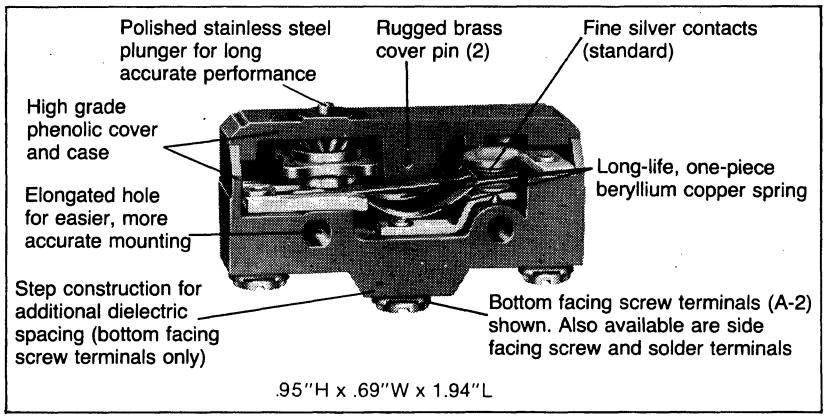
*ES current sensors are factory calibrated for use in DC circuits. AC applications are possible, but should be reviewed by MICRO SWITCH.
**Tolerance applies at 16VDC, 24°C.
① Applies at 25°C, with no heat sink.
② Applies at 80°C, with no heat sink.

MICRO SWITCH, a Honeywell division

BZ/BA Standard basic switches

STANDARD BASIC SWITCH CUT-A-WAY

The cut-a-way shown is representative of the BZ/BA standard basic switches described.



FEATURES

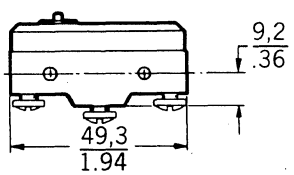
- *Operating force as low as 4 oz. (113 grams) maximum*
- *Sensitive differential travel as low as .0002 to .0003 inches (0,005 to 0,008 mm)*
- *Power load switching capability to 25 amperes*
- *Motor handling capacity to 2 horsepower at 250 VAC*
- *High temperature constructions for up to +400°F (204°C)*
- *Alloy contacts available for special application needs*
- *Variety of integral actuators*
- *Variety of auxiliary actuators*
- *Variety of terminal designs*
- *Optional sealed plunger and cover*
- *Over 50 listings available which meet MIL-S-8805 Qualified products list*
- *UL and CSA listed*

GENERAL INFORMATION

MICRO SWITCH standard basic switches are precision snap-action mechanisms enclosed in accurately molded plastic cases. These switches are carefully manufactured and thoroughly inspected. They are industry-known for their compactness, light weight, accurate repeatability and long life.

AVAILABLE TERMINALS

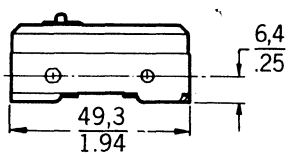
Most of the BZ/BA catalog listings have A2 type terminals. Several other terminal styles are shown and others are available. Specific information should be requested from the nearest MICRO SWITCH Sales Office or local Authorized Distributor.



A2

Bottom facing
6-32 NC x .218"
screw with cup washers

A4 (same as A2 except #8 screws)

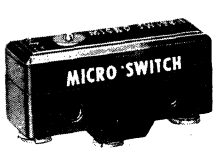


Solder

Use up to #14 wire

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

PIN PLUNGER



ORDER GUIDE

Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
BZ-2R-A2	Most applications. Screw terminals	15 Amps L96	2,5-3,61 9-13	1,11 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
BZ-2R	Same as above, Solder terminals	15 Amps L96	2,5-3,61 9-13	1,11 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
BZ-R21-A2	Lower force	10 Amps L8	1,11 4	0,7 2.5	0,30 .012	0,13 .005	0,005-0,013 .0002-.0005	15,88 .625
BZ-R-A2	Less differential travel	15 Amps L103	1,95-2,5 7-9	1,11 4	0,30 .012	0,13 .005	0,005-0,008 .0002-.0003	15,88 .625
BZ-R19-A2	Best repeatability	15 Amps L103	1,95-3,34 7-12	1,11 4	0,30 .012	0,13-0,2 .005-.008	0,005-0,02 .0002-.0008	16,26 .640
BZ-7RT04	MIL-S-8805/1-008 application requirements	15 Amps —	6,0-12,0	1,67 6	0,76 .030	0,13 .005	0,063-0,13 .0025-.0050	15,88 .625
YZ-2R-A2	SPST (normally open)	15 Amps L96	2,5-3,61 9-13	1,11 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
WZ-R	SPST (normally closed) Solder terminals	15 Amps L103	1,95-2,5 7-9	1,11 4	0,30 .012	0,13 .005	0,005-0,009 .0002-.00035	15,88 .625

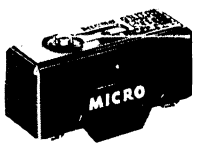
* ±0,38 mm ±.015 in.

MICRO SWITCH, a Honeywell division

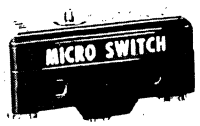
Standard basic switches BZ/BA

PIN PLUNGER

ORDER GUIDES



Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
BZ-2R5551-A2	Dustproof and splash resistant seal	15 Amp L96	2,5-4,17 9-15	1,11 4	— —	0,13 .005	0,01-0,06 .0004-.0025	15,88 .625
BZ-2R55-A2-S	Best service for sealed construction. Stainless steel spring.	15 Amps L96	2,5-4,17 9-15	1,11 4	— —	0,13 .005	0,01-0,06 .0004-.0025	15,88 .625



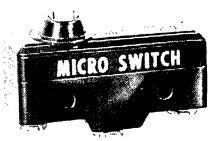
BA-2R	Up to 20 ampere load handling. Solder terminals	20 Amps L23	3,89-6,12 14-22	2,78 10	1,27 .050	0,25 .010	0,05-0,19 .0020-.0075	16,26 .640
BA-2R-A2	Up to 20 ampere load handling	20 Amps L23	3,89-6,12 14-22	2,78 10	1,27 .050	0,25 .010	0,05-0,19 .0020-.0075	16,26 .640
BE-2R-A2	Up to 25 ampere load handling	25 Amps —	3,89-6,12 14-22	2,78 10	1,27 .050	0,25 .010	0,05-0,19 .0020-.0075	16,26 .640

BZ-RX	Manual reset (maintained contact) applications, solder terminals	15 Amps L67	1,95-2,5 7-9 0,56-2,78 2-10	— — — —	0,30 .012 — —	0,13 .005 0,38 .015	— —	15,88 .625

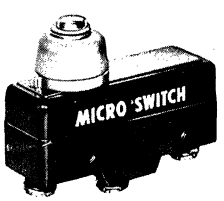
* ±0,38 mm ±.015 in.

LARGE OVERTRAVEL PLUNGER

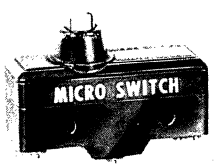
ORDER GUIDES



Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.** mm inches
BZ-2RD-A2	Added overtravel. For manual operation and slow 20° (max.) cam rise	15 Amps L96	2,5-3,61 9-13	1,11 4	0,38 .015	1,52 .060	0,01-0,05 .0004-.0020	21,21 .835



BZ-2RDS-S	Dustproof and splash resistant seal. Solder terminals	15 Amps L96	3,61-5,28 13-19	1,11 4	—	1,5 .062	0,01-0,063 .0004-.0025	28,20 1.110
BZ-2RDS-A2-S	Applications requiring dustproof and splash resistant seal	15 Amps L96	3,61-5,28 13-19	1,11 4	—	1,5 .062	0,01-0,063 .0004-.0025	28,20 1.110



BA-2RB	Up to 20 ampere load handling. Solder terminals	20 Amps L23	3,89-6,12 14-22	2,78 10	1,27 .050	2,39 .094	0,05-0,19 .0020-.0075	26,20 1.03
BA-2RB-A2	Up to 20 ampere load handling	20 Amps L23	3,89-6,12 14-22	2,78 10	1,27 .050	2,39 .094	0,05-0,19 .0020-.0075	26,20 1.03
BE-2RB-A2	Up to 25 ampere load handling	25 Amps —	3,89-6,12 14-22	2,78 10	1,27 .050	2,39 .094	0,05-0,19 .0020-.0075	26,20 1.03

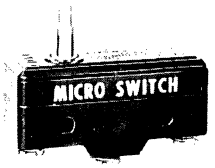
** ±0,51 mm ±.020 in.

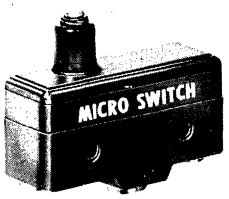
MICRO SWITCH, a Honeywell division

BZ/BA Standard basic switches

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

SMALL OVERTRAVEL PLUNGER



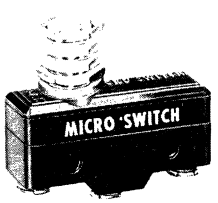


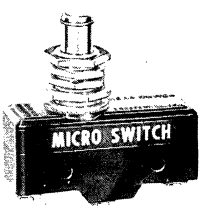
ORDER GUIDES

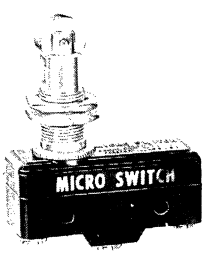
Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. newtons, ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
BZ-2RS	Added overtravel. For in-line operation and with JR auxiliary actuators. Solder terminals	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.015**	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
BZ-2RS-A2	Added overtravel. For in-line operation and with JR auxiliary actuators	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.015**	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
BZ-2RS5551-A2	Dustproof and splash resistant seal	15 Amps **L96**	2,5-4,17 **9-15**	1,11 **4**	—	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**

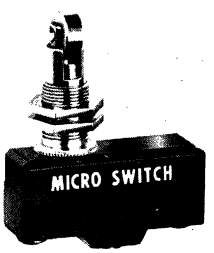
* ±0,51 mm ±.020 in.

BUSHING MOUNT OVERTRAVEL PLUNGER









ORDER GUIDES

Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.** mm inches
BZ-2RQ1	Applications with bushing mount. Solder terminals	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.15**	5,56 **.219**	0,01-0,05 **.0004-.0020**	21,82 **.859**
BZ-2RQ1-A2	Applications with bushing mount.	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.015**	5,56 **.219**	0,01-0,05 **.0004-.0020**	21,82 **.859**
BA-2RQ1	Up to 20 ampere load handling. Solder terminals	20 Amps **L23**	3,89-6,12 **14-22**	2,78 **10**	1,27 **.050**	5,56 **.219**	0,05-0,19 **.0020-.0075**	21,82 **.859**
BA-2RQ1-A2	Up to 20 ampere load handling	20 Amps **L23**	3,89-6,12 **14-22**	2,78 **10**	1,27 **.050**	5,56 **.219**	0,05-0,19 **.0020-.0075**	21,82 **.859**
BZ-2RQ18-A2	Added overtravel. Roller plunger for rapid cam (30° max) rise and slide operation	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.015**	3,56 **.140**	0,01-0,05 **.0004-.0020**	33,32 ±1,14 **1.312 ±.045**
BZ-2RQ181-A2	Applications requiring roller plunger 90° to major axis of switch	15 Amps **L96**	2,5-3,61 **9-13**	1,11 **4**	0,38 **.015**	3,56 **.140**	0,01-0,05 **.0004-.0020**	33,32 ±1,14 **1.312 ±.045**

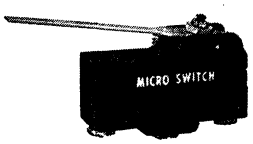
Except where stated ** ±0.76 mm ±.030 in.

MICRO SWITCH, a Honeywell division

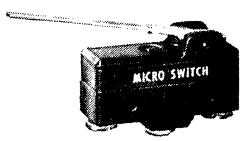
Standard basic switches BZ/BA

STRAIGHT LEVER ORDER GUIDES

Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
BZ-2RW80-A2	2.5 inch (63,5 mm) lever requirements	15 Amps L96	0,7 2.5	0,14 0.5	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
BZ-2RW84-A2	Lower force (without external return spring)	15 Amps L96	0,28 1	0,03 0.125	8,33 .328	5,56 .219	0,18-1,27 .007-.050	19,1 .750
BZ-2RW863-A2	6 inch (152 mm) long lever requirements	15 Amps L96	0,28 1	—	—	14,68 .578	0,46-3,68 .018-.145	19,1 ±1,52 .750 ±.060
BZ-2RW805551-A2	Dustproof and splash resistant seal. 2.5 inch lever	15 Amps L96	0,7 2.5	0,14 0.5	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750



BZ-2RW899-A2	Adjustable operating point (17 mm to 22 mm) .670" to .880"	15 Amps L96	0,7 2.5	0,14 0.5	—	3,54† .125	0,18-1,27 .007-.050	17,02-22,35 .670-.880

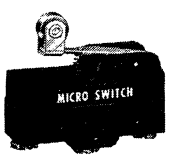


BA-2RV-A2	Up to 20 ampere load handling	20 Amps L23	0,7 2.5	0,14 0.5	15,88 .625	1,98 .078	2,77 .109	19,1 .750
BE-2RV-A4	Up to 25 ampere load handling	25 Amps —	0,7 2.5	0,14 0.5	15,88 .625	1,98 .078	2,77 .109 max.	19,1 .750

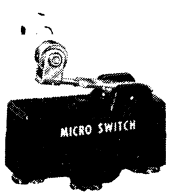
†From 17 mm O.P. .670 in.

Except where stated * ±0,76 mm ±.030 in.

ROLLER LEVER ORDER GUIDES



Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.** mm inches
BZ-2RW822	1.05 inch (26,7 mm) steel roller lever application. Solder terminal	15 Amps L96	1,67 6	0,42 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.118
BZ-2RW822-A2	1.05 inch (26,7 mm) steel roller lever applications	15 Amps L96	1,67 6	0,42 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
BZ-2RW8225551-A2	As above with dustproof and splash resistant seal	15 Amps L96	1,67 6	0,42 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
BZ-2RW82255-A2-S	Dustproof and splash resistant seal with stainless steel spring	15 Amps L96	1,67 6	0,42 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
BM-1RW822-A2	Up to 22 ampere load handling	22 Amps L68	1,67 6	0,42 1.5	—	2,39 .094	0,025-0,33 .001-.013	30,17 1.188



BA-2RV22-A2	Up to 20 ampere load handling	20 Amps L23	1,67 6	0,42 1.5	6,35 .250	0,76 .030	1,14 .045 max.	29,77 1.172
BE-2RV22-A4	Up to 25 ampere load handling	25 Amps —	1,67 6	0,42 1.5	6,35 .250	0,76 .030	1,14 .045 max.	29,77 1.172

Except where stated ** ±0,38 mm ±.015 in

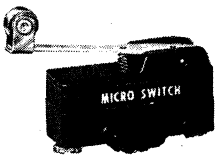
MICRO SWITCH, a Honeywell division

BZ/BA Standard basic switches

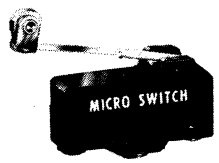
Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

ROLLER LEVER

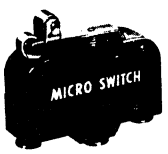
ORDER GUIDES



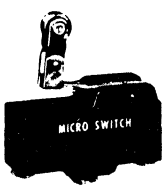
Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
BZ-2RW82-A2	1.90 inch (48.3 mm) steel roller lever applications	15 Amps L96	0,97 3.5	0,21 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030



BA-2RV2-A2	Up to 20 ampere load handling	20 Amps L23	0,97 3.5	0,14 0.5	11,89 .468	1,52 .060	2,16 .085	30,17 ±0,76 1.188 ±.030



BZ-RW922-A2	Best repeatability and O.P. stability	10 Amps L95	3,34 12	1,11 4	0,38 .015	2,54 .100	0,013-0,025 .0005-.0010	31,37 1.235



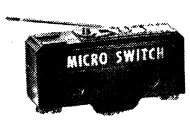
BZ-2RW826-A2	One-way roller (9,4 mm x 3,8 mm) .37" dia. x .15" wide roller	15 Amps L96	1,67 6	0,42 1.5	—	2,39 .094	0,08-0,51 .003-.020	41,34 1.625
BZ-2RW825-A2	One-way roller (4,83 mm x 4,83 mm) .19" dia. x .19" wide roller	15 Amps L96	2,22 8	0,42 1.5	—	1,52 .060	0,38 .015	28,96 1.14

* ±0,38 mm ±0.15 in.

FLEXIBLE LEAF

ORDER GUIDES

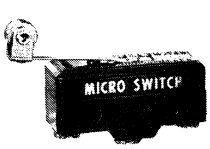
Catalog Listing	Recommended For	Electrical Data and UL Codes	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.** mm inches
BZ-2RL-A2	Force and stability of the flexible leaf actuator	15 Amps L96	1,39 5	0,14 0.5	—	1,52 .060	1,27 .050	17,48 .688



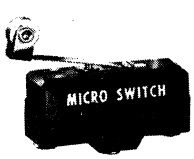
BA-2RL-A2	Up to 20 ampere load handling	20 Amps L23	2,5 9	0,28 1	—	1,57 ,062	1,57 .062	17,48 .688

FLEXIBLE ROLLER LEAF

ORDER GUIDES



BZ-2RL2-A2	Force and stability of the flexible leaf with roller	15 Amps L96	1,39 5	0,14 0.5	—	1,52 .060	1,27 .050	28,6 1.125
BZ-2RL25551-A2	Dustproof and splash resistant seal	15 Amps L96	1,95 7	0,14 0.5	—	1,52 .060	1,27 .050	28,6 1.125

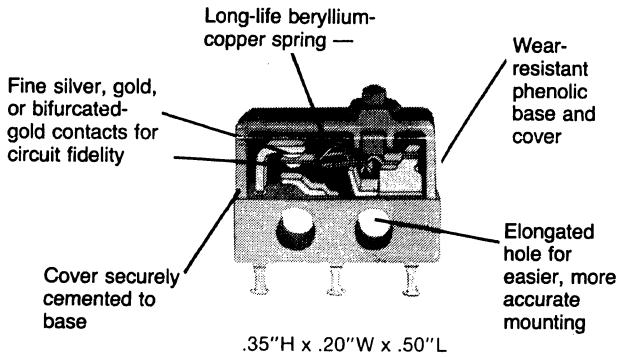


BA-2RL2-A2	Up to 20 ampere load handling	20 Amps L23	2,5 9	0,28 1	—	1,52 .060	1,65 .065	28,6 1.125

** ±0.76 mm ±.030 in

MICRO SWITCH, a Honeywell division

Subminiature basic switches SX



.35"H x .20"W x .50"L

Mounting holes accept pins or screws of .087 inch diameter (2,21 mm) on .19 inch (4,8 mm) centers.

GENERAL INFORMATION

SX subminiature basic switches are the smallest snap-action switches from MICRO SWITCH. These switches are ideal where savings in space and weight are important. Unless otherwise noted, all listings have silver contacts.

FEATURES

- *Low operating force to 3 oz. (85 grams) maximum*
- *Sensitive differential travel as low as .001 inch maximum*
- *Power load switching capability up to 7 amperes — silver contacts*
- *Optional gold contacts for low energy applications*
- *Optional bifurcated gold contacts for maximum reliability*
- *Long mechanical life of 10,000,000 cycles — 95% survival for 11SX series*
- *Temperature tolerance −65° to +250°F (−54 to 121°C) on standard construction*
- *High temperature designs for up to +400°F (204°C)*
- *Variety of integral and auxiliary actuators*
- *Choice of several terminal styles*
- *Listing available which meet MIL-S-8805 Qualified products list*
- *UL and CSA listed*

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

PIN PLUNGER

ORDER GUIDE

Catalog Listing	Recommended for	Electrical Data And UL Code	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.* mm inches
11SX21-T	Most applications	5 Amps L4	0,70-1,39 2.5-5	0,28 1	0,51 .020	0,1 .004	0,051 .002	8,13 .320
1SX1-T	Up to 7 amps load handling	7 Amps L7	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
2SX1-T	Lower force	7 Amps L7	0,83 3	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
11SX1-T	Lowest differential travel	3 Amps L122	0,97 3.5	0,21 0.75	0,51 .020	0,1 .004	0,025 .001	8,13 .320
21SX1-T	Best stability under varying humidity	7 Amps L7	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
3SX1-T	Applications requiring gold contacts	1 Amp L22	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
21SX39-T (MS24547-1)	MIL-S-8805 application requirements + 180°F (82°C) maximum use	7 Amps —	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
23SX39-T (MS24547-2)	MIL-S-8805 application requirements for gold contacts + 180°F (82°C) maximum use	1 Amp L22	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
4SX1-T	Operating in temperature to + 400°F (204°C)	7 Amps L7	1,39 5	0,28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
12SX2-T	Best reliability (Bifurcated gold contacts)	1 Amp L22	0,70-1,39 2.5-5	0,28 1	0,51 .020	0,1 .004	0,051 .002	8,13 .320
12SX1-T	Best reliability with higher current rating (28 VDC) (Bifurcated gold contacts)	1 Amp L22	1,39 5	0,28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320

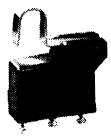
* ±0,38 mm
±.015 in.

MICRO SWITCH, a Honeywell division

SX Subminiature basic switches

INTEGRAL LEVER ORDER GUIDES

Catalog Listing	Description	Electrical Data And UL Code	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches
311SX1-T	.135 inch (3,43 mm) straight lever (shown)	5 Amps L4	0,49 1.76	0,09 .32	1,65 .065	0,36 .014	0,51 .020	8,43 ±1,14 .332 ±.045
311SX2-T	.505 inch (12,8 mm) straight lever	5 Amps L4	0,31 1.1	0,05 .18	2,92 .115	0,64 .025	0,89 .035	8,26 ±1,91 .325 ±.075
311SX3-T	.965 inch (24,5 mm) straight lever	5 Amps L4	0,20 .71	0,03 .11	4,70 .185	1,17 .046	1,52 .060	7,75 ±2,92 .305 ±.115



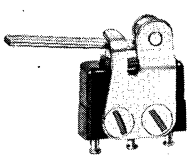
311SX4-T	.042 inch (1,1 mm) simulated roller lever (shown)	5 Amps L4	0,58 2.1	0,11 .39	1,27 .050	0,25 .010	0,38 .015	14,15 ±0,91 .557 ±.036
311SX5-T	.459 inch (11,7 mm) simulated roller lever	5 Amps L4	0,31 1.1	0,05 .18	2,67 .105	0,56 .022	0,89 .035	14,86 ±1,65 .585 ±.065

Auxiliary actuators

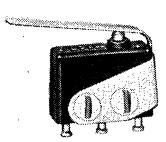
Switches are not included with actuators

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position
* All characteristics are taken with actuator assembled on Catalog Listing 1SX1-T as shown.

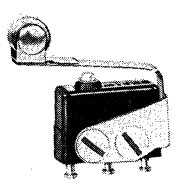
ORDER GUIDES



Catalog Listing	Description	Actuator Length mm inches	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. mm inches	O.T. mm inches	D.T. max. mm inches	O.P.†† mm inches	F.P. mm inches
JX-20	Straight lever (shown)	1,83 .72	0,28 1 approx.	0,04 .14	—	0,76 .030 approx.	0,76 .030 approx.	10,8 .425 approx.	12,3 .485 approx.
JX-25	Roller lever	16,5 .65	0,42 1.5	0,04 .14	—	0,51 .020	0,76 .030	14,9 ±1,14 .585 ±.045	16,8 .660 max.



JX-40	Straight leaf	9,4 .37	1,95 7	0,56 2	.225 approx.	0,38 .015	0,64 .025	7,5 .295	12,3 .485 ref.
JX-45	Roller leaf	6,1 .24	1,95 7	0,28 1	.225 approx.	0,38 .015	0,64 .025	12,2 .480	16,5 .650 ref.



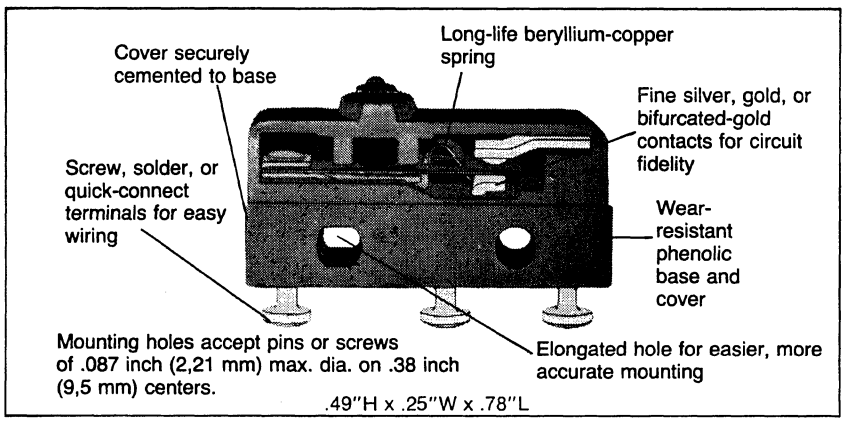
JX-41**	Reverse leaf	9,4 .37	1,67 6	0,28 1	.110 approx.	0,38 .015	0,64 .025	7,5 .295	9,4 .370 ref.
JX-51**	Reverse roller leaf	7,6 .30	1,67 6	0,56 2	.110 approx.	0,38 .015	0,64 .025	12,8 .505	14.7 .580 ref.

** Switch is mounted with plunger end reversed from JX-40.
NOTE: Above actuators should be used at temperatures below +300°F (149°C)

Except where stated †† ±0.76mm ±.030 in.

Subminiature basic switches SM

CUT-A-WAY SM SUBMINIATURE BASIC SWITCH

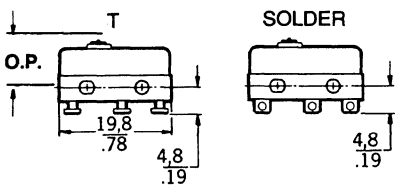


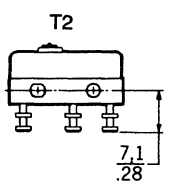
FEATURES

- *Low operating force to 2 ounces maximum.*
- *Sensitive differential travel as low as .001 inch (0,025 mm) maximum*
- *Power load switching capability available to 11 amps (VAC) — silver contacts*
- *Motor load handling capacity to ¼ horse power (VAC)**
- *Optional gold contacts for low energy applications*
- *Optional bifurcated gold contacts for maximum reliability**
- *Long mechanical life of 10,000,000 cycles — 95% survival for 11SM series*
- *Standard temperature range −65° to +180°F (−54 to 85°C)*
- *High temperature construction available for use to +400°F (204°C)**
- *Variety of integral and auxiliary actuators*
- *Choice of several terminal styles*
- *2 listings available which meet MIL-S-8805 Qualified products list.*
- *UL and CSA listed*
- *BEAB and TV-2 construction available**

*Ordering information in Catalog 10.

AVAILABLE TERMINALS



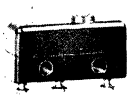


GENERAL INFORMATION

SM subminiature switches are slightly larger than SX switches. These switches combine small size and light weight with ample electrical capacity, precision operation and long life. Unless otherwise noted, all listings have silver contacts.

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

PIN PLUNGERS



ORDER GUIDE

Catalog Listing	Recommended For	Electrical Data And UL Code	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.* mm inches
1SM1	Original design. Solder posts.	5 Amps L4	0,83-1,39 3-5	0,28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330
1SM1-T	Original design. Solder terminals.	5 Amps L4	0,83-1,39 3-5	0,28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330
11SM1	Most applications,long life Solder posts.	5 Amps L4	0,83-1,39 3-5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
11SM1-T	Same as above. Solder terminals	5 Amps L4	0,83-1,39 3-5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
11SM1-T2	Same as above. Double terminals	5 Amps L4	0,83-1,39 3-5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
11SM3-T	Operating in temperatures to +250°F (121°C)	5 Amps L4	0,83-1,39 3-5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
11SM23-T	Application requiring gold contacts	1 Amp L22	0,83-1,39 3-5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
11SM401-T	Less differential travel	5 Amps L4	0,97 3.5 max.	0,28 1	0,51 .020	0,13 .005	0,025 .001	8,38 .330
11SM701-T	Lower force	4 Amps L119	0,56 2	0,14 .5	0,51 .020	0,13 .005	0,051 .002	8,38 .330
21SM284 (MS25085-2)	MIL-S-8805 application requirements	5 Amps —	0,83-1,39 3-5	0,28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330

Except where stated * ±0,38mm ±.015 in

MICRO SWITCH, a Honeywell division

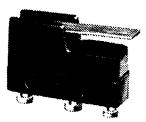
SM Subminiature basic switches

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position

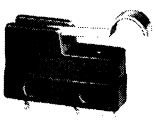
PIN PLUNGER ORDER GUIDES

Catalog Listing	Recommended For	Electrical Data and UL Code	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.* mm inches
411SM1	Sealed plunger construction	5 Amps L4	0,83-2,09 3-7.5	0,28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330

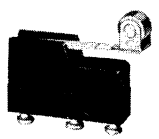
INTEGRAL LEVER ORDER GUIDES



311SM1-T	.285 inch (7,24 mm) straight lever (shown)	5 Amps L4	0,39 1.4	0,07 .25	2,16 .085	0,51 .020	0,48 .019	8,64 ±1,5 .340 ±.060
311SM2-T	.565 inch (14,35 mm) straight lever	5 Amps L4	0,31 1.1	0,05 .18	3,05 .120	0,66 .026	0,69 .027	8,51 ±2 .335 ±.080
311SM3-T	1.765 inch (44,8 mm) straight lever	5 Amps L4	0,15 .53	0,02 .07	7,87 .310	1,45 .057	2,8 .110	7,11 ±4,3 .280 ±.170



311SM4-T	.251 inch (6,38 mm) simulated roller lever	5 Amps L4	0,39 1.4	0,07 .25	2,16 .085	0,46 .018	0,48 .019	11,7 ±1,5 .460 ±.060
311SM5-T	.535 inch (13,6 mm) simulated roller lever	5 Amps L4	0,31 1.1	0,05 .18	3,05 .120	0,66 .026	0,69 .027	11,56 ±2 .455 ±.080



311SM6-T	.251 inch (6,38 mm) roller lever	5 Amps L4	0,39 1.4	0,07 .25	2,16 .085	0,46 .018	0,48 .019	14,2 ±1,5 .560 ±.060
311SM706-T	.251 inch (6,38 mm) roller lever. Lower force	4 Amps L119	0,16 .57	0.03 .11	2,16 .085	0,46 .018	0,33 .013	14,2 ±1,5 .560 ±.060

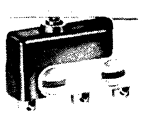
INTEGRAL LEAF ORDER GUIDES

111SM1-T	Force and stability of flexible leaf actuator (shown)	5 Amps L4	1,95 7	0,56 2	5,54 .218	0,76 .030	0,76 .030	8,89 ±0,76 .350 ±.030
111SM2-T	Flexible leaf with roller	5 Amps L4	1,95 7	0,56 2	5,56 .219	0,76 .030	0,64 .025	14,3 ±0,76 .562 ±.030

Except where stated * ±0,38 mm ±.015 in.

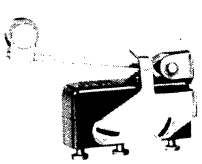
AUXILIARY ACTUATORS ORDER GUIDES

Switches are not included with actuators.*



Catalog Listing	Description	Actuator Length mm inches	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm Inches	O.P. mm inches	F.P. max. mm inches
JS-2	Straight leaf (shown)	16,8 .66	2,78 10	0,56 2	1,98 .078	0,38 .015	0,38 .015	8,89 ±0,76 .350 ±.015	11,3 .445
JS-5	Roller leaf (Bronze roller)	15 .59	2,78 10	0,83 3	1,98 .078	0,38 .015	0,38 .015	14,2 ±0,76 .560 ±.015	16,9 .665

JS-7	Formed leaf (Simulated roller)	14,7 .58	2,78 10	0,56 2	2,39 .094	0.79 .031	0,38 .015	9,65 ±0,76 .380 ±.015	12,1 .475



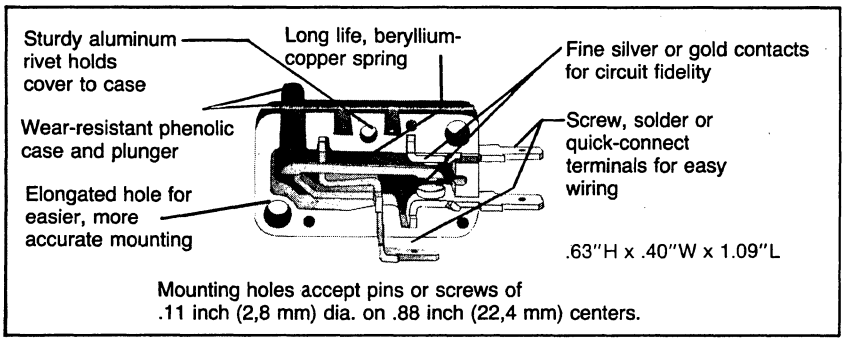
JS-220	Straight lever	26,2 1.03	0,28 1	0,04 .14	3,18 .125 approx.	0.76 .030	0,76 .030	10,3 .406 approx.	—
JS-246	Roller lever (shown) (Steel roller)	25,4 1.00	0,28 1	0,04 .14	3,18 .125 approx.	0,76 .030	0,76 .030	14,3 .562 approx.	—

NOTE: Above actuators should be used below +300°F (149°C)

* All characteristics are taken with actuator assembled to Catalog Listing 11SM3-T as shown.

Miniature basic switches V3

CUT-A-WAY V3 MINIATURE BASIC SWITCH



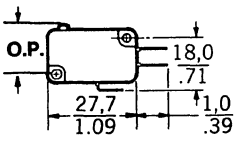
FEATURES

- *Low operating force to .53 ounce maximum*
- *Sensitive differential travel as low as .008 inch maximum**
- *Power load switching capability up to 15 amperes — silver contacts*
- *Motor handling capacity of ½ horse-power — silver contacts*
- *Gold alloy contacts for special applications*
- *Long mechanical life of 10,000,000 cycles — 95% survival for V3-100 Series.*
- *Temperature tolerance up to +180°F (82°C) on standard construction*
- *High temperature construction for use up to +600°F (316°C)**
- *3,1 mm mounting holes available*
- *UL and CSA listed*

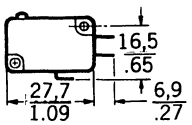
*Ordering information in Catalog 10.

AVAILABLE TERMINALS

D8 QUICK CONNECT

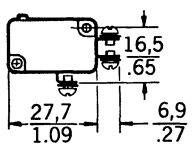


SOLDER

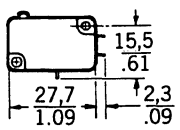


.188" wide by .020" thick terminals

SCREW



SHORT SOLDER

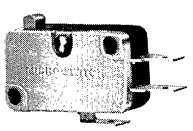


GENERAL INFORMATION

V3 miniature basic switches feature high electrical capacity and long life. Their size and shape meet design requirements in all types of applications.

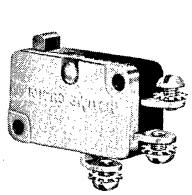
Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

PIN PLUNGER



ORDER GUIDES

Catalog Listing	Recommended For	Electrical Data And UL Code	O.F. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.** mm inches
V3-1-D8	Best for use under shock and vibration	15 Amps L83	1,67-3,89 6-14	1,11 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-101-D8	Most applications	11 Amps L156	2,22 8 max.	0,56 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-1101-D8	Added overtravel	10 Amps L112	0,72 max. 2.6	0,10 .35	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14.7 .578
V3-2101-D8	Lower force, added overtravel	10 Amps L131	0,50 max. 1.8	0,05 .18	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
V3-2401-D8	Lower force	5 Amps L162	0,24 .9	—	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
V3-2451-D8	Lowest force	3 Amps L163	0,15 .53	—	1.2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
V3-3001-D8	Up to 15 amps load handling	15 Amps L83	1,33 max. 4.8	0,15 .53	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
V3-343-D8*	Applications requiring gold alloy contacts	1 Amp L22	2,22 8 max.	0,56 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578



V3-1	Best for use under shock and vibration	15 Amps L83	1,67-3,89 6-14	1,11 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-15	Same as V3-1 except short solder terminals	15 Amps L83	1,67-3,89 6-14	1,11 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-19	Same as V3-1 except solder terminals	15 Amps L83	1,67-3,89 6-14	1,11 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-101	General use.	11 Amps L156	2,22 8 max.	0,56 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
V3-1001 (MS25253-1)	MIL-S-8805 application requirements (SPDT)	1u Amps —	1,67-3,89 6-14	1,11 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578

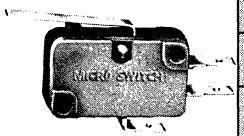
** ±0,38 ±0,15

MICRO SWITCH, a Honeywell division

V3 Miniature basic switches

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

STRAIGHT LEVER ORDER GUIDES

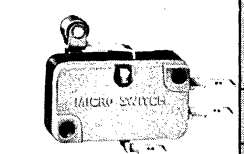


Catalog Listing	Recommended For	Electrical Data and UL Code	Length of Lever "A" mm inches	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.* mm inches
V3L-101-D8	Most applications Short lever	11 Amps L156	21,3 .860	2,50 9	0,56 2	1,5 .060	1,02 .040	0,41 .016	15,2 ±0,51 .600 ±.020
V3L-104-D8	Most applications (Shown) med.	11 Amps L156	35,6 1.40	1,11 4	0,14 .5	3,18 .125	2,29 .090	1,27 .050	15,2 ±1,5 .600 ±.060
V3L-131-D8	Most applications long lever	11 Amps L156	59,4 2.34	0,58 2.1	0,12 .42	6,6 .260	3,81 .150	2,29 .090	14,7 ±2 .580 ±.080
V3L-3013-D8	Up to 15 amps load handling. Best performance under shock and vibration	15 Amps L83	59,4 2.34	0,39 1.4	0,03 .11	5,33 .210	4,06 .160	1,52 .060	15,2 ±1,9 .600 ±.075

SIMULATED ROLLER ORDER GUIDE

V3L-121-D8	Most applications	11 Amps L156	32,6 1.285	1,11 4	0,14 .5	3,18 .125	2,03 .080	1,27 .050	18,5 .730

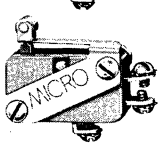
ROLLER LEVER ORDER GUIDES



V3L-139-D8	Most applications (Shown)	11 Amps L156	20.6 .81	2,22 8	0,56 2	1,5 .060	1,02 .040	0,41 .016	20,6 ±0,76 .810 ±.030
V3L-3003-D8	Up to 15 amps load handling. Best for performance under shock and vibration	15 Amps L83	20,6 .81	1,33 4.8	0,15 .53	1,2 .047	1,02 .040	0,33 .013	20,6 ±0,76 .810 ±.030
V3L-111-D8	Most applications longer lever	11 Amps L156	34 1.34	1,11 4	0,14 .5	3,18 .125	2,16 .085	1,27 .050	20,6 ±1,5 .810 ±.060
V3L-3004-D8	Up to 15 amps load handling. Best for performance under shock and vibration	15 Amps L83	34 1.34	0,70 2.5	0,14 .49	3,18 .125	2,16 .085	0,76 .030	20,6 ±1,5 .810 ±.060

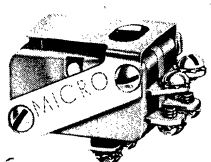
AUXILIARY ACTUATORS ORDER GUIDES

Switches are not included with actuators.*



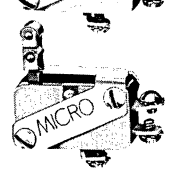
Catalog Listing	Description	Actuator Length mm inches	O.F. max. newtons ounces	R.F. min. newtons ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches	F.P. max. mm inches
JV-1	Leaf type (shown)	21,3 .84	3,34 12	1,11 4	1,19 .047	0,79 .031	0,41 .016	15 ±0,38 .590 ±.015	16,4 .645
JV-7	Long leaf	32,3 1.27	2,50 9	1,11 4	1,57 .062	1,27 .050	0,64 .025	14,5 ±0,76 .570 ±.030	17,4 .685
JV-5	Roller leaf (shown)	20,6 .81	3,34 12	1,11 4	1,52 .060	0,79 .031	0,41 .016	20,3 ±0,64 .800 ±.025	22,1 .870

*Characteristics taken with actuator assembled on Catalog Listing V3-100 switch as shown.



JV-91**	Tandem leaf (shown)	20,6 .81	5,00 18	1,67 6	1,57 .062	0,89 .035	—	14,9 ±0,76 .588 ±.030	16,5 .650
JV-82**	Tandem roller leaf	20,6 .81	5,00 18	1,67 6	1,57 .062	0,89 .035	—	20,5 ±0,76 .806 ±.030	21,8 .860

JV-20	Roller lever	19,1 .750	0,83 3	0,14 .5	4,78 .188	1,57 .062	1,98 .078	19,5 ±1,4 .766 ±.055	23,8 .936
JV-26	Long lever	44,5 1.75	0,39 1.4	0,06 .21	8,33 .328	3,58 .141	4,75 .187	12,7 ±3,18 .500 ±.125	—



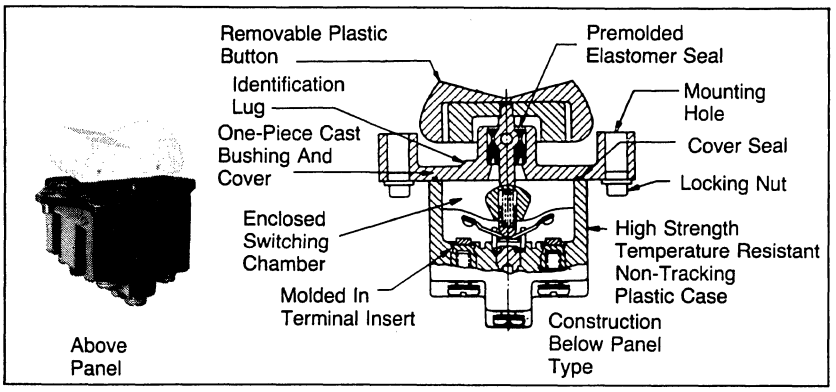
JV-30	One-way roller lever	20,6 .81	3,34 12	1,11 4	2,03 .080	0,51 .020	0,38 .015	25,7 ±0,76 1.010 ±.030	27,7 1.09

NOTE: Contact a MICRO SWITCH Sales Office for application assistance when actuators will be used at temperatures above 300°F (149°C).

**Travel characteristics on tandem actuators vary with actual basic switch characteristics. These shown are typical for the assembly.

MICRO SWITCH, a Honeywell division

Rocker button switches TP



FEATURES

- *2 and 3 position pushbutton action*
- *Various button colors*
- *1, 2, and 4 pole circuitry*
- *Flush panel and above panel mounting*
- *Temperature range is from −54°C to +71°C (−65°F to +160°F)*
- *UL listed, CSA certified*

SWITCHES WITHOUT BUTTONS

To order switches without buttons, convert catalog listings shown in the order guides. Substitute **TP7** for TP4 and TP16 above panel mounted switches; substitute **TP8** for TP1 and TP12 flush panel mounted switches. Order buttons separately from the chart below.

BUTTON ORDER GUIDE

Color	Catalog Listing
Translucent	12PA6
Transparent	12PA4
White*	12PA5-W
Yellow*	12PA5-Y
Black*	12PA5-BK
Green*	12PA5-G
Red*	12PA5-R
Blue*	12PA5-BL

*Opaque

ELECTRICAL RATINGS

(In amperes)

Elec. Rating Code	28 Volts DC			115 VDC	250 VDC	115 Volts AC 60 & 400 HZ			230 VAC
	Ind.	Res.	Lamp	Res.	Res.	Ind.	Res.	Lamp	Res.
1	15	20	5	0.75	0.5	10	15	3	6
2	10	15	4	0.75	0.5	7	15	2	6
3	15	20	7	0.75	0.5	15	15	4	6
4	10	18	5	0.75	0.5	8	11	2	6
5	12	20	5	0.75	0.5	15	15	4	6
6	10	18	4	0.75	0.5	8	11	2	6

2-POSITION ORDER GUIDE

Furnished with buttons.

No. of Poles	Circuits Made with Button At:		UL/CSA Rating Code	Elec. Rating Code	Catalog Listings			
					Flush Panel		Above Panel	
	Ident. Lug Position	Opposite Ident. Lug			Translucent Button	Transparent Button	Translucent Button	Transparent Button
1	OFF	2-3	L191	1	1TP201-2	1TP12-2	1TP216-2	1TP4-2
	1-2	2-3	L191	1	1TP201-3	1TP12-3	1TP216-3	1TP4-3
2	OFF	2-3, 5-6	L191	3	2TP201-2	2TP12-2	2TP216-2	2TP4-2
	1-2, 4-5	2-3, 5-6	L191	3	2TP201-3	2TP12-3	2TP216-3	2TP4-3
4	OFF	2-3, 5-6, 8-9, 11-12	L191	5	4TP201-2	—	—	—
	1-2, 4-5, 7-8, 10-11	2-3, 5-6, 8-9, 11-12	L191	5	4TP201-3	—	—	—

3-POSITION ORDER GUIDE

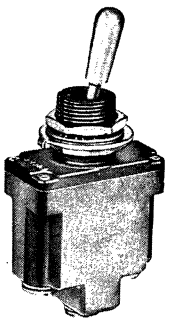
Furnished with buttons.

No. of Poles	Circuits Made with Button At:			UL/CSA Rating Code	Elec. Rating Code	Catalog Listings			
						Flush Panel		Above Panel	
	Ident. Lug Position	Center Position	Opposite Lug Lug Pos.			Translucent Button	Transparent Button	Translucent Button	Transparent Button
1	1-2	OFF	2-3	L191	1	1TP201-1	1TP12-1	1TP216-1	1TP4-1
	1-2*	OFF	2-3*	L192	2	1TP201-7	1TP12-7	1TP216-7	1TP4-7
2	1-2, 4-5	OFF	2-3, 5-6	L191	3	2TP201-1	2TP12-1	2TP216-1	—
	1-2, 4-5*	OFF	2-3, 5-6	L192	4	2TP201-5	—	—	—
	1-2, 4-5*	OFF	2-3, 5-6*	L192	4	2TP201-7	2TP12-7	2TP216-7	—
4	1-2, 4-5, 7-8, 10-11	OFF	2-3, 5-6, 8-9, 11-12	L191	5	4TP201-1	—	—	—
	1-2, 4-5, 7-8, 10-11*	OFF	2-3, 5-6, 8-9, 11-12*	L192	6	4TP201-7	4TP12-7	—	—

*These positions only are momentary. All others are maintained.

MICRO SWITCH, a Honeywell division

TK Toggle switches



FEATURES

- *Environment sealed enclosure*
- *1 and 2-pole circuitry*
- *2 and 3-position, maintained and momentary toggle action*
- *Temperature range: −40° to +71.1°C (−40° to +160°F)*
- *UL listed, CSA certified*

TK toggles answer the need for an environment sealed industrial grade toggle switch. When mounted with a 15PA87 seal accessory, they meet NEMA 4 requirements on food processing and other industrial panels subjected to periodic washdowns. TK's withstand heavy morning dew found in the cabs of construction and farm vehicles, and beverage spillage.

ELECTRICAL RATINGS

UL/CSA Rating Code	Electrical Rating
L192	10 amps — 125, 250, 277 VAC; ¼ Hp — 125 VAC; ½ Hp — 250, 277 VAC; 3 amps — 125 VAC "L"
L191	UL Code L-191: 15 amps — 125, 250, 277 VAC; ½ Hp — 125 VAC; 1 Hp — 250, 277 VAC; 5 amps — 125 VAC "L"

2-POSITION ORDER GUIDE

No. Of Poles	Circuit(s) Made With Toggle At: Keyway Position	Opposite Keyway	UL/CSA Rating Code	Catalog Listing
1	OFF 1-2	2-3 2-3	L191 L191	1TK1-2 1TK1-3
2	OFF 1-2, 4-5	2-3, 5-6 2-3, 5-6	L191 L191	2TK1-2 2TK1-3

3-POSITION ORDER GUIDE

No. Of Poles	Circuit(s) Made With Toggle At: Keyway Position	Center Position	Opposite Keyway	UL/CSA Rating Code	Catalog Listing
1	1-2 1-2*	OFF OFF	2-3 2-3*	L191 L192	1TK1-1 1TK1-7
2	1-2, 4-5 1-2, 4-5*	OFF OFF	2-3, 5-6 2-3, 5-6*	L191 L192	2TK1-1 2TK1-7

*These positions only are momentary. All others are maintained.

CONSTRUCTION

There is a premolded elastomer seal between the toggle lever and bushing, and an elastomer gasket seal between the cover and case. Terminal inserts are molded into the case.

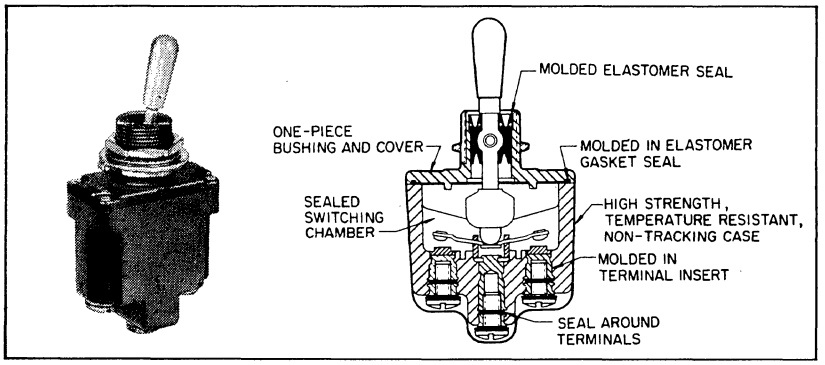
TK's embody many of the time-proven construction features of the TL design, such as: spring-loaded actuating mechanism for direct-action operation and excellent tactile feedback; stepped terminals, which aid non-shorting wiring connections; and a high strength non-tracking case, which promotes electrical stability.

TERMINAL CIRCUIT IDENTIFICATION

Terminal identifications are refered to in the Ordering Charts to indicate which circuits are made in each toggle position (i.e. 1-2 reference indicates circuit closure through terminals 1 and 2.)

MICRO SWITCH, a Honeywell division

Toggle switches TL



FEATURES

- *Qualified to MIL-S-3950*
- *Environment-proof sealing*
- *1, 2, and 4 pole circuitry*
- *Standard and pull to unlock levers*
- *2 and 3 position, maintained, and momentary toggle action*
- *Temperature range: −65°C to +71°C (−85°F to +160°F)*
- *UL listed, CSA certified*

2-POSITION ORDER GUIDE

No. of Poles	Circuit(s) Made w/Toggle At: Keyway Position	Opposite Keyway	Electrical Rating Code	UL/CSA Rating Code	Standard Toggle Catalog Listing	Standard Toggle Military Number	Pull-to-Unlock Toggle Add Suffix to Standard Listing	Pull-to-Unlock Toggle Military Number**
1	OFF	2-3	1	L191	1TL1-2	MS24523-22	D, F, G	MS24658-22
	OFF*	2-3	2	L192	1TL1-4	MS24523-29	F	MS24658-29
	1-2*	OFF	2	L192	1TL1-6	MS24523-30	F	MS24658-30
	1-2	2-3	1	L191	1TL1-3	MS24523-23	D, F, G	MS24658-23
	1-2*	2-3	2	L192	1TL1-8	MS24523-26	F	MS24658-26
2	OFF	2-3, 5-6	3	L191	2TL1-2	MS24524-22	D, F, G	MS24659-22
	1-2, 4-5*.	OFF	4	L192	2TL1-6	MS24524-30	F	MS24659-30
	1-2, 4-5	2-3, 5-6	3	L191	2TL1-3	MS24524-23	D, F, G	MS24659-23
	1-2, 4-5*	2-3, 5-6	4	L192	2TL1-8	MS24524-26	F	MS24659-26
4	OFF	2-3, 5-6 8-9, 11-12	5	L191	4TL1-2	MS24525-22	D, F, G	MS24660-22
	1-2, 4-5 7-8, 10-11	2-3, 5-6 8-9, 11-12	5	L191	4TL1-3	MS24525-23	D, F, G	MS24660-23

*These positions only are momentary. All others are maintained.
**Also add the appropriate suffix letter to the Military number.

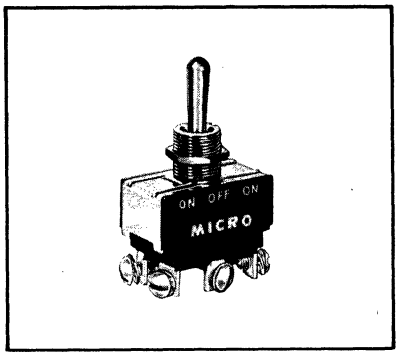
3-POSITION ORDER GUIDE

No. of Poles	Circuit(s) Made w/Toggle At: Keyway Position	Center Position	Opposite Keyway	Electrical Rating Code	UL/CSA Rating Code	Standard Toggle Catalog Listing	Standard Toggle Military Number**	Pull-to-Unlock Toggle Add Suffix to Standard Listing	Pull-to-Unlock Toggle Military Number**
1	1-2	OFF	2-3	1	L191	1TL1-1	MS24523-21	ALL TYPES	MS24658-21
	1-2*	OFF	2-3	2	L192	1TL1-5	MS24523-31	E, F, K, L, M, N	MS24658-31
	1-2*	OFF	2-3*	2	L192	1TL1-7	MS24523-27	E, L, N	MS24658-27
2	1-2, 4-5	OFF	2-3, 5-6	3	L191	2TL1-1	MS24524-21	ALL TYPES	MS24659-21
	1-2, 4-5*	OFF	2-3, 5-6	4	L192	2TL1-5	MS24524-31	E, F, K, L, M, N	MS24659-31
	1-2, 4-5*	OFF	2-3, 5-6*	4	L192	2TL1-7	MS24524-27	E, L, N	MS24659-27
	1-2, 4-5	1-2, 5-6	2-3, 5-6	3	L191	2TL1-10	MS27407-4	ALL TYPES	MS27408-4
	1-2, 4-5*	1-2, 5-6	2-3, 5-6	4	L192	2TL1-50	MS27407-5	E, F, K, L, M, N	MS27408-5
	1-2, 4-5*	1-2, 5-6	2-3, 5-6*	4	L192	2TL1-70	MS27407-6	E, L, N	MS27408-6
4	1-2, 4-5 7-8, 10-11	OFF	2-3, 5-6 8-9, 11-12	5	L191	4TL1-1	MS24525-21	ALL TYPES	MS24660-21
	1-2, 4-5 7-8, 10-11*	OFF	2-3, 5-6 8-9, 11-12*	6	L192	4TL1-7	MS24525-27	E, L, N	MS24660-27
	1-2, 4-5 7-8, 10-11	2-3, 4-5 7-8, 11-12	2-3, 5-6 8-9, 11-12	5	L191	4TL1-12	MS27406-1	ALL TYPES	MS27409-1

*These positions only are momentary. All others are maintained.
**Also add appropriate suffix letter to the Military number.

MICRO SWITCH, a Honeywell division

TS Toggle switches



FEATURES

- *2 or 3-position, momentary and maintained action*
- *1 and 2-pole circuitry*
- *Rated up to 15 amps*
- *Lever-to-bushing seal*
- *Solder, screw, or quick-connect terminals*
- *UL listed, CSA certified*

ELECTRICAL RATINGS

UL/CSA Rating Code	Electrical Rating
L192	10 Amps, 125, 250, 277 VAC; ¼ HP — 125 VAC; ½ HP — 250, 277 VAC; 3 amps — 125 VAC "L"
L191	15 amps, 125, 250, 277 VAC; ½ HP — 125 VAC; 1 HP — 250, 277 VAC; 5 amps — 125 VAC "L"

2-POSITION ORDER GUIDE

No. of Poles	Circuit(s) Made w/Toggle At: Keyway Position	Circuit(s) Made w/Toggle At: Opposite Keyway	UL/CSA Rating Code	Screw Terminals	Solder Terminals	Quick-Connect Terminals
1	OFF	2-1 ON	L191	11TS15-2	11TS115-2	11TS95-2
	2-1 ON	2-3 ON	L191	11TS15-3	11TS115-3	11TS95-3
2	OFF	2-3 & 5-6 ON	L191	12TS15-2	12TS115-2	12TS95-2
	2-1 & 5-4 ON	2-3 & 5-6 ON	L191	12TS15-3	12TS115-3	12TS95-3

3-POSITION ORDER GUIDE

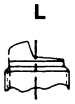
No. of Poles	(Circuits) Made w/Toggle At: Keyway Position	Center Position	Opposite Keyway	UL/CSA Rating Code	Screw Terminals	Solder Terminals	Quick-Connect Terminals
1	2-1 ON	OFF	2-3 ON	L191	11TS15-1	11TS115-1	11TS95-1
	2-1 ON*	OFF	2-3 ON	L192	11TS15-5	11TS115-5	11TS95-5
	2-1 ON*	OFF	2-3 ON*	L192	11TS15-7	11TS115-7	11TS95-7
2	2-1 & 5-4 ON	OFF	2-3 & 5-6 ON	L191	12TS15-1	12TS115-1	12TS95-1
	2-1 & 5-4 ON*	OFF	2-3 & 5-6 ON*	L192	12TS15-7	12TS115-7	12TS95-7

*Marked toggle positions are momentary. All other positions are maintained.

LOCKING CONFIGURATIONS FOR TL, 13AT AND 23AT SERIES ONLY

When ordering pull-to-unlock toggle listings, add the suffix letter shown in the chart below to the standard toggle listing and the MS number. For example, to order a 1TL1-1 pull-to-unlock toggle switch with the lever locked in the center position, add the letter **E**; i.e., 1TL1-1**E**, MS-24658-21**E**.

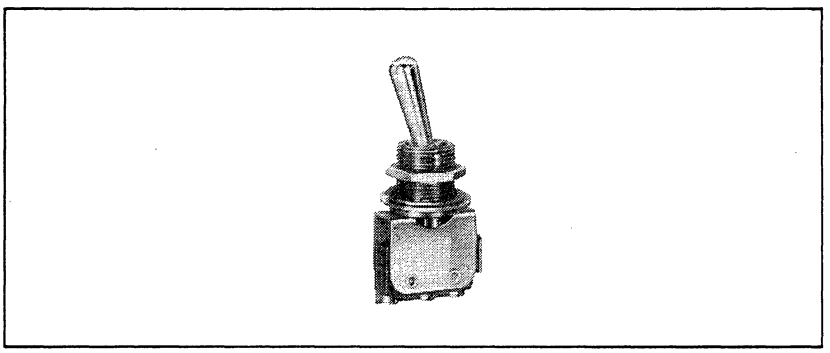
A	B	D	E	F	G	H
Locked In Three Positions	Locked In Center and Extreme Position (Keyway Side)	Locked Out Of Center Position	Locked In Center Position	Locked In Extreme Position (Opposite Keyway)	Locked In Extreme Position (Keyway Side)	Locked Out Of Center And Extreme Position (Keyway Side)

J	K	L	M	N	P
					
Locked Out Of Center And Extreme Position (Opposite Keyway)	Locked In Center And Extreme Position (Opposite Keyway)	Locked Out Of Extreme Position (Keyway Side)	Locked Out Of And Into Extreme Position (Opposite Keyway)	Locked Out Of Extreme Position (Opposite Keyway)	Locked Out Of And Into Extreme Position (Keyway Side)

MICRO SWITCH, a Honeywell division

Toggle switch assemblies AT

6AT SERIES



FEATURES

- *2-position, momentary and maintained action*
- *1, 2 or 3 SPDT precision basic switches*
- *Short behind-panel depth*
- *Choice of ¼ or 15/32-inch bushings*
- *Silver contacts (gold available)*
- *UL listed, CSA certified basic switches*

ELECTRICAL RATINGS

For 6AT, 13AT, 23AT switches

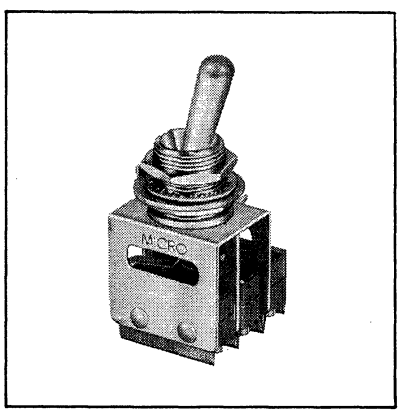
UL/CSA Rating	30VDC Rating		
	Load	Amps	
		Sea Level	50,000 ft.
5 amps, 125-250VAC	Inductive	3	2.5
	Resistive	5	5
	Max. Inrush	24	24

6AT ORDER GUIDE

Mounting Style	No. of Poles	Solder Terminals*
¼" bushing with key tab	1	6AT2
	2	6AT3
	3	6AT501
¼" bushing without key tab	1	6AT1
	2	6AT4
15/32" bushing with key washer	1	6AT6
	2	6AT7
	3	6AT10

*"T" and "T2" terminal versions, gold contact versions for low energy circuits: See Catalog 30.

13AT/23AT SERIES



FEATURES

- *2 or 3 position, momentary or maintained action*
- *2, 3 or 4 SPDT precision basic switches*
- *Standard toggle, tab or pull-to-unlock levers*
- *Silver contacts (gold available)*
- *15/32-inch bushing*
- *UL listed, CSA certified basic switches*
- *Lever-to-bushing seal option*

23AT 2-POSITION ORDER GUIDE

Toggle Lever Position		No. of Poles	Solder Terminals*
Keyway	Opposite Keyway		
Maint.	Maint.	2	23AT1
		3	23AT2
		4	23AT3

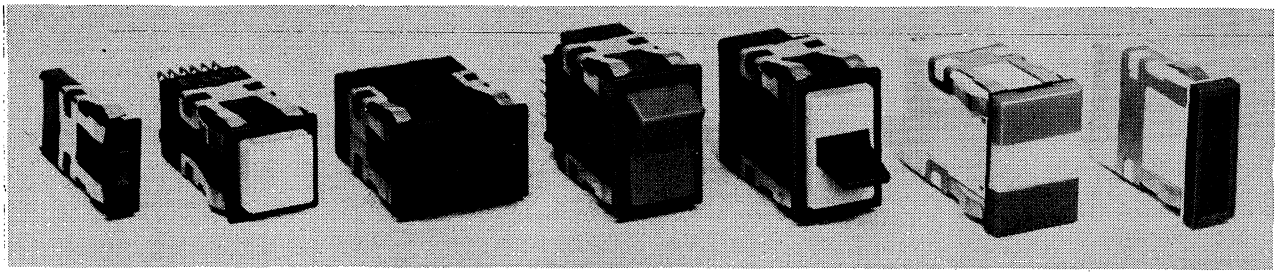
13AT 3-POSITION ORDER GUIDE

Toggle Lever Position			No. of Poles*	Solder Terminals*
Keyway	Center	Opposite Keyway		
Maint.	Maint.	Maint.	2	13AT2
Mom.	Maint.	Mom.	2	13AT1
Maint.	Maint.	Mom.	2	13AT3

*Pull-to-unlock lever, tab lever, 3 and 4-pole versions, M8805 types, gold contacts, and "T" or "T2" terminals: see Catalog 30, Manual Switches.

MICRO SWITCH, a Honeywell division

AML Advanced manual line



AML's classic design blends with other panel components to enhance total display harmony. Well-accepted as the only comprehensive line of its kind, AML features uniformly functional and attractive pushbuttons, paddles, rockers, indicators, and annunciators. LED, incandescent, and neon illumination . . . solid state to electronic and power duty control.

AML electrical data ..... p. 26
Solid state pushbuttons AML11/12 ..... p. 27
Power duty pushbuttons AML31/32 ..... p. 27
Electronic control pushbuttons AML21/22 ..... p. 28
LED application notes/panel cutouts ..... p .28
Lighted indicators AML41/42 ..... p. 29
Buttons, lenses, lamps AML51/52/91 ..... p. 30
Solid state paddles & rockers AML13/14/15/16 ..... p. 31
Electronic control paddles & rockers AML23/24/25/26 ..... p. 32
Power duty paddles & rockers AML33/34/35/36 ..... p. 33
Paddle covers AML53/55 ..... p. 34
Rocker operators AML54/56 ..... p. 35
AML accessories ..... p. 36

A companion line of MIL-S-22885 qualified products is available. Ask for information on M22885 series.

ELECTRICAL SPECIFICATIONS

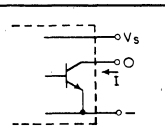
AML10 SERIES SOLID STATE SWITCHES

Electrical Characteristics						Absolute Maximum Rating			
Integrated Circuit Function	Supply Current (Max.)	Output Voltage (Operated)	Output Leakage Current Max. (Released)	Switching Time Max. Rise 10% to 90%	Switching Time Max. Fall 90% to 10%	Supply Voltage (V_s)	Voltage Externally Applied to Output	Loads to Output	Storage Temperature
5 VDC Sinking[1]	3.5 mA (Released) 6.5 mA (Operated — no load)	+.4 Volt (Sinking 8 mA)	2.0 μ A	1.0 μ sec. (Sinking 8 mA)	1.0 μ sec (Sinking 8 mA)	−.5 to +7.0 VDC 0° to +65°C (+32° to +149°F)	−.5 Volt min. +15 Volts Max. (Off condition)	20 mA (Sinking)	−40°C to +65°C (−40° to +149°F)
6-16 VDC Sinking[2]	6.5 mA @ 6 VDC. 10.0 mA @ 16 VDC (Plus load current)[3]	+.4 Volt (Sinking 20mA max.)	20 μ A	1.5 μ sec (Sinking 20 mA)	0.5 μ sec (Sinking 20 mA)	−1.2 to +20 VDC	+20 VDC max. in Off condition only −0.5 VDC min. in Off or On condition	40 mA	−40°C to +65°C (−40° to +149°F)

[1]Over temperature range of 0° to +55°C (+32° to +131°F) and supply voltage of 4.5 to 5.5 VDC.
[2]Over temperature range of 0° to +55°C (+32° to +131°F) and supply voltage to 16 VDC.
[3]At 24°C (+75°F).

A permanent magnet plunger moves adjacent to the Hall effect integrated circuit to give a digital, current sinking output.

Hall effect integrated circuit



AML20 SERIES ELECTRONIC CONTROL SWITCHES

Contacts	Voltage	Current	Load Type	Contact Arrangement
Silver	250 VAC 125 VAC 24 VDC	2 Amps 3 Amps 2 Amps	75% Power Factor 75% Power Factor Resistive	1, 2, 0r 4 poles: Form C
Gold	24 VDC 5 VDC .5 VDC	100 mA 10 mA 1 mA	Resistive Resistive Resistive	

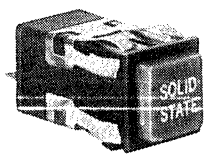
AML30 SERIES POWER DUTY SWITCHES

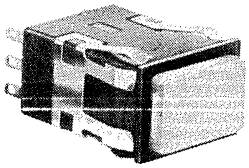
	Voltage	Current	Load Type	Contact Arrangement
Pushbutton Switches	125 VAC* 250 VAC*	10 amps 10 amps	60% Power Factor 60% Power Factor	2 poles: Form X
Rocker & Paddle Switches	125 VAC 250 VAC	15 amps 15 amps	60% Power Factor 60% Power Factor	1 Or 2 poles: Form A

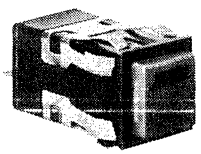
*10 amps, ⅓ hp.

MICRO SWITCH, a Honeywell division

Solid state pushbutton switches AML11/12







AML11 non-lighted or incandescent illuminated

Buttons (AML51) and incandescent lamps (AML91) are ordered separately.

AML12 w/integral LED indicator

LED "window" buttons (AML52) are ordered separately.

FEATURES

- *Hall effect reliability. (For electrical specifications, refer to facing page.)*
- *Low voltage signal interfaces with nearly all DC logic.*
- *5 or 6-16 supply voltage.*
- *UL recognized.*

AML11 B

Housing Type
Standard Bezel: **AML11B** Square Non-Lighted **AML11C** Square 1 Lamp Ckt. **AML11E** Rect. Non-Lighted **AML11F** Rect. 1 Lamp Ckt.
Standard Bezel: **AML12C** Square 1 LED

B

Bezel Color
B Black

A

Lamp Type
A No Lamp Installed

LED Color/ Voltage	
Red	
B	V*
C	5 V
Yellow	
H	V*
J	5 V
Green	
R	V*
S	5 V

2

Terminal Type
2 .110 x .020 (Solder or Quick-Connect
3 .025 x .025 (Printed Circuit or Push-On)

AA

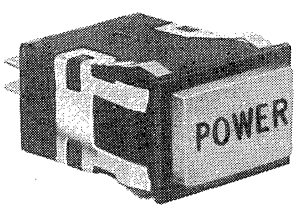
Circuitry Codes	
5 VDC Sinking	**AA** Momentary Action
6-16 VDC Sinking	**BA** Momentary Action

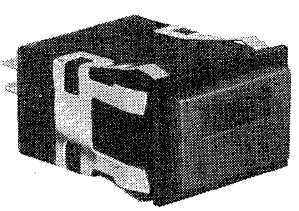
*See LED Application Notes.

Additional AML11 options: Full guard bezel, two-level alternate action, and rectangular housings with two lamp circuits.

Additional AML12 options: Full guard bezel, integral diode LED protection, 15 V LED voltage, and two-level alternate-action.

Power duty pushbutton switches AML31/32





AML31 non-lighted or incandescent illuminated

Buttons (AML51) and incandescent lamps (AML91) are ordered separately.

AML32 w/integral neon indicator

Neon "window" buttons (AML52) are ordered separately.

FEATURES

- *Up to 10 amps, 125/250 VAC.*
- *UL listed, CSA certified.*

Additional AML31 Options: Momentary action, full guard bezel.

Additional AML32 Options: Full guard bezel, momentary action.

AML31 E

Housing Type
Standard Bezel: **AML31E** Rect. Non-Lighted **AML31F** Rect. 1 Lamp Ckt.
Standard Bezel: **AML32F** Rect. 1 Neon Lamp

B

Bezel Color
B Black

A

Lamp Type
A No Lamp Installed

Neon Lamp Voltage/Color	
Red	
B	125 VAC
C	250 VAC
Clear	
K	125 VAC
L	250 VAC

4

Terminal Type
4 .187 x .020 (Solder or Quick-Connect)

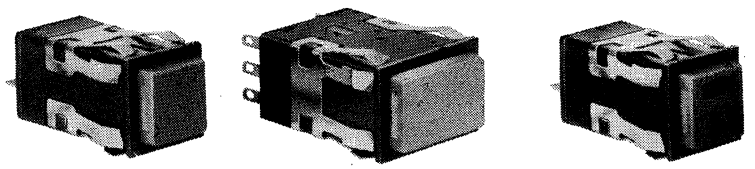
Terminal Type Lamp Circuit
4 .187 x .020 (Solder or Quick-Connect) with isolated lamp circuit
7 .187 x .020 with integral lamp circuit

AD

Circuitry Codes
2-Pole, Single-Throw Normally-Open, Form X: **AD** Alternate Action

MICRO SWITCH, a Honeywell division

AML21/22 Electronic control pushbutton switches



AML21 non-lighted or incandescent illuminated Buttons (AML51) and incandescent lamps (AML91) are ordered separately.

AML22 w/integral LED indicator LED "window" buttons (AML52) are ordered separately.

FEATURES

- *Up to 3 amps, 125 VAC.*
- *Silver or gold contacts.*
- *Momentary or 2-level alternate-action.*
- *UL listed, CSA certified.*

AML21 B

Housing Type
Standard Bezel: **AML21B** Square Non-Lighted **AML21C** Square 1 Lamp Ckt. **AML21E** Rect. Non-Lighted **AML21F** Rect. 1 Lamp Ckt.
Standard Bezel: **AML22C** Square 1 LED

B

Bezel Color
B Black

A

Lamp Type
A No Lamp Installed

LED Color/ Voltage
Red **B** V* **C** 5.0 V **Yellow** **H** V* **J** 5.0 V **Green** **R** V* **S** 5.0 V

*See LED Application Notes.

2

Terminal Type
2 .110 x .020 (Solder or Quick-Connect)
3 .025 x .025 (Printed Ckt. or Push-On)

AA

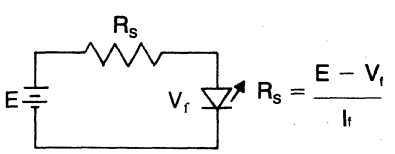
Circuitry Codes (Each pole has double-throw)	
Silver Contacts	Mom. Action **AA** 1-Pole **AC** 2-Pole
	Alt. Action **AB** 1-Pole **AD** 2-Pole
Gold Contacts	Mom. Action **BA** 1-Pole **BC** 2-Pole
	Alt. Action **BB** 1-Pole **BD** 2-Pole

Additional AML21 Options: Full guard bezel, 4 poles, and rectangular housings with two lamp circuits.

Additional AML22 Options: Full guard bezel, integral diode protection for LED, 15 V LED voltage, and 4 poles.

LED Application Notes:

1. Internal resistors control LED current to nominal 20 mA on 5 VDC devices.
2. Devices without internal current-limiting resistors require suitable external control of the LED current.
3. A minimum of 5 VDC open circuit voltage with an appropriate series resistance should drive the LED. This minimizes effect of temperature (current variation) on forward voltage of LED.
4. Reverse breakdown voltage of LED is 5 volts min.
5. Following example includes a simple DC drive circuit and equation used to determine value of series resistance.



$$R_S = \frac{E - V_f}{I_f}$$

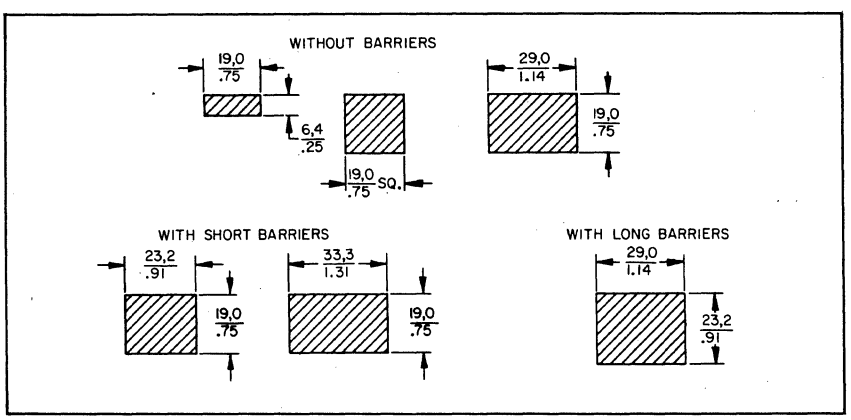
Where: R_S = Series Resistance
E = Supply Voltage
V_f = Forward Voltage of LED
I_f = Circuit Current

If a diode is added in series for reverse polarity protection then:

$$R_S = \frac{E - V_f - V_{PD}}{I_f}$$

Where: V_{PD} = Forward Voltage of Protection Diode

PANEL CUTOUTS FOR SINGLE SWITCHES/INDICATORS

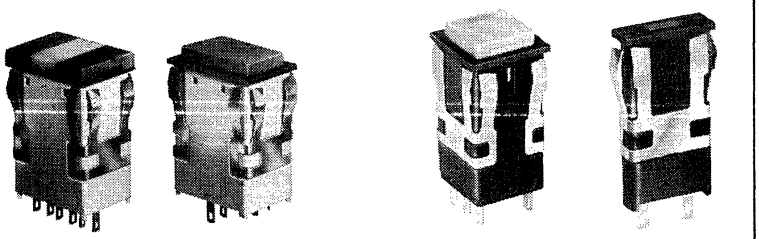


MICRO SWITCH, a Honeywell division

Lighted indicators AML41/42

FEATURES

- *Choice of incandescent or LED illumination.*
- *UL listed, CSA certified (except LED indicators, which are UL recognized).*



AML41 incandescent illuminated pushbutton style (left) and lens style.

AML42 LED pushbutton style (left) and compact style.

AML41 pushbutton style indicators match display of incandescent illuminated switches.

Lens style indicators use a special cap-like button which covers the bezel to present a larger display area, without affecting family appearance. Up to 3-lamp split screen capability.

Note: Buttons (AML51) and incandescent lamps (AML91) ordered separately.

AML41 ORDER GUIDE

AML41 C — **B** — **A** — **2**

Housing Type		Bezel Color	Lamp Type	Terminal Type
Pushbutton Style:	**Lens Style:**			
AML41 C Square 1 lamp ckt.	(Use AML51-J, -K, and -L buttons only)	**B** Black	**A** No lamp installed	**2** .110 x .020 (Solder or Quick-Connect)
AML41 D Square 2 lamp ckts.	**AML41 J** Rectangular 1 lamp ckt.			**3** .025 x .025 (Printed Circuit or Push-On)
AML41 F Rectangular lamp ckt.	**AML41 K** Rectangular 2 lamp ckts.			
AML41 G Rectangular 2 lamp ckts.	**AML41 L** Rectangular 3 lamp ckts.			

AML42C housings have an integral LED indicator which is flush with the button face. Note: LED "window" buttons (AML52) are ordered separately.

AML42S feature a compact (.9 x .3") package. The LED is flush with the bezel.

AML42 ORDER GUIDE

AML42 S — **B** — **C** — **2**

Housing Type	Bezel Color	LED Color/ Voltage	Terminal Type	
			2 .110 x .020 (Solder or Q.C.)	**3** .025 x .025 (Printed Circuit or Push-On)
AML42 C Square 1 LED	**B** Black	**Red** B V* C 5 V		
AML42 S Compact 1 LED		**Yellow** H V* J 5 V		
		Green R V* S 5 V		

*See LED Application Notes.

Additional Indicator Options: 15 V LED voltage, neon indicators which match the display of neon power duty pushbutton switches.

MICRO SWITCH, a Honeywell division

AML51/52 Buttons/lenses/lamps

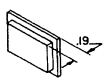
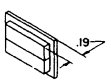
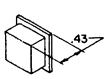
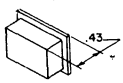
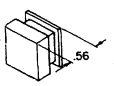
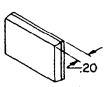
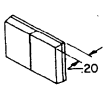
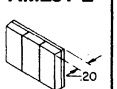
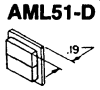
AML51 ORDER GUIDE

AML51 buttons are for non-lighted or incandescent illuminated display.

Specify AML51-J, AML51-K, and AML51-L buttons for use with AML41J, AML41K, and AML41L **lens style indicators only.** They do not fit other AML pushbutton switches or indicators.

Split colors for display/legend types 10, 11, 20, and 21 are visible whether lighted or unlighted. On all other types, split colors are only visible when lighted.

AML51-C

Button Type
For Pushbuttons Or Indicators
AML51-C **AML51-F**  **AML51-G** 
AML51-B  **AML51-E**  **AML51-M** 
Button Types B, E, and M are available with Display/ Legend Types 10 and 20 only.
For Indicators Only Lens Style:
AML51-J  **AML51-K**  **AML51-L** 
Pushbutton Style: **AML51-D** 

10

Display Legend/Type
Transmitted Color **10** No legend **20** With legend
Transmitted Color (Clear cap and color insert) **11** No legend **21** With legend
Dead Front (Smoky gray cap and color insert) **30** No legend **40** With legend
Projected Color (White cap and color insert) **50** No legend **60** With legend

R

Full Color or 1st Color Split
R Red **Y** Yellow **G** Green **B** Blue **W** White

—

2nd Color Split
R Red **Y** Yellow **G** Green **B** Blue **W** White

—

3rd Color Split
R Red **Y** Yellow **G** Green **B** Blue **W** White

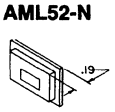
INCANDESCENT LAMPS
AML91 ORDER GUIDE

Lamp Type	Industry Lamp No.	Voltage	Catalog Listing
Incandescent T-1¾ wedge base	86	6.3	AML91LA86
	73	14.0	AML91LA73
	85	28.0	AML91LA85

AML52 ORDER GUIDE

AML52 buttons have an open window which allows the LED or neon lamp lens to be flush with the button face.

AML52-N

Button Type
For LED Devices **AML52-C**
For Neon Devices **AML52-N** 

10

Display/Legend Type
Transmitted Color **10** No Legend **20** With Legend

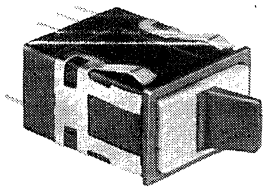
R

Button Color
R Red **Y** Yellow **G** Green **B** Blue **W** White **K** Black

Note: Dimensions include the .060 in. bezel.

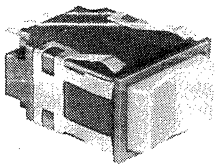
MICRO SWITCH, a Honeywell division

Solid state paddle and rocker switches Non-lighted or incandescent illuminated AML13/14



AML13

Paddle covers (AML53) and incandescent lamps (AML91) ordered separately.



AML14

Rockers (AML54) and incandescent lamps (AML91) ordered separately.

FEATURES

- *Hall effect reliability.*
- *Low voltage signal interfaces with nearly all DC logic.*
- *5 or 6-16 supply voltage.*
- *Black toggle type paddle operators. (Switch covers provide color display.)*
- *UL recognized.*

Additional Options: Two lamp circuits; other two and three-position operating actions; printed circuit or push-on terminals; and two 6-16V sinking IC's.

AML13 E

Housing Type
AML13 E Rect. Paddle Non-Lighted
AML13 F Rect. Paddle 1 Lamp Ckt. (A)
AML14 E Rect. Rocker Non-Lighted
AML14 F Rect. Rocker 1 Lamp Ckt. (A)

B

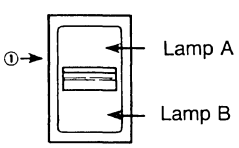
Operator/Bezel Color
B Black

A

Lamp Type
A No Lamp Installed

2

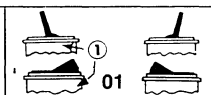
Terminal Type
2 .110 x .020 (Solder or Quick-Connect)



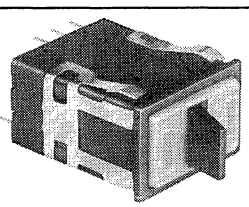
AA

Circuitry
One IC (Ckt. A): AA 5 V Sinking
BA 6-16 V Sinking
Two IC's (Ckts. A & B): AC 5 V Sinking

01

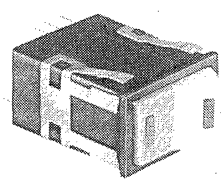
Operating Action		
Circuit Output States	 ① 01	
	Maint.	**Maint.**
Ckt. A	Low (operated)	High
Ckt. B	High	Low (operated)

Solid state paddle and rocker switches With integral LED indicators AML15/16



AML15

LED "window" covers (AML55) are ordered separately.



AML16

LED "window" rockers (AML56) are ordered separately.

FEATURES

- *Hall effect reliability.*
- *Low voltage signal interfaces with nearly all DC logic.*
- *5 or 6-16 supply voltage.*
- *UL recognized.*

Additional Options: Two LED's, integral diode LED protection, 15V LED voltage, printed circuit/push-on terminals, other two and three-position operating actions.

AML15 F

Housing Type
AML15 F Rect. Paddle 1 LED
AML16 F Rect. Rocker 1 LED

B

Operator/ Bezel Color
B Black

B

LED Voltage
B V*
C 5 V

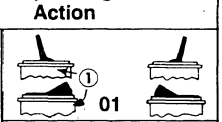
2

Terminal Type
2 .110 x .020 (Solder or Quick-Connect)

AA

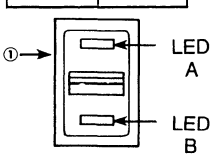
Circuitry
One IC (Ckt. A): AA 5 V Sinking
BA 6-16 V Sinking
Two IC's (Ckts. A & B): AC 5 V Sinking

01

Operating Action		
Circuit Output States	 ① 01	
	Maint.	**Maint.**
Ckt. A	Low (operated)	High
Ckt. B	High	Low (operated)

R X

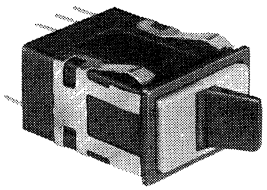
LED Color	
LED A	**LED B**
R Red **Y** Yellow **G** Green	**X** No LED



*See LED Application Notes.
① The "MICRO SWITCH" identification is shown on this side of the switch housings.

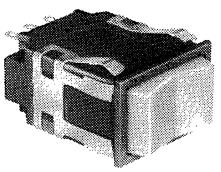
MICRO SWITCH, a Honeywell division

AML23/24 Electronic control paddle and rocker switches Non-lighted or incandescent illuminated



AML23

Paddle covers (AML53) and incandescent lamps (AML91) ordered separately.



AML24

Rockers (AML54) and incandescent lamps (AML91) ordered separately.

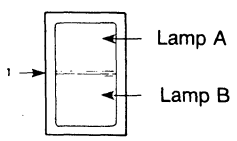
FEATURES

- *Up to 3 amps, 125 VAC.*
- *Silver or gold contacts*
- *Black toggle type paddle operators. (Switch covers provide color display.)*
- *UL listed, CSA certified.*

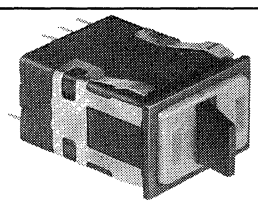
Additional Options: Two lamp circuits, printed circuit/push-on terminals, other two and three-position operating actions, and additional circuitry.

AML23 E B A 2 AA 01

Housing Type	Operator/Bezel Color	Lamp Type	Terminal Type	Circuitry	Operating Action
AML23 E Rect. Paddle Non-Lighted **AML23 F** Rect. Paddle 1 Lamp Ckt. (A) **AML24 E** Rect. Rocker Non-Lighted **AML24 F** Rect. Rocker 1 Lamp Ckt. (A)	**B** Black	**A** No Lamp Installed	**2** .110 x .020 (Solder or Quick-Connect)	Insert Code Letters from chart below	Insert Code Numbers from chart below

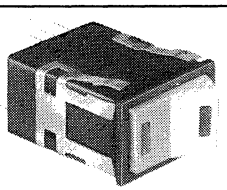


AML25/26 Electronic control paddle and rocker switches With integral LED indicator



AML25

LED "window" covers (AML55) are ordered separately.



AML26

LED "window" rockers (AML56) are ordered separately.

FEATURES

- *Up to 3 amps, 125 VAC.*
- *Silver or gold contacts.*
- *UL listed, CSA certified.*

Additional Options: Two LED's, 15V LED voltage, printed circuit/push-on terminals, other two and three-position operating actions, and additional circuitry.

AML25 F B B 2 AA 01 R X

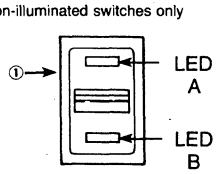
Housing Type	Operator/ Bezel Color	LED Voltage	Terminal Type	Circuitry	Operating Action	LED Color	
						LED A	LED B
AML25 F Rect. Paddle 1 LED **AML26 F** Rect. Rocker 1 LED	**B** Black	**B** V* **C** 5.0 V	**2** .110 x .020 (Solder or Quick-Connect)	Insert Code Letters from chart below	Insert Code Numbers from chart below	**R** Red **Y** Yellow **G** Green	**X** No LED

Circuitry Codes		Operating Action Codes				
		2-Position		3-Position		
		01		04		
Silver Contacts	Gold Contacts	Maint.	Maint.	Maint.	Maint.	Maint.
AA	BA	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
AC[2]	BC[2]	3 2 1 6 5 4	3 2 1 6 5 4	3 2 1 6 5 4	3 2 1 6 5 4	3 2 1 6 5 4

*See LED Application Notes.

① The "MICRO SWITCH" identification is shown on this side of the switch housings.

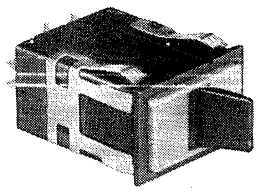
② For non-illuminated switches only



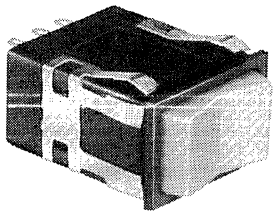
MICRO SWITCH, a Honeywell division

Power duty paddle and rocker switches Non-lighted or incandescent illuminated

AML33/34



AML33
Paddle covers (AML53) and incandescent lamps (AML91) ordered separately.



AML34
Rocker operators (AML54) and incandescent lamps (AML91) ordered separately.

FEATURES

- *Up to 15 amps, 125/250 VAC.*
- *Black toggle type paddle operators. (Switch covers provide color display.)*
- *UL listed, CSA certified.*

AML33 E

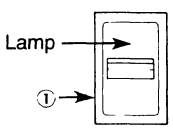
Housing Type
AML33 E Rect. Paddle Non-Lighted **AML33 F** Rect. Paddle 1 Lamp Ckt.
AML34 E Rect. Rocker Non. Illum. **AML34 F** Rect. Rocker 1 Lamp Ckt

B

Operator/Bezel Color
B Black

A

Lamp Type
A No Lamp Installed



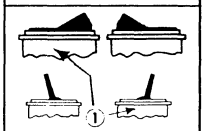
4

Terminal Type
4 .187 x .020 (Solder or Quick-Connect)

AA

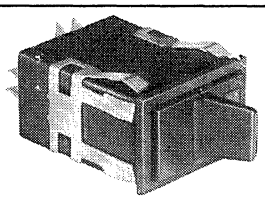
Circuitry Codes
Silver Contacts: **AA** 1-Pole (One Form A Single-Throw, Normally-Open) **AC** 2-Pole (Two Form A)

01

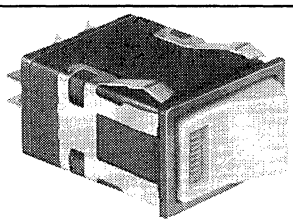
Operating Action
 **01** Maint. ON — Maint. OFF

Power duty paddle and rocker switches With integral LED indicator

AML35/36



AML35
Neon "lens" covers (AML55) ordered separately.



AML36
Neon "lens" rockers (AML56) ordered separately.

FEATURES

- *Up to 15 amps, 125/250 VAC.*
- *UL listed, CSA certified.*

AML35 F

Housing Type
AML35 F Rect. Paddle 1 Neon Lamp
AML36 F Rect. Rocker 1 Neon Lamp

B

Operator/Bezel Color
B Black

B

Lamp Voltage
B 125 VAC **C** 250 VAC

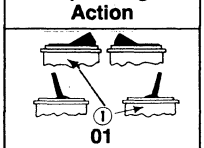
4

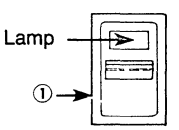
Terminal Type/ Lamp Circuit
4 .187 x .020 (Solder or Quick-Connect) With Isolated Lamp Circuit **7** .187 x .020 With Integral Lamp Circuit (Available with 2-Pole devices only)

AA

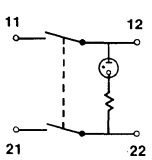
Circuitry Codes
Silver Contacts: **AA** (One Form A Single-Throw) Available only with isolated lamp circuit, term. type 4. **AC** 2-Pole (Two Form A)

01

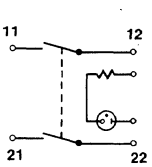
Operating Action
 **01** Maint. ON — Maint. OFF



Integral Neon Circuit



Isolated Neon Circuit



① The "MICRO SWITCH" identification is shown on this side of the switch housings.

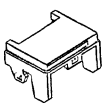
MICRO SWITCH, a Honeywell division

AML53/55 Covers for paddle switches

AML53 ORDER GUIDE

AML53 covers are for non-lighted or incandescent illuminated display.

AML53-E

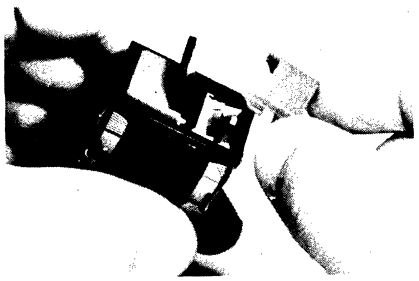
Paddle Switch Cover Type
 **AML53-E** ½ Cover

10

Display/Legend Type
Transmitted Color **10** No legend **20** With legend **Transmitted Color** (Clear cap and color insert) **11** No legend **21** With legend

R

Cover Color
R Red **Y** Yellow **G** Green **B** Blue **W** White **K*** Black



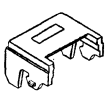
Colored covers simply snap into the top of paddle switch housings.

*Not recommended for lighted display.

AML55 ORDER GUIDES

AML55 covers are used with LED and neon display paddle switches. AML55-E covers have a "window" which allows the LED to be flush with the top surface of the cover. AML55-N covers have a colored lens which extends over the neon lamp.

AML55-E

Paddle Switch Cover Type
 **AML55-E** ½ Cover (For One LED)*

10

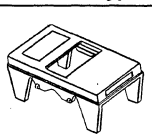
Display/Legend Type
Transmitted Color **10** No legend **20** With legend

Y

Cover Color
R Red **Y** Yellow **G** Green **B** Blue **W** White **K** Black

*To order a ½ cover without the LED "window", specify an AML53-E listing.

AML55-N

Paddle Switch Cover Type
 **AML55-N** Full Neon Cover, with Colored lens

10

Display/Legend Type
Transmitted Color **10** No Legend **20** With Legend

R

Lens Color
T Clear **R** Red

K

Cover Color
R Red **K** Black **L** Gray

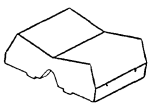
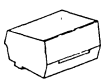
MICRO SWITCH, a Honeywell division

Rocker operators AML54/56

AML54 ORDER GUIDE

AML54 rockers are for non-lighted or incandescent illuminated display.

AML54-F

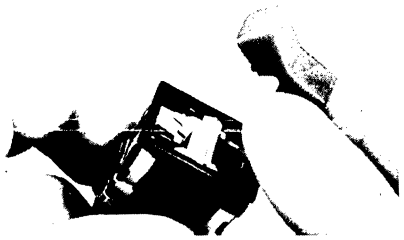
Rocker Operator Type
AML54-F Full Rocker  **AML54-E** ½ Rocker 

10

Display/Legend Type
Transmitted Color **10** No legend **20** With legend

R

Rocker Color
R Red **Y** Yellow **G** Green **B** Blue **W** White **K*** Black



Rocker operators are assembled to the switches by simply snapping them into recesses in the switch actuator sockets.

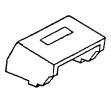
INCANDESCENT LAMPS AML91 ORDER GUIDE

Lamp Type	Industry Lamp No.	Voltage	Catalog Listing
Incandescent T-1¾ wedge base	86	6.3	AML91LA86
	73	14.0	AML91LA73
	85	28.0	AML91LA85

AML56 ORDER GUIDES

AML56 rockers are used with LED and neon display switches. AML56-E rockers have a "window" which allows the LED to be flush with the top surface of the rocker. AML56-N rockers have a colored lens which extends over the neon lamp.

AML56-E

Rocker Operator Type
AML56-E ½ Rocker* (For one LED) 

10

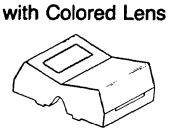
Display/Legend Type
Transmitted Color **10** No Legend **20** With Legend

R

Rocker Color
R Red **Y** Yellow **G** Green **B** Blue **W** White **K** Black

*To order a ½ rocker without the LED "window", specify an AML54-E listing.

AML56-N

Rocker Operator Type
AML56-N Full Rocker with Colored Lens 

10

Display/Legend Type
Transmitted Color **10** No Legend **20** With Legend

R

Lens Color
T Clear **R** Red

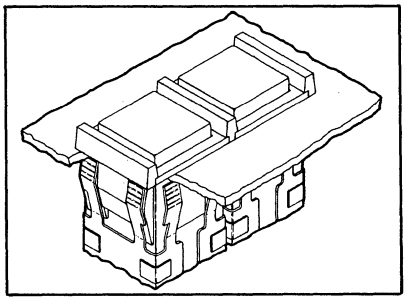
R

Rocker Color
R Red **K** Black

MICRO SWITCH, a Honeywell division

AML Advanced manual line accessories

BARRIERS



When mounting an individual unit, an end barrier is attached to each side of housing. The center barrier is used in a slot mount array (see drawing).

FEATURES

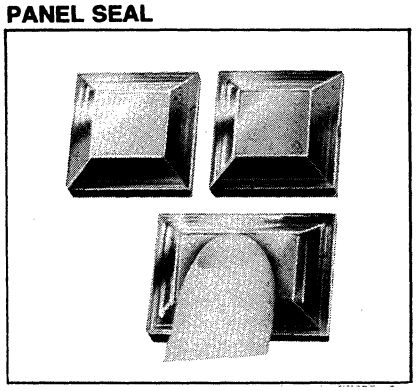
- *Helps prevent inadvertent actuation of two pushbuttons with a single push.*
- *Front of panel mounting simplifies installation.*

AML71 ORDER GUIDE

Barriers shown in order guide are black. They are not for use with AML61 mounting hardware; or with AML41J, AML41K, or AML41L lens type indicators or AML45 annunciators.

Barrier Length	Type	Catalog Listing
Short Barrier (For use with square devices and short side of rectangular devices.)	Center	AML71SCB
	End	AML71SEB
Long Barrier (For use with long side of rectangular devices.)	Center	AML71LCB
	End	AML71LEB

PANEL SEAL



AML75 panel seals are used to help protect pushbutton switches and indicators from contamination from accidental beverage spills, dust and dirt.

FEATURES

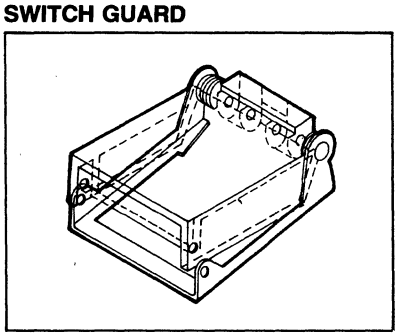
- *Easy to install, without tools.*
- *No effect on display color, light intensity, or legend quality.*
- *Replace seal or lamps without demounting switch.*

AML75 ORDER GUIDE

Panel seals are not for use with AML61 mounting hardware: or with AML41J, AML41K, or AML41L lens type indicators.

Description	For Use With: Square .19" high buttons	Rectangular .19" high buttons
Base & Seal	AML75ABC	AML75BBC
Base Only	AML75ABN	AML75BBN
Seal Only	AML75ANC	AML75BNC

SWITCH GUARD

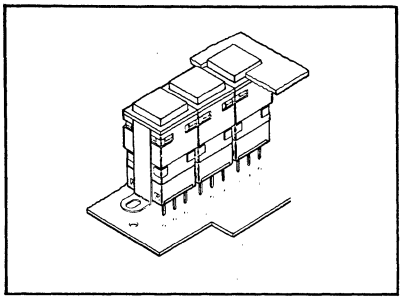


AML76 switch guard protects square and rectangular .19-inch standard height pushbuttons from inadvertent actuation. Not for use with AML61 mounting hardware, AML71 barriers or full guard bezel housings.

AML76 ORDER GUIDE

Guard Type	Catalog Listing
Square	AML76C10T01P
Rectangular	AML76F10T01P

MOUNTING HARDWARE

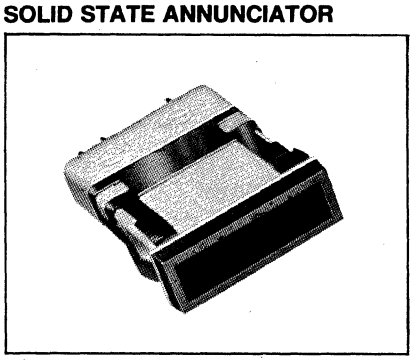


AML61 mounting hardware enables subpanel mounting of devices in factory assembled metal cans which are welded together in strips or matrices.

FEATURES

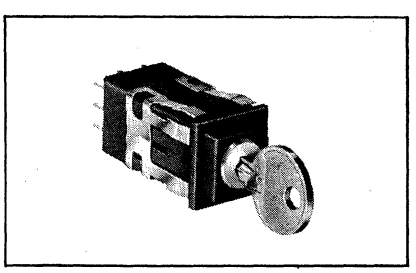
- *L-shaped mounting brackets conform to various panel thicknesses, using spacers.*
- *Simplifies panel fabrication, since only one large cutout is required.*
- *Facilitates printed circuit board mounting. For ordering information, refer to Catalog 30.*

SOLID STATE ANNUNCIATOR



AML45/59 solid state annunciators display messages which are backlighted by two LED's. Choice of full face one-color or two-color display, in red, green, and yellow.

KEYLOCK SWITCH

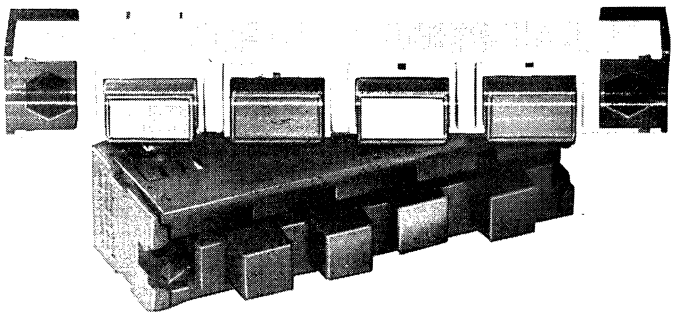


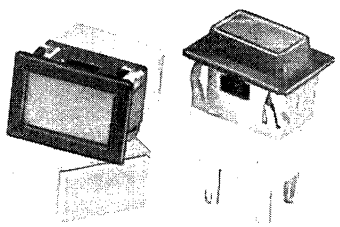
AML27 keylock switches enable control of access to computer peripherals, keyboards, point-of-sale terminals, security systems and other locations where tampering must be discouraged.

For ordering information, refer to Catalog 30.

MICRO SWITCH, a Honeywell division

Miniature manual line pushbutton switches MML





MICRO SWITCH MML Series Miniature Manual Line pushbutton switches deliver a large measure of design freedom in a miniature size package. Their attractive low-profile appearance answers space and styling needs of your future computer/business, instrument, and communication equipment. MML's many design options and modular ordering system provides you flexibility to choose the mounting options, lens colors, illumination means, electrical ratings, and circuitry/operating action combinations (including multi-switch interlock) that best meet your application needs.

HOW TO ORDER

Switches, indicators, lenses, LED's, incandescent lamps, bezels/mounting clips, strip mounting frames, end rails for matrix mount, and multi-switch interlock assemblies are ordered as separate items. To order assembled combinations to meet your special needs, contact your nearest MICRO SWITCH sales office.

Refer to the order guides to specify desired MML catalog listings.

ORDER GUIDES

	Page
MML11 Solid State Switches	38
MML21 Electronic Control Switches	38
MML31 Power Duty Switches	39
MML44 Indicators/LED Display	40
MML46 Indicators/LED or Incandescent Display	40
MML51 Lenses/Incandescent or Non-lighted Display	39
MML52 Lenses/LED Display	39
MML61 Strip Mounting Frames	43
MML62 End Rails For Matrix Mount	43
MML72/73 Bezels and Mounting Clips	43
MML82 Electronic Control Interlock Switches	45
MML83 Power Duty Interlock Switches	45
MML88 Multi-Switch Interlock Assemblies	45
MML91 Incandescent Lamps/Receptacles	41
MML92 LED's	42
MML93 Receptacles	41

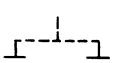
ELECTRICAL SPECIFICATIONS — SOLID STATE SWITCHES

Electrical Characteristics		Absolute Maximum Ratings	
Integrated Circuit Function	5 VDC Sinking ①	Supply Voltage (V_S)	−1.2 to +10.0 VDC
Supply Current (Max.)	3.0 mA (Released) 4.0 mA (Operated no load)	Voltage Externally Applied to Output	−0.5 Volt min. +10.0 Volts max. (Off condition)
Output Voltage (Operated)	0.3 Volt (Sinking 8 mA)	Loads to Output	20 mA (Sinking)
Output Leakage Current Max. (Released)	5.0 μA	Storage Temperature	−40° to +85°C (−40° to +185°F)
Switching Time Max. Rise 10% to 90% Fall 90% to 10%	 1.5 μsec (Sinking 8 mA) 0.5 μsec (Sinking 8 mA)		① Over temperature range of −18° to +65°C (0° to +149°F) and supply voltage of 4.5 to 5.5 VDC.

ELECTRONIC CONTROL SWITCHES

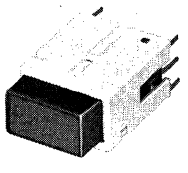
ELECTRICAL RATING	LIFE	CONTACT ARRANGEMENT
Gold contacts: Up to 0.1 amp, 30 VDC, resistive. Silver contacts: Up to 1 amp, 125 VAC	No load @ −20°C (−40°F): 500,000 operations.* Full load @ +65°C (+149°F): 25,000 operations.* * 95% survival.	1 or 2 poles, Form C.

POWER DUTY SWITCHES

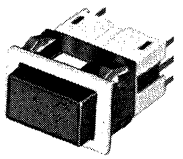
ELECTRICAL RATING	LIFE	CONTACT ARRANGEMENT
Up to 6 amps, 125 VAC; 4 amps inductive, 250 VAC.	No load @ −20°C (−40°F): 500,000 operations.* Full load @ +65°C (+149°F): 25,000 operations.* * 95% survival.	1 or 2 poles, Form X. 

MICRO SWITCH, a Honeywell division

MML11 Solid state pushbutton switches



PWB Mount



Panel Mount

Use as an unlighted pushbutton or add one LED or incandescent lamp for lighted display.

Order LED's (MML92) and lenses (MML52) or incandescent lamps (MML91) and lenses (MML51) separately

CURRENT SINKING OUTPUT
A permanent magnet plunger moves adjacent to the Hall effect integrated circuit to give a digital, current sinking (normally high and normally low) output.

FEATURES
- LED, incandescent, or non-lighted display
- Hall effect reliability
- Provides low voltage signals that interface with nearly all DC logic
- 5 VDC supply voltage
- Momentary action or 2-level alternate action
- Printed wiring board or panel mounting
- Legendable lenses
- Designed to comply with UL, CSA

MML11 ORDER GUIDE

MML11E A 3 AA K

Housing Type (Rectangular)
- **MML11E** White housing
- **MML11K** Black housing

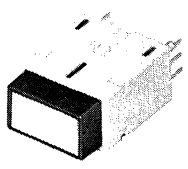
Mounting
- **A** No bezel, printed wiring board mounting

Terminals
- **3** Printed wiring board

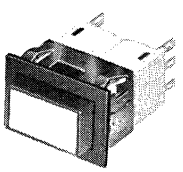
Circuitry/Action
- **AA** 5 VDC sinking, mom.action
- **AE** 5 VDC sinking, alt. action

Plunger
- **K** Black

MML21 Electronic control pushbutton switches



PWB Mount



Panel Mount

Use as an unlighted pushbutton or add one LED or incandescent lamp for lighted display.

Order LED's (MML92) and lenses (MML52) or incandescent lamps (MML91) and lenses (MML51) separately.

FEATURES
- LED, incandescent, or non-lighted display
- 1 or 2 poles
- Silver or gold contacts
- Momentary action or 2-level alternate action
- Printed wiring board or panel mounting
- PWB or solder terminals
- Legendable lenses
- Designed to comply with UL, CSA

MML21 ORDER GUIDE

MML21E A 3 AA K

Housing Type (Rectangular)
- **MML21E** White housing
- **MML21K** Black housing

Mounting
- **A** No bezel, printed wiring board mounting

Terminals
- **3** Printed wiring board
- **2** Solder

Circuitry/Action (Each pole is double throw)

Silver Contacts
- **AA** 1 pole, mom. action
- **AB** 1 pole, alt. action
- **AC** 2 poles, mom. action
- **AD** 2 poles, alt. action

Gold Contacts:
- **BA** 1 pole, mom. action
- **BB** 1 pole, alt. action
- **BC** 2 poles, mom. action
- **BD** 2 poles, alt. action

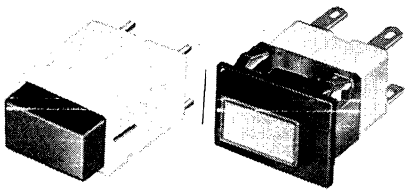
Plunger
- **K** Black

For snap-in panel mounting, order **MML72** bezels/mounting clips.

For strip mounting, order **MML61** mounting frames.

MICRO SWITCH, a Honeywell division

Power duty pushbutton switches MML31



PWB Mount Panel Mount

MML31 switches do not have a provision for illumination of buttons. Visual feedback can be achieved by using a 2-level alternate action switch. Or add a companion lighted indicator.

Order lenses (MML51) separately.

FEATURES
- 1 or 2 poles
- Momentary or 2-level alternate action
- Printed wiring board or panel mounting
- PWB or solder/quick-connect terminals
- Legendable lenses
- Designed to comply with UL, CSA, and international standards.

MML31 ORDER GUIDE

MML31E A 3 AA K

Housing Type (Rectangular)
- **MML31E** White housing non-lighted
- **MML31K** Black housing non-lighted

Mounting
- **A** No bezel, printed wiring board mounting

For snap-in panel mounting, order **MML72** bezels/mounting clips.

For strip mounting, order **MML61** mounting frames.

Terminals
- **3** Printed wiring board
- **2** Solder/Quick-connect

Circuitry/Action (Each pole is single-throw, normally open)
- **AA** 1 pole, mom. action
- **AB** 1 pole, alt. action
- **AC** 2 poles, mom. action
- **AD** 2 poles, alt. action

Plunger
- **K** Black

Switch and indicator lenses for incandescent or non-lighted display MML51

MML51 ORDER GUIDE

MML51E 20 R

Lens Type
- **MML51E** Switch lens
- **MML51G** Indicator lens

Display/Legend Type

Transmitted Color
- **10** No legend
- **20** With legend

Color
- **R** Red
- **Y** Yellow
- **G** Green
- **B** Blue
- **W** White
- **K** Black*

*Opaque

Switch and indicator lenses for LED display MML52

MML52 ORDER GUIDE

MML52G 10 Y

Lens Type
- **MML52E** Switch lens
- **MML52G** Indicator lens

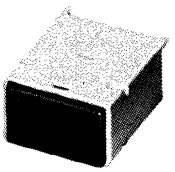
Display/Legend Type

Transmitted Color
- **10** No legend
- **20** With legend

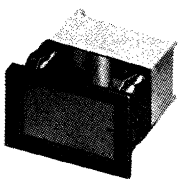
Color
- **R** Red
- **Y** Yellow
- **G** Green

MICRO SWITCH, a Honeywell division

MML44 Indicators



PWB Mount

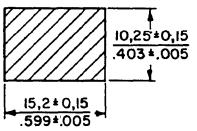


Panel Mount

FEATURES
- Illumination by one LED
- Legendable lenses

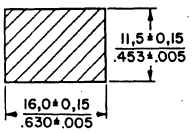
MML44 indicators are for use with **one LED only:** Order LED's (MML92) and lenses (MML52) separately.

PANEL CUTOUTS
PRINTED WIRING BOARD MOUNT



HOUSING THRU PANEL

PANEL MOUNT



MML44 ORDER GUIDE
(No LED included)

MML44F A A

Housing Type
(Rectangular)

MML44F
White housing, accommodates one LED

MML44K
Black housing,accommodates one LED

Mounting

A No bezel, printed wiring board mounting

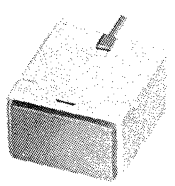
For snap-in panel mounting, order **MML72** bezels/mounting clips.

For strip mounting, order **MML61** mounting frames.

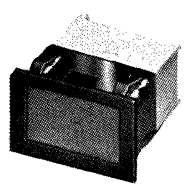
LED

A None

MML46 Indicators



PWB Mount



Panel Mount

FEATURES
- Illumination by one or two LED's or incandescent lamps
- Legendable lenses

Order LED's (MML92) and lenses (MML52) or incandescent lamps (MML91) and lenses (MML51) separately.

MML46 ORDER GUIDE
(No LED's or incandescent lamp included)

MML46F A 3

Housing Type
Rectangular)

MML46F
White housing, provision for two LED's or incand. lamps

MML46K
Black housing, provision for two LED's or incand. lamps

Mounting

A No bezel, printed wiring board mounting

For snap-in panel mounting, order **MML72** bezels/mounting clips.

For strip mounting, order **MML61** mounting frames.

Termination

0 None
For panel mount

3 Support terminals for PWB mount

MICRO SWITCH, a Honeywell division

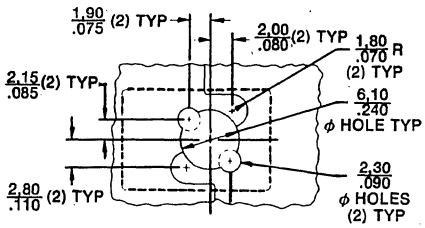
Incandescent lamps/receptacles MML91/93

T-1 INCANDESCENT LAMP AND PWB RECEPTACLE

MML91 ORDER GUIDES

Catalog Listing
MML91C
T-1 6V lamp and receptacle, with printed wiring board, ⅛-turn base.

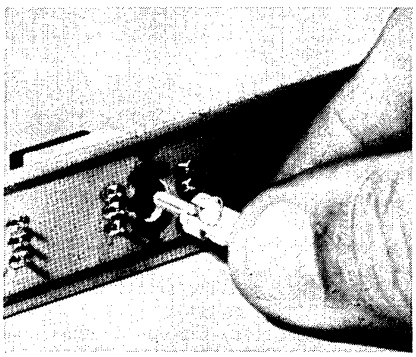
PWB Pad Location For Receptacle



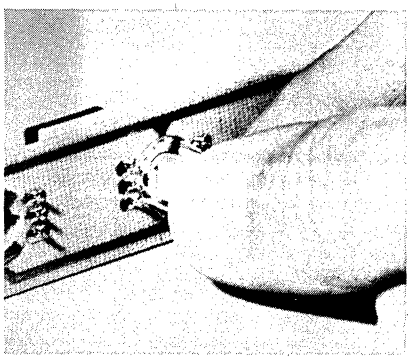
HOW TO INSTALL INCANDESCENT LAMPS

With MML91C Printed Wiring Board Receptacle (Incl. lamp)

MML11/21 SWITCHES AND MML46G/K INDICATORS:



1. After installing an MML11/21 switch or MML46G/H indicator, insert the PWB receptacle/incandescent lamp assembly through a hole in the printed wiring board.



2. A ⅛-turn applied clockwise to the receptacle locks it in the printed wiring board and establishes the electrical connection.

T- INCANDESCENT LAMP AND SOLDER RECEPTACLE (Separate)

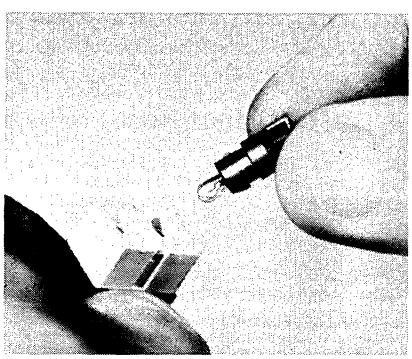
Catalog Listing
MML91B
T-1 bi-pin 6V lamp only
(Industry Lamp No. 7683)

MML93 ORDER GUIDE

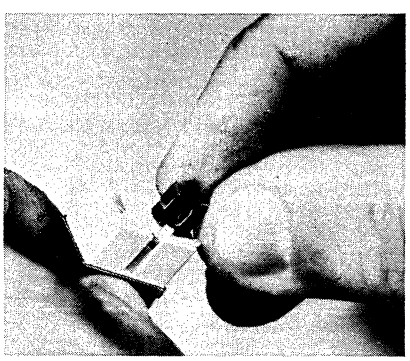
Catalog Listing
MML93J
Incandescent T-1 bi-pin lamp receptacle, with solder terminals, ⅛-turn base. No lamp furnished.

With MML93J Solder Termination Receptacle And MML91B Lamp

MML21 SWITCHES AND MML46G/K INDICATORS:



1. The solder terminal receptacle/incandescent lamp assembly is inserted into the hole in the base of MML21 switches or MML46G/K indicators.



2. A ⅛-turn clockwise applied to the receptacle locks it in the base of the switch or indicator.

MICRO SWITCH, a Honeywell division

MML92/93 LED's/receptacles

MML92 T-1¾ LED's

MML92 ORDER GUIDE

Note: LED's should be the same color as the button/lens they illuminate. LED's are packaged 10 per listing, including stand-off spacers for mounting on printed wiring board.

Catalog Listing	LED Color	Forward Characteristics Typ. @ 20 mA	Forward Characteristics Max. @ 20 mA	LED Manufacturers' Part Numbers
				Stanley
MML92ERS	Red	1.7V	2.0V	ESBR5633
MML92EGS	Green	2.1V	2.5V	ESBG5633
MML92EYS	Yellow	2.1V	2.5V	ESPY5633
				Hewlett-Packard:
MML92ERH	Red	2.2V	3.0V	HLMP-3366
MML92EGH	Green	2.3V	3.0V	HLMP-3568
MML92EYH	Yellow	2.2V	3.0V	HLMP-3466

MML93 ORDER GUIDE

Catalog Listing

MML93K

LED receptacle, with printed wiring board, ⅛-turn base. No LED furnished.

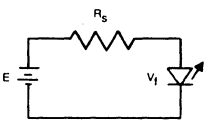
LED APPLICATION INFORMATION

To insure stable conditions, suitable external control of the LED current must be provided. It is recommended that a minimum of 5 VDC open circuit voltage with an appropriate series resistance be used to drive LED devices. This minimizes current variation and its effect on temperature and forward voltage of the LED.

Maximum drive current is 30 mA. Reverse voltage breakdown of the LED's is 4 volts (min).

Resistor values can be determined by supply voltage or current for LED:

$$R_S = \frac{E - V_f}{I_f}$$

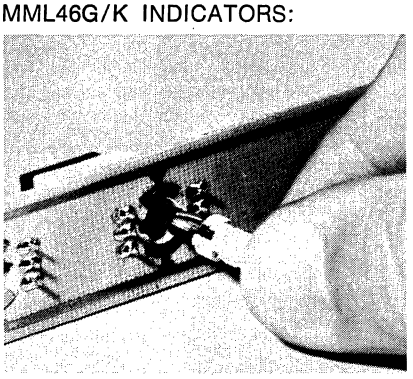


WHERE: R_S = Series Resistance
E = Supply Voltage
V_f = Forward Voltage of LED
I_f = Circuit Current

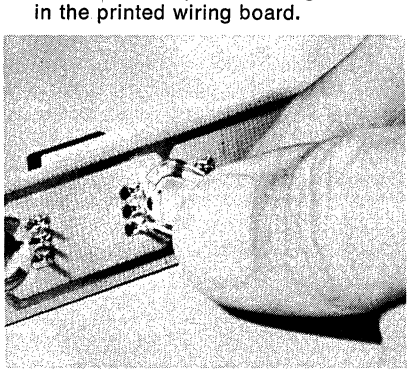
HOW TO INSTALL LED's

With MML93K Printed Wiring Board Receptacle

MML11/21 SWITCHES AND MML46G/K INDICATORS:



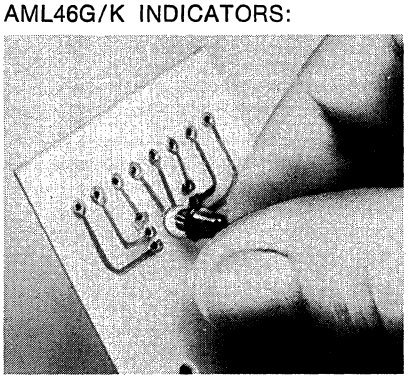
1. After installing an MML11/21 switch or MML46G/K indicator, insert the LED/PWB receptacle through a hole in the printed wiring board.



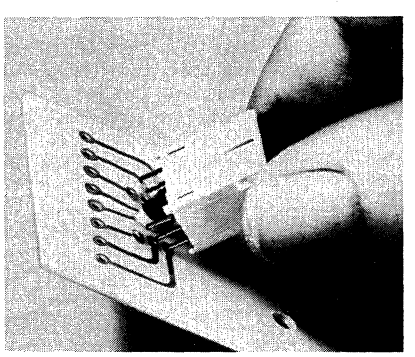
2. A ⅛-turn applied clockwise to the receptacle locks it in the printed wiring board and establishes the electrical connection.

With Solder Termination to Printed Wiring Board

MML11/21 SWITCHES AND AML46G/K INDICATORS:



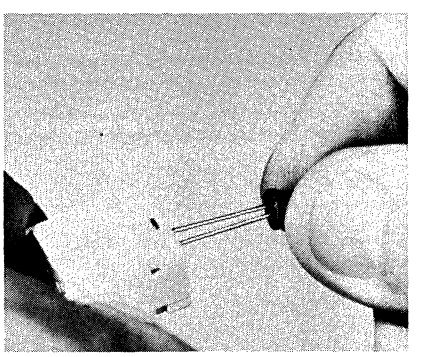
1. Assemble stand-off spacer to MML92E LED terminals and seat on printed wiring board.



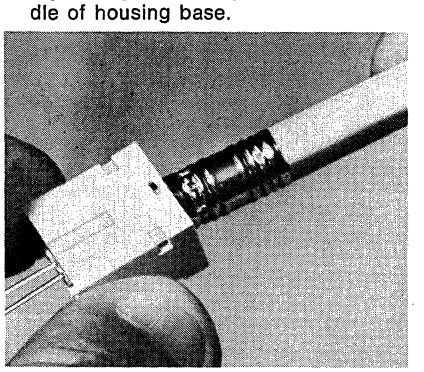
2. Seat housing on printed wiring board, with LED projecting into hole at the base of the housing.

With Solder Termination to Printed Wiring Board or Leadwire

MML44 INDICATORS:



1. Assemble LED to MML44 indicator, with MML92E LED terminals protruding through assembly slot in the middle of housing base.

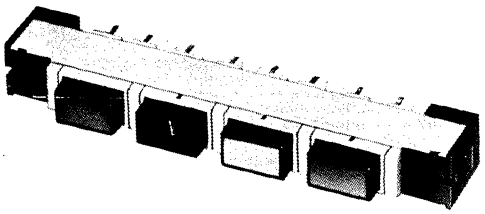


2. Use of pencil eraser to snap LED securely in place.

MICRO SWITCH, a Honeywell division

Mounting hardware MML61/62/72

MML61 STRIP MOUNTING FRAMES



Switches and indicators are ordered as separate items.

FEATURES

- Provides back of panel or printed wiring board mounting in a multi-unit strip of switches/indicators.
- Devices can be pre-wired prior to installation.
- Holes at each end of frame will accept No. 4 screws.

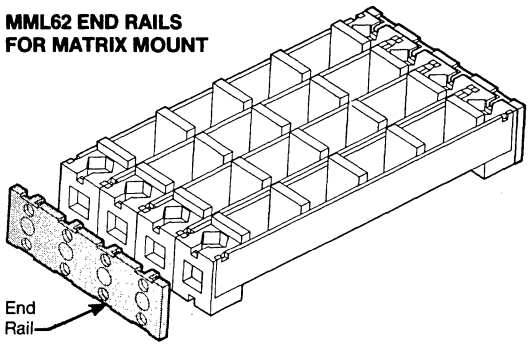
MML61 ORDER GUIDE

MML61E 5

Orientation/Color	No. of Stations
MML61E Horizontal, white	**1** One
MML61K Horizontal, black	**2** Two
	3 Three
	4 Four
	5 Five
	6 Six
	7 Seven
	8 Eight
	9 Nine
	10 Ten

Example: **MML61E5**
White 5-station strip mounting frame, horizontal orientation.

MML62 END RAILS FOR MATRIX MOUNT



FEATURES

- Fasten up to ten MML61 strip frames together to form matrix array.
- End rails snap fit into slots at each end of the strip frames.

MML62 ORDER GUIDE

Each catalog listing includes a pair of end rails.

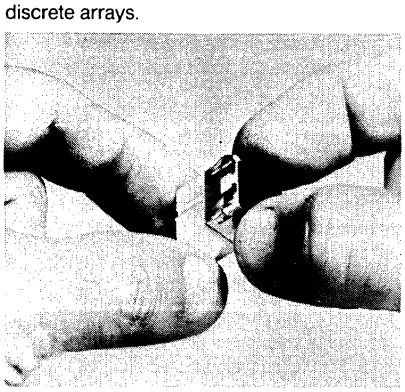
MML62E 4

Color	No. of MML61 Strip Frames in Matrix
MML62E For horizontal strips, white	**2** Two
MML62K For horizontal strips, black	**3** Three
	4 Four
	5 Five
	6 Six
	7 Seven
	8 Eight
	9 Nine
	10 Ten

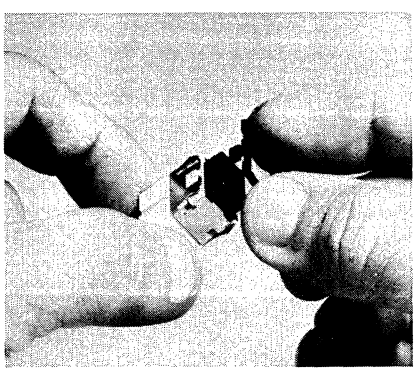
Example: **MML62E4**
White end rails for fastening four horizontal strips.

MML72 BEZELS/MOUNTING CLIPS

Bezels and mounting clips are assembled to switches and indicators to provide snap-in front panel mounting in horizontal rows or discrete arrays.



1. Slip mounting clip over top of switch/indicator housing.



2. Snap bezel onto mounting clip.

MML72 ORDER GUIDE

(Includes mounting clip.)

MML72EE W

Bezel Type	Color
MML72EE Switch	**K** Black
MML72EG Indicator	**L** Gray
	W White

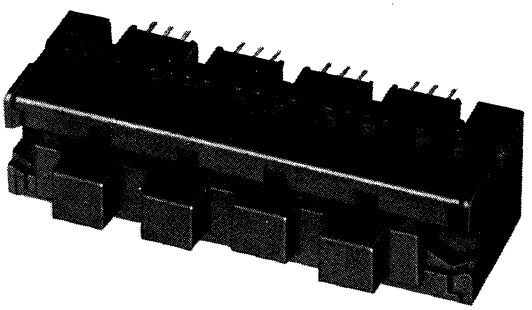
Example: **MML72EEW**
White switch bezel with mounting clip.

NOTE:
To order mounting clips separately, specify **MML73EA**.

MICRO SWITCH, a Honeywell division

MML Interlock assemblies

MECHANICAL INTERLOCK
Mechanically interlocked switches with 1-4 pole circuitry provide latching functions. They are furnished **factory assembled** in a strip frame — ready for back of panel and/or printed wiring board mounting. Each end of the strip frame has mounting holes which will accept No. 4 screws.



Operating Mode. Depressing a switch button will release any previously operated button within a group of interlocked switches. One button is always being held down by a mechanical detent. This provides a "key-down memory" feature which indicates which switch was last operated. Circuit transfer is maintained until another button is depressed.

Override release. If two or more interlocked switches are inadvertently engaged at the same time, fully depressing any engaged switch button will release the others. (An increased actuation force is necessary for override.)

Assembly options. The following options are possible:
1. A strip of two to ten interlocked switches.
2. More than one group of two or more switches can be independently interlocked, providing there is a one-unit spacing between the groups. For example, the first four switches and the last five switches in the strip can be interlocked as separate groupings, with a one-station spacing between them.
3. A strip can include both interlocked groups of switches and switches which operate in their normal momentary or alternate action mode.

HOW TO ORDER
Only the momentary action **MML82** Electronic Control interlock switches can be used for interlocking. **MML82** alternate action switches and **MML83** Power Duty switches function as individually isolated units when added to the interlock strip.

Use the **MML88** Interlock Strip Assembly Order Sheet (FO-74023) on page 12 to specify the desired switch listings and their location in the strip. Reproduce it on your office copier or request a pad of forms from your nearest MICRO SWITCH Sales Office. (See completed example.)

MML INTERLOCK STRIP ORDER

Customer Name ABC Company
Address Anywhere, NV 89502

Catalog Listing
MML88 K-
Customer Dwg. No.

INTERLOCK STRIP STATION NO.'s

⊕	1	2	3	4	5	6	7	8	9	10	⊕

STATION NO.	SWITCH CATALOG LISTING (1)	LATCHING BAR POSITION (2)
1	MML82KK2AA	↑
2	MML82KK2AA	
3	MML82KK2AA	
4	MML82KK2AA	
5	MML82KK2AA	↓
6		
7	MML82KK2BA	↑
8	MML82KK2BA	
9	MML82KK2BA	↓
10	MML83KK2AA	

SPECIAL REQUIREMENTS:

INSTRUCTIONS

(1) Enter MML82/83 Catalog Listings in each station location where a switch is to be installed.

(2) Draw a line thru all stations which are to be latched. (MML82 Interlock Action Switches only.)

3 - Allow one station spacing between separate groups of latched units within the 10-unit strip.

4 - Momentary and Alternate Action MML82/83 Switches can be located at any station.

Prepared by R. J. Jones
Date 12-3-82

MICRO SWITCH
FREEPORT, ILLINOIS U.S.A.
FO-74023

MICRO SWITCH, a Honeywell division

Interlock switches and assemblies MML82/83/88

MML82 ELECTRONIC CONTROL INTERLOCK PUSHBUTTON SWITCHES

MML82 ORDER GUIDE

Enter MML82 catalog listings in space provided in Interlock Strip Assembly Order Sheet (FO-74023), and indicate the stations which are to be interlocked. These switches do not have a provision for adding LED's or incandescent lamps.

MML82K K 2 AA

Housing Type (Rectangular)
- **MML82K** Black housing, non-lighted

Button Type
- **K** Black square button

Terminals
- **3** Printed wiring board
- **2** Solder

Circuitry/Action (Each pole is double-throw)

Silver Contacts
- **AA** 1 pole, mom. action*
- **AC** 2 poles, mom. action*
- **CA** 3 poles, mom. action*
- **CC** 4 poles, mom. action*
- **AB** 1 pole, alt. action**
- **AD** 2 poles, alt. action**
- **CB** 3 poles, alt. action**
- **CD** 4 poles, alt. action**

Gold Contacts:
- **BA** 1 pole, mom. action*
- **BC** 2 poles, mom. action*
- **DA** 3 poles, mom. action*
- **DC** 4 poles, mom. action*
- **BB** 1 pole, alt. action**
- **BD** 2 poles, alt. action**
- **DB** 3 poles, alt. action**
- **DD** 4 poles, alt. action**

Example: **MML82KK2AA**
Electronic control interlock switch (black housing and button), non-lighted; solder terminals; 1 pole, momentary action, silver contacts.

*When not used in a group of interlocked switches, these devices function as individually isolated momentary action switches.

**Although alternate-action switches can be used in interlock strip assemblies, they cannot be latched. They will function as individually isolated alternate-action switches.

MML83 POWER DUTY INTERLOCK SWITCHES

MML83 ORDER GUIDE

MML83 power switches function as individually isolated units when added to an interlock strip. They are **not** for use in an interlocking mode.

Enter MML83 catalog listings in space provided in Interlock Strip Assembly Order Sheet (FO-74023). These switches do not have a provision for adding LED's or incandescent lamps.

MML83K K 2 AA

Housing Type (Rectangular)
- **MML83K** Black housing, non-lighted

Button Type
- **K** Black square button

Terminals
- **3** Printed wiring board
- **2** Solder/quick-connect

Circuitry/Action (Each pole is single-throw, normally open)
- **AA** 1 pole, mom. action
- **AB** 1 pole, alt. action
- **AC** 2 poles, mom. action
- **AD** 2 poles, alt. action

Example: **MML83KK2AA**
Power duty interlock switch (black housing and button), non-lighted; solder termination; 1 pole, momentary action, silver contacts.

MML88 INTERLOCK SWITCH ASSEMBLIES

MML88 ORDER GUIDE

MML88K

Type
- **MML88K** Black interlock strip

Serial Number

Note: MICRO SWITCH will assign a serial number to code your desired combination of switches and their location on the strip. (Per your instructions on the Interlock Strip Order Sheet, F0-74023.)

MICRO SWITCH, a Honeywell division

MML Interlock ordersheet

MML INTERLOCK STRIP ORDER

Customer Name_____

Address _____

Catalog Listing
MML88_-
Customer Dwg. No.

INTERLOCK STRIP STATION NO.'s

	1	2	3	4	5	6	7	8	9	10	

STATION NO.	SWITCH CATALOG LISTING (1)	LATCHING BAR POSITION (2)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
SPECIAL REQUIREMENTS:		

INSTRUCTIONS

(1) Enter MML82/83 Catalog Listings in each station location where a switch is to be installed.

(2) Draw a line thru all stations which are to be latched. (MML82 Interlock Action Switches only.)

3 - Allow one station spacing between separate groups of latched units within the 10-unit strip.

4 - Momentary and Alternate Action MML82/83 Switches can be located at any station.

Prepared by_____

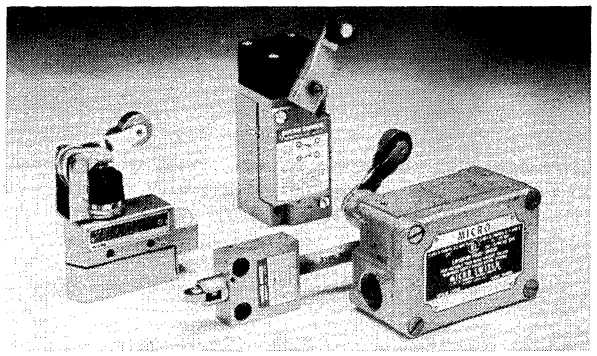
Date_____

MICRO SWITCH
FREEPORT, ILLINOIS, U S A
FO-74023

Other MICRO SWITCH products

MICRO SWITCH's reputation as an innovator in the design and manufacture of quality position sensing and manual control products spans 40 years. Shown is a cross-section of the many varieties. This broad selection offers a wide range of technologies, sizes, actuation means, circuitries, electrical capacities, and terminations, for in-plant and original equipment needs.

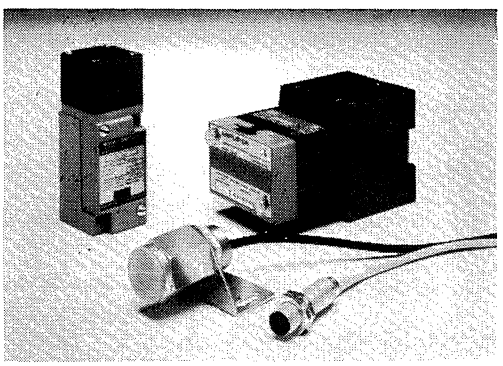
Contact your nearest MICRO SWITCH Sales Office or Authorized Distributor for complete catalog information. Sales Office location's are shown in this Directory. Authorized Distributors are listed on the next pages.



Limit and enclosed switches

MICRO SWITCH offers the world's most advanced line of heavy duty limit switches and a wide selection of application proven enclosed switches (precision snap-acting switches sealed in rugged metal housing). Sealed versions keep out moisture and other contaminants. Explosion-proof types are designed for use in hazardous locations.

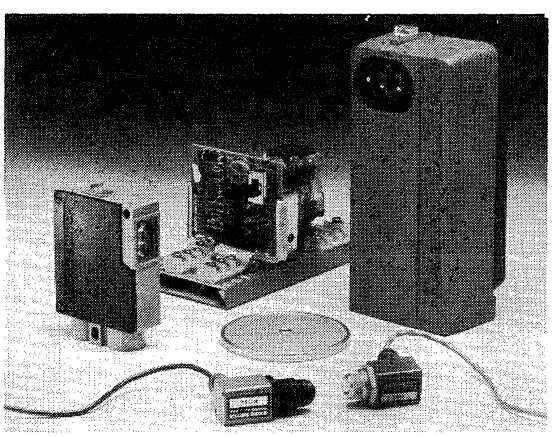
Request Catalog 40.



Proximity sensors

Proximity sensors detect the presence of metals or react to a magnetic field. Cylindrical, cannister, and limit switch style housings provide application versatility. Their high speed operation keeps pace with production. Models are available for operation at A.C. line voltage or 8.5 to 30 VDC. Optional LED indicators signal on-off condition.

Request Catalog 50.

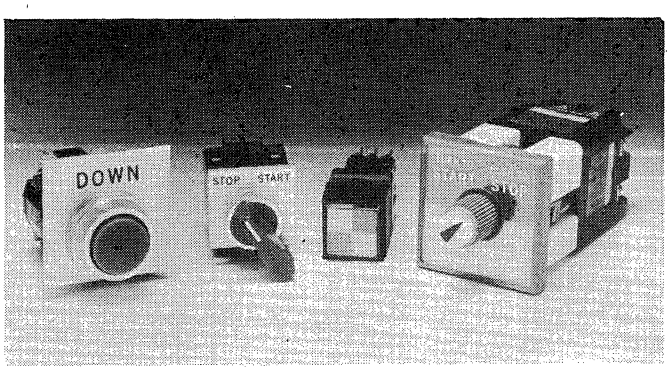


Photoelectric sensors

MICRO SWITCH has a complete offering of modulated LED and incandescent controls. These no-touch devices detect opaque or translucent material at long or short range.

Single unit retroreflective and separate emitter/receiver styles fill a variety of application requirements. High intensity models penetrate foggy, dusty, and other poor visibility conditions. Scanning capability ranges from a fraction of an inch to hundreds of feet.

Request Catalog 60.



Oiltight manual controls

Featuring a contemporary square appearance and lighted display, these families offer a wide selection of industrial pushbuttons, selectors, and indicators. Standard, miniature, and compact sizes provide flexibility in format and circuitry. Contact blocks feature heavy duty, standard or electronic duty capabilities plus solid state.

Request Catalog 70.

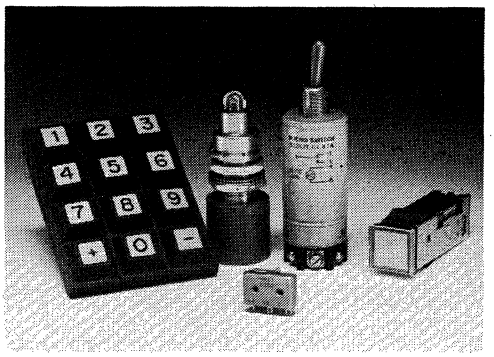
MICRO SWITCH, a Honeywell division

Other MICRO SWITCH products

Environmentally protected switches

Rugged, high performance designs; environment-proof or hermetically sealed. A complete selection includes miniature limit switches, miniature and standard size basic switches, sealed toggle switches and the highest quality lighted pushbuttons.

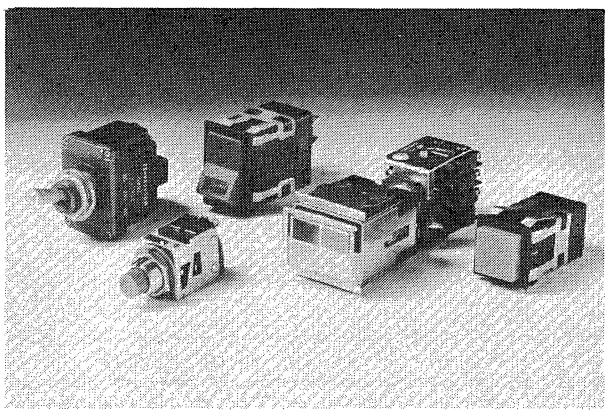
Request Catalog 80.



Manual control switches

Whether you're prototyping a new design or planning to face-lift an existing panel, you'll benefit by considering the wide selection of pushbuttons, indicators, toggles, rockers, paddles, rotary selectors and interlock switches available from MICRO SWITCH. Developed with adherence to good human factors principles, these products aid the designer by offering almost limitless options in visual display techniques, operators, and arrangement of components. Many are military qualified.

Request Catalog 30.



Keyboards

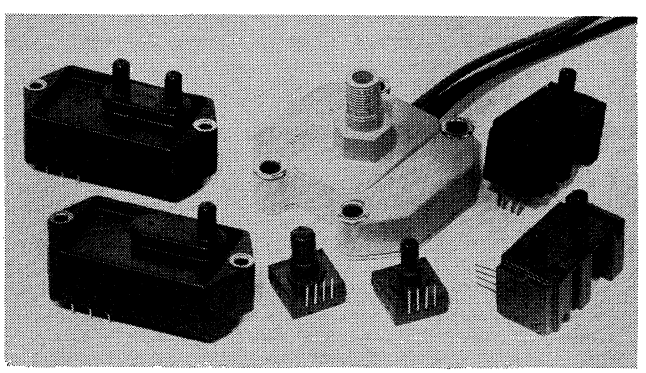
MICRO SWITCH offers the world's widest selection of keyboard designs. It includes capacitance membrane and contact membrane keyboards in standard or low-profile versions; touch panels; and time-proven solid state Hall effect keyboards. With our experienced application engineers and complete capabilities, we can handle virtually any keyboard application.

For further information contact your local MICRO SWITCH sales office.

Pressure transducers

MICRO SWITCH piezoresistive pressure transducers accurately measure gaseous pressure as the sensitive silicon diaphragm integral to the IC chip distorts ever so slightly, resulting in linear output voltage directly proportional to pressure.

Both signal conditioned (amplified and temperature-compensated) and unamplified transducers of absolute, differential, and gage pressure design are available. Applications range from medical instruments to home appliances to altimeters. Accurate repeatability, low hysteresis, and long-term stability are characteristics of these transducers, whose pressure range extends to 250 psi.



MICRO SWITCH, a Honeywell division

MICRO SWITCH AUTHORIZED DISTRIBUTOR DIRECTORY

ALABAMA

Birmingham
MG Electronics and Equip.
Phone: 205/328-4525

Decatur
Frazier Electrical Supply
Phone: 205/353-6131

Dothan
Mack Electric Supply Co.
Phone: 205/792-2111

Mobile
Brownell Electro, Inc.
Phone: 205/479-5405

ARIZONA

Phoenix
BeSwitched
Phone: 602/275-4805

East Side Electric Supply, Inc.
Phone: 602/273-1415

Electric Supply, Inc.
Phone: 602/252-2343

Kierulff Electronics
Phone: 602/243-4101

Tucson
Tucson Electric Supply Inc.
Phone: 602/624-8241

ARKANSAS

Fort Smith
Carlton-Bates Company
Phone: 501/646-8201

Little Rock
Carlton-Bates Company
Phone: 501/562-9100

CALIFORNIA

Anderson
Industrial Electric Service Co.
Phone: 916/365-3381

Arcata
Industrial Electric Service Co.
Phone: 707/822-2485

Bakersfield,
Controlco, Inc.
Phone: 805/323-8111

Carson
Nunn-Royal Wholesale Electric, Inc.
Phone: 213/637-6377

Crescent City
Industrial Electric Service Co.
Phone: 707/464-4123

El Monte
Howland Electric Wholesale
Phone: 213/444-0503

Gardena
California Switch & Signal
Phone: 213/770-2330

Fresno
Electric Motor & Supply Co.
Phone: 209/486-0960

Los Angeles
Andrews Industrial Hardware
Phone: 213/483-8110

Argo Electric Supply
Phone: 213/588-8233

Electric Switches, Inc.
Phone: 213/660-1310

Kierulff Electronics
Phone: 213/725-0325

Minarik Electric Co.
Phone: 213/624-3161

Western Electromotive
Phone: 213/820-3777

Modesto
Wille Electric Supply Co., Inc.
Phone: 209/527-6800

Oakland
Western Electro-Mechanical
Phone: 415/452-1936

Orange
County Wholesale Electric
Phone: 714/633-6440

Pico Rivera
Amfac Electrical Supply Co.
Phone: 213/949-7841

Riverside
Consolidated Electrical Dist.
Phone: 714/684-7811

CALIFORNIA — Cont'd

Sacramento
Kaman Bearing & Supply Corporation
Phone: 916/444-0700

Sacramento Electronics Supply
Phone: 916/441-4821

Salinas
Electric Supply of Salinas
Phone: 408/422-4789

San Diego
Amfac Electrical Supply Co.
Phone: 714/268-1020

County Wholesale Electric Co.
Phone: 714/578-0210

Kierulff Electronics
Phone: 714/278-2112

San Jose
Buckles-Smith Electric Co.
Phone: 408/280-7777

Consolidated Parts, Inc.
Phone: 408/263-9521

Quement Electronics
Phone: 408/998-5900

San Leandro
Nunn Royal Electric Supply Co.
Phone: 415/895-9810

Santa Clara
Wyle Distribution Group
Phone: 408/727-2500

So. San Francisco
Consolidated Electrical Dist.
Phone: 415/871-2893

Steven Engineering
Phone: 415/588-9200

Stockton
Valley Electric Co. of Stockton
Phone: 209/948-1911

Sunnyvale
Powell Electronics
Phone: 408/739-4321

Ukiah
Industrial Electric Service
Phone: 707/485-0376

Visalia
Medallion Supply, Inc.
Phone: 209/625-0333

COLORADO

Denver
Integrated Electronics Co., Inc.
Phone: 303/534-6121

Newark Electronics
Phone: 303/757-3351

Ryall Electric Supply Co.
Phone: 303/629-7721

TESSCO
Phone: 303/778-1119

CONNECTICUT

Bridgeport
Electric Maintenance Service
Phone: 203/333-6163

Danbury
Spring & Buckley
Phone: 203/743-0034

Hartford
Frank A. Blesso Inc.
Phone: 203/527-6461

New Britain
Spring & Buckley
Phone: 203/224-2451

Norwalk
Machine Drives & Controls, Inc.
Phone: 203/846-2007

Wallingford
Marshall Industries
Phone: 203/265-3822

DELAWARE

Wilmington
United Electric Supply Inc.
Phone: 302/322-3333

FLORIDA

Ft. Lauderdale
Peerless Radio Corp.—Florida
Phone: 305/973-4141

Powell Electronics
Phone: 305/972-4300

Jacksonville
Turner Electric Works
Phone: 904/757-7790

Lakeland
A.A. Electric Div. of AEC
Phone: 813/665-6941

Miami
Hummel Industrial Sales, Inc.
Phone: 305/651-0196

Orlando
Brownell Electro, Inc.
Phone: 305/843-6770

Hammond Electronics, Inc.
Phone: 305/849-6060

Pensacola
Trio Electric Supply Co., Inc.
Phone: 904/476-5580

Tampa
Tampa Armature Works, Inc.
Phone: 813/621-5661

GEORGIA

Albany
Mack Electric Supply Co.
Phone: 912/883-5156

Atlanta
A-A Electric, Inc.
Phone: 404/449-8670

A-C Equipment Co.
Phone: 404/451-2747

Brownell Electro, Inc.
Phone: 404/762-5181

Augusta
Electrical Equipment Co.
Phone: 404/722-6685

Macon
Lowe Electric Company
Phone: 912/743-8661

Rome
Battey Machinery Company
Phone: 404/291-4141

Savannah
Lakeland Engineering Equipment Co.
Phone: 912/964-7318

West Point
Georgia Alabama Supply Co.
Phone: 404/645-1321

HAWAII

Honolulu
ATECS Corporation
Phone: 808/845-2991

ILLINOIS

Addison
LCOMP, Inc.
Phone: 312/628-1400

Aurora
Electric Supply Corporation
Phone: 312/897-8663

Champaign
Klaus Radio Co.
Phone: 217/356-1896

Chicago
Revere Electric Co.
Phone: 312/738-3636

Danville
Danville Electric Supply Co.
Phone: 217/442-5282

ILLINOIS — Cont'd

Decatur
Englewood Electrical Supply
Phone: 217/875-7300

Lakeland Engineering Equip.
Phone: 217/423-2531

Elgin
Fox Electric Supply Company
Phone: 312/695-7400

Revere Electric Supply Co.
Phone: 312/741-8900

Freeport
Koym Electric Supply
Phone: 815/235-7595

Joliet
Englewood Electrical Supply
Phone: 815/725-3900

Kankakee
Blitz Electrical Supply Co.
Phone: 815/933-5536

Lombard
MacGregor and Co.
Phone: 312/629-5752

Melrose Park
Electric Supply Corp.
Phone: 312/450-3211

Peoria
Kiefer Electrical Supply Co.
Phone: 309/674-1143

Klaus Radio, Inc.
Phone: 309/691-4840

Peru
Englewood Electrical Supply
Phone: 815/223-2650

Quincy
Heintz Electric Company
Phone: 217/222-0113

Rockford
Forest City Electric Supply Co.
Phone: 815/968-5781

Skokie
Electric Supply Corporation
Phone: 312/673-1600

INDIANA

Anderson
Ralph David Inc.
Phone: 317/649-3504

Columbus
Daniel Hayden Electric Co.
Phone: 812/372-2596

Evansville
Evansville Supply Company
Phone: 812/424-7541

Fort Wayne
Graham Electronics
Phone: 219/423-3422

National Mill Supply, Inc.
Phone: 219/484-0575

Hammond
Electric Supply Corp.
Phone: 312/374-6000
219/932-8840

Indianapolis
Graham Electronics Supply
Phone: 317/634-8202

Peerless Electric Supply Co.
Phone: 317/635-2361

Logansport
Ralph David, Inc.
Phone: 219/722-2200

South Bend
Koontz-Wagner Electric Co.
Phone: 219/232-2051

IOWA

Cedar Rapids
Hupp Electric Motors, Inc.
Phone: 319/366-0761

Davenport
Industrial Eng. Equip. Co.
Phone: 319/323-9721

Des Moines
Electrical Engineering & Equipment
Phone: 515/282-0431

Mechanical & Electrical Warehouse
Phone: 515/243-3102

IOWA — Cont'd

Sioux City
Lakeland Engineering Equip.
Phone: 712/252-3611

KANSAS

Kansas City
Kornfeld Thorp Electric Co.
Phone: 913/321-7070

Lakeland Engineering Equip.
Phone: 913/384-0050

Wichita
Kriz-Davis, Inc.
Phone: 316/267-4354

LCOMP, Inc.
Phone: 316/265-8501

KENTUCKY

Bowling Green
Randolph, Hale & Meredith, Inc.
Phone: 502/781-1460

Lexington
Radio Electronic Equip. Co.
Phone: 606/255-6661

Louisville
E & H Electric Supply Co., Inc.
Phone: 502/587-0991

Paducah
Hannan Supply Company
Phone: 502/442-5456

LOUISIANA

Baton Rouge
A.W.C. Inc.
Phone: 504/275-5480

Industrial Electronic Supply
Phone: 504/926-0513

Harahan
MG Electronics & Equip. Co.
Phone: 504/733-0070

Summers Electric Co.
Phone: 504/733-4567

Shreveport
Industrial Electronic Supply
Phone: 318/222-9459

MAINE

Newport
Gilman Electrical Supply
Phone: 207/368-4306

Portland
The Leen Company
Phone: 207/774-6266

MARYLAND

Baltimore
Automation Industrial Control
Phone: 301/747-0044

Lee Electric Company
Phone: 301/752-4080

Beltsville
Powell Electronics
Phone: 301/937-4030

Cumberland
Clayton Electric, Inc.
Phone: 301/724-6321

Kensington
Marine Air Supply Co., Inc.
Phone: 301/949-9560

MASSACHUSETTS

Boston
Controller Service & Sales Co.
Phone: 617/269-1300

Burlington
Marshall Wilshire
Phone: 617/272-8200

Lawrence
Dyer Clark Company
Phone: 617/683-2467

Springfield
T. F. Cushing, Inc.
Phone: 413/788-7341

MASSACHUSETTS — Cont'd

Woburn
Brownell Electro, Inc.
Phone: 617/935-7820

Worcester
Coghlin Electric Company
Phone: 617/791-7861

MICHIGAN

Ann Arbor
Wedemeyer Electronic Supply
Phone: 313/665-8611

Battle Creek
All-Phase Electric Supply Co.
Phone: 616/962-7557

Benton Harbor
All-Phase Electric Supply Co.
Phone: 616/926-6194

Flint
Advance Electric Supply Co.
Phone: 313/238-5611

Grand Rapids
RS Electronics
Phone: 616/241-3483

United Electric Supply Co.
Phone: 616/531-5310

Jackson
Fulton Radio Supply Co.
Phone: 517/784-6106

Kalamazoo
RS Electronics
Phone: 616/381-5470

Lansing
All-Phase Electric Supply Co.
Phone: 517/482-4449

Livonia
Allen Electronic Supply Co.
Phone: 313/421-9300

RS Electronics
Phone: 313/525-1155

Madison Heights
McNaughton-McKay Electric
Phone: 313/399-7500

Muskegon
Fitzpatrick Electric Supply Co.
Phone: 616/722-6621

Negaunee
NWR Electronics, Inc.
Phone: 906/228-9080

Saginaw
Fischer-Flack Inc.
Phone: 517/752-4181

Southfield
Michigan Lectrols Corp.
Phone: 313/353-1350

Traverse City
William J. Becker Co.
Phone: 616/947-4440

MINNESOTA

Duluth
Mielke Electric Works, Inc.
Phone: 218/727-7411

Minneapolis
Lakeland Eng. Equip. Co.
Phone: 612/544-0321

Northland Electric Supply Co.
Phone: 612/341-6100

St. Paul
Gopher Electronics Co.
Phone: 612/483-3322

Power/Mation Divn.
Phone: 612/645-0781

MISSISSIPPI

Jackson
Ellington Electronic Supply
Phone: 601/355-0561

MISSOURI

Bridgeton
Van Dusen Aircraft Supplies
Phone: 314/731-1700

Joplin
Four State Radio Supply Co.
Phone: 417/624-0368

Kansas City
LCOMP, Inc.
Phone: 816/221-2400

Maryland Heights
Barrett Electrical Supply Co.
Phone: 314/878-1300

French Gerleman Electric Co.
Phone: 314/569-3122

LCOMP, Inc.
Phone: 314/291-6200

St. Louis
Crescent Electric Supply Co.
Phone: 314/533-6161

Springfield
Southern Materials Company
Phone: 417/865-2822

MONTANA

Billings
Glacier State Electric Supply
Phone: 406/252-4663

Missoula
West Electric Distributors
Phone: 406/728-4020

NEBRASKA

Omaha
Enterprise Electric Company
Phone: 402/341-4787

Lakeland Engineering Equip.
Phone: 402/734-2600

NEVADA

Reno
WEDCO, Inc.
Phone: 702/329-1131

NEW HAMPSHIRE

Manchester
Controller Service & Sales Co.
Phone: 603/623-7225

NEW JERSEY

Cherry Hill
Fromm Electric Supply
Phone: 609/662-8300

Dover
Kahant Electrical Supply Co.
Phone: 201/366-2966

Edison
Miller Knapp Incorporated
Phone: 201/985-2600

Hanover
State Electronics Parts Corp.
Phone: 201/887-2550

Linden
Turtle & Hughes, Inc.
Phone: 201/574-3600

Newark
Keer Electrical Supply Co.
Phone: 201/484-7400

Piscataway
Fromm Electric Supply Corp.
Phone: 201/981-0400

Saddlebrook
Ribble Engineering Co.
Phone: 201/791-0233

Secaucus
Franklin & Smith, Inc.
Phone: 201/864-0555

South Plainfield
Brownell Electro, Inc.
Phone: 201/753-4600

Trenton
Griffith Electric Supply Co.
Phone: 609/695-6121

Vineland
Kay Electric Supply Company
Phone: 609/692-2020

NEW MEXICO

Albuquerque
Sterling Electronics
Phone: 505/884-1900

Carlsbad
H & E Electric Supply Co.
Phone: 505/887-1146

NEW YORK

Albany
Edwin E. Taylor Co., Inc.
Phone: 518/438-7811

Henzel Powers, Inc.
Phone: 518/465-2351

Brooklyn
Coleman Electrical Supply
Phone: 212/272-1313

Buffalo
Genesee Radio & Parts Co.
Phone: 716/873-9661

Wehle Electric Company, Inc.
Phone: 716/854-3270

Elmira
Brady Supply Corporation
Phone: 607/733-6591

Forest Hills
The Jack Miller Company
Phone: 212/263-4446

Jamestown
Westburgh Electric Inc.
Phone: 716/488-1172

Lynbrook
Peerless Radio Corporation
Phone: 516/593-2121

Mamaroneck
Logicomp Electronics
Phone: 914/698-9332

New York
Baitinger Electric Co., Inc.
Phone: 212/431-6400

Blan Electronics Corporation
Phone: 212/233-6288

Brownell Electro, Inc.
Phone: 212/924-6000

City Electric Distributors, Inc.
Phone: 212/564-5454

Plainview L.I.
Mid Island Electrical Sales Co.
Phone: 516/293-9300

Rochester
Requa Electrical Supply Co.
Phone: 716/475-1600

Simcona Electronics Corp.
Phone: 716/328-3230

Wehle Electric Company, Inc.
Phone: 716/275-0200

Syracuse
Baldwin Hall Co., Inc.
Phone 315/463-9251

Utica
M & L Electric Supply Corp.
Phone: 315/733-2326

Vestal
Wholesale Electric Supply Co.
Phone: 607/729-1526

White Plains
H. H. Benfield Elec. Supply
Phone: 914/948-6660

NORTH CAROLINA

Charlotte
Brownell Electro, Inc.
Phone: 704/597-1270

Mill Power Supply Company
Phone: 704/527-2800

Greensboro
Hammond Electronics
Phone: 919/275-6391

Laurinburg
Electrical Equipment Co.
Phone: 919/272-2141

Raleigh
Electrical Equipment Co.
Phone: 919/828-5411

Southeastern Electronics
Phone: 919/828-2311

Shelby
Shelby Supply Co., Inc.
Phone: 704/482-6781

OHIO

Akron
Akron Electronic Supply
Phone: 216/762-8818

The Sacks Electrical
Supply Co.
Phone: 216/253-2141

Cincinnati
Graham Electronics, Inc.
Phone: 513/772-1661

Hughes-Peters, Inc.
Phone: 513/351-2000

The Johnson Electric Supply
Phone: 513/421-3700

Columbus
Basic Distribution Corp.
Phone: 614/481-8801

Hughes-Peters, Inc.
Phone: 614/294-5351

Dayton
John A. Becker Electric Co.
Phone: 513/226-1341

The Stotts-Friedman Co.
Phone: 513/298-5555

Lancaster
Basic Distribution Corp.
Phone: 614/653-9231

Lima
LPR Electronics Corp.
Phone: 419/228-1220

Mansfield
Mansfield Electric Supply Co.
Phone: 419/529-2750

Newark
Basic Distribution
Corporation
Phone: 614/522-1116

Sandusky
Brohl & Appell Inc.
Phone: 419/625-6761

Solon
Midland Electric Co.
Phone: 216/248-3800

REPCO
Phone: 216/248-8900

Toledo
The H. Poll Electric Company
Phone: 419/255-1660

Warren
REM Electronics Supply Co.
Phone: 216/373-1300

OKLAHOMA

Oklahoma City
Electro Enterprises, Inc.
Phone: 405/427-6591

Hunzicker Brothers
Phone: 405/239-7771

Tulsa
Oil Capitol Electronics Corp.
Phone: 918/622-8520

OREGON

Beaverton
Almac Electronics
Phone: 503/641-9070

Bend
Eoff Electric Company
Phone: 503/388-1544

Eugene
North Coast Electric Co.
Phone: 503/343-7701

Klamath Falls
North Coast Electric Co.
Phone: 503/884-4171

Medford
North Coast Electric Co.
Phone: 503/772-7131

Portland
North Coast Electric Co.
Phone: 503/228-5111

Platt Electric Supply Inc.
Phone: 503/228-6121

Tek-Electric Controls, Inc.
Phone: 503/246-5451

OREGON — Cont'd

Roseburg
Roseburg Electric Wholesale
Phone: 503/673-6657

Salem
Stusser Elec. Co.
Phone: 503/581-3711

PENNSYLVANIA

Allentown
Crowder Jr. Company
Phone: 215/791-1551

Altoona
Allegheny Electronics, Inc.
Phone: 814/946-0871

Bradford
McKean Supply Division
Phone: 814/362-3523

Erie
Erie Industrial Elec. Supply
Phone: 814/455-8051

Kingston
ANESCO
Phone: 717/287-2101

Philadelphia
Powell Electronics, Inc.
Phone: 215/365-1900

Royal Electric Supply Co.
Phone: 215/221-1200

Rumsey Electric Company
Phone: 215/456-2500

Pittsburgh
CAM/RPC Electronics
Phone: 412/782-3770

McCullough Electric Co.
Phone: 412/261-2420

Reading
Barbey Electronics
Phone: 215/376-6116

St. Marys
B & R Electric Company
Phone: 814/834-2814

West Chester
West Chester Electric Supply
Phone: 215/696-7500

York
Graybill's Incorporated
Phone: 717/843-0786

PUERTO RICO

Bayamon
Caribbean Contracting Corp.
Phone: 809/786-7815

RHODE ISLAND

Providence
Controller Services &
Sales Co.
Phone: 401/781-7100

William Dandreta & Company
Phone: 401/861-2800

Leavitt-Colson Company
Phone: 401/521-8800

SOUTH CAROLINA

Charleston
Wholesale Industrial
Electronics
Phone: 803/722-2634

Columbia
Dixie Electronics, Inc.
Phone: 803/779-5332

Greenville
Hammond Electronics
Phone: 803/233-4121

Shealy Electrical Wholesale
Phone: 803/242-6880

SOUTH DAKOTA

Aberdeen
McLaughlin Electric Supply
Phone: 605/225-7100

TENNESSEE

Chattanooga
Mills & Lupton Supply Co.
Phone: 615/266-6171

Kingsport
Wholesale Electric, Inc.
Phone: 615/246-2900

Knoxville
Brownell Electro, Inc.
Phone: 615/966-3441

Stokes Electric Company
Phone: 615/525-0351

TENNESSEE — Cont'd

Memphis
Bluff City Distributing Co.
Phone: 901/345-9500

Brownell Electro, Inc.
Phone: 901/795-8483

Nashville
Brownell Electro, Inc.
Phone: 615/889-8230

Carlton-Bates
Phone: 615/244-3562

Electra Distributing
Phone: 615/329-3971

TEXAS

Amarillo
Snook & Aderton, Inc.
Phone: 806/374-5229

Austin
Harrison Equipment Co.
Phone: 512/458-3555

Beaumont
Ralph's Industrial Electronics
Phone: 713/833-9443

Warren Electric Company
Phone: 713/833-9405

Corpus Christi
Nunn Electric Supply Corp.
Phone: 512/884-0311

Dallas
Associated Aircraft
Supply Co.
Phone: 214/331-4381

King Bearing, Inc.
Phone: 214/630-7600

Norvell Electronics, Inc.
Phone: 214/233-0020

Wilkinson Brothers
Phone: 214/747-1571

El Paso
Midland Specialty Company
Phone: 915/533-9555

Triangle Electric Supply Co.
Phone: 915/533-5981

Fort Worth
SWIECO, Inc.
Phone: 817/335-6521

Garland
Industrial Equipment Co.
Phone: 214/271-5494

Harlingen
Bush Supply Co., Inc.
Phone: 512/428-1613

Houston
Buffalo Electric Company
Phone: 713/688-2300

King Bearing, Inc.
Phone: 713/688-5701

Industrial Equipment
of Houston
Phone: 713/928-3181

Norvell Electronics, Inc.
Phone: 713/777-1666

Lubbock
Snook & Aderton, Inc.
Phone: 806/763-9323

Odessa
Western Controls Co.
Phone: 915/332-0771

San Antonia
Blackburn Drives & Ctrls., Inc.
Phone: 512/349-2621

Stafford
Harrison Equipment Co., Inc.
Phone: 713/879-2727

UTAH

Salt Lake City
Stuart Electric Supply, Inc.
Phone: 801/466-8603

Western Controls
Phone: 801/328-4302

VERMONT

Springfield
Coghlin Electric Co.
Phone: 802/885-5136

VIRGINIA

Charlottesville
ECK Supply Co.
Phone: 804/977-2990

Lynchburg
ECK Supply Co.
Phone: 804/846-6555

Norfolk
Priest Electronics, Inc.
Phone: 804/855-0105

VIRGINIA — Cont'd

Richmond
Electrical Equipment Co.
Phone: 804/353-7841

Roanoke
Williams Supply, Inc.
Phone: 703/343-9333

WASHINGTON

Aberdeen
Industrial Electric Service Co.
Phone: 206/533-2792

Bellevue
Almac Electronics
Phone: 206/643-9992

Bellingham
North Coast Electric Co.
Phone: 206/671-1100

Clarkston
AMFAC Electrical Supply
Phone: 509/758-5563

Everett
North Coast Electric Co.
Phone: 206/259-7263

Longview
North Coast Electric Co.
Phone: 206/423-1550

Pasco
AMFAC Electrical Supply Co.
Phone: 509/547-9733

Seattle
North Coast Electric Co.
Phone: 206/682-4444

Platt Electric Supply, Inc.
Phone: 206/624-4083

Tek-Electric Control, Inc.
Phone: 206/283-7100

Spokane
Amfac Electrical Supply
Phone: 509/534-0611

Tacoma
Consolidated Electrical Dist.
Phone: 206/383-5961

Yakima
Picatti Brothers, Inc.
Phone: 509/248-2540

WEST VIRGINIA

Clarksburg
Tolley Electric Company
Phone: 304/624-7468

Dunbar
State Electric Supply Co.
Phone: 304/768-8856

Huntington
West Virginia Electric Supply
Phone: 304/525-0361

Wheeling
Gee Electric Company
Phone: 304/233-3200

WISCONSIN

Appleton
Langstadt Electric Supply Co.
Phone: 414/733-3791

Cedarburg
A.A. Electric, Inc.
Phone: 414/377-8000

Green Bay
A.A. Electric Division
Phone: 414/499-0258

Beemster Electric Company
Phone: 414/437-3238

Janesville
Cole Electric Supply, Inc.
Phone: 608/752-9496

Madison
Satterfield Electronics, Inc.
Phone: 608/257-4801

Manitowoc
Englewood Electric Supply
Phone: 414/684-6653

Milwaukee
Standard Electric Supply Co.
Phone: 414/272-8100

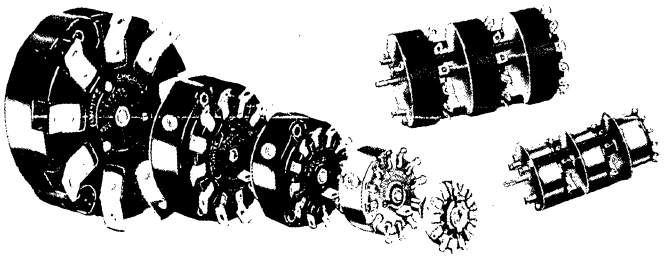
Racine
Nelson Electric Supply Co.
Phone: 414/637-7661

Waukesha
Power/Mation Division
Phone: 414/542-2868

WYOMING

Casper
Ryall Electric Supply Co.
Phone: 307/237-7198

OHMITE® power tap switches, high current, non-shorting type



INTRODUCING

MODEL 711

Smallest Switch for Its Rating
7 Amps, 125 Volts

All Ohmite switches feature the slow-break, quick-make action deemed so desirable for switching of AC current.

All models except 711 feature all ceramic, arc-proof bodies and solid silver alloy, fixed and movable contacts. The large, thick, silver-alloy fixed contact disks are permanently welded to copper studs. These, in turn, are riveted and soldered to sturdy terminal lugs, assuring a permanent mechanical and electrical joint. The rotor (moving) contact, also of solid silver-alloy, is riveted and soldered to the contact arm. Face of the rotor contact is slightly rounded assuring a perfect seating of the contacts with a slight rubbing, self-cleaning motion on every operation. Models 111, 212, 312 and 412 are UL listed.

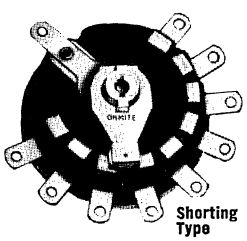
The new Model 711 tap switch was designed to achieve high current capability with small size. It is actually smaller than many low current instrument switches. It interrupts 7 amperes at 125 VAC and can carry 15 amperes AC or DC. The Model 711 features a melamine phenolic body with solid silver-alloy fixed and movable contacts.

All models can be provided as 2-in-tandem or 3-in-tandem (except Model 111) assemblies.

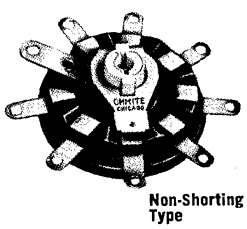
TO ORDER indicate model, followed by a dash and the number of taps required. If tandem assemblies are desired, add another dash, followed by T2 or T3 to indicate total number of switches in the assembly. Thus 212-6-T2 would indicate two 20 amp switches with 6 taps, in tandem. A single switch would be 212-6.

Model	Alternate Current Rating		Diameter	Shaft Diameter	Max. Panel Thickness	Weight	No. of Taps
	Amps.	Volts					
711	7	125	1 1/8"	1/4"	1/8"	.047 lb.	3-11
111	15	125	1 3/4"	1/4"	1/4"	.16 lb.	3-11
212	20	150	2 1/4"	1/4"	1/4"	.4 lb.	3-12
312	30	300	3 5/16"	1/4"	1/4"	.75 lb.	3-12
412	50	300	4 3/16"	1/4"	1/4"	1.4 lb.	3-12
608	100	300	6"	3/8"	1"	5 lb.	3-8

ALL CERAMIC OPEN TYPE TAP SWITCHES



Shorting Type



Non-Shorting Type

Designed to transfer currents of several amperes in circuits requiring high voltage insulation. Ceramic body construction. Monel metal taps; silver-graphite brush.

Switches up to 8 taps are approximately 3 1/4" diameter including lugs; 9 to 12 tap switches are approximately 4 1/4" diameter. Switches can be ordered assembled 2 to 3 in tandem. Single hole mounting by means of 3/8" diameter bushing and hexagon nut accommodates panels up to 1/4" thick (maximum).

Maximum current capacity is 7 amperes but only 3 amperes at 120 V.A.C. should be interrupted. Current ratings are less for all direct current circuits above 20 volts, for inductive circuits and high voltages.

OHMITE® OHMITROL solid state power and motor speed controls

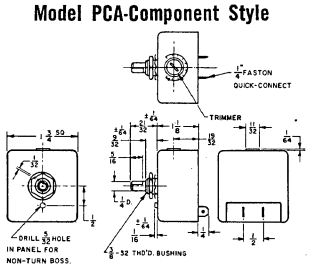
FEATURES:

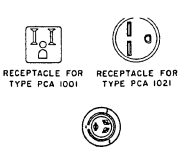
- Conserves space & power
- Smallest 1 & 2 KW control
- AC & DC output types
- Built-in on-off switch
- Adjustable control range
- Choice of component & portable styles
- Long life

Catalog No.		Input Volts	Freq.	Output Range (Nominal)	Load Capacity Rating (Maximum)
Component Style	Portable Style*				
PCA-1000	PCA-1001	120 VAC	60 Hz	0-120 VAC	1 KW, 8.3 Amps AC
PCA-1050	—				15 Amps AC
PCA-1100	PCA-1101		50 Hz		1 KW, 8.3 Amps AC
PCA-1020	PCA-1021	240 VAC	60 Hz	0-240 VAC	2 KW, 8.3 Amps AC
PCA-1120	PCA-1121		50 Hz		
PCD-1000	PCD-1001	120 VAC	60 Hz	0-120 VDC and Full 120 VDC	6.0 Amp DC Resistive 3.5 Amp DC Motor Load
PCD-1100	PCD-1101		50 Hz		
PCD-1020	PCD-1021	240 VAC	60 Hz	0-240 VDC and Full 240 VDC	
PCD-1120	PCD-1121		50 Hz		

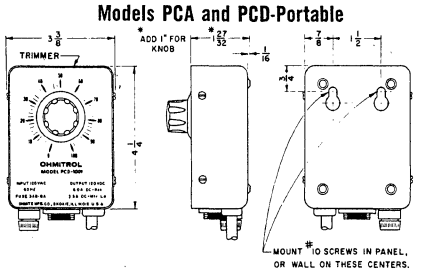
*Available by special order

Model PCA-Component Style





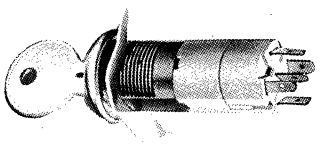
Models PCA and PCD-Portable



FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

OHMITE MFG. CO., a NORTH AMERICAN PHILIPS company / 3601 W. Howard St., Skokie, IL 60076 / (312) 675-2600 / TWX 910-223-0805 / TELEX 72-4433

OAK SWITCHES

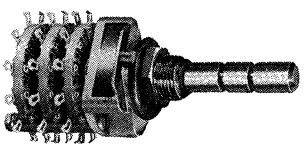


OAK ANTI-STATIC KEYLOCK SECURITY SWITCH

¾" diameter security switches provide up to 20 kV static protection for sensitive electronic circuitry. Supplied with stainless steel bezel and two brass keys. Keyed alike for each part number. Key pull in all positions. Single pole only.

SPECIFICATIONS

Operating Life: Tested to 10,000 cycles.
Switching: Enclosed; SPST, SPDT, SP3T
Throw: 90°.
Operating Torque: 7 to 16 in. oz.
Temperature Range: 0° to +85°C
Positive Detenting Stops: Integral with lock.
Housing: Zytel 101, Gray.
Switch Terminals: Copper alloy, silver plated.
Contact Material: Copper alloy, silver-plated.
Barrel: Zinc alloy, chromate dipped.
Bezel: Stainless steel.
Keys: Brass (2)
Hex Mtg. Nut: Cadmium plated steel.
Elec. Ratings: 1.0 A @ 28 Vdc
4.0 A @ 120 Vac
2.0 A @ 240 Vac
Contact Resistance: 10 milliohms (nominal). All switches make before break. UL and CSA listed. Specifications through rated life after break in.

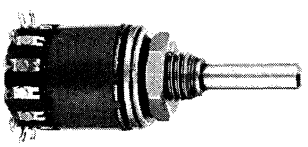


OAK TYPE AM (ACORN) ROTARY SWITCH

1" diameter with patented Unidex® detent action. Double-wiping and self-cleaning contacts.

SPECIFICATIONS

Size: 1" dia. (nom.), 1 to 3 sections.
Mounting: ⅜" dia. with locating key.
Shaft: 0.250" dia. x 1½" grooved (breakoff).
Indexing: Dual ball 30°.
Stop Strength: Fixed — 15 in. lbs.
Adjustable — 10 in. lbs.
Terminal Strength: 2½ lb. pull.
Stator: Diallyl phthalate (MIL-M-14).
Rotor: Thermoplastic.
Contacts: Brass, silver plated and protected.
Contact Resistance: 0.003 to 0.015 Ohms between adjacent clips.
Elec. Rating: Break 0.5 A @ 28 Vdc, 0.25 A @ 110 Vac (resistive). Carry 5.0 A.
Life: 10,000 cycles at rated load (min.).
Temperature: −65° to +85°C.
Hardware: Nut, lockwasher, stopwasher.
Finish: Withstands 50 hr. MIL-S-3786 salt spray.



OAK ½" ROTARY SWITCH

A superior subminiature switch with negligible contact noise and circuit resistance.

SPECIFICATIONS

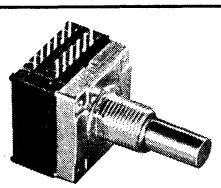
Size: ½" (nominal).
Mounting: "D" hole, ¼" bushing.
Shaft: ⅛" dia. x ¾".
Indexing: 30°, up to 11 detents.
Stop Strength: 5 in. lbs.
Terminal Strength: 1 lb. pull.
Stator & Spacers: Diallyl phthalate.
Rotor: Thermoplastic.
Contacts: Silver alloy, gold plated.
Contact Resistance: 10-20 milliohms.
Insulation Resistance: 10 megohms (min.).
Elec. Rating: 0.25 A @ 110 Vac resistive.
0.50 A @ 30 Vdc resistive.
Life: 10,000 cycles at rated load (min.) room
Temperature: −65° to +85°C
Hardware: Nut, lockwasher, stopwasher.
Finish: Withstands 50 hr. MIL-S-3786 salt spray.

OAK TYPE 500 ½" ROTARY SWITCH

Superior long-life subminiature switches are designed to meet MIL-S-3786/20.

SPECIFICATIONS

Size: ½" (nom), single pole.
Positions: 4, 6, 8, 10 & 12.
Detent: 90°, 60°, 45°, 36° & 30°.
Base: Diallyl phthalate, MIL-M-14.
Rotor: Phenolic, MIL-M-14.
Contacts: Copper alloy w/silver crown, gold plate.
Terminals: Copper alloy, silver crown, gold plate.
Contact Resistance: 20 milliohms (max) MIL.
50 milliohms (max) non-MIL
Stops: Fixed or adjustable.
Shaft & Panel Seal: Neoprene.
Voltage: 600 Vac breakdown (min).
Current Rating: 6.0 A @ 30 Vdc & 110 Vac. Resistive.
Mechanical: Stainless steel & nickel plated steel detent balls.
Write for Bulletin F-1096 for complete details and specifications.



OAK TYPE 850 PROGRAMMABLE ROTARY SWITCH

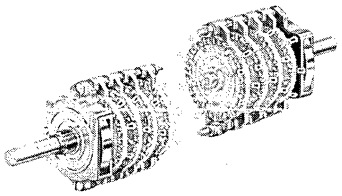
0.850" square, sealed programmable switch with up to 28 positions, 4 sections and/or 7 outputs plus common per section. Dual-concentric shafts available. Can be wave soldered.

SPECIFICATIONS

Rating: 250 mA @ 28 Vdc resistive.
Contact Resistance: 100 milliohms (max).
Voltage Breakdown: 500 V (min) between common and open contact. 100 V (min) between any contact and housing.
Contacts: Make before break.
Detent Angles: Depends on positions.
Operating Temperature: −55° to +85°C.
Stops: As required.
Coding: Hexidecimal, BCD, Grey and others.
Shafts: Steel, cadmium plated, chromate or zinc plate as required. Outer: 0.250" (nom).
Write for Bulletin F-1093.

OAK SWITCH SYSTEMS, INC. P.O. Box 517, Crystal Lake, IL 60014
An Oak Technology Inc. Company (815) 459-5000 • TWX 910-634-3353 • TLX 72-2447

OAK SWITCHES



OAK MULTIDEX ROTARY SWITCH

Oak Multidex Switches replace older models with a completely new design. Multidex switches are smaller than older models yet provide more contacts (up to 32 and 36 positions). The patented Unidex detent system has one or two balls riding on the starwheel for smooth and positive action. The detent housing is a one-piece molding. They meet or exceed the requirements of MIL-S-3786, SR32 (latest issue).

Multidex rotors and stators are molded of diallyl phthalate and meet MIL-M-14 requirements. Contacts are silver plated brass (standard) or silver alloys (other available).

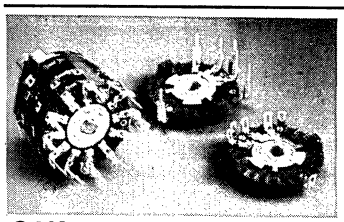
The contacts are self-cleaning, double-wiping types and are coated to resist corrosion.

Terminals are Type "A" clips for easy wire insertion and soldering.

Rated at 0.5 A @ 28 Vdc and 0.25 @ 110 Vac with silver plated contacts. Silver contacts are rated 1.0 @ 28 Vdc and 0.5 A @ 110 Vac. All ratings are for resistive loads.

Temperature ratings are:
MIL: −65° to +85°C.
Commercial: −25° to +85°C.

Both types are made of materials which meet or exceed the requirements of MIL-S-3786 50 hour salt spray test.



OAK TYPE FJ 1.421" DIAMETER ROTARY SWITCH

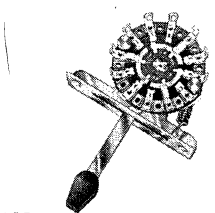
This series of Oak switches is a product expansion of the standard "F" series. They are designed to meet the requirements of MIL-S-3786/SR03.

The FJ series offers terminal clips which are offset on the rear 15° from those on the front. Each section can accommodate up to 22 clips in 30°, 60° or 90° throw. The FJ series utilizes Oak's durable high pressure double wiping contacts which are self-cleaning and corrosion resistant. Terminals are available for both hard soldering and printed circuit board mounting.

Rotation may be either continuous, with a fixed stop or with an adjustable stop.

FJ switches are rated 1.0 A @ 28 Vdc and 5.0 A @ 110 Vac with silver plated brass contacts. Ratings for silver alloy contacts are: 2 A @ 28 Vdc and 1.0 A @ 110 Vac. Contacts can be make before break or break before make or any combination of these.

All FJ switches are made of the highest quality material to meet or exceed all military and commercial requirements.



OAK TYPE 184 LEVER SWITCHES

Oak Type 184 lever switches are designed for reliable operation over thousands of cycles. The proven Type 184 offers a number of options. They are available as either 2, 3, or 4 position styles and with up to 12 terminals per side so that 12 pole 2 position circuits can be used or up to 8 poles with the 3 position style.

Mounting requires a slot and 2 holes to accept the two #4-40 mounting screws. The face of the switch is tapped. The switches require only 1 1/64" of space behind the panel.

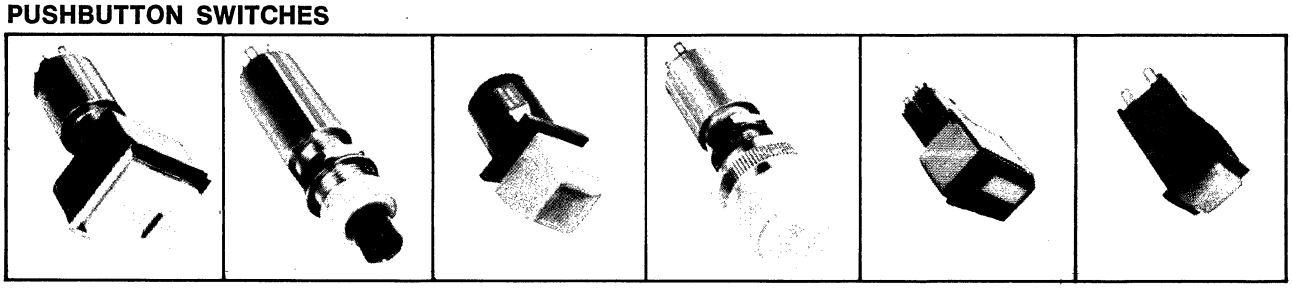
Contacts are silver plated brass and are rated at 0.5 A @ 28 Vdc and 0.25 A @ 110 Vac, resistive. The contacts will carry 5 Amps continuously.

The life of this series is rated at 10,000 cycles under standard conditions as a minimum.

The switches are supplied with a standard knob. Other designs are possible.

Write for complete details or contact your nearest Oak distributor or sales office. These are listed in EEM's "Yellow Pages" in this Volume.

OAK OPTOLITE™ PUSHBUTTON SWITCHES



FRICTION CAP PRESSLITES
Momentary & Alternate Action

LOW PROFILE PRESSLITES
Momentary & Alternate Action

SNAP-IN PRESSLITES
Momentary Action Only

WATERTIGHT & EMI SUPPRESSED PRESSLITES
Momentary & Alternate Action

SPLIT LEGEND
Momentary & Alternate Action

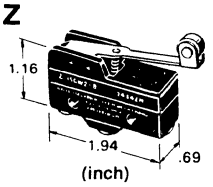
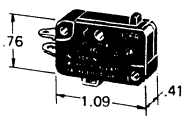
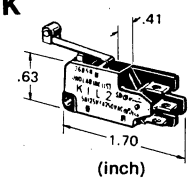
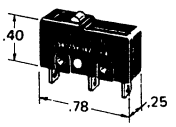
MACROFLEX
Momentary & Alternate Action

OAK SWITCH SYSTEMS, INC. P.O. Box 517, Crystal Lake, IL 60014
An Oak Technology Inc. Company (815) 459-5000 • TWX 910-634-3353 • TLX 72-2447

OMRON®

BASIC SWITCHES

The switch products outlined on these pages are representative of hundreds of switches manufactured and distributed by Omron. Omron also manufactures a wide variety of other control components including: switches, photoelectric sensors, proximity sensors, timers, counters, temperature controllers and programmable controllers.

	Z	**V**	**K**	**SS**
	 (inch)	 (inch)	 (inch)	 (inch)
Features	• Best-Selling • Wide Variety • Breaks up to 15A Loads	• Miniature • Breaks 5 to 15A Loads • Variety of Actuators	• Economical • With Insulation Barrier	• Economical • Subminiature
Contact Form	SPDT	SPDT	SPDT	SPDT
Basic Operating Force (OF) Range (oz.) (Pin Plunger)	8.8 to 12.3	0.9 to 14.1	0.42 to 1.76	0.9 to 5.3
Terminals	Solder Screw Quick Connect	Solder Screw Quick Connect	Solder Quick Connect	Solder Quick Connect PCB
Contact Rating [Rated Current (A)]	0.1 to 15 250 VAC	0.1 to 15 125 VAC	5 125 VAC	0.1 to 10 125 VAC
Mechanical Service Life (Operations)	2×10^7	1×10^6 to 1×10^7	2×10^7	3×10^7
Approvals	Ⓤ Ⓢ	Ⓤ Ⓢ	Ⓤ Ⓢ	Ⓤ Ⓢ

OMRON®

For more information contact **Omron Electronics, Inc.,**
Dept. EM, 650 Woodfield, Schaumburg, Illinois 60195
Phone: (312) 843-7900, TWX 910-291-2494

LED ILLUMINATED PUSHBUTTON SWITCHES

The A3SA and A3SJ series feature replaceable 4-chip LED(s). This state-of-the-art design provides incandescent brightness, (120° wide viewing angle and viewing distance up to 200 ft.), with LED economy. The A3SJ is available with a 2-way split screen configuration. Incandescent types are also available.

A3SA , A3SJ

■ **AVAILABLE TYPES**

• SWITCH UNITS*/**

Function	Construction: Contact & Output form		Alternate action	Alternate action
Switch-indicator unit (switching and indicating functions)	Silver alloy contact	SPDT	A3SA-7020	A3SJ-8020
		DPDT	A3SA-7040	A3SJ-8040
	Gold alloy contact	SPDT	A3SA-7060	A3SJ-8060
		DPDT	A3SA-7080	A3SJ-8080
	Solid-state output		A3SA-7100	A3SJ-8100

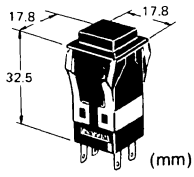
• LED (T-1¾ Bulb Package)

Description: Operating voltage	Color of display screen unit	Color of belt	Type
5V	Red	Red	SLL-05ER
	Yellow or white	Yellow	SLL-05EY
	Green	Green	SLL-05EG
6V	Red	Red	SLL-06ER
	Yellow or white	Yellow	SLL-06EY
	Green	Green	SLL-06EG
12V	Red	Red	SLL-12ER
	Yellow or white	Yellow	SLL-12EY
	Green	Green	SLL-12EG
24V	Red	Red	SLL-24ER
	Yellow or white	Yellow	SLL-24EY
	Green	Green	SLL-24EG

• LED RATINGS

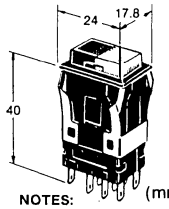
Rated voltage	Rated current	Operating voltage range
5VDC	30mA	5VDC+5%
6VDC	30mA	6VDC+5%
12VDC	15mA	12VDC+5%
24VDC	10mA	24VDC+5%

A3SA — SQUARE TYPE



(mm)

A3SJ — RECTANGULAR TYPE



(mm)

• A3SA DISPLAY SCREEN UNITS***

Color: Switch unit	For switch-indicator unit
White	A3SA-5801
Red	A3SA-5802
Green	A3SA-5803
Yellow	A3SA-5805

• A3SJ DISPLAY SCREEN UNITS***

Screen pattern & color: Switch unit		For switch-indicator unit
Single-screen type (solid color) □	White	A3SJ-5801
	Red	A3SJ-5802
	Green	A3SJ-5803
	Yellow	A3SJ-5805
2-split screen type (2 split colors) □	White/red	A3SJ-5901
	White/green	A3SJ-5902
	White/yellow	A3SJ-5904
	Red/green	A3SJ-5905
	Red/yellow	A3SJ-5907
	Green/yellow	A3SJ-5909

NOTES:
1. When placing your order, specify the required number of switch units, display screen units and LEDs, respectively.
2. *The switch unit is supplied with a spring mounting clip.
3. **Momentary Action types and indicator unit (indicating function only) are available.
4. ***The display screen unit is supplied with a transparent legend plate.

Approved by Standard
UL (File No. E41515)
CSA (File No. LR45258)

Silver contact type: 3A 125 VAC, 2A 250 VAC
Gold alloy contact type: 0.1A 30 VDC, 0.1A 125 VAC
Solid-state output type: Vcc 4.5 to 26.4 VDC

The A3PA and A3PJ series feature an array of LEDs providing incandescent brightness, (120° wide viewing angle and viewing distance up to 200 ft.), with LED economy. The A3PA is available with a 2-way split screen configuration. The A3PJ offers 2, 3 and 4-way split screen configurations. Incandescent types are also available.

A3PA, A3PJ

■ **AVAILABLE TYPES**

• SWITCH UNITS*

Function	Construction: Contact & Output form		Alternate action	Alternate action
Switch-indicator unit (switching and indicating functions)	Silver alloy contact	SPDT	A3PA-7020-1	A3PJ-7020-1
		DPDT	A3PA-7040-1	A3PJ-7040-1
	Gold alloy contact	SPDT	A3PA-7060-1	A3PJ-7060-1
		DPDT	A3PA-7080-1	A3PJ-7080-1
	Solid-state output		A3PA-7100-1	A3PJ-7100-1

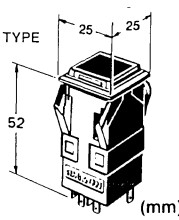
NOTE: The switch unit is supplied with a black flange and a short spring mounting clip.

*Momentary Action types and indicator unit (indicating function only) are available.

• DISPLAY SCREEN UNITS**

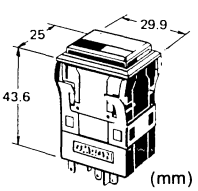
Screen pattern & color		Switch unit	For switch-indicator unit	For switch-indicator unit
Single screen type (solid color) □		White	A3PA-5701-□□E	A3PJ-5701-□□E
		Red	A3PA-5702-□□E	A3PJ-5702-□□E
		Green	A3PA-5703-□□E	A3PJ-5703-□□E
		Orange	A3PA-5706-□□E	A3PJ-5706-□□E
2-split screen type (2 split colors) □□	White	White	A3PA-5711-□□E	A3PJ-5711-□□E
		Red	A3PA-5712-□□E	A3PJ-5712-□□E
		Green	A3PA-5713-□□E	A3PJ-5713-□□E
		Orange	A3PA-5716-□□E	A3PJ-5716-□□E
	Red	White	A3PA-5721-□□E	A3PJ-5721-□□E
		Red	A3PA-5722-□□E	A3PJ-5722-□□E
		Green	A3PA-5723-□□E	A3PJ-5723-□□E
		Orange	A3PA-5726-□□E	A3PJ-5726-□□E
	Green	White	A3PA-5731-□□E	A3PJ-5731-□□E
		Red	A3PA-5732-□□E	A3PJ-5732-□□E
		Green	A3PA-5733-□□E	A3PJ-5733-□□E
		Orange	A3PA-5736-□□E	A3PJ-5736-□□E
	Orange	White	A3PA-5741-□□E	A3PJ-5741-□□E
		Red	A3PA-5742-□□E	A3PJ-5742-□□E
		Green	A3PA-5743-□□E	A3PJ-5743-□□E
		Orange	A3PA-5746-□□E	A3PJ-5746-□□E

A3PA — SQUARE TYPE



(mm)

A3PJ — RECTANGULAR TYPE



(mm)

• LED RATINGS

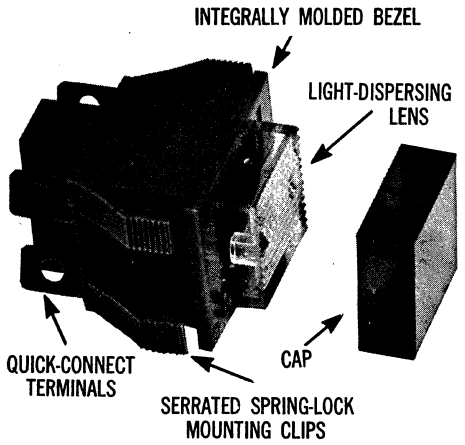
Rated voltage	Current (mA): Single screen type	Current (mA): 2-split screen type	Operating voltage range
5VDC	80	40 x 2	5V+5%
6VDC	80	40 x 2	6V+5%
12VDC	40	20 x 2	12V+5%
24VDC	20	15 x 2	24V+5%

NOTES:
1. The display screen unit incorporates a lens, a transparent legend plate, a plunger, a colored plate and LED(s). The 2-split screen type incorporates a light baffle in addition to the above items.
2. When placing your order for the display screen unit, fill one of the following rated voltage codes in □□ of the part number.
   5 VDC: 05
   6 VDC: 06
   12 VDC: 12
   24 VDC: 24
3. **3-split and 4-split screen types are available. (A3PJ only)

Approved by Standard
UL (File No. E41515)
CSA (File No. LR45258)

Silver contact type: 3A 125 VAC, 2A 250 VAC
Gold alloy contact type: 0.1A 30 VDC, 0.1A 125 VAC
Solid-state output type: Vcc 4.5 to 26.4 VDC

OSLO • PUSHBUTTON SWITCHES



Circuit Number	Circuit Diagram	Switching	TYPE DL LIGHTED CATALOG NUMBER Momentary Action	TYPE DL LIGHTED CATALOG NUMBER Alternating Action	TYPE DP NON-LIGHTED CATALOG NUMBER Momentary Action	TYPE DP NON-LIGHTED CATALOG NUMBER Alternating Action
1		single-pole single-throw normally open	DLM1	DLA1	DPM1	DPA1
2		single-pole single-throw normally closed	DLM2	DLA2	DPM2	DPA2
3		double-pole single-throw normally open	DLM3	DLA3	DPM3	DPA3
4		double-pole single-throw normally closed	DLM4	DLA4	DPM4	DPA4
5		double-pole cir. #1 normally open cir. #2 normally closed	DLM5	DLA5	DPM5	DPA5
6		single-pole single-throw normally open	DLM6	DLA6	Above types do not include lamp-circuit.	
7		double-pole single-throw normally open	DLM7	DLA7		

ELECTRICAL FEATURES

Load rating: 10 amperes 125/250 volts ac.
Contacts: fine silver, double-break, break-before-make
Circuits: single-pole and double-pole
Dielectric strength: 2000 volts ac rms.
Life: 25,000 operations at maximum rating

MECHANICAL FEATURES

One-piece molded-nylon body has integral, serrated, spring-lock clips.
Bezel molded integral with body.
Metal bezel available.
Molded-in light-dispersing lens.
Interchangeable lens-caps in wide choice of colors.
Positive mechanical indication of switch-contact position.
100,000 mechanical operations.

TERMINALS

Style A—1/4-inch quick-connect
Style B—3/16-inch quick-connect
Style C—Solder-lug, for #12 wire

STANDARD LAMPS

Integral with switch;
Internally connected per diagrams above.
6, 12, and 28 volt incandescent lamps standard.
125 and 250 volt neon lamps standard.

SPECIAL ORDER LAMPS

125 and 250 volt Blue or Green neon lamps available. Consult factory for price and delivery information.

COLOR DESIGNATIONS

Body and integral bezel
White—C7, Grey—C8, Black—C9,

Transparent lens-cap
Red—1, Clear—2, Amber—3, Green—4, Blue—5

Opaque pushbutton-cap
White—7, Grey—8, Black—9, Blue—10, Green—11, Red—12

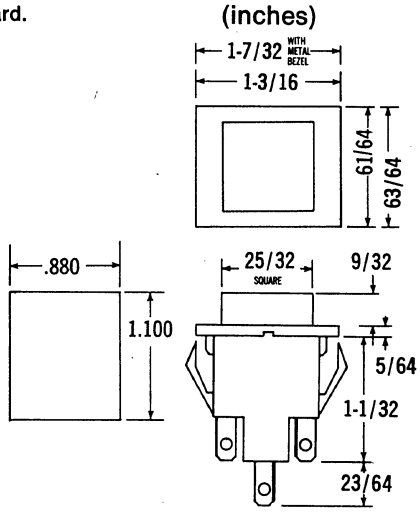
TYPE DG – Lighted Indicators

Type DG Lighted Indicators are identical in size and mounting with Type DL and DP switches and can be grouped easily with them without need for special mounting provision. A choice of different lens-cap heights is available.

TYPE DGS the low-profile indicator extends the same distance from the panel as the Type DL or DP switch in its ON position (1/16 inch).

TYPE DGT the high-profile indicator extends the same distance from the panel as the Type DL or DP switch in its OFF position (9/32 inch).

OUTLINE DIMENSIONS (inches)



METAL BEZELS (optional)

Gold-color—F1, Chrome—F2

MARKINGS

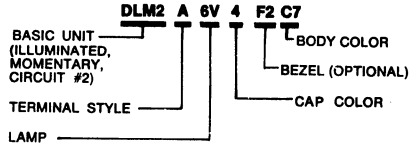
Letters, numbers, and symbols can be applied to lens-caps.

MOUNTING

Snap-in mounting in rectangular hole; fits any panel-thickness 1/32 to 3/16 inch.

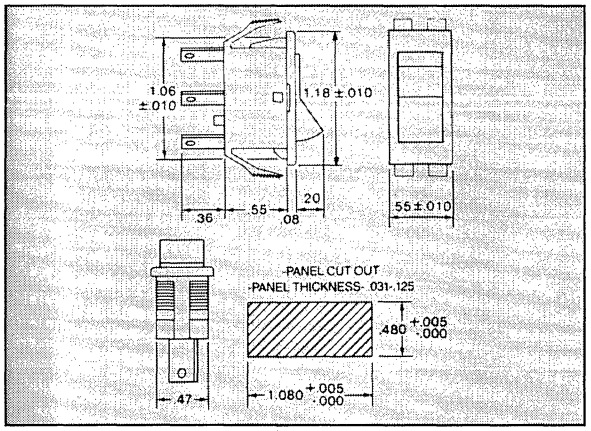
ORDERING EXAMPLE

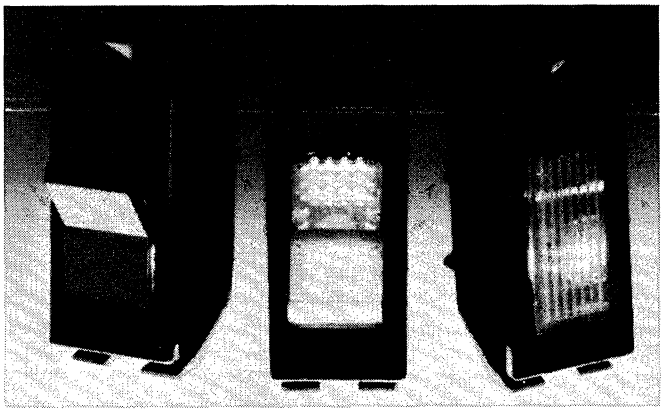
Develop catalog-number of unit by adding to the basic Type Number, shown above, the applicable code-letters or numbers in the sequence shown below.



OSLO CONTROLS INC.
328 Industrial Avenue, Cheshire, Connecticut 06410
Tel.: (203) 272-2794 TWX 710 455 3774

OSLO • ROCKER SWITCHES





Electrical Features
Load Rating: 20 amperes 125/250 volts AC
Contacts: Fine silver for long life dependability
Dielectric strength: 1250 volts (live parts to ground)
Electrical Life: 25,000 operations at maximum rating.
Insulation Resistance: 5 megohms

Terminals
Style A – ¼ inch quick-connect

Lamps
6, 12, 28 volt incandescent, 125, 250 volt Neon

Mechanical Features
One-piece molded-nylon housing, available in choice of colors.
Integral spring-lock clip design speeds assembly.
Optional metal bezels available.
Rocker actuator available in choice of colors.
250,000 mechanical operations.

Markings
Letters, numbers, and symbols can be applied to rocker actuator or to integral nylon bezel.

Mounting
Snap-in mounting in rectangular hole; fits any panel thickness from .031 to .125 inch.

ORDERING PROCEDURE

To the basic catalog number listed, suffix letters and numbers are added in the sequence indicated below:

Example: RSL1A6V1C9F2 This specifies a SPST, lighted, maintained Off-On switch with ¼" quick-connect terminals, transparent red actuator, black housing and optional chrome bezel.

LAMP VOLTAGE	LENS COLORS	HOUSING-COLORS	METAL BEZEL (OPTIONAL)
6V=6 Volt Incandescent	1 = Red 2 = Clear 3 = Amber *4 = Green *5 = Blue 6 = White	C7 = White C8 = Grey (Non-Stock) C9 = Black	F1=Gold Colored F2=Chrome
12V=12 Volt Incandescent			
28V=28 Volt Incandescent			
125V=125 Volt Neon			
250V=250 Volt Neon			

*Blue or green actuators are not recommended for units with neon lamps

RSL1A 6V 1 C9 F2

- RSL1A — BASIC UNIT LIGHTED MAINTAINED ON-OFF SWITCH ¼" QUICK TERM
- 6V — LAMP
- 1 — LENS COLOR
- C9 — HOUSING COLOR
- F2 — BEZEL (OPTIONAL)

NON-LIGHTED SWITCHES

CIRCUIT		BASIC CAT. NO.
SPST Maintained	2 1 OFF — 2 1 ON	RSP1A
SPDT Maintained	2 1 3 ON — 2 1 3 ON	RSP2A
SPDT Maintained Center Off	2 1 3 ON — 2 1 3 OFF — 2 1 3 ON	RSP3A
SPST (Momentary) Normally Open	2 1 OFF — 2 1 (ON)	RSP4A
SPST (Momentary) Normally Closed	2 1 ON — 2 1 (OFF)	RSP5A
SPDT (Momentary) Transfer	2 1 3 ON — 2 1 3 (ON)	RSP6A

LIGHTED ROCKER SWITCHES

CIRCUIT		BASIC CAT. NO.
SPST Maintained	2 1 3 OFF — 2 1 3 ON	RSL1A
SPST (Momentary) Normally Open	2 1 3 OFF — 2 1 3 (ON)	RSL4A

LIGHTED INDICATORS

BASIC CATALOG NO.
RSOA

*Basic catalog number includes ¼ - inch quick-connect terminals.
CODE: SPST = Single-Pole, Single Throw
SPDT = Single-Pole, Double Throw
( )= Momentary Action

OSLO CONTROLS INC.
328 Industrial Avenue, Cheshire, Connecticut 06410
Tel.: (203) 272-2794 TWX 710 455 3774

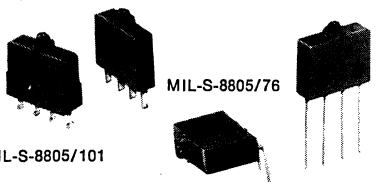
OTTO CONTROLS

OTTO® SNAP-ACTION SWITCHES...

because the OTTO design features inherent rocking-action

BASIC SWITCHES sub-miniature

DOUBLE-BREAK B3 SERIES



MIL-S-8805/76 THIN **B3-22141**

For your run-of-the-"MIL" projects, OTTO's B3-22141 Series is only .200" thick. Contact resistance less than 25 milliohms, contact pressure higher than normal, minimal contact bounce. Gold flashed contacts, solder terminals in diallyl case. Rated 7A Res.

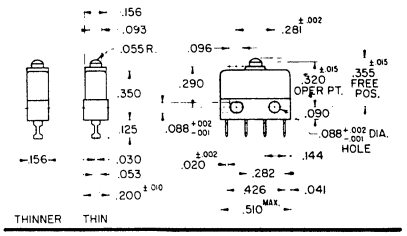
MIL-S-8805/101 THINNER **B3-12141**

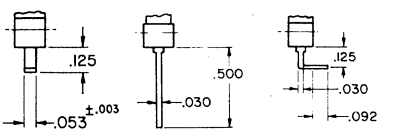
OTTO inspired military spec. is only .156" thin, yet all the rating, life, and reliability of the /76 version. Five B3-12141 Series in the space of four B3-22141. Choice of double-break from X, Y, Z and single break form C. B3-12141 turret terminals, B3-11141 p.c. pins. Also commercial versions.

CHARACTERISTICS

- Contact Resistance: .025Ω max.
- 10 million mechanical cycles.
- Operating Force: 5 $^{+3}_{-2}$ oz.
- Release Force: 1.5 oz. min.
- Overtravel: .006" min.
- Move. Diff.: .018 ±.008"
- Rating: 7A Res., 115 VAC, 28 VDC.

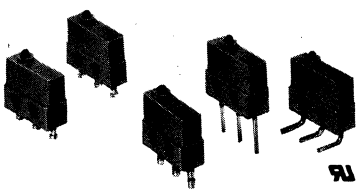
BASIC SWITCH, TURRET TERMINALS





All terminals are .020" thick.

SINGLE-BREAK B2 SERIES



Now available in a choice of .200 and .156 inch wide models. While the OTTO B2 is qualified to MIL-S-8805/4, the same switch can be specified for commercial use at a cost savings. Whether it be military or commercial, low-level "dry circuit" or high ampacity, large or close differentials, you can specify the exact switch to meet your needs. Case is diallyl. Terminals are gold-flashed brass. Contacts are silver or gold.

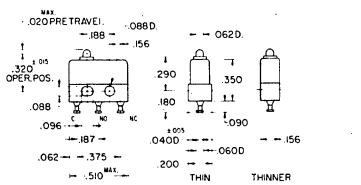
CHARACTERISTICS

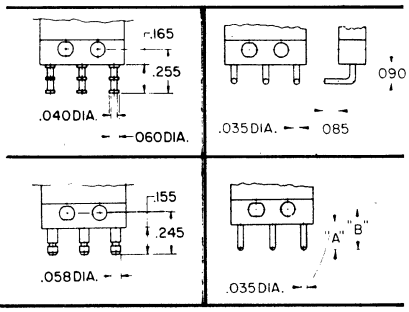
- Contact Resistance: .025Ω max.
- 1 million mechanical cycles.
- Operating Force: 5 oz. max.
- Release Force: 1 oz. min.
- Overtravel: .004" min.
- Move. Diff.: .005" max.
- Rating: 7A res. @ 115 VAC, 28 VDC.

APPROVALS TO MIL-S-8805/4

MS P/N	OTTO P/N
MS24547-1	B2-211351
MS24547-2	B2-211353
MS24547-4	B2-212351
MS24547-5	B2-212353

DIM. "A"	DIM. "B"	CAT. P/N CODE
.090	.180	6
.150	.240	4
.270	.360	5

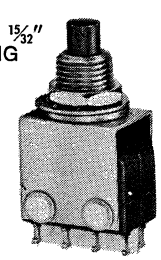




ACTUATORS FOR BASICS

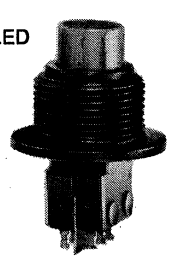
PUSHBUTTONS

¼" OR 15/32" BUSHING



¼" or 15/32" bushings, red or black button, 1 to 4 poles. Feature B3 basics. Overtravel: .006" min. Total travel: .036" Typical.

SEALED

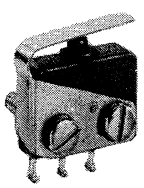


Choice of 3 panel bezels styles, 1 or 2 poles. Feature B3 basics. Operating force: 4 lbs. max. Total travel: .050" Typical.

TOGGLES

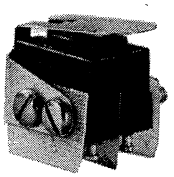
¼" or 15/32" bushings, 1 to 3 poles, B2 or B3 basics. Momentary and three position.

LEVERS



For B3 Basics

# Poles	Cat. No.
1	A3-101
2	A3-102



For B2 Basics

# Poles	Cat. No.
1	A2-101
2	A2-102

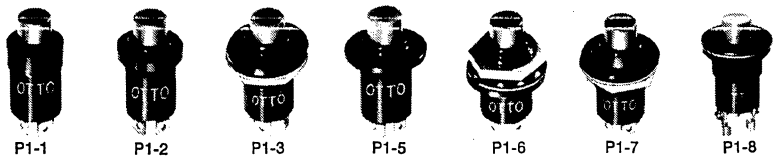
OTTO CONTROLS Division / OTTO Engineering Inc.

...MAKE AND BREAK EVERYTIME

...that breaks welds and wipes contacts clean

PUSHBUTTONS miniature & moistureproof

OTTO CONTROLS



P1-1 P1-2 P1-3 P1-5 P1-6 P1-7 P1-8

FEATURES

- 250,000 mechanical cycles.
- High Contact Pressure: 120 gr.
- Low Contact Resistance:
- Repeatable trip point within .001".
- Rolling sleeve principle seals button.
- Sealed case and terminals.

TYPE P1 (MIL-S-8805/3)

Pushbutton is sealed by silicone rubber boot operating on a "rolling sleeve" principle to give long life and smooth operation. Case and terminals sealed against environment and solder flux. Load ratings: 10A res., 5A ind., 3A lamp. Contact forms: N.O., N.C., 2-circuit. Red or black button.

P3-3 P3-6 P3-7 P3-8

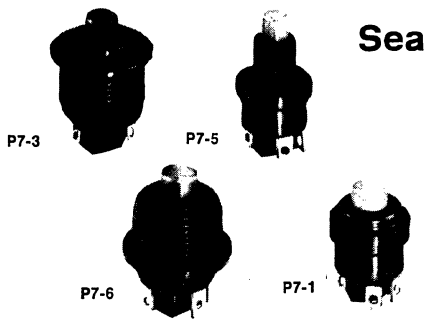
TYPE P3 Commercial Grade

Momentary or push-pull double-break action. Same specs as P1 military series. Choice of solder or screw terminals. Designed for use in panel boards, computers, business machines, instruments. Can be used as limit switch.

NEW

FEATURES:

- Mini size and sealed.
- .025 ohms max. contact resistance.
- Positive tactile feed back.
- 4 mounting styles.
- 6 circuit variations.



P7-3 P7-5 P7-6 P7-1

Sealed Subminiature Pushbutton

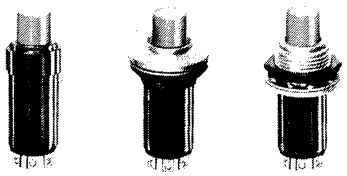
TYPE P7

Double-break action with sealed pushbutton meets environmental and electrical requirements of MIL-S-8805. Switches loads from 10 mA @ 30 mV to 5 amps @ 28 VDC. Choice of black or silver bezel and nine button colors. The P7-1 series features swage bushing, P7-3's have front panel bezel, P7-5's have ¼" bushing while P7-6's have $^{15}/_{32}$" bushing. Seal is either moisture-proof/dust-tite or water-proof. Back-of-panel less than .500". Front panel .437" to .562" diameter.

twostep™ for applications requiring 3 modes of operation

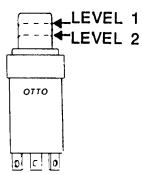
FEATURES

- Unique 2-position design.
- Sequential contact action.
- 12 contact arrangements.
- Make-before-break contact option.
- Moistureproof construction.
- 25,000 mechanical cycles.



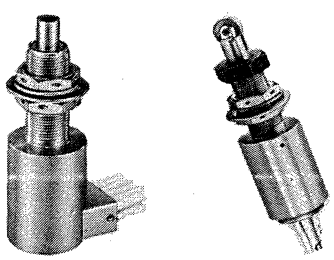
P2-1 P2-3 P2-6

Ideal for "off-high-low," "off-slow-fast," "Stop-fine-course" applications. Each level operates an independent set of SPDT circuits rated to 5A. Twelve contact arrangements are offered to satisfy just about any circuit requirement. Also available as DPDT single detent.



SPECIAL PURPOSE SWITCHES

ENVIRONMENT-FREE

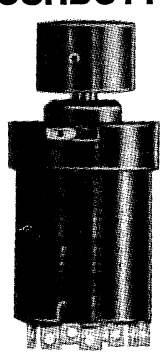


One piece housing, sealed at plunger with ring seals and at base with hermetic header for immersion proof and against corrosive atmospheres. Case grounded for EMI reduction. P6 Series available with roller or in-line plunger.

CHARACTERISTICS

- Rating: 7A res. at 28 VDC.
- Actuating Force: 9 lbs. Typ.
- Reset Force: 5 lbs. min.

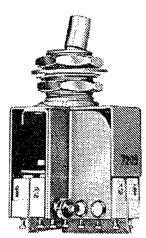
TOGGLE/ PUSHBUTTON



T2-0001

Combo toggle and pushbutton. It's a 2-position toggle and a pushbutton switch all in one. 30° toggle throw, .135" total pushbutton travel with 4.5 lbs. operating force. Rated 10A res. and ind.

TOGGLE



T1-0001

Four position, 6-pole toggle featuring MIL-S-8805/4 basic switches. Positions #1 and #3 are 2PDT maintained action each, position #4 is 2PDT momentary, position #2 is center "off." Rated 7A. res. each pole.

T1-0004

Same except 3-position, 4-pole toggle. Position #1 is 2PDT momentary, position #2 is center "off," position #3 is 2PDT maintained action.

DEPT. EM, 2 EAST MAIN STREET / CARPENTERSVILLE, ILLINOIS 60110 / TEL: (312) 428-7171 / TELEX: 72-2426

Power Dynamics, Inc.

177 Valley Street, South Orange, New Jersey 07079 • (201) 762-6886 • TWX: 136567 (PDI)

Micro-Miniature Toggle Switches

FSC 60046 • PC • Ultra-Low Current • Low Cost

Developed especially for use with ultra-low currents. Gold-plated, plus extra heavy gold-plating on contact points. Unique contact design assures stronger and more stable contact resistance.

SPECIFICATIONS

Contacts and Terminals: Gold-plated

Rating: 5 VDC 100 mA
25 VDC 25 mA

Contact resistance: Less than 20m ohms (100 mV 1 mA)

Insulation resistance: More than 1000M ohms (500 VDC)

Current capacity: 0.1 micron A~0.1A

Dielectric strength: 100 VRMS at sea level

Life cycle: 50,000 contacts (standard type)

Mechanical life: 2 Pos.: 100,000 operations
3 Pos.: 50,000 operations

Electrical life: 2 Pos.: 50,000
3 Pos.: 25,000

Low Cost Commercial Versions: 2 Pos.: 40,000
3 Pos.: 20,000

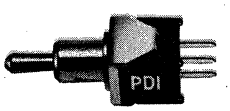
FEATURES

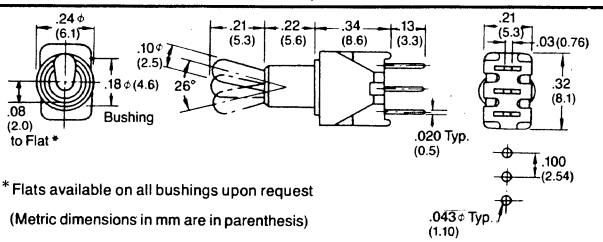
- ▲ Terminals utilize international printed circuit board standard spacing to match most PC boards.
- ▲ Pins and contacts are nickel, gold-plated. (3 microns of nickel-plating with a minimum of 1.3 microns of gold).
- ▲ Case is UL-standard approved 0-94V Valox. Resists the effects of chemicals, high impact shock and high temperatures.
- ▲ Cleaning is simple even after mounting because of the design of the standoffs.
- ▲ Single and double pole types have four standoffs to allow maximum mounting stability.
- ▲ Available:
  - Plain bushing, no threads
  - ¼ threaded bushings with hexagon nuts
  - Toothwasher (standard)
  - Locking washer
  - 10.4mm long lever
  - Low-Cost Commercial Version—0.5 Microns Aμ

CROSS REFERENCE ORDERING CHART

Power Dynamics Part #	Comparable Alcoswitch Part #
UTID-1	TT11DG-PC-1
UTID-2	TT11DG-RA-1
UTIE-1	TE11EG-PC-1
UTIE-2	TT11EG-RA-1
UT2N-1	TT21NG-PC-1
UT2N-2	TT21NG-RA-1
UT2P-1	TT21PG-PC-1
UT2P-2	TT21PG-RA-1

STANDARD (One Pole)





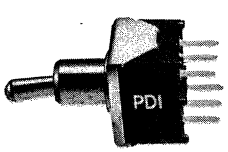
*Flats available on all bushings upon request

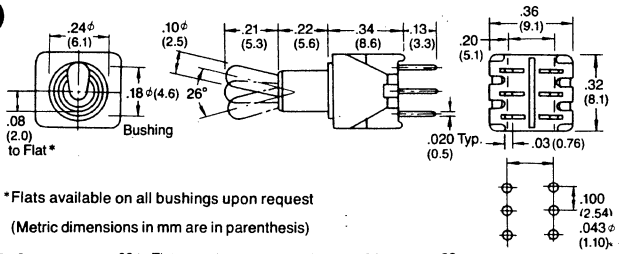
(Metric dimensions in mm are in parenthesis)

PDI MODEL	TYPE			
UT-1D-1	SPDT	On	None	On
UT-1E-1	SPDT	On	Off	On
UT-1F-1	SPDT	On	None	(On)
UT1G-1	SPDT	(On)	Off	(On)
UT1H-1	SPDT	On	Off	(On)

(On) Momentary

STANDARD (Two Poles)





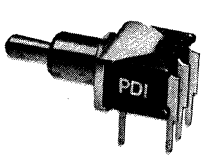
*Flats available on all bushings upon request

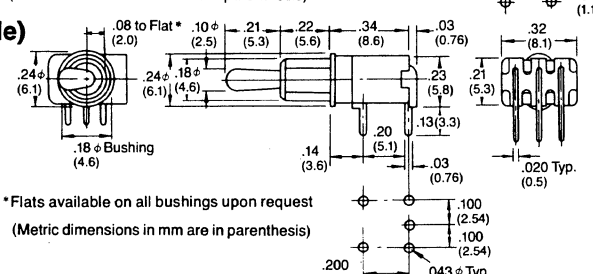
(Metric dimensions in mm are in parenthesis)

PDI MODEL	TYPE			
UT-2N-1	DPDT	On	None	On
UT-2P-1	DPDT	On	Off	On
UT-2R-1	DPDT	On	None	(On)
UT2S-1	DPDT	(On)	Off	(On)
UT2T-1	DPDT	On	Off	(On)

(On) = Momentary

RIGHT ANGLE (One Pole)





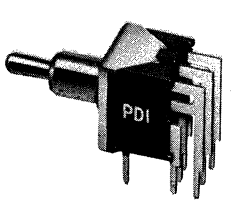
*Flats available on all bushings upon request

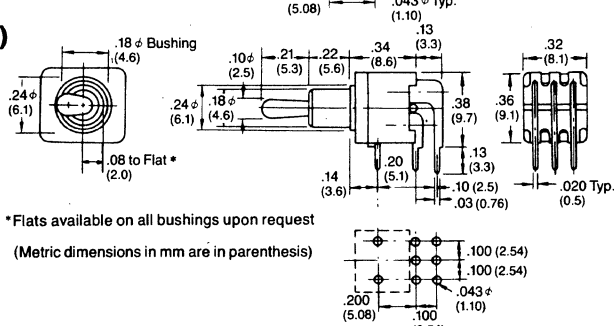
(Metric dimensions in mm are in parenthesis)

PDI MODEL	TYPE			
UT-1D-2	SPDT	On	None	On
UT-1E-2	SPDT	On	Off	On
UT-1F-2	SPDT	On	None	(On)
UT1G-2	SPDT	(On)	Off	(On)
UT1H-2	SPDT	On	Off	(On)

(On) = Momentary

RIGHT ANGLE (Two Poles)





*Flats available on all bushings upon request

(Metric dimensions in mm are in parenthesis)

PDI MODEL	TYPE			
UT-2N-2	DPDT	On	None	On
UT-2P-2	DPDT	On	Off	On
UT-2R-2	DPDT	On	None	(On)
UT2S-2	DPDT	(On)	Off	(On)
UT2T-2	DPDT	On	Off	(On)

(On) = Momentary

Ordering notes for all models:

- Add Suffix "E" to part number to indicate Silver Plating.
- Add Suffix "S" to part number to indicate Waterproof Sealing.
- Add Suffix "5" to part number to indicate Threaded Bushing.

Rotary Switches
• Molded
• RF Power
• Subminiature

Radio Switch has a complete line of rotary switches to meet a wide variety of applications requiring exceptional reliability and quality.

With over 40 years experience in design and manufacturing, Radio Switch has the capability of providing a broad selection of standard switches as well as supplying switches to customers stringent specifications. Our staff will work closely with your engineering personnel to develop, test, and implement the rotary switch that is custom-designed for your application.

Our RF and power switches range from 2,000 volts peak flashover at 20 amperes to 24,000 volts peak flashover at 100 amperes. In the sub-miniature size, coin silver current carrying components can carry 5 amperes with initial contact resistance of only .010 ohms max. where low current switching applications are critical. Our molded type switches have the capability of switching 20 positions per circuit and are ideal for test equipment and industrial control systems.

For high performance, quality, and fast delivery, specify Radio Switch.

RSC **RADIO SWITCH CORPORATION**

ROUTE 79 • MARLBORO, NEW JERSEY 07746 • 201•462-6100

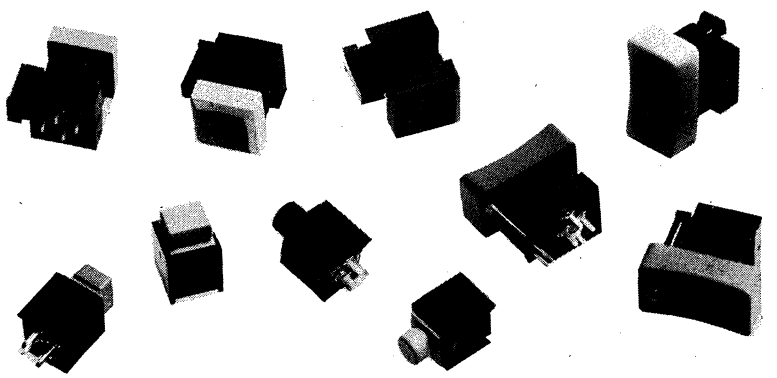
ROTARY SWITCHES FOR INDUSTRY

SEACOR

SEACOR INC.

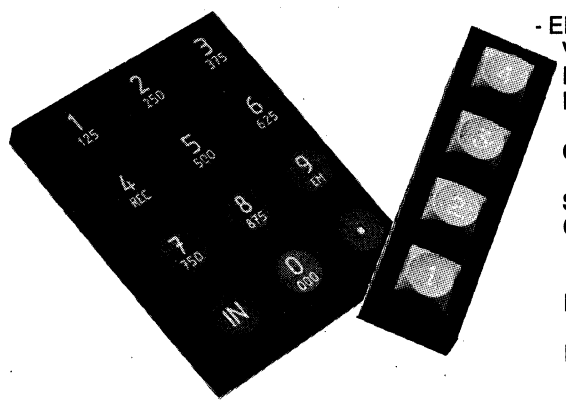
KEY SWITCHES

- Electromechanical control for a wide variety of applications.
- Body is made of Noryl SEI/ Buttons are of ABS plastic in various colors.
- Single pole
- Special <<click>> effect gives clear evidence that the contact has been made.
- Available with luminous led.
- Contacts are brass - silver plated.
- Springs are bronze - silver plated
- Electrical Specifications:
  Insulation Resistance: $>2.5 \times 10^4 M\Omega$
  Contact Resistance: $<25\ M\Omega$
  Operating Temperature: $-20°C$ to $+70°C$
  Bounce Time: <2 MS
  Operating Force: <4.3 oz. (1.2 N)
  Operating Travel: $.028 \pm .008$ ($.7 \pm .2$)
  Operating Life: $>5 \times 10^5$ Cycles



SEALED KEYPADS

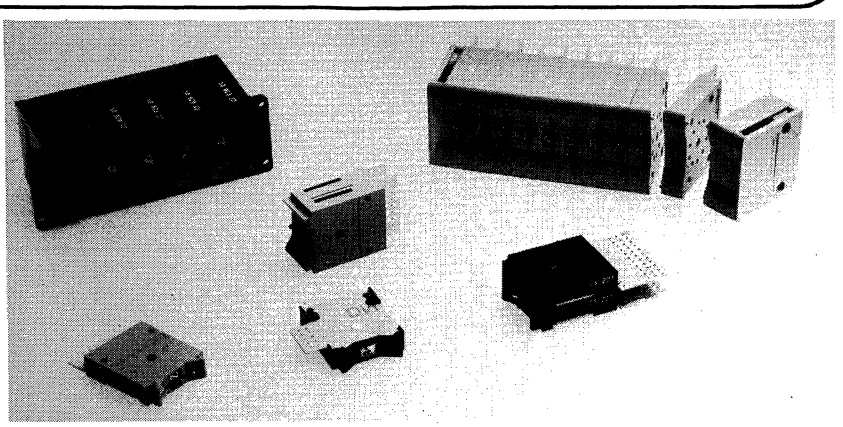
- Designed for applications in climatic and environmental conditions.
- 4, 12, 16, 20, Key configurations available.
- Available in luminous type.
- Protection and sealing are obtained by elastic sheet.
- Keycaps are mounted directly onto outer elastic sheet.
- Standard mounting uses metal plate and 3mm threaded studs.
- Available in flush or surface mounted
- Keycaps
  - ABS molded plastic in many different colors
  - Legends are hot stamped white or black
  - Metal caps also available upon request
- Gold crosspoint contacts
- Mechanical Specifications:
  Pretravel: .0394 to .0591 (1 to 1.5mm)
  Contact Travel: .02 (.5mm)
  Operating Force: 150-300 grams
- Electrical Specifications:
  Voltage: 50V AC or DC
  Max. Voltage: 100V AC
  Dielectric Strength: 1.5 KV minimum
  Current: 50 mA maximum on resistive load
  Switching: 2.5 VA maximum
  Contact Resistance: 60-150 milliohms at the connector terminals
  Insulation Resistance: 100 megohms min. at 200V
  Bouncing: <5 ms



MINIATURE THUMBWHEEL SWITCHES

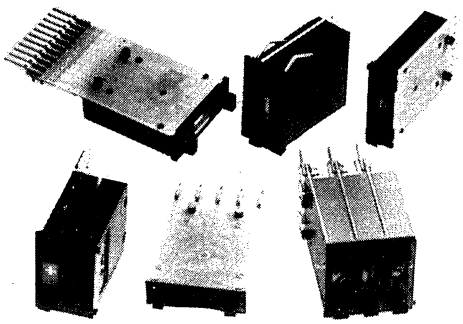
SEACOR SERIES CS 200, CS 600, CS 700, and CS 800

- Available in popular sizes to meet your present and potential requirements.
- Front and rear mounting options.
- Rugged construction/ minimum operational life is 10^6 operations.
- Illumination of thumbwell digits available.
- ABS plastic thumbwheel and case.
- Competitively priced and prompt delivery.
- Common Specifications:
  Switching Capacity: 1 to 50 mA
  Current Carrying Capacity: 50V
  Nom. Switched Operating Voltage: 120V
  Contact Resistance: <100 milliohms
  Insulation Resistance: $>10^5$M
  Dielectric Strength: >750 Volts



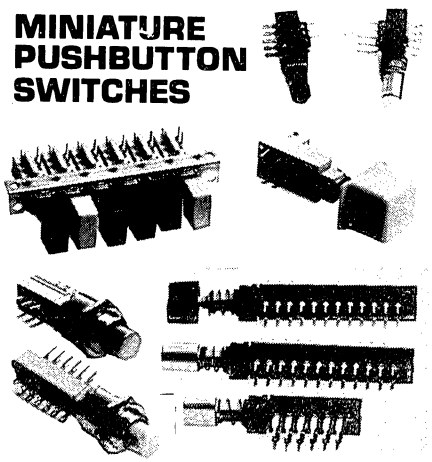
MINIATURE SWITCHES and KEYPADS

MINIATURE PUSHWHEEL SWITCHES

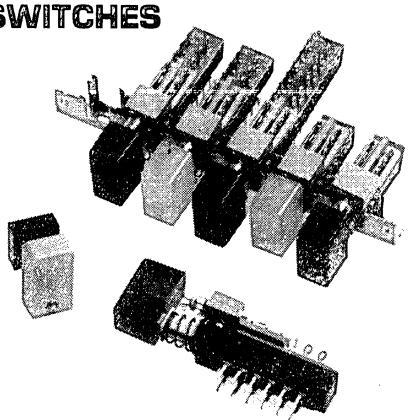


Seacor Series DP100 and DP200
- These switches allow undisturbed view of digits while operating.
- Snap together assembly-no hardware required.
- Economically priced for applications requiring minimum size.
- ABS plastic pushwheel and case.
- Rotation stops available on request.
- Illumination of pushwheel digits is available.
- Miniature and subminiature sizes available
- Common Specifications:
  - Switching Capacity: 1 to 50 mA
  - Current Carrying Capacity: 500 mA
  - Switched Operating Voltage: 50V
  - Nom. Switched Operating Voltage: 120V
  - Contact Resistance: 80 m or 100 m (depending on series selected)
  - Insulation Resistance: 10^5 M or 10^3 M (depending on series selected)

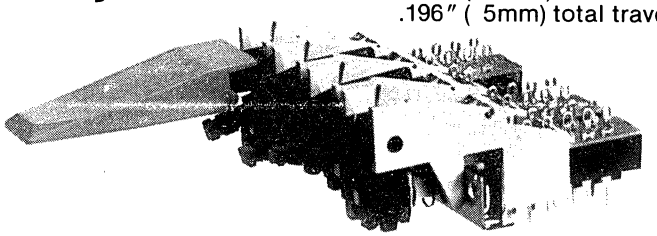
MINIATURE PUSHBUTTON SWITCHES



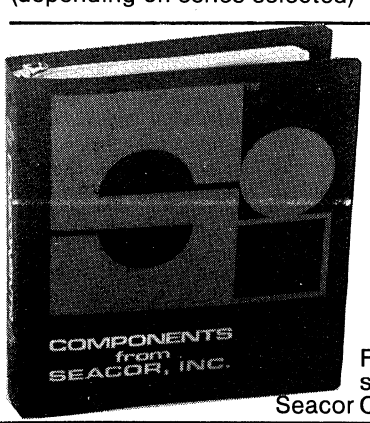
MINIATURE ILLUMINATED SWITCHES



MINIATURE PRESS (PIANOKEY) SWITCHES



- Versatile system of modules allows virtually any combination of switches required.
- Modules are dust-tight closed.
- Hardened silver plated contacts.
- Mounting brackets are made of tinned steel
- Up to 20 stations per assembly
- Up to 10 PDT circuits per key
- Functions (Mode)
  - Self Releasing
    - push to latch, push to release
    - push-pull, alternate action
  - Mutual Latching
    - interlatch, mutual releasing
    - push to latch, push different key in chain to release
  - Momentary
    - spring loaded non-latching
- Electrical Specifications:
  - Electrical Rating: 0.4A 125 VAC 50 Watts
  - Contact Resistance: < 5 Milliohms
  - Breakdown Voltage: > 2000 Volts RMS
  - Insulation Resistance: > 25,000 Megohms
- Machanical Specifications:
  - Life Test: Over 50,000 Cycles
  - Station Spacing (Pitch):
    - .394″ (10mm)
    - .492″ (12.5mm)
    - .590″ (15mm)
    - .689″ (17.5mm)
    - .787″ (20mm)
  - Stoke: .137″ (3.5mm) make and locking
    - .059″ (1.5mm) over travel
    - .196″ (5mm) total travel

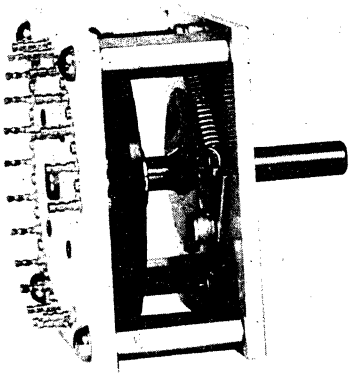


For detailed electrical and dimensional specifications call or write for the Seacor Catalog of Electronic Components.

SEACOR INC.™

123 Woodland Avenue
P.O. Box 541
Westwood, NJ 07675
(201) 666-5600
TLX 135354

Shallco ROTARY SWITCHES SERIES C, D, AND E



SPECIFICATIONS

GENERAL:

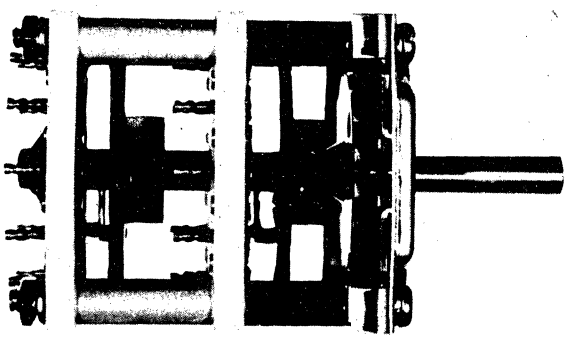
Meets or surpasses requirements of MIL-S-3786

ELECTRICAL:

Current carrying capacity—10 amps.
Current switching capacity—up to 2 amps.
Contact resistance—Initial—.005 ohms max.
Contact resistance—After Life—.010 ohms max.
Insulation resistance—50,000 megohms
Dielectric withstanding voltage—1500V rms
Dielectric withstanding voltage after life—1000V rms

MECHANICAL:

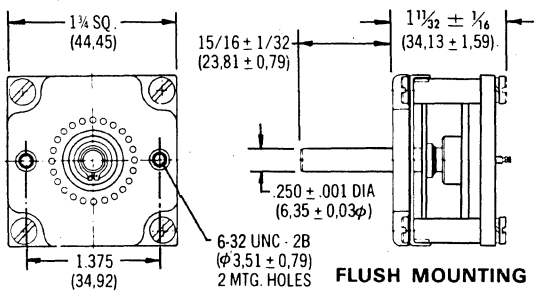
Rotational life—50,000 cycles* min.@.250 amps.@85° C
Stop torque—50 In. Lbs.
Type construction—Open frame
Stops—Factory set to desired position.
Optional features—⅜-32 UNEF-2A bushing mount with anti-rotation pin. Shaft and front panel "O" ring seals. Spring return feature.
Concentric shafts available
Progressive shorting available
*One cycle = one full cw plus one full ccw rotation.



FEATURES OF SHALLCO 1¾, 2¼, 2¾ SQUARE SERIES C, D, E SINGLE DECK SWITCH MULTI DECKS AVAILABLE

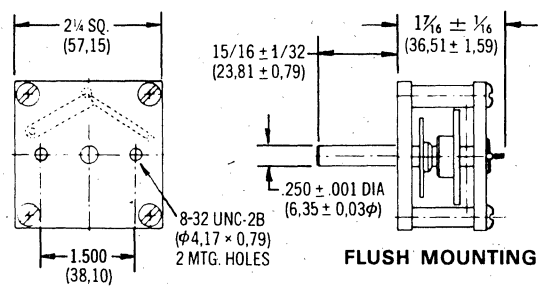
- Meets or surpasses requirements of MIL-S-3786
- Available in one pole 2-48 position through four pole 2-15 position. See ordering information
- High current carrying capacity
- Low contact resistance

SERIES C



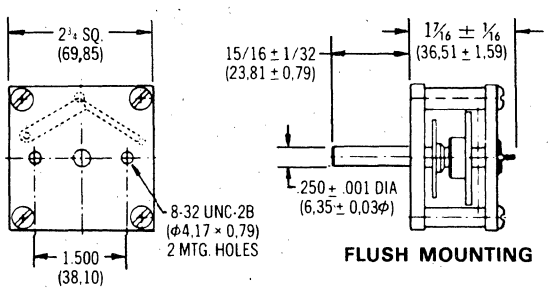
FOR ADDITIONAL DECKS ADD. 29/32 (23,02) PER DECK

SERIES D



FOR ADDITIONAL DECKS ADD 1 1/16 (26,99) PER DECK

SERIES E



FOR ADDITIONAL DECKS ADD 1 1/16 (26,99) PER DECK.

REQUEST CATALOG IO FOR COMPLETE INFORMATION

NUMBERS IN ( ) ARE METRIC EQUIVALENT (MILLIMETERS)

USE ORDER FORM

SHALLCO INC. / SMITHFIELD IND. PARK / P.O. BOX 1089 / SMITHFIELD, N.C. 27577 / (919) 934-3135

SHALLCO ORDERING INFORMATION

SHORTING				NON-SHORTING		
SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE	NUMBER OF POLES	SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE
111-CM	15°	24*	one	111-CB	30°	12**
112-CM	11¼°	32*		112-CB	22½°	16**
121-CM	15°	11	two	121-CB	30°	6
122-CM	11¼°	15		122-CB	22½°	8
131-CM	15°	5	three	131-CB	30°	3
132-CM	11¼°	7		132-CB	22½°	4
141-CM	15°	5	four	141-CB	30°	3
142-CM	11¼°	7		142-CB	22½°	4

*Maximum number of positions may be used with continuous rotation only.
**Normally supplied as continuous rotation; stops available on request.

SHORTING				NON-SHORTING		
SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE	NUMBER OF POLES	SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE
111-DM	15°	24*	one	111-DB	30°	12*
112-DM	11¼°	32		112-DB	22½°	16*
113-DM	7½°	48		113-DB	15°	24*
121-DM	15°	24*	two	121-DB	30°	12*
122-DM	11¼°	32		122-DB	22½°	16*
123-DM	7½°	23		123-DB	15°	12
141-DM	15°	11	four	141-DB	30°	6
142-DM	11¼°	15		142-DB	22½°	8
143-DM	7½°	11		143-DB	15°	6

*Normally supplied as continuous rotation; stops available on request.

SHORTING				NON-SHORTING		
SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE	NUMBER OF POLES	SERIES	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE
111-EM	15°	24*	one	111-EB	30°	12*
112-EM	11¼°	32		112-EB	22½°	16*
113-EM	7½°	48		113-EB	15°	24*
121-EM	15°	24*	two	121-EB	30°	12*
122-EM	11¼°	32		122-EB	22½°	16*
123-EM	7½°	48		123-EB	15°	24*
141-EM	15°	11	four	141-EB	30°	6
142-EM	11¼°	15		142-EB	22½°	8
143-EM	7½°	23		143-EB	15°	12
161-EM	15°	7	six	161-EB	30°	4
162-EM	11¼°	9		162-EB	22½°	5
163-EM	7½°	15		163-EB	15°	8
181-EM	15°	5	eight	181-EB	30°	3
182-EM	11¼°	7		182-EB	22½°	4
183-EM	7½°	11		183-EB	15°	6

*Normally supplied as continuous rotation; stops available on request.

(Order Form to order Series C, D, E)

Order by using a six-place "shorthand" description

Example: 211—EB—12

Rotary Selector Switch, two decks, 1 pole per deck, 30° of spacing between positions, E series, non-shorting, 12 positions.

2 1 1 - E B - 12

PLACE 1	PLACE 2	PLACE 3	PLACE 4	PLACE 5	PLACE 6
indicates number of decks:* 1 = One Deck 2 = Two Decks 3 = Three Decks, etc.	indicates number of poles per deck: 1 = One Pole 2 = Two Poles 3 = Three Poles 4 = Four Poles	indicates degrees of spacing between positions: Shorting 1 = 15° 2 = 11¼° 3 = 7½° Non-Shorting 1 = 30° 2 = 22½° 3 = 15°	indicates series of switch: C = C Series D = D Series E = E Series	indicates Shorting or Non-Shorting: M = Shorting (make before break) B = Non-Shorting (break before make)	indicates number of positions per pole: 2 = Two positions 3 = Three positions 4 = Four Positions, etc.

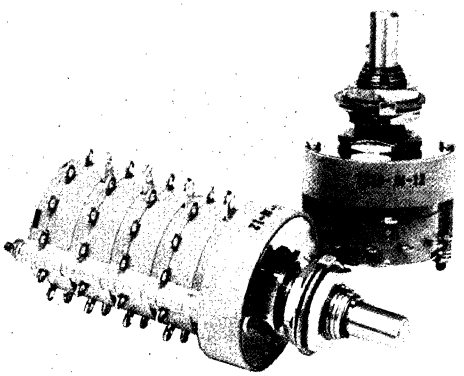
Request catalog 10 for more detailed information and additional switch types.

Shallco

SHALLCO, INC.
PRECISION ELECTRONIC COMPONENTS
SMITHFIELD INDUSTRIAL PARK • P.O. BOX 1089 • SMITHFIELD, N.C. 27577 • 919/934-3135

series **J**

ROTARY SELECTOR SWITCHES



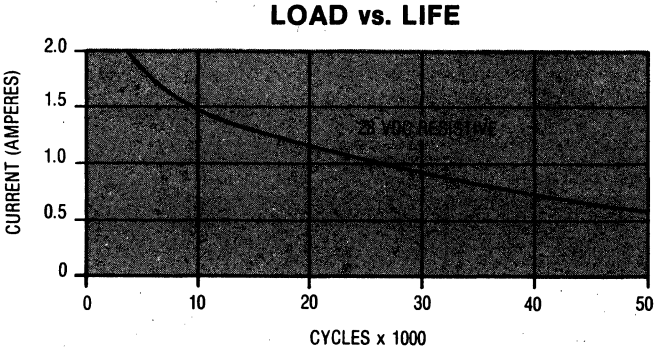
SPECIFICATIONS

GENERAL:
Designed to meet the requirements of MIL-S-3786/SR04

ELECTRICAL:
Current carrying capacity - 10 amperes
Current switching capacity - 1 ampere (28 VDC, Resistive)
Contact resistance - Initial - 5 milliohms maximum
Contact resistance - After Life - 20 milliohms maximum
Insulation resistance - 50,000 megohms
Voltage breakdown - 1000 VAC
Voltage breakdown - After Life - 500 VAC minimum

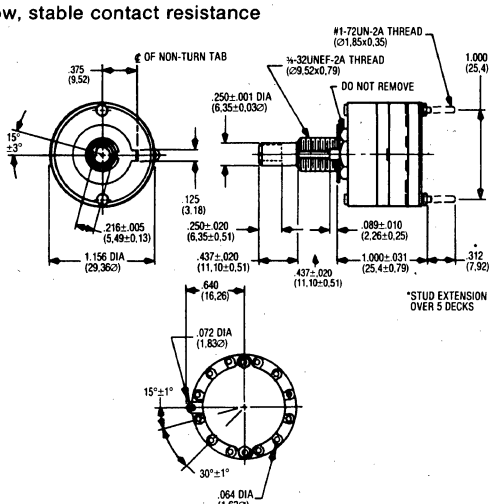
MECHANICAL:
Rotational life - 50,000 cycles
Stop torque - 15 pound-inches minimum
Construction - Enclosed
Stops - Factory set
Torque - 8 to 120 ounce-inches (dependent on decks, poles/deck)
Shaft flat - Opposite moving contact, see diagrams

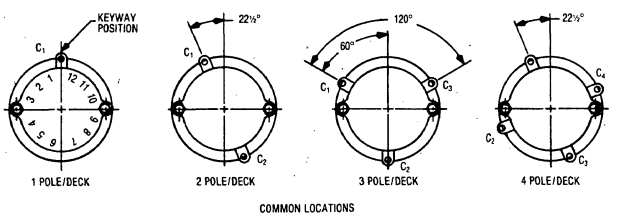
LOAD vs. LIFE



FEATURES OF SHALLCO ONE INCH SERIES J SINGLE OR MULTIDECK SWITCH

- Designed to meet requirements of MIL-S-3786
- Closed construction
- Smooth, positive detent
- Low, stable contact resistance





BACK-PANEL DEPTH

DECKS	INCHES	MM	DECKS	INCHES	MM
1	1.000	25.4	7	2.992	76
2	1.332	33.8	8	3.324	84.4
3	1.664	42.3	9	3.656	92.9
4	1.996	50.7	10	3.988	101.3
5	2.328	60.5	11	4.320	109.7
6	2.660	67.6	12	4.652	118.2

APPROXIMATE WEIGHT
Switch, 1 Deck/W Hardware ..... 50 grams
Additional Deck ..... 8 grams

MATERIALS AND FINISHES
Insulation - Diallyl Phthalate
Rotor/Stator Contacts - Silver Alloy
Shaft, Stampings, Hardware - Stainless Steel
Detent Spring - Tinned Music Wire
Terminals - Brass under Silver or Gold
Mounting Bushing - Brass, Zinc Plated - Chromate

NUMBERS IN ( ) ARE IN MILLIMETERS

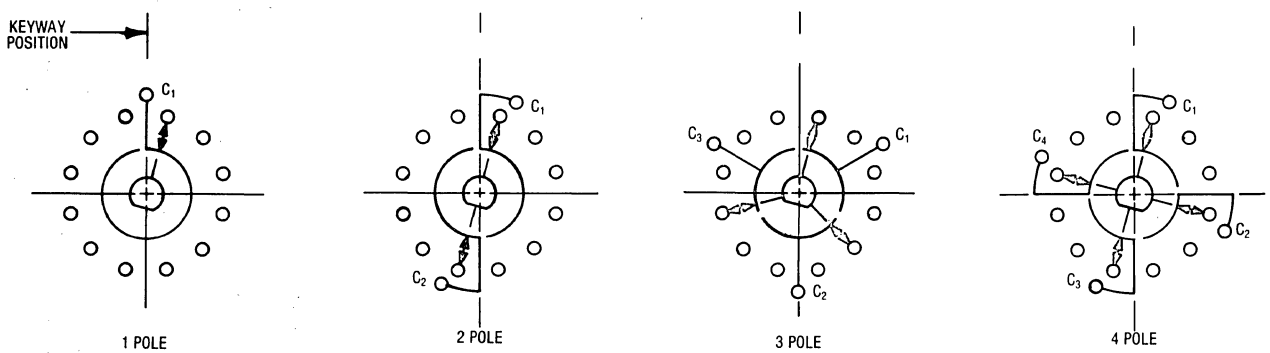
Shallco

SHALLCO, INC.
PRECISION ELECTRONIC COMPONENTS
SMITHFIELD INDUSTRIAL PARK • P.O. BOX 1089 • SMITHFIELD, N.C. 27577 • 919/934-3135

SHORTING				NON-SHORTING		
CODE	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE	NUMBER OF POLES	CODE	SPACING BETWEEN POSITIONS	MAXIMUM POSITIONS PER POLE
1130-JM	30°	12	ONE	1130-JB	30°	12
1230-JM		6	TWO	1230-JB		6
1330-JM		4	THREE	1330-JB		4
1430-JM		3	FOUR	1430-JB		3

SINGLE DECK SHOWN. FOR MULTI-DECK, INCREASE FIRST DIGIT OF ABOVE CODES.

CIRCUIT DIAGRAMS



(VIEWED FROM SHAFT END AND SHOWN IN POSITION 1, EXTREME CCW POS.)

ORDERING CODE

NO. DECKS — DETENT — B = BBM; M = MBB — OPTIONS

3 1 30 – J B – 12 [ ] SPECIFY

POLES/DECK — SERIES — POSITIONS

G = GOLD PLATED
C = CONTINUOUS ROTATION
M = CUSTOMER MARKING
S = SEALED SHAFT

ADDITIONAL PRODUCTS

Audio Attenuators and Attenuation Networks Request Catalog A82 for complete product listing and Engineering Data.

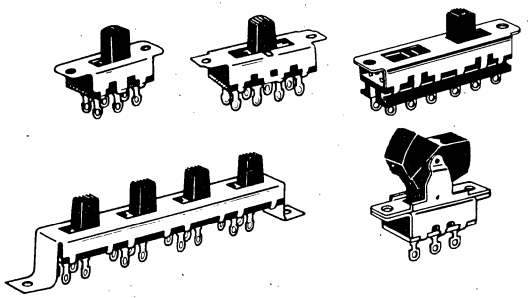
SWITCHCRAFT INC.

A Raytheon Company

Switches

5555 NORTH ELSTON AVENUE / CHICAGO, ILLINOIS 60630 / TEL: (312) 792-2700 / TWX: 910-221-5199

SLIDE SWITCHES

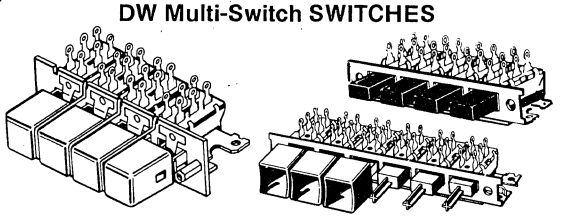


DW SLIDE SWITCHES

Instrument quality Switchcraft slide switches have low cost, precision "double-wipe" contacts with "U"-shaped bifurcated contacts rated at 0.5 A DC, 3 A AC, 125 V, non-inductive. Solder lugs have 5/64" dia. center holes and wrap-around notch. Many knob styles: crowned, rocker, flush. U.L. & C.S.A. listed types. Up to 4 poles of switching with locking or momentary action.

Series 46000E — General purpose slide switches
Series 47000E — Tandem switches
Series 51000E — Rocker switches
Series 58000 — Slide switches (6 amp)

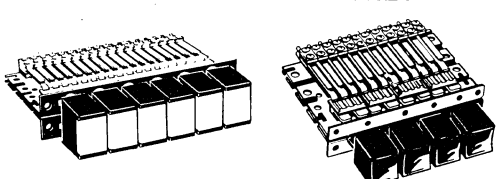
DW Multi-Switch SWITCHES



The DW (double-wipe) Multi-Switch switch is available up to 18 stations in a single row; or on special order, ganged assemblies with interaction between rows. Max. switching per station is 4-C (4PDT). Each station utilizes specially designed switching modules with U-shaped, high reliable bifurcated contactors rated at 3 amps, A.C.; 0.5 amp. D.C., 125 V, non-inductive load. DW Multi-Switch switches are available in 5 series: 65000, 66000, 67000, 70000, and 71000. All provide four standard functions: **Interlock**—actuating a pushbutton automatically restores to normal the pushbutton previously actuated. **Lock-Out**—prevents operation of more than one pushbutton at a time. This feature is included on all interlock switches. **Non-Lock**—each pushbutton has momentary action. **All-Lock**—all pushbuttons, except release, lock when depressed. All pushbuttons restored to normal by actuating (momentary) release pushbutton. **Push-Lock/Push-Release**—pushbuttons lock when depressed and release when again depressed. **All Series**—pushbuttons on ¾" centers. DW Multi-Switch switches are available in single row assemblies with interlock and all-lock functions from one to twelve stations; with non-lock and push-lock/push-release functions up to eighteen stations.

Series 65000—Non-illuminated, integral pushbutton.
Series 66000—Non-illuminated version of Series 67000.
Series 67000—Illuminated pushbuttons.
Series 70000, 71000—Non-illuminated, cross-rib plungers, accept up to 12 different styles of pushbuttons.

littel Multi-Switch SWITCHES



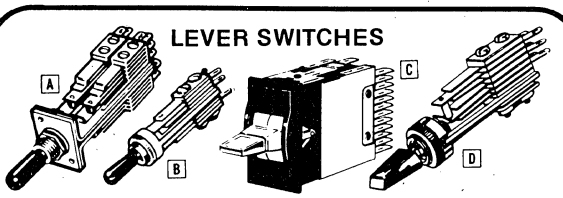
Series 35000—Non-illuminated.
Compact, rugged multiple-station switches feature up to 6PDT per station in .6 square inch space. Excellent selection of contacts for low or high current switching. Plungers accept nine different Switchcraft pushbuttons. Mechanical functions are: interlock, all-lock, non-lock and push-lock/push-release. One to 12 stations; many legends are possible.

Series 36000—Non-illuminated companion series to Series 37000. All other basic functions and features are same as Series 35000.

Series 37000—Single lamp illumination at each station. All other basic functions and features are same as Series 35000.

Series 38000—Twin lamp illumination using low power, low heat lamps. All other basic functions and features same as Series 35000.

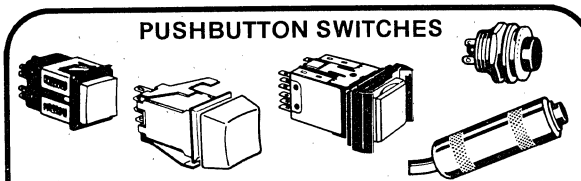
LEVER SWITCHES



Large variety of illuminated and non-illuminated switches are rugged and compact and are ideal for all control panel applications. Non-illuminated types have up to 4PDT in locking or momentary actions. Ratings: up to 3 A, 300 W max., AC non-inductive load. Illuminated switches have up to 8 A, 125 V AC contacts with up to 8PDT switching. Lever lights a different color for each position. Terminals can be solder lug or quick-connect.

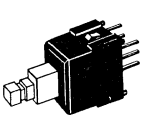
A **Series 16000**—Telephone-type lever switches
B **Series 3000, 13000**—Locking and non-locking multi-position switches
C **Series 84000**—Illuminated lever switches
D **Series 28000**—Compact, low-cost lever type switch

PUSHBUTTON SWITCHES



Design versatility creates switches for a spectrum of equipment and system applications. Features include illuminated or non-illuminated, tactile pushbuttons, legends (standard and custom), ultra-compact types, dry circuit to high current, multiple pole contacts, momentary or locking actions, colored pushbuttons, single-hole panel/chassis mount or pendant (cord) mount, solder or PC terminals. Lighted switches can be specified with incandescent or LED lighting.

IBS SWITCHES



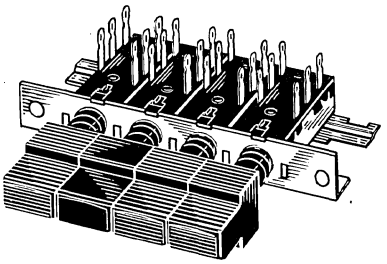
Series 98000 IBS miniaturized pushbutton switches have special versatility, low cost, low contact resistance (tested to 30 milliohms). IBS Multi-Switch key switches offer 10, 15, 20 mm centers; 1-12 stations; interlock, non-lock, push-lock/push-release. IBS switches can be used anywhere — business equipment, computers, test equipment, medical electronics, telecommunications, digital transmission equipment, and other modern applications. Standard mounting dimensions, simple panel design; close stacking; fast assembly; automatic wave soldering. Precious metal contacts — .125 A resistive @ 125 V AC; up to 2-C or 2-D circuitry.

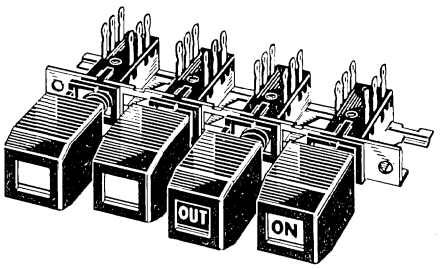
Switches

SWITCHCRAFT INC.
A Raytheon Company
5555 NORTH ELSTON AVENUE / CHICAGO, ILLINOIS 60630 / TEL: (312) 792-2700 / TWX: 910-221-5199

Tini DW Multi-Switch® SWITCHES

NEW FROM SWITCHCRAFT . . .





The first American made, subminiature, non-illuminated, multiple-station switches on 10 mm and 15 mm centers. Produced with completely proven design concept, Tini DW Multi-Switch switches have long life and extremely attractive mechanical and electrical characteristics . . . and Tini DW Multi-Switch switches are your only domestically produced switch of this type.

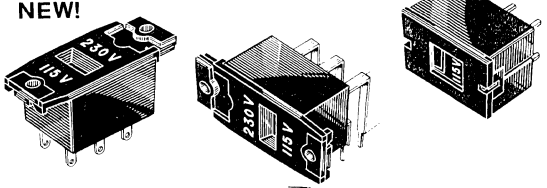
Dependable, low cost Series 90000 (10 mm centers) and 92000 (15 mm centers) switches offer a full range of versatile mechanical functions and the exclusive "Snap-Slide" switching technique. Applications are analog and digital computers, analyzers, transmitters and receivers, intercoms, numerical control, ground support systems, scientific instruments, home entertainment systems and appliances, and a multitude of other critical control panel switching tasks where size, low cost and rugged reliability are prime engineering requisites.

And Tini DW Multi-Switch switches offer the bonus of up to 18 stations in a single row, each having up to 8-C (8PDT) switching. Mechanical functions include interlock, non-lock, all-lock and push-lock/push-release.

"Flip-Flop" Pushbuttons, Series TDW-F have unique internal "flip-flop" mechanism which permits button face to change colors without electrical energy, without lamps and without wiring. When pushbutton is operated, highly reflective panels inside housing change position and use ambient light to give a bright illuminated effect. ("Flip-Flop" pushbuttons designed for use on Series 92000 Tini DW Multi-Switch").

EUROPEAN LINE VOLTAGE SELECTOR SWITCHES

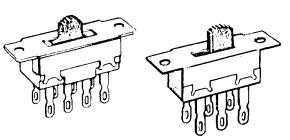
NEW!



Durable slide switches provide quick and easy programming/selection of 115 V or 230 V primary power in electrical/electronic equipment for international marketplace. UL, CSA and VDE (Verband Deutscher Elektrotechniker) approved. Mounting are flange or PC (straight or right angle), DPDT, locking. Ratings: UL & CSA: 2 A, 250 V AC & 4 A, 125 V AC. VDE: 2 A, 250 V AC. Switches also designed to comply with CEE and IEC requirements. Legends: 115 V-230 V.

"Tini-Slide" SWITCHES

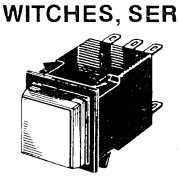
ANOTHER Switchcraft INNOVATION . . .



Miniature "**Tini-Slide**" switches are precision locking switches with unique lift/wipe/slide action and silver contacts. Ratings: 0.5 A, 125 V AC or DC, non-inductive. 2- and 3-position types. U.L. listed. Solder lugs or PC terminals. Crowned knobs.

"Box Switch" SWITCHES, SERIES BXL

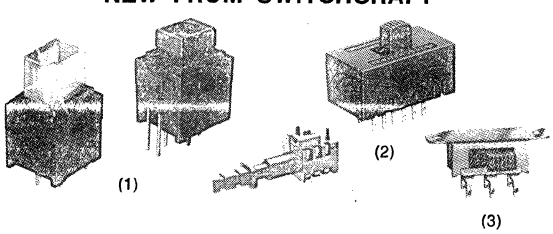
NEW, LOW COST!



NEW miniature momentary or locking pushbutton switches offer lighted and unlighted options in minimum panel space. Molded black plastic housing protects against dust and dirt; prevents bending/disfiguring contacts caused by excessive handling. Attractive bezel frames pushbutton and acts as built-in escutcheon. Can be mounted in rows or matrices; completely compatible in front-of-panel appearance with Switchcraft Series BXR "Box Switch" switches.

Integral slide contacts are silver plated copper alloy, rated at 0.25 A, resistive, 125 V AC. Choice of terminals are solder lug/quick connect (AMP Faston series 110) or P.C. terminals. Switches accept standard incandescent T-1 ¾ wedge base lamps. Relamp from front of panel. Pushbuttons must be ordered separately and customer-installed.

NEW FROM SWITCHCRAFT



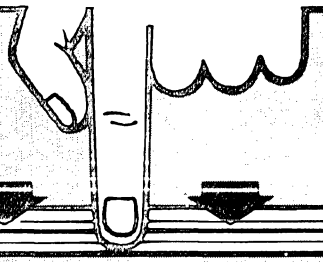
1. P70000 Series lighted/unlighted miniature key switches offer variety of features; short stroke switching action; long life; audible "click" positive tactile feel for operation awareness.
2. Space-saving Series C63000 miniature slide switches offer 4-pole/2-position switching for close PC mounting on .100 x .200-inch centers.
3. Series 62000 miniaturized right angle slide switches; 2C (DPDT) locking action; knob actuator on the side, offer low profile, PC board space savings.

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

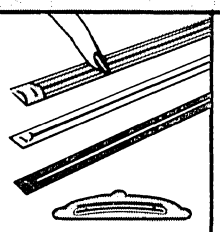
Tapeswitch

PRESS-AT-ANY-POINT

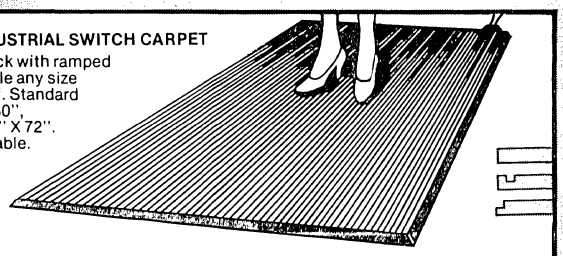


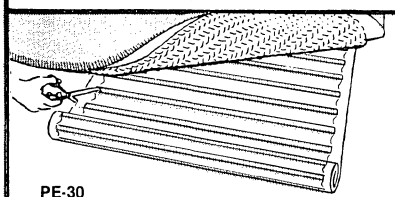
SENSING SWITCHES

RIBBON SWITCHES
Factory sealed units with 18 inch connecting leads at one end. Sensitivity: 8, 12, or 40 ounce finger pressure. Standard lengths: 1, 2, 5, 8, 10, 12, 15, 18, 20 ft. Double leads on order. See text at bottom.
Now available with self adhesive.

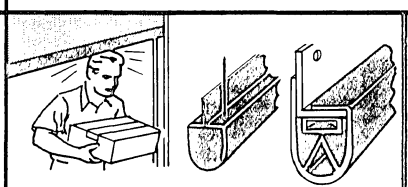


CKP HEAVY DUTY INDUSTRIAL SWITCH CARPET
Both styles 1/2 inch thick with ramped edging. Sealed. Available any size or shape. Weatherproof. Standard sizes: 24" X 36", 30" X 30", 30" X 48", 36" X 48", 36" X 72". Optional features available.
Ideal for Robots.



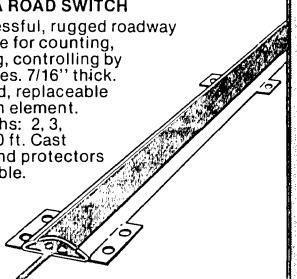


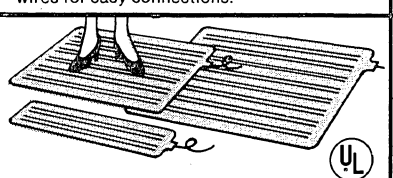
PE-30
UNDER CARPET SWITCHING RUNNER
30 inches wide X 3/32 inches thick 5ft., 25ft., 50ft. roll. Can be cut to any length from roll. For indoor use under carpeting. Excellent under plywood or tile. Parallel Tapeswitches between clear sheeting. Tinned wires for easy connections.



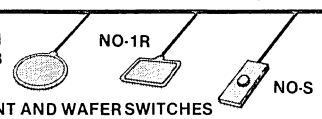
TAPESWITCH
CONTROFLEX® SAFETY EDGES
Serve as cushioned sensing switches for the leading edges of doors, gate arms, machinery, etc., to stop or reverse the action. Numerous styles available. Write or call for details.

RBMA ROAD SWITCH
Successful, rugged roadway treadle for counting, timing, controlling by vehicles. 7/16" thick. Sealed, replaceable switch element. Lengths: 2, 3, 5, 8, 10 ft. Cast iron end protectors available.

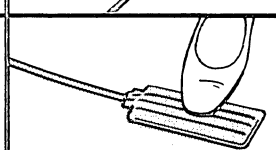




CVP SWITCHING MATS
CVP style mats are durable flexible area switches for use exposed or under rubber mat or carpeting. UL listed for use in alarms. 3/32" thick. Available 6" X 23", 17" X 23", 23" X 35".

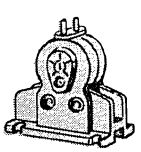


POINT AND WAFER SWITCHES
NO-1 and **NO-1R**—Rugged compact wafer switch. Normally Open. For under valuable objects or general purpose detection. 2 lb. nom. sensitivity.
NC-3—Normally Closed detector switch. Opens when weight is lifted off. 2 lb. nom. sensitivity.
NO-S—1 ounce sensitivity wiping action. Super sensitive.

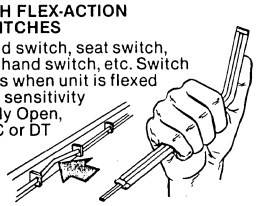


111 CONTROFLEX® FOOTSWITCH
Rugged, low-profile sealed vinyl footswitch. Rated at 100 watts. Employs Controflex® in flat pad. Non tiring. Stand or jump on it. 2″ x 5″ x ⅜″ 6 ft. lead wire. SPST N.O.

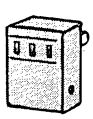
SENSITIVE AIRWAVE SWITCH MODEL AW
High quality diaphragm switch, adjustable sensitivity. Operates from tubing squeeze, air motion, light vacuum, breath pressure, etc. Silver contacts. Many adjustment features.



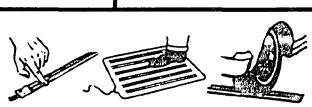
TAPESWITCH FLEX-ACTION RIBBON SWITCHES
Ideal for wand switch, seat switch, limit switch, hand switch, etc. Switch action occurs when unit is flexed 10°. Nominal sensitivity 4 oz. Normally Open, standard. NC or DT available.



TAPESWITCH RELAY R-1
FOR AC CONTROL WITH ANY TAPESWITCH. This plug-in unit has AC outlet sockets giving Normally ON or Normally OFF 117 Volts AC at 5 Amperes. Built-in low voltage transformer. Simultaneous action.



Tapeswitch products are proven in all industries. Patented construction withstands tons of force yet can close on light finger pressure. TAPESWITCHES are unexcelled for—*safety...automation...antiburglar systems...counting...timing...door control...light switching...machine control...material handling...seat switching...computer and console switching*...plus many other applications. TAPESWITCH RIBBON SWITCHES can be bought in the size and length needed.



HAND . . . . . FOOT . . . . . VEHICLE

Features: Inherently sealed. Self bottoming. **Press-at-any-point operation** eliminates linkages. All styles except flex-action switches can be coiled without shorting. Millions of impacts at one point.
Rating: All Tapeswitches are rated at more than 1 ampere, 117 VAC. However, for floow switching low voltage is recommended.
TAPESWITCHES are designed in accord with the best principles of switch and cable design, with jacketing and insulation meeting the requirements of MIL-C-9154 and MIL-I-631C respectively.
Unique Fail-Safe circuitry is feasible with all Tapeswitches.

Call or write for complete information:

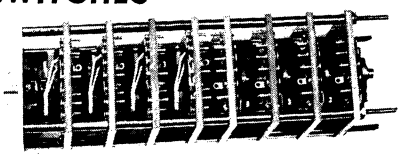
TAPESWITCH CORPORATION OF AMERICA
100 SCHMITT BOULEVARD, FARMINGDALE, NEW YORK 11735
(516) 694-6312
Telex: 144611

Tech labs SINCE 1935

SWITCHES AND ATTENUATORS

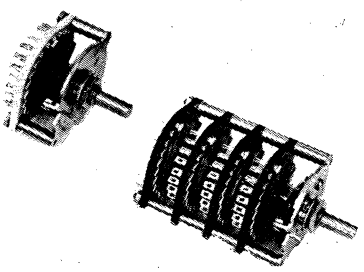
TECH LABORATORIES, INC.
DEPT. EM
BERGEN AND EDSALL BOULEVARDS
PALISADES PARK, N.J. 07650
TEL: (201) 944-2221

SQUARE ROTARY SWITCHES



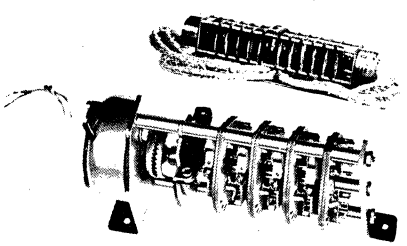
- 13 models available
- 1 5/16" sq. to 8" sq. x 15 decks (max.)
- 1 to 12 poles
- Up to 150 positions/pole
- Fixed stops or continuous rotation
- 3 amps at 120 VAC to 15 amps at 120 VAC
- Precious metal contacts
- Adjustable stops available

TYPE 2 ROTARY SWITCH



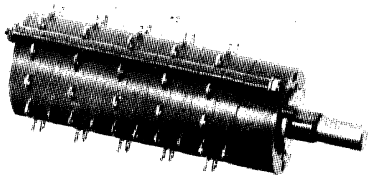
- Two insulation materials available
- 1 to 4 poles/deck
- Up to 24 positions/pole
- Adjustable stops
- 5 amps, 120 VAC max.
- Precious metal contacts

REMOTELY CONTROLLED ROTARY SWITCHES

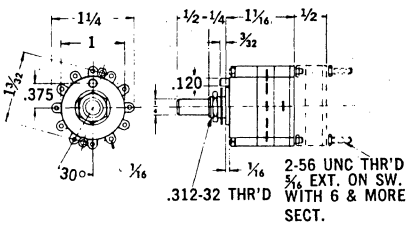


- All Tech Lab Switches can be supplied as stepping switches or continuous motor driven
- Solenoid drives
- Motor and Geneva drives
- Enercon AC incremental motor drive
- Available with interrupters or homing decks
- Completely pre-wired ready to install
- Hermetic sealing available
- May be remotely controlled by: Master-slave arrangement; Computer or other; External pulse
- Either AC or DC operation

TYPE 3 ROTARY SWITCH

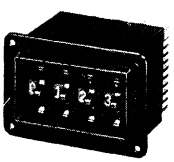


DIMENSIONS



- Enclosed molding in diallyl phthalate
- Molded in terminals
- 1 or 2 poles/deck
- Up to 12 positions/pole
- 1¼" OD up to 8 decks (max.)
- Adjustable stops
- 12 amps, 28 VDC
- Precious metal contacts
- Mixed decks of shorting and non-shorting
- Mixed shorting and non-shorting contacts on each deck
- Choice of either 3/8-32 or 5/16-32 mounting bushing
- External adjustable stops
- Offset wipers

THUMBWHEEL SWITCHES

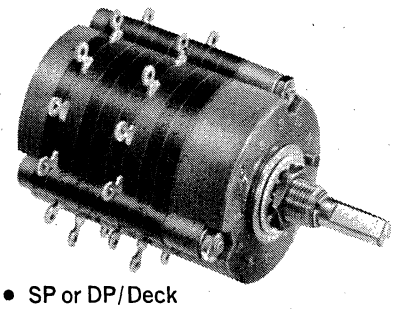


- Compact modular construction
- Positive detent, 8, 10, 11, 12 pos.
- Simple installation
- Two models available
- Wide range of codes
- Various terminations
- Illuminated
- Adjustable stops
- Decade transfer drive
- KV voltage dividers
- Precision Res. Dec.
- Capacitance decades
- Various colors

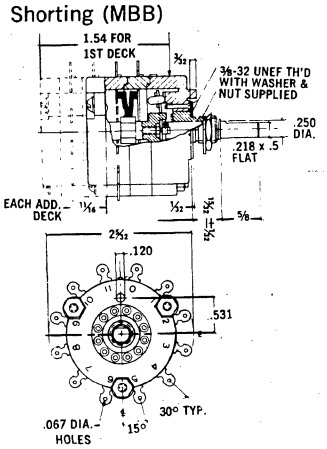
SPECIALS

Tech Labs can customize your Switch and Attenuator requirements, completely pre-wire your switches ready for installation. We can also undertake prototype design and manufacturing. Contact our factory for quotations.

ROTARY INSTRUMENT SWITCH SERIES 2000



- SP or DP/Deck
- Extremely low contact resistance — <1 milliohm
- Extremely high insulation resistance — more than one million megohms
- Totally enclosed -- dust tight
- Long life — > one million
- 12 position/1-6 pole/deck max.
- Silver alloy contacts
- External adjustable stops
- Shorting (MBB)



SPECIAL DESIGN VARIATIONS

SIX AND ELEVEN POSITION DETENTS
The six position detent is 60° throw, skipping every other contact. The eleven position detent is 30° throw with the eleventh position omitted so that the detent goes 60° from position ten to position zero.

OFFSET WIPERS
30° and 180° offset wipers are available for use in special circuits.

CAPACITANCE
Less than 1 micromicrofarad between contacts or to ground.

CURRENT CAPACITY
5 amps maximum continuous duty.

THERMAL EMF
Extremely low. Silver contacts & brushes.

VOLTAGE BREAKDOWN
Withstands 1500V RMS between contacts and to ground.

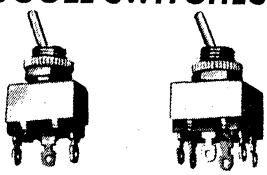
LOSSES
Low electrical losses at frequencies up to several megacycles.

Tech labs
SINCE 1935

SWITCHES AND ATTENUATORS

TECH LABORATORIES, INC.
DEPT. EM
BERGEN AND EDSALL BOULEVARDS
PALISADES PARK, N.J. 07650
TEL: (201) 944-2221

TOGGLE SWITCHES



Tech Lab switches are available in many **combinations** of bushings, terminals, handles, housings and electrical styles.

OPERATING CHARACTERISTICS

- **Insulation Resistance**
  Greater than 100,000 megohms at 100 VDC and 70°F
- **Dielectric Strength**
  At sea level 1,000V rms at 60 cps for 1 min.
- **Contact Resistance**
  Initial — less than .010 ohms
- **Contact Rating**

DC Load Inductive	AC Load Inductive
28V	**125V**
5 amp	5 amp

- **Temperature Range**
  −55°C to 85°C
- **Vibration Endurance**
  10 to 2,000 cps per MIL-R-25018
- **Shock Endurance**
  75G
- **Contact Chatter**
  10 microseconds or less MIL-R-5757
- **Corrosion Resistance**
  of complete assembly 50 hrs per QQ-M-151
- **Mechanical Endurance**
  100,000 cycles switching 10 amp. 50 VDC resistive load

MATERIAL SPEC

- **Base**
  Rogers RX-600
  Phenolic Glass Fiber
- **Housing and Mounting Bushing**
- **Brass**
- **Contacts**
  Fine silver-gold plated

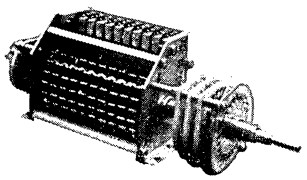
DIMENSIONS

- SP ¼" x ½" x 5/16"
- DP ½" x ½" x 5/16"
- ¼-40 TH'D Bushing
  ¼ or ⅜ long with Keyway
- Various type actuator levers
- Solder or PC Terminals

APPLICABLE MIL SPEC

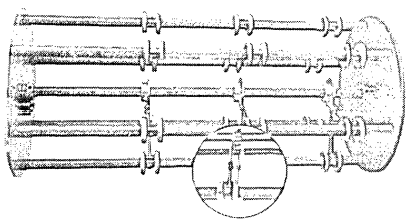
MIL-S-3950 MS-75028 MS-75029

PROGRAMMING SWITCH



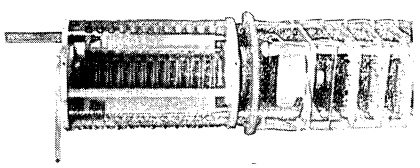
- Adjustable programming for process control, testing, sequencing, scanning, etc.
- SP or DP switches/section
- Up to 25 amp. contact rating
- Up to 48 pos./section/switch
- Remote control
- Computer interface opto-isolated

HIGH VOLTAGE SWITCHES



- Up to 100 KV (low power)
- Corona shields

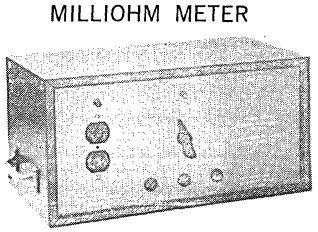
SLIP RING COMMUTATORS



- Integrated with remote controlled stepping switch
- Lift off brushes
- Multiplexing for temp. and strain gauge read out of rotating machinery

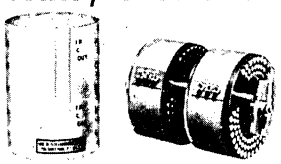
INSTRUMENTS

DC-AC INVERTERS
PREC. DECADE RESISTORS
KV-VOLTAGE DIVIDERS
MILLIOHM METER



ATTENUATORS

ROTARY/VARIABLE



- Five basic models — 1 7/16" to 3" dia.
- All circuit configurations
- Wide range of impedance
- Available with detents, tapers and cueing
- Aluminum anodized can
- Precious metal contacts
- Up to 45 steps
- Audio, video and RF

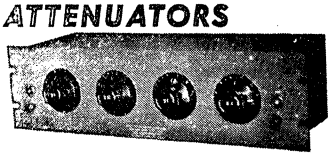
FIXED ATTENUATORS

- Two basic models
- Standard circuits "T" and Bridged "H" — others available
- Octal plug-in base available
- Up to 80 db loss
- Many impedance available

VERTICAL/VARIABLE

- Two basic models — 1" and 1½" wide
- Many circuit configurations available
- Wide range of impedance
- Available with detents, tapers and cueing
- Black anodized escutcheon plate
- Precious metal contacts
- Up to 30 steps

PRECISION ATTENUATORS



TYPE 11T AND 11H PRECISION ATTENUATORS — DC to 10 MHz*

- Circuit: "T" or Balanced "H"
- Impedance: 50 to 600 ohms, as specified
- Resistor Accuracy: ±0.1% or better
- Accuracy: ±0.1 db to 200 KHz (overall) ±0.6 db to 2 MHz
  Lower values of loss, essentially flat to 10 MHz

Type No.	Circuit	db Range	db/ Step	Dimensions
11-T	"T"	111	0.1	5¼"x19"x5"
11-H	Bal. "H"	111	0.1	5¼"x19"x10"

* On Low Impedance Units, Lower Losses Usable to 100 MHz.

TYPE 850T AND 850H FOR THE AUDIO RANGE

- Circuit: "T" or Balanced "H"
- Impedance: 600/600 ohms unless specified — Other values to order
- Range: 2 dial unit gives 93 db in 0.1 db steps: 3 dial unit gives 111 db in 0.1 db steps
- Terminals: Telephone type jacks for input and output — Solder terminals provided on rear for permanent connections: Insertion of plugs into jacks lifts rear connections
- Accuracy: Resistors adjusted to ±0.1% excepting low values of loss are ±.25%

UNIMAX: BETTER SWITCHING SOLUTIONS

Lighted Pushbutton Switches

status symbols®

In a field full of appearance quality/performance switching variables, Unimax switches are the ones that show you care about quality, performance and price.

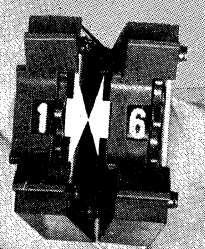
- *Single Lamp* —Round, square or rectangular, lighted and unlighted, momentary or alternate switching. 1-4 poles. Flat, concave and mushroom caps.
- *Four Lamp* — Multi-switch configurations. Approved to MIL-S-22885/9-12. Also meets high-shock requirements of MIL-S-910C.
- *Oil-Tight* — Key-operated, Interlock and Multi-position models also available.

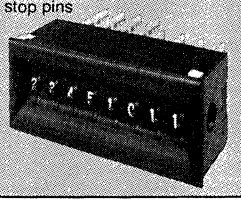
Ask for Catalog TH

they SNAP together!

"No Hardware" Digital Thumbwheel Switches

- No assembly hardware required
- Large selection of output codes on standard models
- Built-in logic standard on "Smart Switches"
- Either Snap-in front, or rear hard mount
- Matte finish standard
- Only 5 parts per switch
- Standard .315" (8mm) width
- Removable stop pins

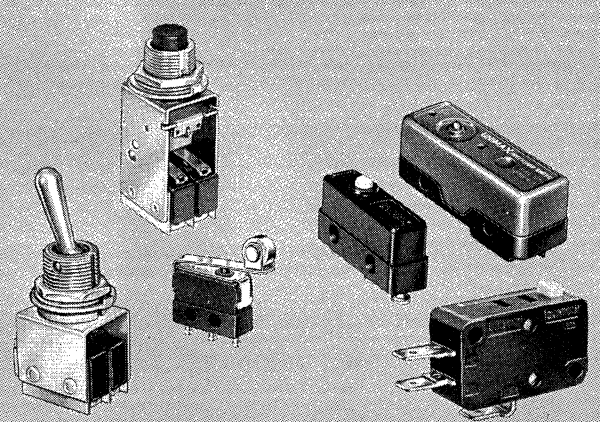




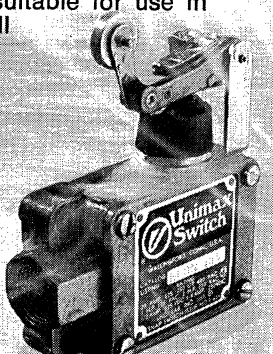
Ask for catalog 80.

The industry's widest selection of precision, general purpose, miniature and sub-miniature snap-action switches, as well as toggle and push-button switch assemblies. Ratings from low-level to 25A. All actuator styles available. Ask for catalog 60.

Snap-Action Switches



A full range of snap-acting switches enclosed in rugged die cast metal housings for protection against mechanical damage and, depending on the method of sealing, against destructive environmental conditions, Series KS (compact) is available with either through bolt or flange mounting. Series KL (heavy duty) is horsepower rated. Series KWL (splash proof) and KXL (explosion proof) are suitable for use in severe environments. All types are available with a variety of actuators. Ask for Catalog 30.

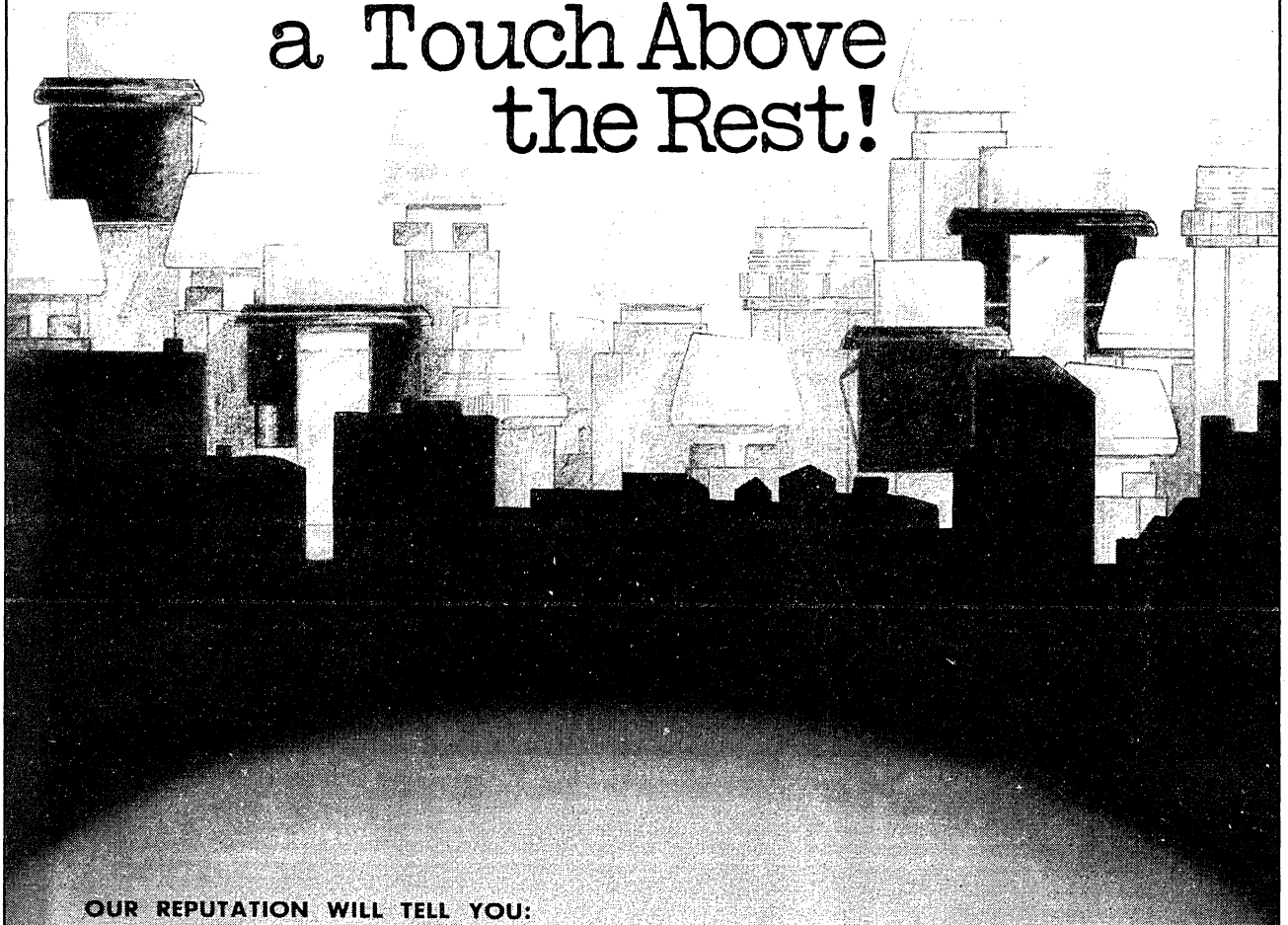


Metal Case Limit Switches

Unimax Switch®

A Subsidiary of The Unimax Corporation, Wallingford, CT. 06492 • (203) 269-8701
or your local distributor

In a World of Touch'n Go switch to VEETRONIX & find out why we think we're a Touch Above the Rest!



OUR REPUTATION WILL TELL YOU:
With a decade of experience in designing and building switches our objective is to produce a reliable switch that meets your specifications, your time table and at a competitive price. With an in-house tool and mold shop we can respond to your needs quickly. We also furnish several OEM's with special items produced on proprietary tooling.

OUR SWITCH DESIGN WILL TELL YOU:
We design panel switches and key board switches, long and short series with bi-level, alternate actions and switching forms. Both are hermetically sealed reed switches with optional illumination. The key board switches are for PCB mounting with several options. We also design and manufacture a variety of switch caps, space-bar and supporting mechanisms.

Contact us today
and find out for yourself why we think we're a
TOUCH ABOVE THE REST!

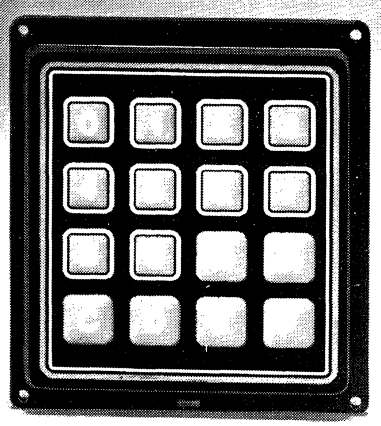
THE KEY TO QUALITY

VEETRONIX™

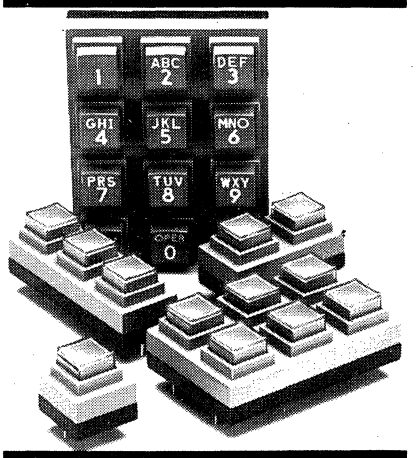
VEETRONIX, INC.
P. O. Box 480 • Lexington, Nebraska 68850
308-324-4600

GRAYHILL KEYBOARDS: DIFFERENT STROKES FOR DIFFERENT FOLKS

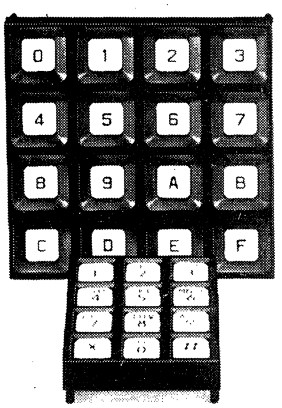
SERIES 88 A short stroke *sealed* keyboard with excellent audible and tactile feedback. Colorful standard or custom-made graphics integrates this keyboard into your front panel. Coded outputs and low bounce characteristics easily mate with logic circuitry.



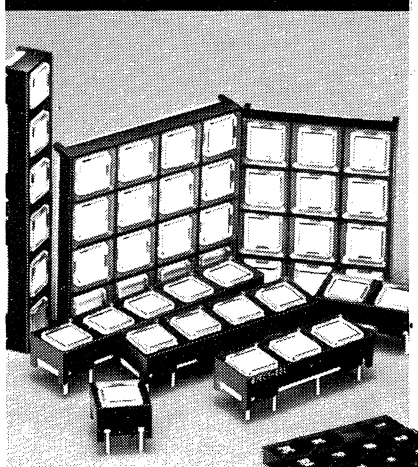
SERIES 82 Long stroke high profile, wiping contacts, 1, 2, 3 and 6 button modules can be arranged for your specific needs. SPST to 4PST circuitry under each button; also available with coded outputs.



SERIES 83-84-86 Short stroke standard 3x4 and 4x4 keyboard configurations. Choice of ½ inch or ¾ inch button centers and post or flange mounting. Standard coded outputs—easily interfaces with logic circuitry. Excellent audible and tactile feedback.



SYSTEM 87 Short stroke low profile, snap dome contact system provides tactile and audible feedback. Modular units—1 thru 6 buttons and 3x4 and 4x4 pads can provide any conceivable button arrangement. Clear caps snap off for legending.



Your product is distinctive, and thus your keyboard needs are also likely to be unique. That's why Grayhill offers you four different keyboard families, with a host of options in each. We'll help you arrive at the keyboard solution that's most practical, attractive, and cost effective. Two of our four families—Series 83-84-86 and Series 88—are built around the popular 3 x 4 and 4 x 4 keyboard configuration; the other two—Series 82 and System 87—are modular, allowing you to create any unique keyboard arrangements.

Other features and options include:

- up to 3,000,000 operations per button
- standard or special coded outputs
- sealed or unsealed
- high or low profile
- short stroke or long stroke—dome or wiping contacts
- excellent audible and tactile feedback in dome contacts
- post, flange or PC mount
- ½", 11/16" or ¾" button centers
- wide choice of legending modes
- color choices

For detailed information on Grayhill Keyboards, consult EEM, ask your local distributor, send for a copy of The Grayhill Keyboard Catalog or call us with your questions at (312) 354-1040.

Grayhill INC
the Difference Between Excellent and Adequate

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Keyboards and Keypads provide the physical interface between humankind and a wide variety of machines which make our lives more pleasant, more productive and/or more frustrating. As in most electromechanical products, the designer engineer has several alternatives when it comes to selecting keyboards and keypads. Four primary considerations apply: 1. The Environment; 2. Operating Life; 3. The Nature of the Equipment; and, 4. Equipment Cost. Each of these factors impacts each of the others.

The Product Selection Guide which appears below can provide the design engineer with a quick guide to the data pages in EEM where descriptions of the various keyboards are shown. When more information is needed you can turn to EEM's "Yellow Pages" to find the phone number of the nearest sales office for the manufacturer involved. Some manufacturers include distributors and their phone numbers. Or, you may choose to call the manufacturer directly.

Before calling a manufacturer, make certain you can tell the person who answers (usually an operator) the exact nature of your problem. For example, if you need technical assistance, tell the operator exactly that. Chances are your call will be quickly routed to the proper person and you can get right to the heart of the matter. It would be helpful if you would tell the person you are looking at a specific page in EEM so that the person on the other end can also turn to that page in their copy of EEM to better communicate with you. The overwhelming majority of manufacturers are anxious to assist you in every way possible. That's why they place data pages in EEM. Help them help you.

			TYPE						FEATURES										
Manufacturer	Address Encoded Keyboards	Keypads	Mechanical (Hard Contact)	Capacitive	Conductive Elastomers	Hall Effect	Membrane	Solid State	Low Profile	Full-Travel	Pad Keyboards	Sealed Keyboards	Modular	Back-Lighted	LED-Lit Switches	Keyboard Switches	Keyboard Legends & Symbols	MIL-Spec	Custom Capabilities
Alps Electric	1•2227		1•2227		1•2227				1•2227	1•2227						1•2227			1•2227
AMP		1.2408					1•2408		1•2408	1•2408	1•2408	1•2408		1•2408				1•2408	1•2408
Cherry Electrical	1•2409		1•2409	1•2409			1•2409	1•2409	1•2409	1•2409		1•2409				1•2409			1•2409
Flex-Key	1•2411	1•2410			1•2410				1•2410	1•2411	1•2410	1•2410		1•2411	1•2410		1•2410	1•2410	1•2410
Grayhill		1•2412	1•2412						1•2414	1•2416	1•2412	1•2414	1•2416	1•2416	1•2416	1•2416	1•2413		
IEE		1•2418	1•2418				1•2418		1•2418		1•2418	1•2418		1•2418	1•2418			1•2418	1•2418
Mantex		1•2420					1•2420				1•2420	1•2420					1•2420		1•2420
Mechanical Enterprises																1•2421			
Microswitch/ Honeywell	1•2422	1•2422		1•2422		1•2422	1•2422	1•2422	1•2422	1•2422	1•2422	1•2422			1•2422			1•2423	1•2422
Oak Switch Systems	1•2424	1•2424					1•2424		1•2424	1•2424	1•2424	1•2424			1•2424	1•2424			1•2424

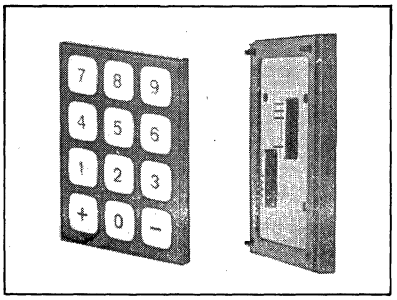
AMP keyboards—technology and experience to give your products a competitive edge.

Proven in more than 1,000 diverse applications . . .
■ Consumer products ■ Telecommunications ■ Data processing ■ Appliances ■ Instrumentation

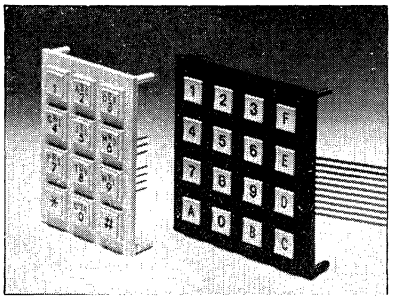
Gives you more choice . . .
■ Standard or custom designs ■ Micromotion to full travel ■ Sublimated graphics that won't peel or wear ■ Static protection ■ EMI/RFI Shielding

And more choice . . .
■ Temperature range: —40°C to 70°C ■ Key travel: 0.005 to 0.125 inch ■ Profile thickness: 0.015 to 0.625 inch ■ Life: 1 to 10 million operations ■ Encoding: single pole, matrix, or custom ■ Operating force: 3 to 18 ounces ■ Termination: Printed or flex tail (range of center to center, 0.100 inch minimum) ■ Capacitance: ≤20 pf ■ Contact Bounce: ≤3 ms ■ Contact Rating: 20 ma at 30 vdc

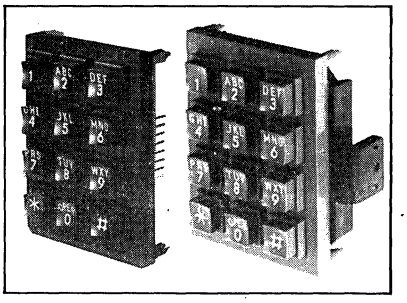
And high reliability
■ Designed and tested to meet the requirements of **MIL STD 810C**



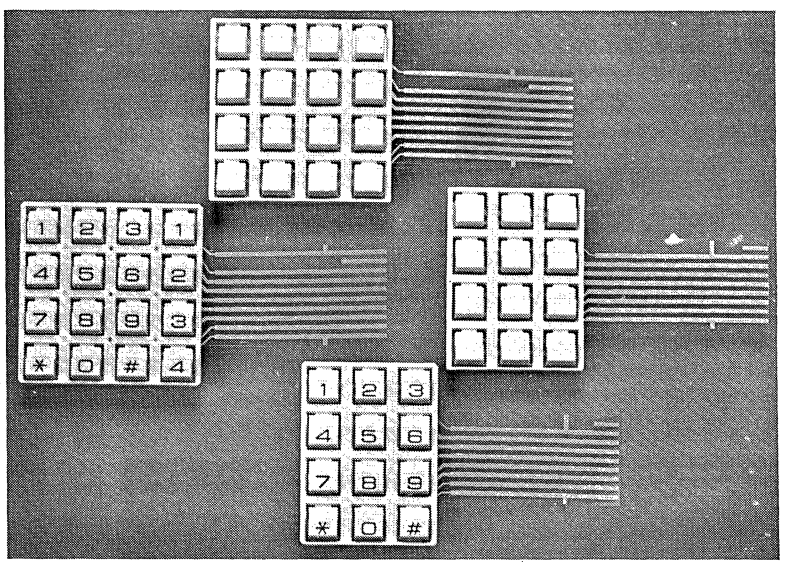
Model EC Environmentally-Sealed Tactile Keyboards
■ Environmentally resistant design ■ "Snap action" feedback for positive data entry ■ Electrically and physically stable ■ Standard and custom legend formats available ■ Life — 1 million operations
Request Catalog No. 81-637



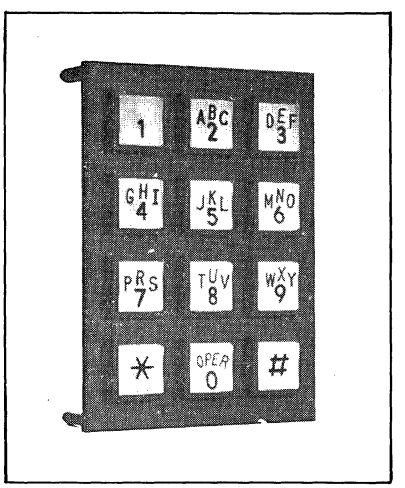
Short-Stroke ET Keyboards
■ "Snap action" feel ■ 12 and 16 key models available ■ Long life — 10 million operations ■ Matrix encoding standard with other options available
Request Catalog No. 81-639



Long-Stroke LT & BT Telephone Keyboards
■ Western Electric and GTE telephone keyboard "look-alike" ■ Simple mounting ■ Standard and optional encodings available ■ Low cost ■ .125 [3.18] key travel ■ Life — 10 million operations
Request Catalog No. 81-641



Model EH Hinged-Key Keyboards
■ Several encodings available ■ Low profile tactile feedback ■ Stackable for large arrays ■ Life — 1 million operations
Request Catalog No. 81-640



Model BL (Back Lightable) Tactile Keyboards
■ Translucent keytops ■ Proprietary key marking insures long wear ■ Snap-action tactile feel ■ Long life — 2 million operations ■ Easy front panel mounting
Request Catalog No. 81-642

Need more details? Call AMP Customer Service at (717) 780-4400, or write AMP Incorporated, Harrisburg, PA 17105.

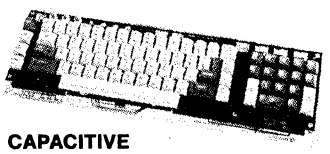
Specifications subject to change. Consult AMP Incorporated for latest design specifications.

AMP — Trademark of AMP Incorporated

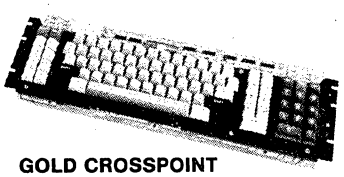
AMP INCORPORATED

CHERRY keyboards and displays

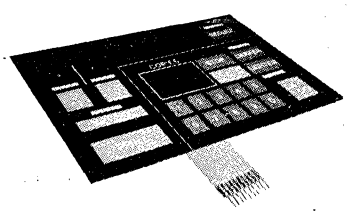
KEYBOARDS



CAPACITIVE
Highly reliable solid state design make capacitive keyboards ideal for any and all high speed data entry. Applications include computers and word processors. Custom designs available.



GOLD CROSSPOINT
Knife-edge gold alloy contacts virtually eliminate interference from contaminates, are inert to chemical action and assure long service life. Completely encoded, standard models are available for off-the-shelf delivery. Custom designs, encoded and non-encoded, are available.



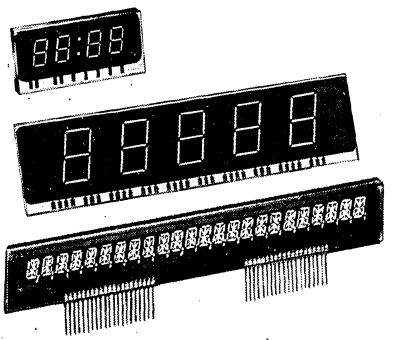
TOUCH PANEL

Touch panel membrane keyboards are thin, lightweight and cost effective—ideal for demanding applications such as electronic and office equipment, home appliances and communications equipment. Completely sealed construction resist spills and corrosive attack. Each panel is custom designed to meet your requirements.

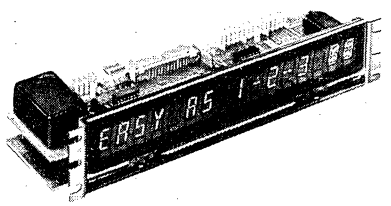
KEYBOARD SWITCHES AND KEYCAPS

Individual gold cross-point switches are available with a variety of contact forces in both lit and un-lit versions.
2-shot and 3-shot molded keycaps in almost any size, color, character or shape—including sculptured and stepped versions.

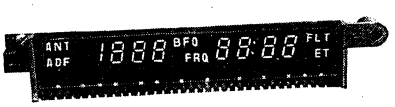
DISPLAYS AND DISPLAY SYSTEMS

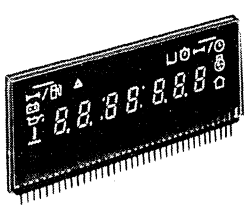


Numeric and Alphanumeric Display Panels. Seven and 14 segment displays with from 4 to 24 digits. Character heights from 0.25" to 2". Customized characters available.

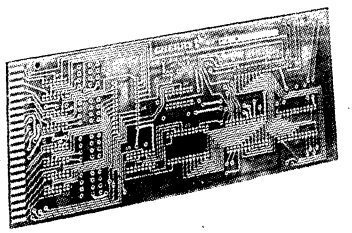


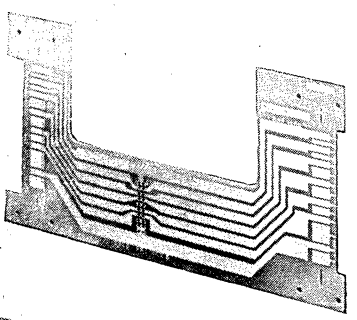
Alphanumeric display systems with easy-to-add-on option boards of electronics that offer a wide range of functions.



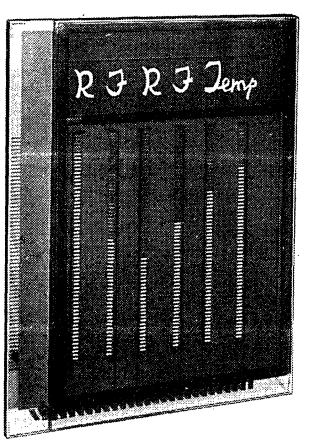


CUSTOM PC BOARDS





In-house engineering, design, manufacture and assembly with 3 to 6 week delivery



CUSTOM PANELS • MULTI-DIGIT CHARACTERS • LEGENDS • SYMBOLS

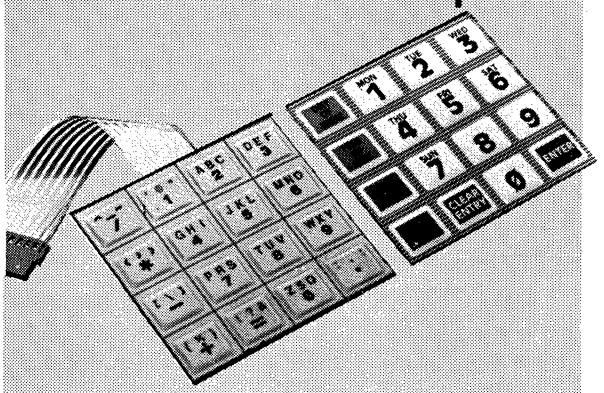
CHERRY KEYBOARDS AND DISPLAYS

CHERRY ELECTRICAL PRODUCTS CORP. • 3623 Sunset Ave., Waukegan, IL 60087 • 312/578/3500

FLEX-KEY

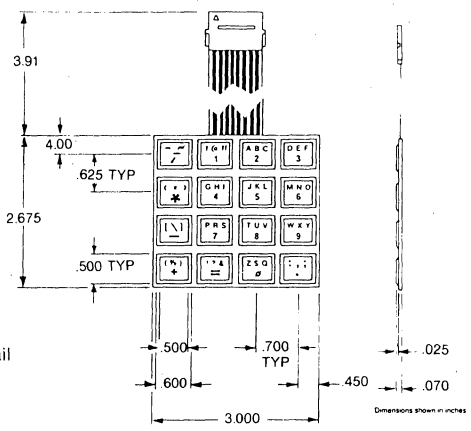
FLEX-KEY CORPORATION. 18 Sargent Street, Gloucester, Massachusetts 01930 (617) 281-2040

Standard Low Profile Touch Panels with Tactile Snap Action

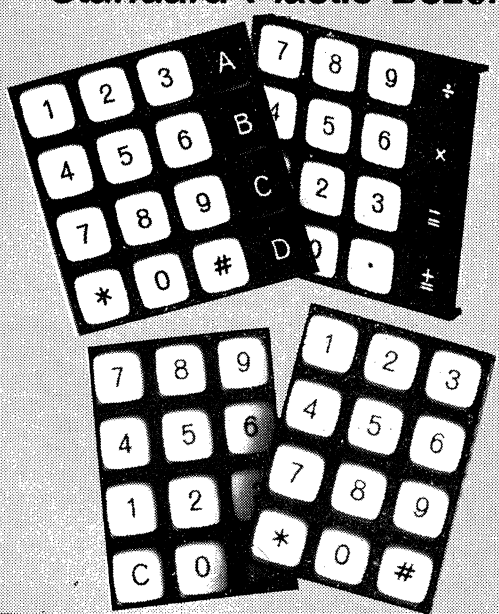


Customizing options include:

- special legends
- special circuits
- EMI/ RFI shielding
- static discharge protection.
- choice of colors
- choice of connectors
- interconnection tail length
- overlay size and shape



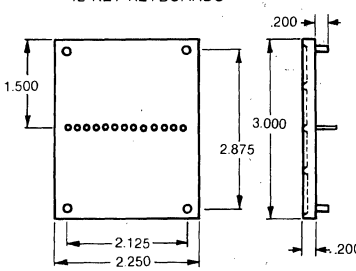
Standard Plastic Bezel Keyboards



Customizing options on Flex-Key's plastic bezel keyboards include:

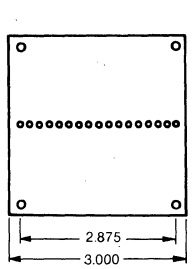
- key size, shape and arrangement
- legend and background colors
- terminal type and location
- switch matrices

12 KEY KEYBOARDS



12DK-1B 12DK-2B

16 KEY KEYBOARDS



16DK-1B 16DK-2B

12DK-1B: FORM A SWITCHES, TERMINAL SEQUENCE: Com, 6, 3, 9, ., 8, 5, 2, 0, C, 7, 1, 4

12DK-2B: FORM A SWITCHES, TERMINAL SEQUENCE: Com, 6, 9, 3, #, 2, 5, 8, 0, *, 1, 7, 4

16DK-1B: FORM A SWITCHES, TERMINAL SEQUENCE: Com, X, ∓, ÷, ±, 9, 6, 3, *, 8, 2, 5, 0, C, 7, 1, 4

16DK-2B:FORM A SWITCHES, TERMINAL SEQUENCE: Com, B, C, A, D, 3, 6, 9, #, 2, 8, 5, 0, *, 1, 7, 4

Custom Backlighted Keyboards for Hostile Environments

Flex-Key offers advanced electroluminescent (EL) backlighting in custom keyboard assemblies.

ILLUMINATED CHARACTERS

Low profile backlighted keyboards have custom options available including:

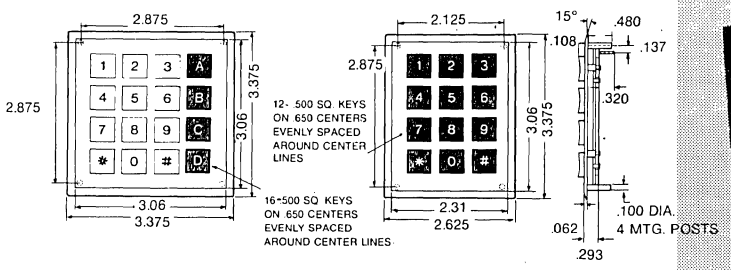
- special legends
- special circuits
- EMI/ RFI shielding
- static discharge protection.
- tempest protection
- encoding
- choice of colors

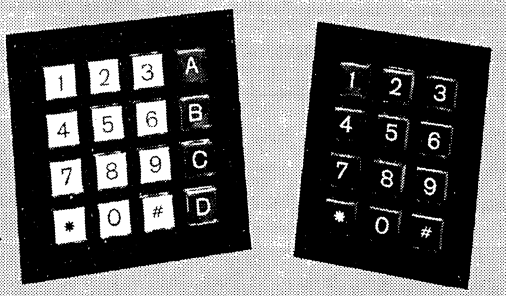
ILLUMINATED BACKGROUND

FLEX-KEY

A Subsidiary of Rogers Corp.

Standard Medium Travel Keyboards with Clear Key Caps





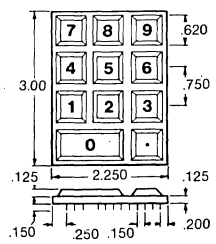
TERMINAL SEQUENCE:
12SK-72: 3, 6, 9, #, 0, 8, 5, 2, *, 7, 4, 1, Com.
16SK-62: A, B, C, D, #, 9, 3, 6, 0, 8, 5, 2, *, 7, 4, 1, Com.

Standard Rubber Covered Keyboards

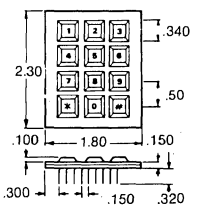
Customizing options include:

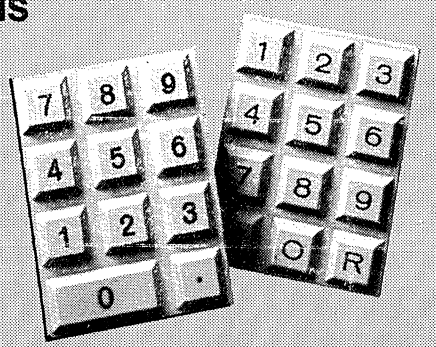
- number of keys
- key and key legend colors
- key spacing
- special matrix
- termination

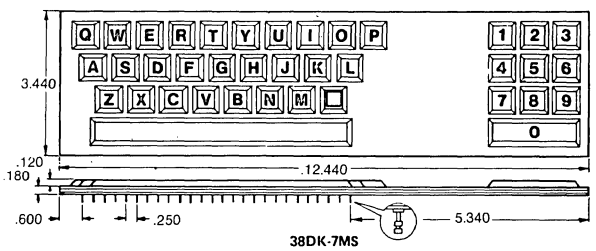
DK-1M and DK-1MS



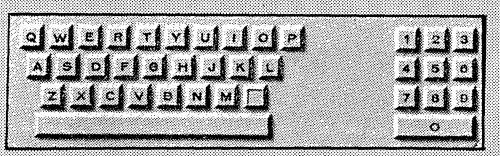
12DK-5M







38DK-7MS



Militarized Full Travel Keyboards

These rugged custom units meet military requirements for vibration, shock, fungus, water, dust, salt spray, EMI/RFI, thermal, blast, EMP, high/low temperature, and key cycle life. Full tempest shielding is available.

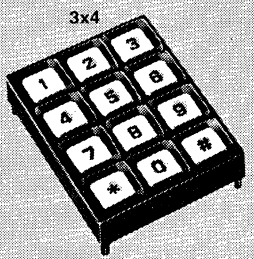
Flex-Key engineers its militarized full-travel keyboards for optimum reliability and continuous operation while meeting all human factor requirements. These conductive elastomer keyboard assemblies provide command, control, communications, and data entry functions and have proven themselves in many demanding applications.

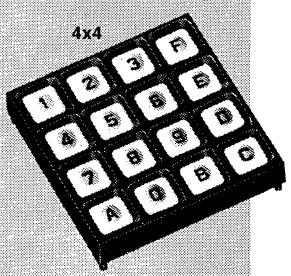
Grayhill INC

12, 16, and 20 Button Keyboards

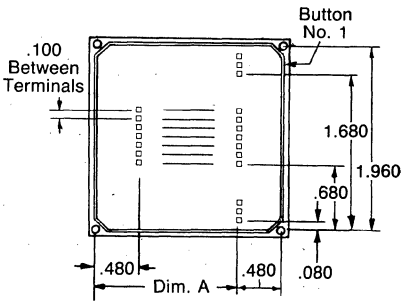
Series 83

1/2" Button Centers—Post Mount





Circuitry: 2 Out Of 7 (8); Matrix; or Single Pole/Common Bus *

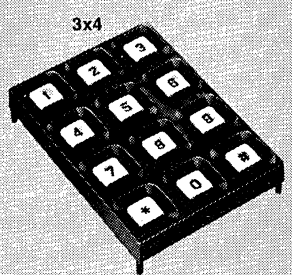


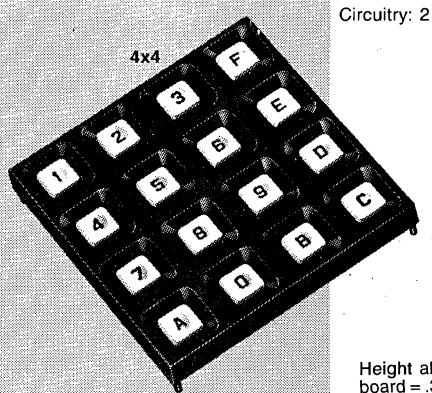
Height above board = .350"

Dim.	3x4	4x4
A	.980	1.480

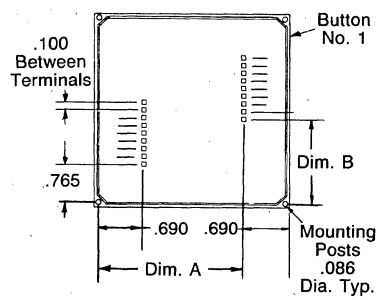
Series 84

3/4" Button Centers—Post Mount





Circuitry: 2 Out Of 7 (8); Matrix; or Single Pole/Common Bus *

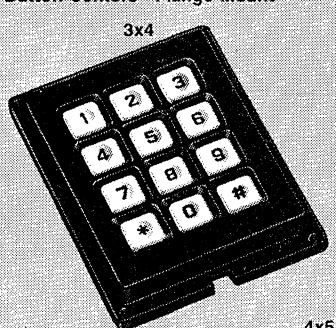


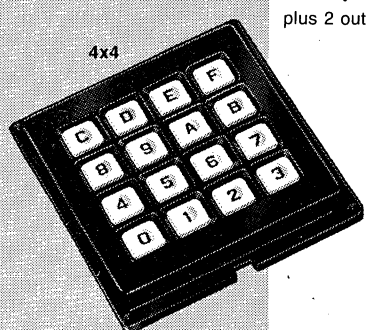
Height above board = .350"

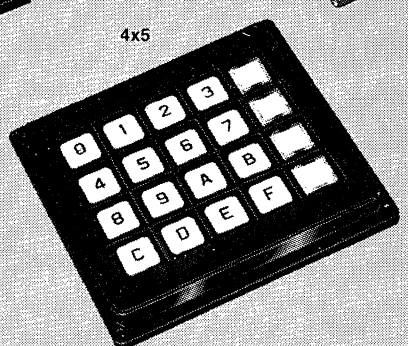
Dim.	3x4	4x4
A	1.438	2.190
B	1.513	1.313

Series 86

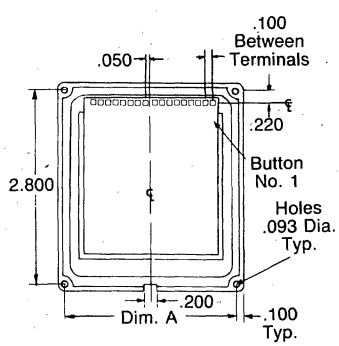
1/2" Button Centers—Flange Mount







Circuitry: Matrix or Single Pole/Common Bus in all formats; plus 2 out of 7 (in 3x4), and 2 out of 8 (in 4x4) *



For legend number -202, terminal pins are located along the "3, 7, B, F" edge

Height above board = .360"

Dim.	3x4	4x4	4x5
A	2.000	2.500	3.000

* Views show maximum terminals (SP/Common Bus) in the 4x4 format; for other circuitry, see GRAYHILL Catalog Number One.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Legends, Specifications, Prices

Standard Legends

All legended buttons shown here are two-shot molded. Blank areas are self-legend style buttons with snap-on caps as shown at right. The legend card with adhesive backed, printed inserts has additional blank inserts for dry transfer lettering. Inserts are 0.275" square. Snap-on cap projects 0.015" above keyboard.

Special—contact GRAYHILL.

—001

—002

0	1	2	3
4	5	6	7
8	9	A	B
C	D	E	F

—003

C	D	E	F
8	9	A	B
4	5	6	7
0	1	2	3

—004

1	2	3	C
4	5	6	D
7	8	9	E
A	0	B	F

—005

1	2	3	F
4	5	6	E
7	8	9	D
A	0	B	C

—006

1	ABC 2	DEF 3	A
GHI 4	JKL 5	MNO 6	B
PRS 7	TUV 8	WXY 9	C
*	OPER 0	#	D

—101

—102

1	2	3
4	5	6
7	8	9
*	0	#

—103

1	ABC 2	DEF 3
GHI 4	JKL 5	MNO 6
PRS 7	TUV 8	WXY 9
*	OPER 0	#

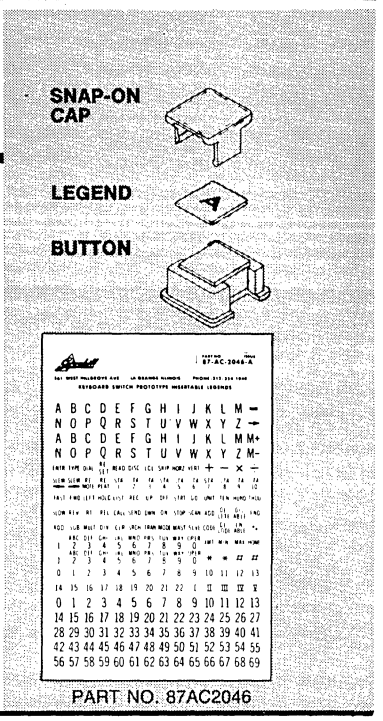
—201

—202

0	1	2	3
4	5	6	7
8	9	A	B
C	D	E	F

—203

0	1	2	3
4	5	6	7
8	9	A	B
C	D	E	F



Specifications

Rating Criteria

Rating At 24 VDC: 10 milliamps, resistive.

Contact Resistance: Compatible with MOS, TTL and DTL

Voltage Breakdown: 250 VAC between mutually insulated parts.

Life Expectancy: 3,000,000 operations per button.

Contact Bounce: Less than 4 milliseconds at make, 10 milliseconds at break.

Operating Temperature: -40°C to +80°C.

Materials and Finishes

Housing: ABS Plastic (Black).

Button: ABS Plastic (White with Molded-in Black Legend; White Self-Legend Style.

Snap-On-Cap: Clear Polycarbonate.

Terminals: Copper Alloy, CDA No. 725.

Operating Features

Button Travel: 0.015" nominal total travel.

Typical Operating Force: 350 grams.

Note:

The 2 out of 7 (8) "Telephone Code" was developed primarily for audio tone generation. To discuss critical data input applications, please contact Grayhill.

Ordering Information and Prices

83 A A 1-001

- Series: 83, 84, or 86 See facing page.
- Keyboard Format: A = 3x4 (12 Button) B = 4x4 (16 Buttons) J = 4x5 (20 Buttons)
- Circuitry Code: A = 2 Out Of 7 (8) B = Matrix C = SP/Common Bus
- Legend Number: See Above. Must agree with format.
- Termination: 1 = Series 83 and 84 2 = In-line, Series 86

Number of Buttons	Partial Part Number	Circuitry Code	Quantity 1-49	50-99	100-499
12	83AA1-	2 of 7	$10.60	$9.01	$7.95
	83AB1-	Matrix	9.54	8.11	7.16
	83AC1-	SP/Common	10.07	8.56	7.55
	84AA1-	2 of 7	11.66	9.91	8.75
	84AB1-	Matrix	10.60	9.01	7.95
	84AC1-	SP/Common	11.13	9.46	8.35
	86AA2-	2 of 7	10.60	9.01	7.95
	86AB2-	Matrix	9.54	8.11	7.16
	86AC2-	SP/Common	10.07	8.56	7.55
16	83BA1-	2 of 8	11.66	9.91	8.75
	83BB1-	Matrix	10.60	9.01	7.95
	83BC1-	SP/Common	11.13	9.46	8.35
	84BA1-	2 of 8	13.25	11.26	9.94
	84BB1-	Matrix	11.13	9.46	8.35
	84BC1-	SP/Common	12.19	10.36	9.14
	86BA2-	2 of 8	11.66	9.91	8.75
	86BB2-	Matrix	10.60	9.01	7.95
	86BC2-	SP/Common	11.13	9.46	8.35
20	86JB2-	Matrix	12.50	10.63	9.38
	86JC2-	SP/Common	13.25	11.26	9.94
Insertable Legend Card, Part No. 87AC2046			1.06	.90	.80
Dry Transfer—Small, Part No. 87-DT-2096-088			2.00	1.70	1.50
Dry Transfer—Medium, Part No. 87-DT-2096-125			2.00	1.70	1.50
Dry Transfer—Large, Part No. 87-DT-2096-187			2.00	1.70	1.50

Discount Schedule

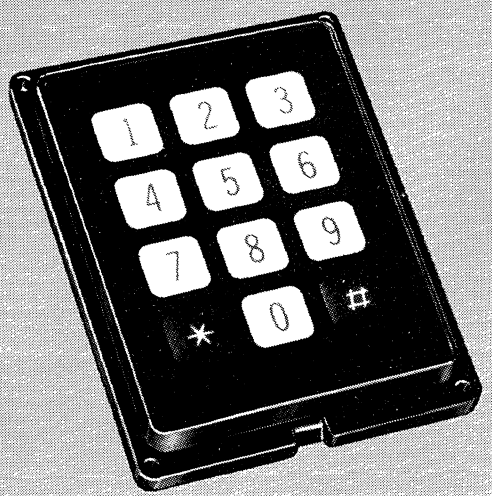
1-49 . . . . . Unit Price 500-999 . . . . Less 36%
50-99 . . . . . Less 15% 1000 UP
100-499 . . . . Less 25%

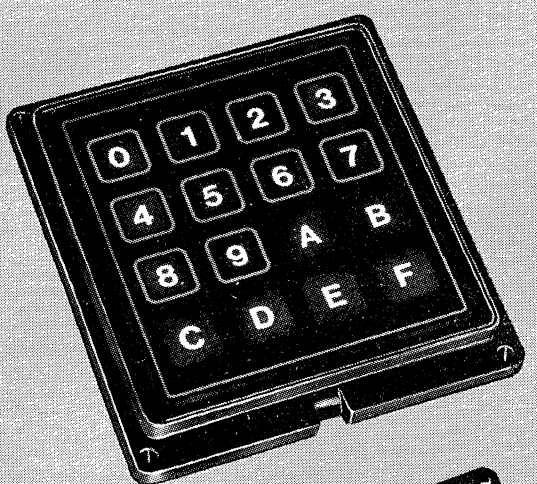
Contact your local Distributor or Grayhill

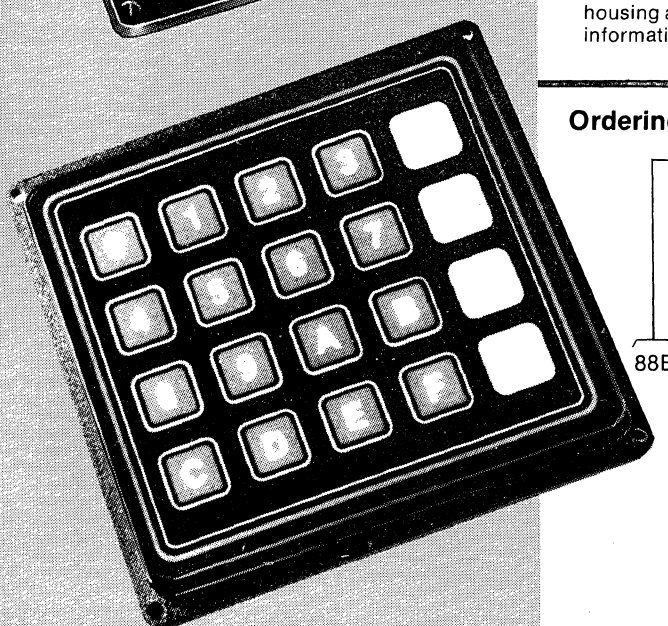
Available Locally Through Your Grayhill Distributor

Grayhill INC.

Sealed Keyboards







1/2 Inch Button Centers— Flange Mounted Keyboards

Features

- Colorful Legend Options
- Sealed Contact System
- Optional Gasket to Seal to Panel
- Washable and Watertight
- Resists Common Solutions
- Low Profile

Dimensions—See the dimensions listed for the Series 86 Keyboards.

Code and Truth Tables—See GRAYHILL Catalog Number One.

Specifications—See the Specifications listed for the Series 83, 84 and 86 Keyboards.

Graphic Overlay Characteristics

The legend is printed on the second surface of a graphic overlay providing maximum legend protection. The graphic overlay is made of a polyester material which has excellent solvent resistance to water, petroleum oil, alcohols and aliphatic hydrocarbons. Common solutions that do not attack the graphic overlay include 5% acetic acid, 5% citric acid, 2% detergent solution, soapy water, 30% hydrogen peroxide, wine, beer, whiskey, coffee, cocoa, milk, tomato juice, lemon juice, etc. The graphic overlay is resistant to scratching, marring, and dulling of the surface from contact by fingernails, wiping cloths, and cleaning materials; it will withstand high humidity conditions.

Although the polyester overlay may not be affected by hydrocarbons, ketones and freon, it is recommended that these chemicals *not* be used since they may affect the switch housing and overlay frame which is ABS Plastic. For specific information on a particular solvent, contact Grayhill.

Ordering Information

88B B2 — 082

- 88A=3 x 4 Sealed Keyboard
  88B=4 x 4 Sealed Keyboard
  88J =4 x 5 Sealed Keyboard
- Circuitry
  A2=2 Out Of 7 (or 8) Code In-Line Pinout, for 3 x 4 (& 4 x 4)
  B2=Matrix Coded, In-Line Pinout
  C2=Single Pole/Common Bus In-Line Pinout
- Legend Option. Add -052, -062, -072, -082, -143, -152, -162, -172, -182, -252, -262, or -292

See Standard Legend Description Next Page

Sample part no. orders 4x4 sealed keyboard, matrix code output, hexadecimal legend in the -082 color scheme.

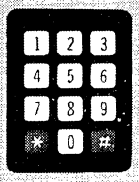
Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Series 88 Keyboards

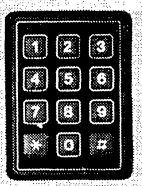
Standard Legends

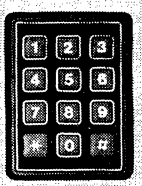
Accent Colors

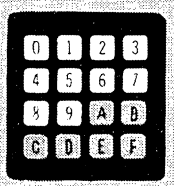
-143
White

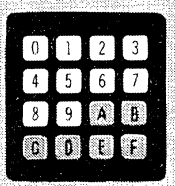

-152
Blue

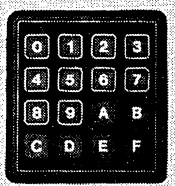
-162
Orange

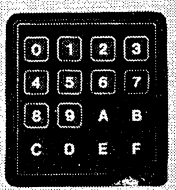

-172
Blue

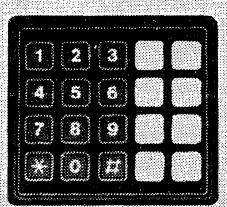

-182
Orange

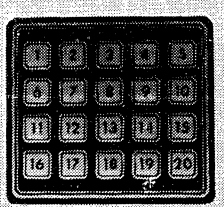

-052
Blue

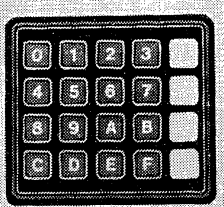

-062
Orange


-072
Blue


-082
Orange


-262
Blue


-292
Silver

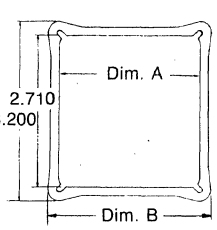

-252
Orange

Special Legends — Contact GRAYHILL

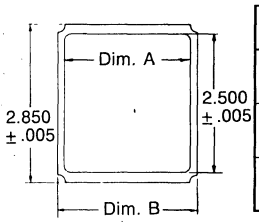
Panel Seal Gaskets

The Series 88 sealed keyboards can be mounted on the top side or front of the panel or subpanel mounted. When subpanel mounted, the keyboard surface can be flush with panel. Regardless of the type of mounting required, a gasket is available to seal the keyboard to the panel. The drawings at the right describe the gaskets for top side and subpanel mounting. Material is cellulose fiber, foam, nitrile rubber. Order gasket as a separate item.

Subpanel Mounting



Topside Mounting



.094
Thick

Size	Style	Dim. A	Dim. B	Part Number
3x4	Topside	1.800	2.040	88M2012-1
	Subpanel	2.010	2.400	88M2001-2
4X4	Topside	2.300	2.540	88M2015-1
	Subpanel	2.510	2.900	88M2009-2
4X5	Topside	2.800	3.040	88M2018-1
	Subpanel	3.010	3.400	88M2019-1

Price

3x4 And 4x4 Keyboards With Standard Legends

No. of Buttons	Series and Type	Circuit Code	Quantity 1-49	50-99	100-499
12	88A	A2	$10.60	$9.01	$7.95
		B2	10.07	8.56	7.55
		C2	10.60	9.01	7.95
16	88B	A2	11.93	10.14	8.95
		B2	11.66	9.91	8.75
		C2	10.60	10.59	9.35
20	88J	B2	15.25	12.96	11.44
		C2	16.00	13.60	12.00

Panel Seal Gaskets

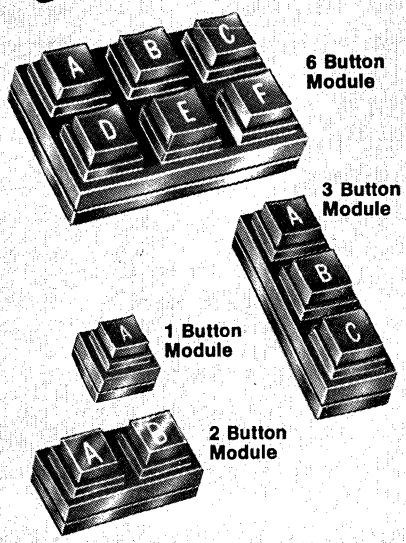
Part No.	Quantity 1-49	50-99	100-499
88M2001-2	$0.37	$0.31	$0.28
88M2009-2	0.42	0.36	0.32
88M2012-1	0.37	0.31	0.28
88M2015-1	0.42	0.36	0.32
88M2019-1	0.47	0.40	0.35
88M2018-1	0.47	0.40	0.35

See Discount Schedule on Keyboard Pricing Page
Prices and Discounts Subject to Change Without Notice.

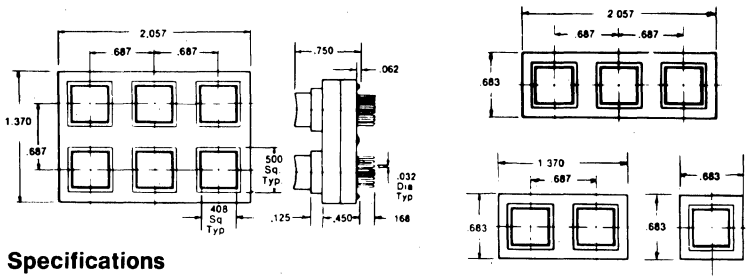
Available Locally Through Your Grayhill Distributor

Grayhill INC

Modular Keyboards
Series 82—Long Stroke, PC Mountable



- **Create Your Own Keyboard Configuration**
- **Modules Retain 0.687 Centers When Placed Side By Side**
- **SPST To 4PST Under Each Button**



Specifications

OPERATING FEATURES:

Button Travel: 0.130" total travel.

Overtravel: 0.080" nominal.

Operating Force: 8 ± 3 ounces (dependent upon number of poles).

MOUNTING:

Modules are designed to plug into any printed circuit board from 1/16" to 1/8" thick.

Modules can be stacked horizontally or vertically for any combination of button array and still maintain 11/16" button centers.

RATING:

Rating at 5 VDC: 100 milliamps.

Contact Resistance: 25 milliohms or less on a new switch.

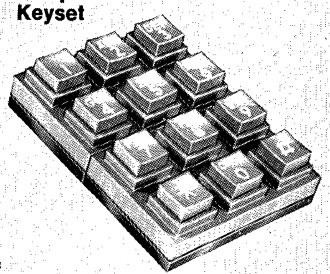
Voltage Breakdown: 250 VAC between mutually insulated parts.

Insulation Resistance: 1,000 megohms minimum.

Life Expectancy: 1,000,000 operations.

Contact Bounce: 10 milliseconds or less for the life of the switch.

Telephone Keyset



Telephone Keysets

- Permanent Molded-In Legends
- 2 Modules Create the Phone Set

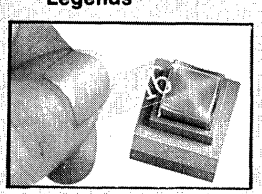
Legend Type	Circuitry Each Button	Part No.	Unit Price
Top Six Buttons Two-Shot Molded	SPST	82-601-85	$7.55
	2PST	82-601-86	8.45
	3PST	82-601-87	9.35
	4PST	82-601-88	10.25
Bottom Six Buttons Two-Shot Molded	SPST	82-601-89	$7.55
	2PST	82-601-90	8.45
	3PST	82-601-91	9.35
	4PST	82-601-92	10.25

Discount Schedule

1-49	Unit Price
50-99	Less 15%
100-499	Less 25%
500-999	Less 36%
1000 UP	Contact your local Distributor or Grayhill

Prices and Discounts subject to change without notice

Self Insertable Legends



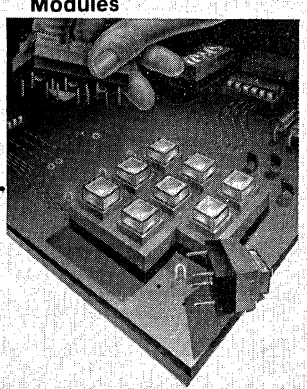
Portion Of Legend Sheet 82AC2017

Self Insertable Legend Modules

- Slotted Cap Permits Insertion Of A Clear Plastic Tab Imprinted With Legend
- Reduces Legending Problems For Prototype Or Small Production Quantities
- Available Legend Sheet Contains White Legends, 0-19, A-Z, Common Symbols

Part No.	No. Of Buttons	Circuitry Each Button	Unit Price
82-101-71	1	SPST	$2.05
82-101-74	1	4PST	2.50
82-201-41	2	SPST	3.30
82-201-44	2	4PST	4.20
82-301-61	3	SPST	4.55
82-301-64	3	4PST	5.90
82-601-81	6	SPST	8.30
82-601-84	6	4PST	11.00
82AC2017	Legend Sheet for Self Legend Modules		1.25

Lightable Modules



Lightable Modules

- Bottom Holes Accomodate PC Mounted Incandescent Or LED Lamp
- Request Bulletin #322 For Complete Mounting Instructions And Lamp Suggestions
- Choice of Insertable Legend Or Non-Insertable Legend Modules

Insertable Legend Modules

No. Of Buttons	Circuitry Each Button	Part No.	Unit Price
1	SPST	82-150-38	$2.40
1	2PST	82-150-16	2.50
3	SPST	82-350-12	5.30
3	2PST	82-350-09	5.60
6	SPST	82-650-19	9.60
6	2PST	82-650-09	10.20
Legend Sheet		82AC2050-1	1.25

Unlegended Non-Insertable Modules

No. Of Buttons	Circuitry Each Button	Part No.	Unit Price
1	SPST	82-150-17	$2.20
1	2PST	82-150-15	2.30
3	SPST	82-350-10	4.70
3	2PST	82-350-08	5.00
6	SPST	82-650-10	8.40
6	2PST	82-650-08	9.00

Contact Grayhill to order printed legends.

Grayhill, Inc. / 561 Hillgrove Ave. / P.O. Box 373 / La Grange, IL 60525-0373 / (312) 354-1040

Keyboard Modules
The Stackable SYSTEM 87

- Low profile
- Long life — 3,000,000 operations
- Positive audible and tactile feedback

Select the modules you require to build your own keyboard design. The modules can be stacked side by side on your prototype PC board in any configuration that is required. ½-inch button centers will be maintained.

Circuitry is single pole/common bus in the single row switches and single pole/common bus or matrix code in the 3 x 4 and 4 x 4 keyboard pads.

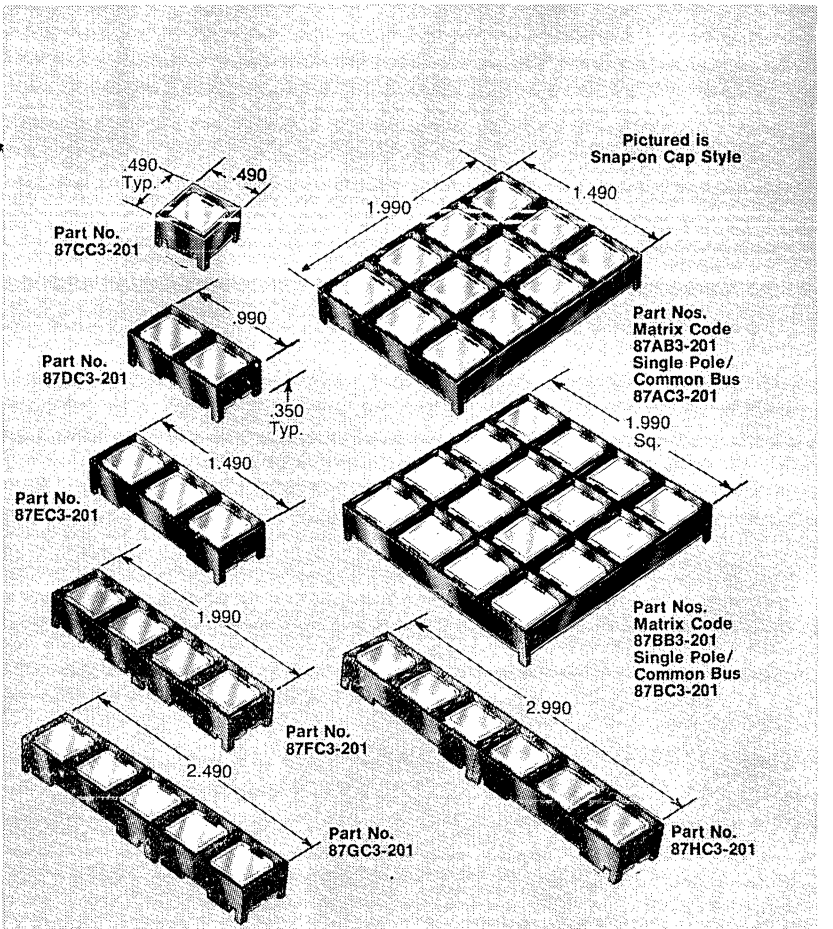
Prototype and Short Run Production

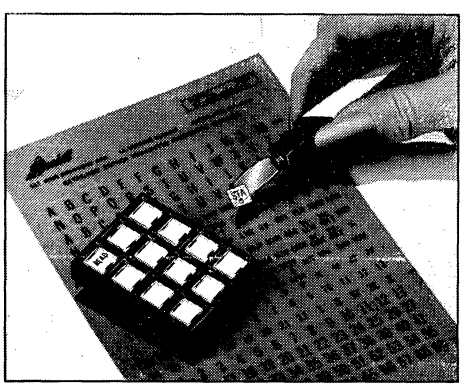
Arrange the modules in the required array on your PC board. Snap-on cap allows user to legend button with inserts from legend card and/or dry transfer lettering. For moderate quantities legends can be printed on the button by Grayhill. Printed legends will closely duplicate your prototype legend.

High Volume Production

Grayhill will provide a custom keyboard. The modules will be arranged and the board terminated to your specifications.

Legends — your choice of printed or molded-in legends; button color and legend color.





Prototype Legends

GIVE THEM A PROFESSIONAL APPEARANCE

The System 87 modules described can be easily legended by you. The clear, protective, snap-on cap removes readily without special tools. To assist you, GRAYHILL has a legend card (Part No. 87AC2046) which includes all the popular legends and symbols on a clear insert, die-cut to fit the button. Type style is News Gothic Condensed.

Or, create your own legends. The GRAYHILL card contains blank inserts for your special needs. For this purpose, sheets of dry transfer lettering are also available in type style and sizes similar to the chart below. A sheet of small type is part number 87DT2096-088; medium is 87DT2096-125; and large is 87DT2096-187. You can also prepare and cut your own legend inserts. They should be cut to fit a 0.275" square surface.

ORDERING INFORMATION

All numbers describe self-legend style. Contact Grayhill for other legends.

Type of Module	Part Numbers	Unit Price	Type of Module or Item	Part Number	Unit Price
1 Button	87CC3-201	$1.54	12 Button—SP/Com Bus	87AC3-201	$9.54
2 Button	87DC3-201	2.23	16 Button—Matrix Code	87BB3-201	11.66
3 Button	87EC3-201	2.86	16 Button—SP/Com Bus	87BC3-201	12.19
4 Button	87FC3-201	3.82	Insertable Legend Card	87AC2046	1.06
5 Button	87GC3-201	4.77	Dry Transfer—Small	87DT2096-088	2.00
6 Button	87HC3-201	5.30	Dry Transfer—Medium	87DT2096-125	2.00
12 Button Matrix Code	87AB3-201	9.01	Dry Transfer—Large	87DT2096-187	2.00

Discount Schedule

1-49 . . . . . Unit Price
50-99 . . . . . Less 15%
100-499 . . . . Less 25%
500-999 . . . . Less 36%
1000 UP Contact your local Distributor or Grayhill

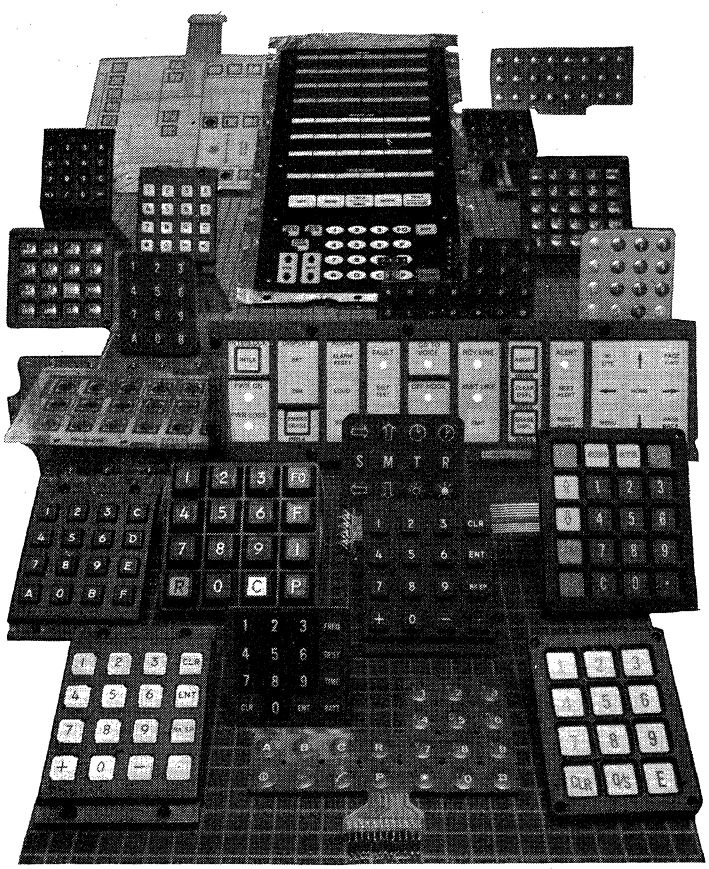
Prices and Discounts subject to change without notice.

Available Locally Through Your Grayhill Distributor

Planar Products Division

For over fifteen years IEE has been the quality leader in keyboards for commercial, industrial and military applications. Today more than 100,000 are in use worldwide, performing reliably despite constant exposure to dust, dirt, corrosive atmospheres, submersion in water, extremes in altitude, to wide temperatures and humidity ranges.

A continuing dedication to high quality is the reason for our success. This can be seen in features like high grade polyester, a special sealing process to keep out moisture, and etched circuitry instead of silkscreened ink for low contact resistance, better quality and longer life. The results are switch products with the highest reliability — with most exceeding many military test requirements. Keys to the maintenance of this reputation for quality are the talents of our engineering staff, the efficiencies of large scale manufacturing, and an exceptionally rigorous quality assurance program.



STANDARD KEYBOARDS

IEE's wide selection of standard keyboard models offers you an opportunity to save costs by consulting with our engineering staff and designing in our standard keyboards in what you might have considered a custom application. Our standard keyboards include: Hi-Rel and INDUSTRIAL PANELSWITCHES™, THINSWITCHES™, SEALEDSWITCHES™ and TELSWITCHES™.

CUSTOM KEYBOARDS

Custom configurations include: special coding/output, multiple color combinations; any number of custom arrangements; keyboards that are resistant to highly caustic solutions; stainless steel construction; EMI/RFI shielding; varying actuation force and key travel; movable legends and rigid backs, wide temperature range, high humidity. Incandescent, LED and electroluminescent backlighting is also available.

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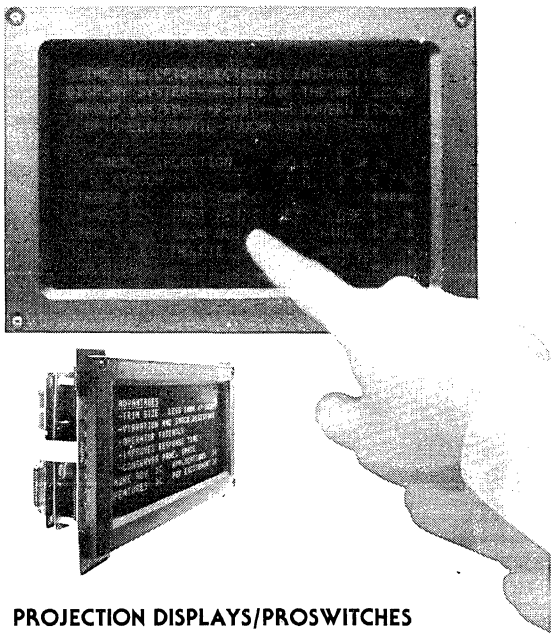
Special Products Division

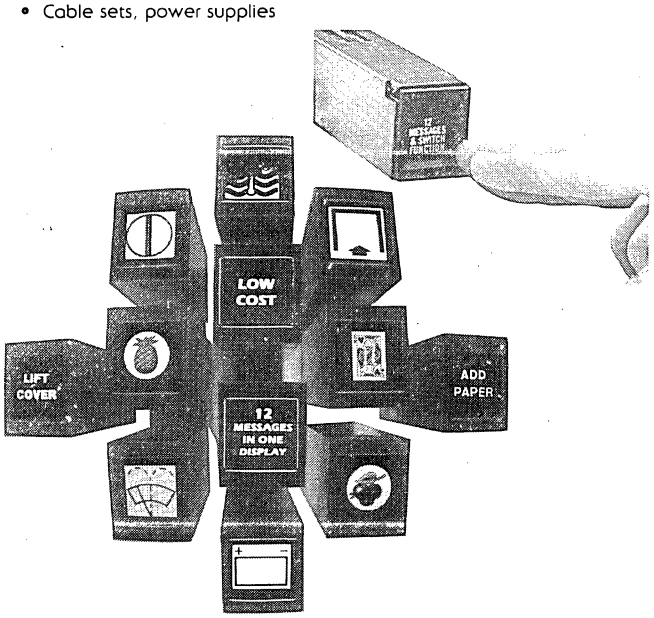
The Special Products Division (SPD) features a wide selection of display and interactive display products. In addition to our standard products SPD has the engineering expertise to recommend and build custom display solutions using many advanced display technologies.

PEP™ INTERACTIVE TOUCH DISPLAYS



PEP is a powerful interactive touch display panel. PEP incorporates the features of a DC plasma display with an invisible switch matrix covering the screen. The operator can be prompted to touch anywhere on the screen by your instructions or menu on the display. PEP can take on any desired control function, limited only by your software. The advantages, features and options include:

- Eliminating the need for keyboards, pads, indicators, and switches
- Reducing operator training
- Trim size - less than 4" deep
- 256 or 480 character display sizes
- Choice of 4 interfaces - Serial/Parallel
- Red, orange, or green characters
- Finished bezel with polarizing filter
- On-board character generation and refresh memory
- Cable sets, power supplies



PROJECTION DISPLAYS/PROSWITCHES

TITAN Projection Displays are the world's most extensively used family of graphic displays. The line offers many features not found in other display technologies.

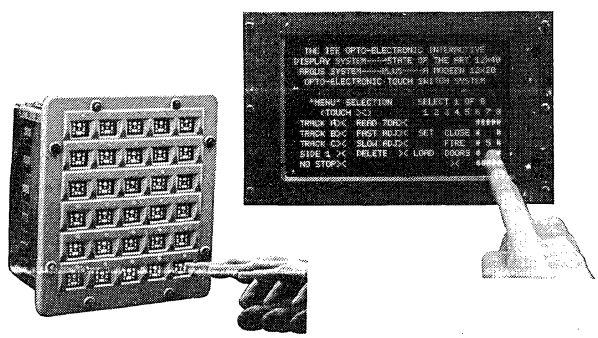
- The most cost effective system for displaying any image in any color
- Displays can be programmed to feature from 11 to 48 messages
- Over 15 models with display screens ranging from .076" to 3.375"

Recent advances include modular lamp assemblies and a new aspheric lens system for greater illumination. Our PROSWITCH series combines the features of projection displays with a tactile, membrane, or opto switches. Projection displays and PROSWITCHES can save panel space, provide a significant reduction in hardware and wiring, and a noticable improvement in man/machine interface. Commercial and ruggedized configurations are available.

DISPLAY SUB-SYSTEMS

The Special Products Division has the capability to engineer the best man/machine interface solution using a wide spectrum of display technologies. Recent programs have involved meeting the custom requirements for a wide range of commercial, industrial and military applications.

Display accomplishments include a ruggedized 10" square interactive panel with over 1400 color and graphic messages, support electronics, and single interface connection. Another program involved a PEP Touch Display militarized with a high MTBF, RFI shielding, and meeting exacting MIL vibration standards.



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WE DO IT ALL~FROM SIMPLE SWITCHES TO BLACK BOXES. YOU GET BETTER MECHANICAL AND GRAPHICS QUALITY CONTROL FROM A SINGLE SOURCE. CALL US NOW!

In-House capabilities

- Design
- Engineering
- Layout
- Graphics
- Material Selection
- Color Matching
- Ink Blending
- Screen Printing
- Laminating
- Forming
- Molding
- Hot Stamping
- Back Lighting
- Coating
- Assembly
- Testing
- Packaging
- Complete Black Box

Man-trix switch products

- Soft Touch Membrane
- Tactile Feel Membrane
- P.C. Board Membrane
- Fold-over Construction
- Stacked Construction
- Front Panel Assemblies
- P.C. Board Assemblies
- Mar-Resistant Surfaces
- Peripheral Plastics

mantex CORPORATION

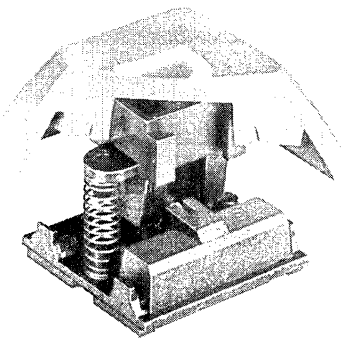
Dept. EEM — P.O. Box 15
1800 Metamora Rd. Oxford, MI 48051
(313) 628-9711

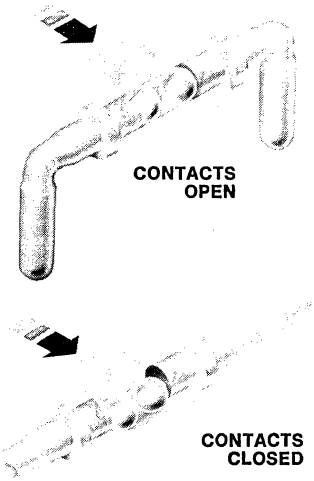
Call us for local representative in your area

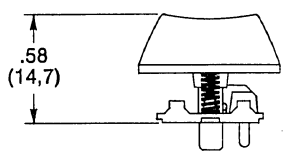
MEI DN SERIES KEYSWITCH

SPECIFICATIONS:

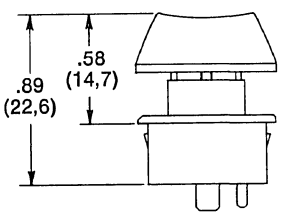
CONTACT RATING, DC RESISTIVE:	3W MAX.
VOLTAGE:	24V MAX.
INITIAL CONTACT RESISTANCE:	20mΩ MAX.
PLUNGER TRAVEL:	.135 (3,43)
PRETRAVEL:	.070 ±.025 (1,78)
OPERATING FORCE TO MAKE:	60 ±15
TEMPERATURE, OPERATING:	−20°C TO 75°C
TEMPERATURE, STORAGE:	−40°C TO 85°
CONTACT BOUNCE:	3 ms MAX.
UL FLAMMABILITY RATING:	94-HB
LIFE:	15 x 10^6 OPERATIONS



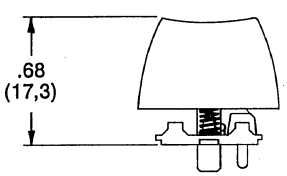




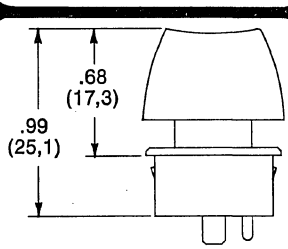
DN500 WITH L STYLE KEYTOP FOR ¾" CENTER MOUNTING.



DN600 WITH L STYLE KEYTOP AND 7.8 MM KEYTOP COUPLING FOR ¾" CENTER MOUNTING.



DN500 WITH C STYLE KEYTOP FOR ¾" CENTER MOUNTING.

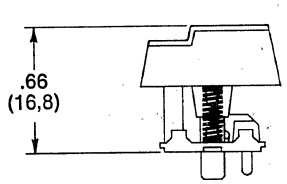


DN600 WITH C STYLE KEYTOP AND 7.8 MM KEYTOP COUPLING FOR ¾" CENTER MOUNTING.

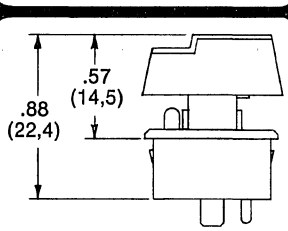
DN switches work in your product's environment because the contacts are sealed in a silicone rubber tube. And since they are sealed, the contacts can be silver with its lower cost and cleaner electrical characteristics. That's why DN reliably tests to over 15 million cycles.

DN switches also work in your production environment. With just a few snap-on parts, you can configure any switch in the line. So stocking for various keyboard configurations is simple and cost effective. Also with sealed contacts and switch modules that clip tightly to the PC board, wave soldering with a water wash is easy.

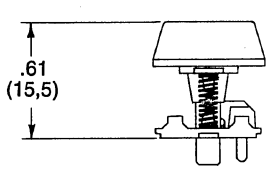
From top of PC board to top of double shot keytop, DN switches measure less than 15mm — easily meeting the new standards for low profile terminal keyboards. Or consider the DN switch to replace a touch panel with a "user friendly" keypad without sacrificing panel space.



DN500 WITH E STYLE RELEGENDABLE LENS KEYTOP LIGHTED WITH 1 OR 2 LED'S FOR ¾" CENTER MOUNTING.



DN600 WITH E STYLE RELEGENDABLE LENS KEYTOP LIGHTED WITH T-1 INCANDESCENT LAMP FOR ¾" CENTER MOUNTING.



DN500 WITH M STYLE KEYTOP FOR ⅝" CENTER MOUNTING.

- ALL SWITCHES SHOWN ACTUAL SIZE
- KEYBOARD ARRAYS AVAILABLE
- DOUBLESHOT MOLDED KEYTOPS
- CUSTOM KEYTOP ENGRAVING
- LARGER LIGHTED KEYSWITCHES AVAILABLE

MECHANICAL ENTERPRISES INC.

The Better Switchmaker

SALES - ENGINEERING
461 CARLISLE DRIVE
HERNDON, VA 22070
(703) 435-9496
TWX 710-832-0942

MANUFACTURING
1321 65th PLACE NW
FT. LAUDERDALE, FL 33309
(305) 979-1333

MICRO SWITCH KEYBOARDS...

Quality and Reliability, each carries a 1% Acceptable Quality Level and a 2-year Warranty*

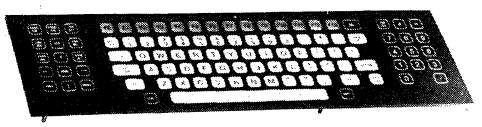
Until now getting a keyboard at the price you needed could have meant giving up the kind of performance you wanted. Not anymore. Now, in addition to our time-proven solid state Hall effect offerings, you can specify full travel capacitance or contact membrane keyboards in either standard or low profile (DIN standards) or touch panel membrane keyboards.

And you get them all — custom or off-the-shelf — backed with the experience and full application support that's been a MICRO SWITCH tradition.

SD Series Hall Effect Keyboard (104SD30)

FEATURES

- Solid state Hall effect keys with a single chip microcomputer
- 4-mode 8-bit USASCII code assignment . . . Key array in 4-language configurations
- Parallel data 8-bits and strobe . . . 50 microseconds nominal strobe pulse
- Serial output . . . 1-start, 8-data, even parity, 1-stop (TTL compatible) with choice of 4 baud rates
- Electronic shift lock with LED indicator
- Choice of 4-tones for audio feedback
- Manual/Auto repeat for designated keys . . . Repeat key controls repeat for other selected keys
- 1-function key . . . positive or negative logic
- 1-shift lock key, 2-shift keys, 1 control key, 1 alternate action caps lock key
- 121 possible coded keys, 6 mode keys, 1 function key
- 14 LED's in top row with current limit resistors
- 8-byte FIFO (first-in first-out) character storage
- N-key rollover
- Operates on a single 5 VDC supply
- Life . . . 100 million operations
- MCBF . . . 20 billion operations

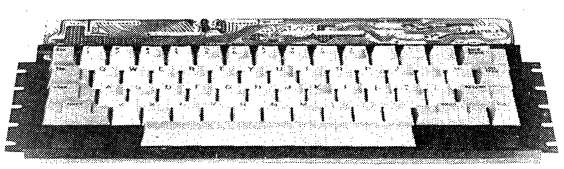


TC Series Touch Panel Keyboard (TC 454)

FEATURES

- Customized design. Graphics, colors, styles, and formats can be selected to achieve optimum clarity of operating functions
- Advanced construction and manufacturing processes. Reflects the MICRO SWITCH commitment to quality, reliability and performance
- Tactile feedback. Snap-disc provides positive feel of switching action; embossed touch surface enables positive finger positioning
- Micro-travel (.016 in. nominal)
- Environmentally sealed. Protects against contamination of switch contacts
- Provides both serial and parallel data outputs
- Pin-for-pin compatible EPROM capability
- Operates on a single 5 VDC supply
- Ultra-low profile membrane easily adapts to styling and package size requirements
- Channel venting. Prevents temperature/altitude changes from affecting operating characteristics
- Life . . . 2 million operations (5 million w/o snap disc)

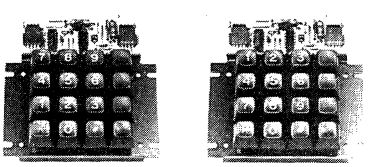
* One year warranty



SC Series Low Profile Capacitance-membrane Keyboard (58SC36-2)

FEATURES

- European ergonomic standards compliance
- Only 18,6 mm (.732″) nominal profile
- 3,2 mm (.125″) nominal key travel
- N-key rollover
- Parallel/serial data outputs
- Environmentally sealed membrane protects against liquid spills, airborne dust and moisture
- Internal venting protects from the effects of ambient temperature and pressure changes
- Tactile feedback gives a smooth, crisp feel
- Electronic shielding reduces problems caused by electrical noise, cross coupling and stray capacitances
- Low power consumption
- Life . . . 30 million operations



CT Series Contact-membrane Keyboard (16CT)

FEATURES

- Environmentally sealed membrane protects the contacts from contamination
- Internal venting protects membrane from effects of ambient temperature/pressure changes
- Tactile feedback and hysteresis gives smooth, crisp feel of the switching action
- Adherence to good human factor principles promotes maximum throughput
- Two-key rollover
- Encoded for adding machine or telephone format
- Operates on 5 VDC supply
- Full-travel (150″ nominal)
- Life . . . 10 million operations

MICRO SWITCH, a Honeywell division

MICRO SWITCH

GENERAL SALES ORDER GUIDE

*Catalog Listings Hall Effect	Typical Applications	Power Requirements	Output Termination	Modes/Code Assignment	Keytops
12SD3-1	High Speed Numeric Entry	+5 VDC @ 50 mA	Solder Pad	Wired-only (Level)	Standard
16SD1-1	High Speed Numeric Entry	+5 VDC @ 132 mA	Card Edge	(1) BCD (Binary Coded Decimal)	Standard
16SD1-2	High Speed Numeric Entry	+5 VDC @ 132 mA	Card Edge	(1) BCD	Standard
16SD3-4	High Speed Numeric Entry	+5 VDC @ 80 mA	Solder Pad	Wired-only (Level)	Standard
16SD3-5	High Speed Numeric Entry	+5 VDC @ 80 mA	Solder Pad	Wired-only (Level)	Relengendable
16SD3-6	High Speed Numeric Entry	+5 VDC @ 130 mA	Solder Pad	Wired-only (Level)	Standard/LED
16SD3-7	High Speed Numeric Entry	+5 VDC @ 80 mA	Solder Pad	Wired-only (Level)	None
16SD3-12	High Speed Numeric Entry	+5 VDC @ 80 mA	40-Pin Header	Wired-only (Level)	Standard
16SD17-1	Adding Machine Format	+5 VDC @ 80 mA	Solder Pad	Wired-only (Scan)	Relegendable
16SD17-2	Telephone Format	+5 VDC @ 80 mA	Solder Pad	Wired-only (Scan)	None
26SD1-2	Point of Sale	+5 VDC @ 250 mA	Card Edge	(1) Six Bit Address	Standard/ Relegendable
51SD12-4	Typewriter Array	+5 VDC @ 200 mA −12 VDC @ 10 mA	Card Edge	(1) Six Bit Address	Sculptured
53SD5-2	Communications (Model 33 Array)	+5 VDC @ 250 mA −12 VDC @ 50 mA	Card Edge	(4) USASCII	Sloped
64SD30-1	Communications (Model 33 Array)	+5 VDC @ 156 mA	Rt. Angle Header	(4) USASCII	Stepped
66SD6-6	Interactive Visual Display (IBM 3790)	+5 VDC @ 0.5A −12 VDC @ 5 mA	Card Edge	(2) EBCDIC	Stepped
66SD12-10	Interactive Visual Display (IBM 3790)	+5 VDC @ 0.5A −12 VDC @ 5 mA	Card Edge	(2) EBCDIC	Stepped
66SD6-7	Interactive Visual Display (IBM 3270)	+5 VDC @ 0.5A −12 VDC @ 5 mA	Card Edge	(2) EBCDIC	Stepped
78SD6-5	Interactive Visual Display (IBM 3270)	+5 VDC @ 0.5A −12 VDC @ 5 mA	Card Edge	(2) EBCDIC	Stepped
83SD30-2	Interactive Visual Display (DEC's VT 100)	+5 VDC @ 350 mA	Rt. Angle Header	(4) USASCII	Sculptured
87SD30-8	Interactive Visual Display (IBM 3278)	+5 VDC @ 300 mA	Rt. Angle Header	(1) USASCII	Front Stamped/ Standard
87SD30-9	Interactive Visual Display (IBM 3278)	+5 VDC @ 300 mA	Rt. Angle Header	(1) USASCII	Front Stamped/ Standard
63SD30-1	General Purpose Visual Display	+5 VDC @ 156 mA	Rt. Angle Header	(4) USASCII	Stepped
103SD24-2	Intelligent Terminals	+5 VDC @ 500 mA	Rt. Angle Header	(4) USASCII	Stepped
103SD30-2	Intelligent Terminals	+5 VDC @ 125 mA	Rt. Angle Header	(4) USASCII	Stepped
104SD30-Series	European Arrays	+5 VDC @ 350 mA	Rt. Angle Header	(4) USASCII	Stepped
Capacitance-membrane (Standard Profile)					
63SC24-4	General Purpose Interactive Terminals	+5 VDC @ 250 mA	Rt. Angle Header	(4) USASCII	Sculptured
103SC24-2	General Purpose	+5 VDC @ 350 mA	Rt. Angle Header	(4) USASCII	Sculptured
(Low Profile DIN Standards)					
58SC36-2	Typewriter Array	+5 VDC @ 250 mA	Rt. Angle Header	(1) USASCII	Low Profile
63SC36-4	Interactive Display Terminal	+5 VDC @ 250 mA	Rt. Angle Header	(4) USASCII	Low Profile
83SC36-1	Interactive Display Terminal (DEC's VT 100)	+5 VDC @ 350 mA	Rt. Angle Header	(4) USASCII	Low Profile
87SC36-1	Interactive Display Terminal (IBM 3278)	+8 VDC @ 250 mA	Telephone Type Header	(1) Eight Bit Address	Low Profile/ Front Stamped
103SC36-1	General Purpose	+5 VDC @ 350 mA	Rt. Angle Header	(4) USASCII	Low Profile
Contact-membrane (Standard Profile)					
16CT1-1	Adding Machine Format	+5 VDC @ 25 mA	Card Edge	(1) BCD	Standard
16CT1-2	Telephone Format	+5 VDC @ 25 mA	Card Edge	(1) BCD	Standard
63CT18-4	Communications	–	Pigtail with Connector	Wired-only-X-Y matrix	Sculptured
103CT18-2	General Purpose	–	Pigtail with Connector	Wired-only-X-Y matrix	Sculptured
(Low Profile DIN Standards)					
63CT38-3	Communications	–	Pigtail with Connector	Wired-only-X-Y matrix	Stepped
103CT58-1	General Purpose	–	Pigtail with Connector	Wired-only-X-Y matrix	Sculptured
Touch Panel					
TCA431-2 (12 Stations)	Numeric Entry	0.5 to 30 VAC/DC @ 10 μA to 100 mA	Pigtail	(1) Wired-only	Embossment
TCA431-4 (16 Stations)	Numeric Entry	0.5 to 30 VAC/DC @ 10 μA to 100 mA	Pigtail	(1) Wired-only	Embossment
TCM454-1 (103 Stations)	General Purpose	+5 VDC @ 500 mA	Rt. Angle Header	(4) USASCII	Embossment
TCA454-1 (103 Stations)	General Purpose	0.5 to 30 VAC/DC @ 10 μA to 100 mA	Pigtail	Wired-only	Embossment

* First 2 digits indicate number of keys on keyboard.

WORLDWIDE SALES AND SERVICE

For technical literature on any of the general sale listings shown, application assistance, pricing and delivery scheduling; contact your nearest MICRO SWITCH Sales Office, write or call MICRO SWITCH, Freeport, IL 61032, Tel. 815/235-6600.

If your application calls for keyboards "sealed for hostile environments" NEMA 2, 3, 3R, 12 and 13, and military specifications MIL-STD-202 contact MICRO SWITCH, Freeport, IL 61032 for off-the-shelf listings.

MICRO SWITCH, a Honeywell division

OAK KEYBOARDS, KEYPADS, KEYSWITCHES

OAK 81 POSITION STANDARD FTM° KEYBOARD

- Low Cost
- Reliable
- Long Life
- Easy Interface
- Sealed
- Automated Assembly E³ Optional

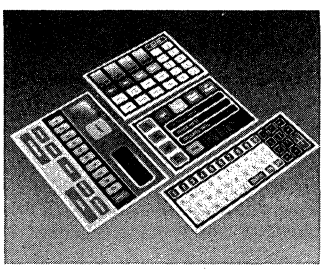
This is a full travel membrane keyboard to provide the latest high speed entry available. This unique keyboard features excellent long life parameters coupled with high resistance to environmental conditions.

The computer-controlled and adaptable membrane is the heart of this rugged keyboard. It features 81 standard keys with 79 momentary and 2 "lock" keys for "Shift" and "Caps." Life expectancy is in excess of 100 million per key. Pretravel is 0.80″ ±0.020″ and total travel is 0.160″.

Contact bounce is 500 microseconds (normal) and 5 milliseconds for hard rap induced bounce.

Operating voltage is from 1.0 to 30 V. Operating current is 50 microamps to 20 milliamps per single switch. Interconnection is row/column.

Complete specifications are available. Contact the nearest Oak sales office or distributor listed in EEM's "Yellow Pages" in this volume.



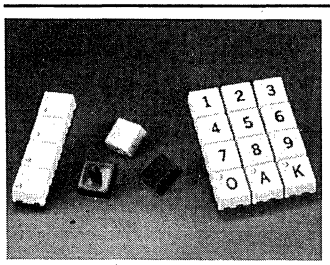
OAK TIP° (TOUCH-IN PANEL) MEMBRANE SWITCH

TIP switches operate reliably for over ten million cycles and offer the ultimate in environmental resistance and flexibility.

A wide variety of colors, key sizes and designs are available. The basic assembly consists of three parts; the outer membrane with graphics normally printed on the back for long life protection, a spacer and a substrate. The substrate is a P/C board with all of the connections and switches permanently positioned. Thousands of designs are possible.

Operating voltage is from 1 to 50 (AC or DC). Operating current is from 250 microwatts to as much as 1.5 Watts (peak).

Contact your nearest Oak sales office for complete details and specifications.



SERIES 225 LOW PROFILE PUSHBUTTON KEYBOARD SWITCH

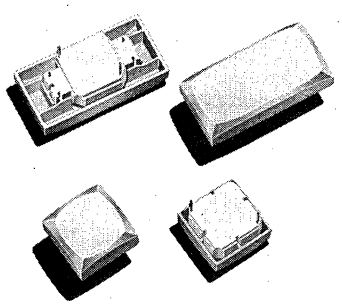
This new series of Oak keyboard switches is supplied in several styles: flattop, standard "cupped" and either .300″ high or the low-profile .225″ high style. Flattop models are available with red, green or yellow LEDs. All styles are .490″ square and are supplied in your choice of color and legend.

Standard mounting is by wave soldering to a P/C board. Almost any combination of key styles may be used on the board.

Typical life is in excess of one million cycles for operation over the range of −25° to +70°C. Maximum loads are 5 V (AC or DC) @ 100 mA.

A projection style is available for use with customer-supplied caps. All series 225 keyswitches are totally sealed for maximum resistance to any environmental hazards.

Contact the nearest Oak sales office for more information and/or specifications. See EEM's "Yellow Pages" for the office nearest you.



SERIES 415 KEYBOARD SWITCH

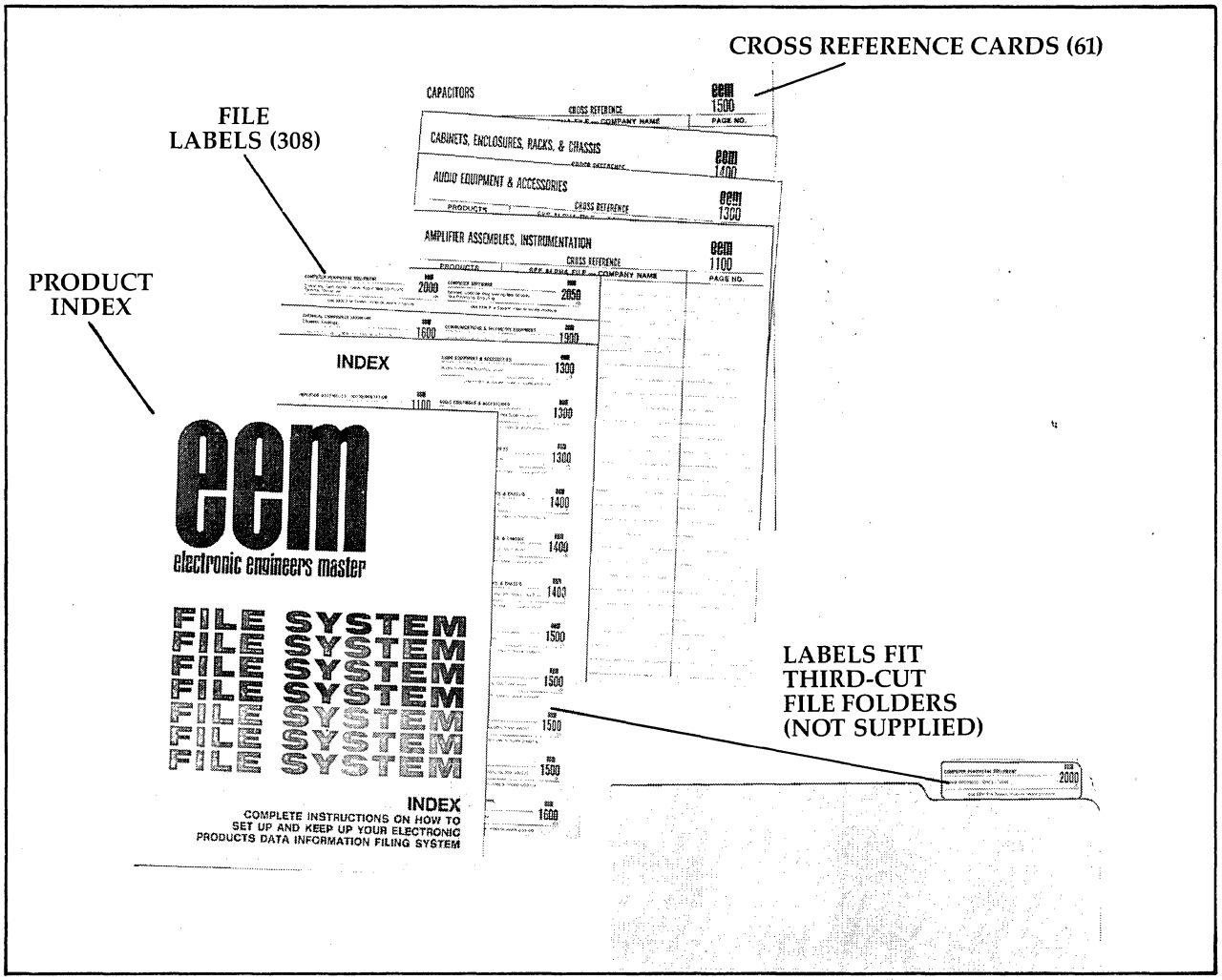
The series 415 keyboard switch is available in both single and double station styles. There are two standard sizes: .610″ square and .720″ square. The double station styles are: .610″ x 1.235″ and .720″ x 1.470″. The .610″ is available with the standard "cupped" design, a flattop or with a "raised" design which increases the height .062″.

Minimum operating life is ten million cycles under rated loads of 5 Volts (AC/DC) @ 100 mA.

This series mounts directly to a P/C board and keys are available in white, black, blue, red and gray. Standard markings are numbers 0-9 or blank. Special markings are available as are special key colors.

For more information, quotations, specifications or samples, contact your nearest Oak sales office listed in EEM's "Yellow Pages."

OAK SWITCH SYSTEMS, INC. P.O. Box 517, Crystal Lake, IL 60014
An Oak Technology Inc. Company (815) 459-5000 • TWX 910-634-3353 • TLX 72-2447



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

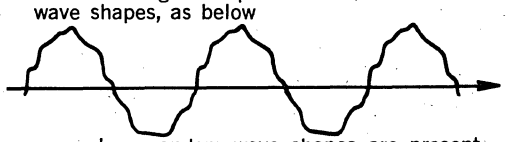
Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

Guide to types, models and applications of BEST vacuo-junction THERMOCOUPLES

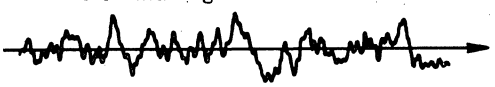
as used by leading instrument manufacturers for:

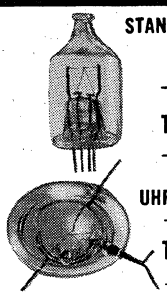
TRUE RMS MEASUREMENT

—where the signal is periodic with distorted wave shapes, as below



—or where random wave shapes are present, even with high crest factors

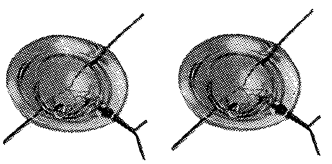
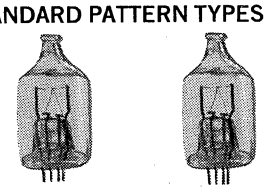




(Use either standard or UHF pattern, depending upon frequency)

LINEAR TRUE RMS MEASUREMENT

MATCHED PAIRS

	UHF TYPES		STANDARD PATTERN TYPES	
				
	Model MPU 1		Model MP1S7	Model MP219
Tracking accuracy	0.5%		0.5%	0.2%
Time constant	1 sec		1 sec	200ms
Nominal current	5mA		5mA	6.67mA

Tracking accuracy applies over full 25°C temperature range.

Single standard patterns for 5mA and higher, useable to −65MHz; for less than 5mA, usable to 10MHz.
Single UHF types usable to 500MHz
Temperature coefficient of output available from −0.2% per °C down to 0.005% per °C on special order.
Reversal error, standard 0.2%. Most models available with R/E down to 0.02%, some models to 0.005%.
Optional special features: short time constants to 50 ms; double heater devices, ultra miniature sizes.

PHYSICAL DATA, STANDARD PATTERNS

Height of envelope	0.900 inch
Diameter of envelope	0.437
Length of lead from envelope	2 ± ¼ inches
Length of sleeve from envelope	1¾ ± ¼ inches
Heater leads:	
Up to 400 milliamps	0.012 ± 0.002 inch diameter
500 milliamps and over	0.020 ± 0.002 inch diameter
Couple leads—all ranges	0.012 ± 0.002 inch diameter

PHYSICAL DATA, U.H.F. PATTERNS

Height of envelopes	0.750 inch
Diameter of envelope	0.800 inch
Width across heater leads	1.500 inches
Diameter of heater and couple wires	0.020 inch

Positive indicated by spot of red lacquer.
Specifications subject to change without notice.

Write on company letterhead for application notes and full line catalog

BEST ELECTRICS DIVISION
HARRY LEVINSON COMPANY
601 Aurora N. #107, Seattle, WA 98109 • Tel. (206) 285-5622 • TWX 910-444-2154

Partial list of BEST STANDARD PATTERNS, INSULATED

*Preferred units, available from stock.

Model No.	Range mA	Heater ohms Resistance ±10%	Couple ohms Resistance ±10%
Following models have O/C E.M.F. of 7mV ±12%. Maximum permissible load, 250% of nominal.			
*S1	1.0	1750	13
S2	1.25	1600	13
S3	1.5	1000	13
*S4	2.0	800	12
*S5	2.5	400	8
S6	3.0	200	8
*S7	5.0	90	8
*S8	7.5	45	8
*S9	10.0	25	8
S10	15.0	20	4
S11	20.0	15	4
S12 thru S23	25.0 thru 1000.0	10.0 thru 0.15	4
Following have O/C E.M.F. of 20mV ±12%. Maximum permissible load, 200% of nominal.			
S45	2.0	2000	13
S46	2.5	1600	13
S47	3.0	800	13
*S48	5.0	250	8
S49	7.5	180	8
*S50	10.0	125	8
S51	15.0	50	4
S52	20.0	30	4
S53 thru S64	25.0 thru 1000.0	25.0 thru 0.25	4
Following models have O/C E.M.F. of 10mV ±12%. Maximum permissible load, 200% of nominal.			
S98	1.25	1600	13
S99	2.0	800	13
S100	2.5	400	8
S101	3.0	300	8
*S102	5.0	125	8
S103	7.5	70	8
*S104	10.0	40	8
S105	15.0	25	4
S106	20.0	20	4
S107 thru S118	25.0 thru 1000.0	15.0 thru 0.15	4

BEST U.H.F. UNITS, INSULATED

*Preferred units, available from stock.

Capacitance	0.3 mfd
Inductance, approx.	0.02 uH

Model No.	Range mA	Heater ohms Resistance ±10%	Couple ohms Resistance ±10%
Following models have O/C E.M.F. of 7 mv ±12%. Maximum permissible load, 250% of nominal.			
*U1	5	90	8
*U2	10	25	8
U3	15	20	4
U4	20	15	4
U5	25	10	4
U6	50	3	4
U7	100	1.5	4
U8	150	1.0	4
U9	200	0.7	4
U10	250	0.6	4
U11	500	0.3	4
U12	1000	0.15	4
U27	2.5	200	8

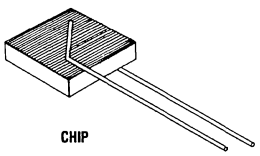
(Max. Perm. Load, Model U27, 150% of nominal)

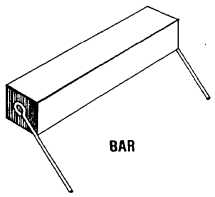
CAL-R, INC.

THERMISTORS

LEADED CHIP, BAR & CUBE

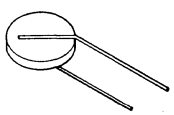
Cal-R Leaded chip and bar thermistors are produced from metal oxide ceramic materials utilizing a unique process which affords the highest degree of manufacturing control.





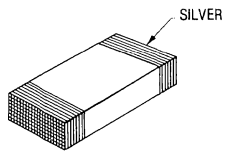
NTC DISCS

Maximum operating temperature 150°C (higher temperatures available).



HYBRID CHIP

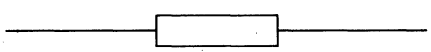
Cal-R Hybrid Chip Thermistors are produced by the same exacting manufacturing process as the Leaded Chip Thermistor and demonstrate the same electrical characteristics. Only the configuration is changed in order that they may be mounted in hybrid circuits utilizing the same equipment and techniques employed in the installation of other hybrid components. Cal-R hybrid chip thermistors are available with either silver or palladium-silver terminations to meet your process requirements.



LINEAR PTC DEVICES

Temperature Coefficient: +.45%/°C & ±.02%/°C (+0.6%°C available).

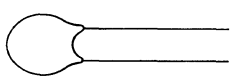
EPOXY COATED — RESISTANCE TOLERANCE ±1, 3, 5 & 10%



INTERCHANGEABLE THERMISTORS

Thermistors designed for interchangeability over a temperature range of 0°C to 80°C without the necessity of recalibrating the system.

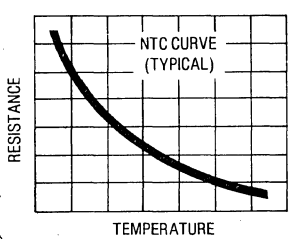
EPOXY COATED

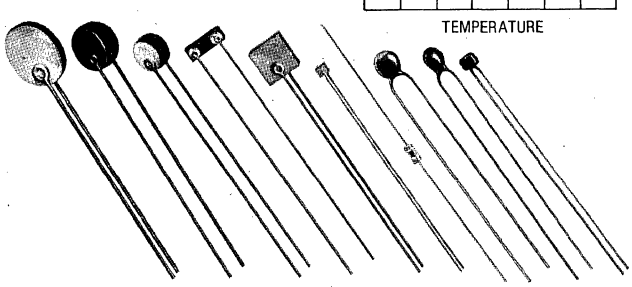


NTC (Negative Temperature Coefficient)

Thermistors offer inexpensive solutions to:

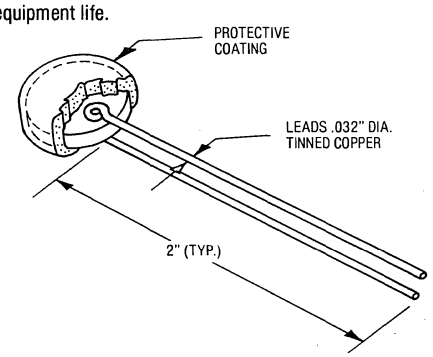
- Temperature Compensation
- Time Delay
- Soft Start
- Gas and Liquid Level Sensing
- Temperature Sensing and Control





SOFT START "INRUSH CURRENT" SUPPRESSING DEVICES

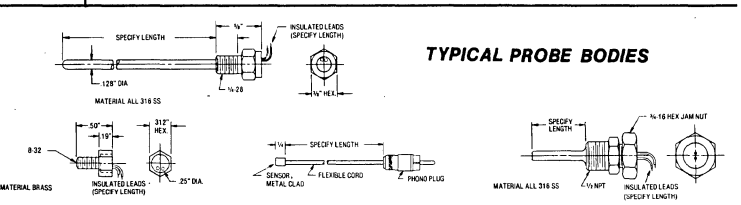
Cal-R Soft Start devices, made from rugged metal oxide ceramic materials, protect against high inrush currents in either AC or DC circuits. Soft Start affords protection for circuit components and assures longer equipment life.



TEMPERATURE SENSING PROBES

NTC, PTC & NETWORKS
(TEMPERATURE RANGE —60 TO +400°C)

Resistance (@ 25°C) range 50 ohm to 1 megohm — tolerance 10% to 0.5% or better.



TYPICAL PROBE BODIES

CAL-R probes are designed for air, surface, and liquid temperature measurement and control applications. Special industrial probes can be produced to customer specifications.

CAL-R engineers will design Temperature Sensing Probes for your special application. Outline your problem or specifications and send them to: CAL-R Applications Engineering Department.

CAL-R INC. THERMONETICS DIVISION

THERMISTORS — Negative Temperature Coefficient

THERMISTOR SPECIFICATIONS

R@ 25°C Ω ±10%	Part Number	NTC %/°C @ 25°C	Nominal D.C.*	Nominal T.C.**	Max. Dimensions A	Max. Dimensions B	Leads AWG#	Type
100,000	2J05	−4.4	3	10	.06	.26	30	Bar
75,000	2J06	−4.4	3	8	.06	.20	30	Bar
50,000	2J07	−4.4	3	7	.06	.15	30	Bar
30,000	2J08	−4.4	2	6	.06	.08	30	Bar
25,000	2J09	−4.4	2	5	.06	.07	30	Bar
20,000	2J10	−4.4	2	5	.06	.06	30	Chip
15,000	2J11	−4.4	2	4	.06	.05	30	Chip
10,000	2J12	−4.4	2	4	.06	.04	30	Chip
10,000	1J112	−4.4	2	4	.08	.05	30	Disc
10,000	1J13	−4.4	4	12	.11	.10	28	Disc
8,000	1J14	−4.4	4	10	.11	.08	28	Disc
7,000	1J145	−4.4	4	10	.11	.07	28	Disc
6,000	1J147	−4.4	3	9	.11	.06	28	Disc
5,000	1J15	−4.4	3	8	.11	.05	28	Disc
5,000	2J15	−4.4	3	8	.10	.04	28	Chip
4,000	1J154	−4.4	5	23	.16	.10	28	Disc
4,000	2J165	−4.4	3	8	.10	.04	28	Chip
3,000	2J16	−4.4	3	—	.12	.04	28	Chip
3,000	1J155	−4.4	6	20	.16	.08	28	Disc
2,500	1J158	−4.4	5	19	.16	.07	28	Disc
2,000	2J17	−4.4	3	5	.10	.03	28	Chip
2,000	1J20	−4.4	7	25	.22	.09	24	Disc
2,000	1D10	−3.9	2	3	.06	.04	30	Disc
2,000	2D10	−3.9	2	4	.06	.04	30	Chip
1,500	1D111	−3.9	2	3	.08	.06	30	Disc
1,000	2J21	−4.4	6	15	.18	.04	24	Chip
1,000	1J24	−4.4	9	48	.32	.09	24	Disc
1,000	1D112	−3.9	2	4	.08	.04	30	Disc
1,000	1D13	−3.9	4	10	.11	.08	28	Disc
1,000	2D13	−3.9	2	3	.08	.04	28	Chip
800	1D14	−3.9	3	8	.11	.06	28	Disc
700	1D145	−3.9	3	7	.11	.05	28	Disc
600	1D147	−3.9	3	7	.11	.04	28	Disc
500	1D15	−3.9	3	6	.11	.04	28	Disc
500	2D15	−3.9	2	4	.10	.04	28	Chip
500	1D153	−3.9	7	20	.16	.08	28	Disc
400	2D165	−3.9	2	4	.11	.04	28	Chip
300	2D16	−3.9	3	5	.10	.03	28	Chip
300	1D19	−3.9	7	25	.22	.09	24	Disc
200	2D20	−3.9	6	—	.15	.04	—	Chip
100	2D21	−3.9	6	—	.18	.04	24	Chip
100	2B13	−3.3	2	4	.07	.04	28	Chip
80	2B14	−3.3	2	4	.08	.04	28	Chip
80	2D211	−3.9	5	—	.20	.04	24	Chip
50	2D24	−3.9	6	—	.32	.04	24	Chip
50	2B15	−3.3	2	4	.10	.04	28	Chip
30	2D31	−3.9	7	—	.35	.04	24	Chip
30	2B16	−3.3	2	4	.10	.03	28	Chip
25	2D33	−3.9	7	—	.36	.04	24	Chip
20	2D34	−3.9	7	—	.36	.04	24	Chip
20	2B17	−3.3	3	4	.16	.04	28	Chip
10	2B21	−3.3	5	—	.18	.04	28	Chip
5	2B24	−3.3	6	—	.30	.04	24	Chip

"INTERCHANGEABLE (±0.2°C 0° To 80°C) THERMISTORS"*** EPOXY COATED

2,000	5J102	—4.4	3	10	.125	.125	30	Spherical
3,000	5J103	—4.4	3	10	.125	.125	30	Spherical
5,000	5J105	—4.4	2	8	.100	.100	30	Spherical
10,000	5J110	—4.4	2	8	.100	.100	30	Spherical
20,000	5J120	—4.4	2	8	.100	.100	30	Spherical

***** INTERCHANGEABLE THERMISTORS**

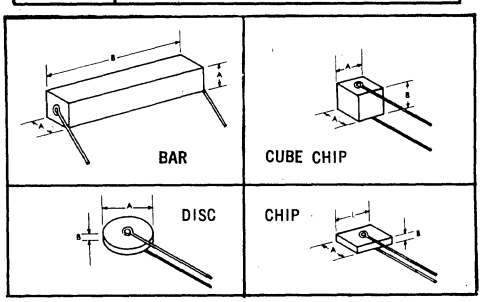
Thermistors designed for interchangability over narrower temperature ranges are available to your specifications at lower cost.

R/T CONVERSION TABLE

TEMPERATURE °C	TEMPERATURE °F	CURVE B R_t/R_{25}	CURVE D R_t/R_{25}	CURVE J R_t/R_{25}
—60	—76	43.0	73.04	140.5
—50	—58	24.3	38.95	67.0
—40	—40	14.4	21.51	33.7
—30	—22	8.93	12.33	17.7
—21.5	—6.7	6.09	—	10.6
—20	— 4	5.69	7.307	9.71
—10	+14	3.68	4.476	5.53
0	32	2.45	2.825	3.27
10	50	1.68	1.830	1.99
20	68	1.18	1.216	1.25
25	77	1.00	1.000	1.00
30	86	.854	.8267	.806
37.8	100	.671	—	.583
40	104	.628	.5742	.533
50	122	.464	.4067	.360
60	140	.350	.2937	.249
70	158	.267	.2160	.175
75	167	.236	—	.148
80	176	.208	.1615	.126
90	194	.163	.1229	.0916
100	212	.130	.0946	.0679
104.4	220	.118	—	.0598
110	230	.105	.0739	.0511
120	248	.0852	.0584	.0389
125	257	.0771	—	.0342
130	266	.0700	.0470	.0301
140	284	.0579	.0382	.0235
150	302	.0483	.0313	.0185

The alphabetical letter in the part number indicates the curve. To determine the approximate resistance of a thermistor at a specified temperature, multiply the thermistor resistance at 25°C by the ratio factor opposite that temperature on the R/T conversion table.

CURVE B	Ratio $\frac{R@\ 25°C}{R@\ 125°C} = 12.95 \pm 10\%$
CURVE D	Ratio $\frac{R@\ 25°C}{R@\ 125°C} = 19.8 \pm 10\%$
CURVE J	Ratio $\frac{R@\ 25°C}{R@\ 125°C} = 29.85 \pm 10\%$



***DISSIPATION CONSTANT**

Dissipation Constant, expressed in mw/°C, represents the amount of power required to raise the temperature of a thermistor 1°C.

****TIME CONSTANT**

Time Constant, expressed in seconds, is the time required for a thermistor dissipating zero power to change 63% of the difference between its initial temperature value and that of a new temperature environment.

CAL-R thermistors conform to AQL and confidence levels specified in MIL-T-23648, tables V and VI.

Coatings, marking, special leads, probes, resistor/thermistor networks, resistance values from 1 ohm to 150 KΩ, and other product variations are produced to meet your design requirements.

Resistance tolerances of ±1% through ±20% are available and may be specified at 25°C or any temperature within the operating range. Maximum operating temperature with leads 150°C.

CAL-R INC. / THERMISTORS • RESISTORS • MICROELECTRONICS
1601 OLYMPIC BOULEVARD, SANTA MONICA, CALIFORNIA 90404 (213) 450-1761 • TWX 910-343-6966

CAL-R®, INC.

THERMISTOR DIVISION

"SOFT-START"

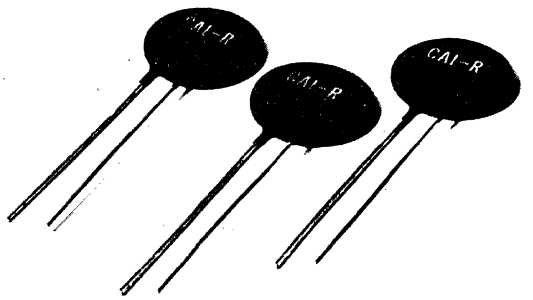
INRUSH CURRENT SUPPRESSING DEVICES

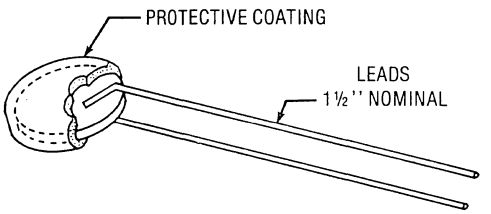
"Soft-Start" devices display relatively high resistance to starting currents in a variety of electronic circuits. Having a negative temperature coefficient of resistance, these devices exhibit a large decrease in resistance when an AC or DC current is applied.

Unlike circuit breakers and fuses, "Soft-Starts" prevent dangerous, short-duration, peak inrush currents present at turn-on. Especially useful in power supplies where charging capacitors initially present extremely low impedance, "Soft-Starts" actually limit inrush currents thereby extending the life of other critical components.

Part Number	I_{max} (Amperes)	R_0 25°C (Ohms)	R@I_{max} (Ohms)	Maximum Diameter (Inches)	Maximum Thickness (Inches)	Lead Diameter (Inches)
25SS25	25	1	.01	1.10	.35	.040
20SS20	20	1	.015	.90	.30	.040
18SS36	18	2	.03	.90	.35	.040
15SS38	15	2.5	.03	.60	.30	.040
14SS56	14	4	.05	.90	.35	.040
12SS60	12	5	.06	.90	.50	.040
12SS30	12	2.5	.04	.90	.35	.040
10SS50	10	5	.06	.90	.35	.040
10SS25	10	2.5	.04	.90	.25	.040
9SS45	9	5	.06	.90	.25	.040
9SS23	9	2.5	.04	.60	.25	.032
8SS40	8	5	.05	.60	.25	.040
8SS32	8	4	.07	.60	.25	.040
7SS35	7	5	.07	.60	.25	.032
7SS18	7	2.5	.05	.60	.25	.032
6SS60	6	10	.15	.60	.35	.040
6SS42	6	7	.15	.60	.30	.040
6SS30	6	5	.07	.60	.25	.032
5SS50	5	10	.20	.60	.35	.040
5SS35	5	7	.15	.60	.30	.040
5SS20	5	4	.15	.60	.25	.032
4SS48	4	12	.22	.50	.35	.040
4SS28	4	7	.15	.60	.30	.040
4SS20	4	5	.15	.60	.25	.032
3SS30	3	10	.20	.50	.30	.032
3SS21	3	7	.14	.60	.25	.032
3SS15	3	5	.17	.60	.25	.032
3SS08	3	2.5	.15	.60	.25	.032
2SS80	2	40	.60	.70	.25	.032
2SS40	2	20	.28	.60	.25	.032
2SS20	2	10	.20	.60	.25	.032
2SS10	2	5	.40	.60	.25	.032
1.5SS90	1.5	60	1.00	.60	.25	.032
1.5SS60	1.5	40	.80	.60	.25	.032
1.5SS38	1.5	25	.60	.50	.30	.032
1.5SS15	1.5	10	.25	.50	.25	.032

- Standard $R_0$25°C tolerance is ±20%. Closer tolerances are available upon request.
- Protective silicone coating is standard and has a nominal thickness of .02 inches. Other coatings are available upon request.
- Standard lead material is tinned copper-clad steel. Nickel or copper leads are available upon request.
- Special marking is available upon request.





DEFINITIONS

I_{max}
Represents the maximum rated steady state DC or RMS current and is expressed in amperes.

$R_0$25°C
Represents the zero power resistance of the device at +25°C and is expressed in ohms.

R@I_{max}
Represents the approximate resistance at maximum steady state current conditions and is expressed in ohms.

Ambient Temp.
Full rated current may be applied in the ambient temperature range of +25°C to +65°C and must be derated in accordance with I_{max} derating curve.

I_{op}
Represents the actual operating current applied.

Cool-Down Time
Is the amount of time needed for a "Soft-Start" device to cool enough to cause the necessary amount of resistance to limit inrush current.

CARBORUNDUM THERMISTORS

APPLICATION DATA

Carborundum thermistors are temperature dependent resistors, offered in a wide variety of resistance-temperature characteristics. They are available with a wide range of negative temperature coefficients at 25°C ranging from −0.3%/°C to −5.4%/°C. These parts are made from ceramic materials, bonded in a high-temperature firing process into rod, disc, and chip configurations. They are available in a large range of sizes, thermal characteristics, resistance values, and temperature coefficients to suit the needs of many types of electrical and electronic circuits.

Carborundum offers long experience in the design of special resistance devices. This, together with expertise in the field of ceramic technology, assures a stable and uniform product to meet your thermistor requirements. All materials used in the manufacture of Carborundum thermistors are of the highest quality. Strict quality control is maintained over all stages of manufacture, and a minimum of two calibrations at the specified reference temperature is standard.

DEFINITIONS

Zero Power Resistance... is the resistance of a thermistor at the calibrating temperature, measured in such a manner that the measuring current does not appreciably heat the thermistor. Resistance, as used here, means zero power resistance unless otherwise stated.

Beta (β)... is the number that satisfies the equation:

$$R_1/R_2 = \epsilon^{\beta\,(1/T_1 - 1/T_2)}$$

Carborundum determines beta from measurements at 25°C and 73.2°C. Beta is proportional to the slope of the resistance-temperature characteristic, and it is also known as the material constant. It is not truly a constant, but it gives a good approximation of resistance over a substantial working range. In the equation, ϵ is 2.718..., the base of natural logarithms, and β, T_1, and T_2 are in Kelvin (K).

Alpha (α)... or temperature coefficient of resistance (TCR) is proportional both to beta and to the square root of the temperature at which it is specified. Very nearly,

$$\alpha = -100\ \beta/T^2$$

In this equation, temperature is in Kelvin (K), and α is in percent per degree C (%/°C). It is evident that alpha becomes much higher as temperatures decrease.

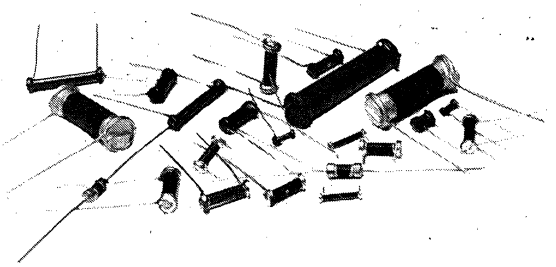
Dissipation Constant (δ)... is the ratio of power dissipated by the thermistor divided by the temperature rise above ambient due to self-heating. Here, it is 20 times the power required, in watts, to bring the thermistor to 75°C in an ambient of 25°C, and it is expressed in milliwatts.

Time Constant (τ)... is the time required for a thermistor which has attained equilibrium after being self-heated to 75°C to cool to 43.4°C in an ambient of 25°C. It is expressed in seconds.

Both δ and τ are necessarily approximate quantities, and they represent complicated concepts. They cannot be fully defined or used unless the conditions under which they are measured are fully defined.

In particular, note that the dissipation of a thermistor is the sum of dissipation due to conduction, convection, and radiation, which are related to temperature by linear, square-law, and fourth-power equations respectively. Only over narrow temperature ranges can dissipation constant be considered constant.

Also note that time constant is defined by a zero-power cooling curve. If the thermistor is attached to a heat sink the effective time constant is changed substantially. The time required for a thermistor to reach equilibrium due to heating from a current passing through it may be dramatically different from the time constant as defined above.



THERMISTOR SPECIFICATION

Thermistors are most often specified by a zero power resistance, suitably toleranced, at some specified temperature (most often 25°C or 37.8°C), and by a temperature coefficient, also suitably toleranced. This is all that is required as an electrical specification. Additional specifications may result in double dimensioning and be unduly restrictive (and therefore costly) or ambiguous.

The zero power resistance of a thermistor should be read in a temperature controlled, agitated oil bath. Not only does the oil bath provide a more controllable constant temperature, but it also speeds the settling of the reading.

ROD THERMISTORS

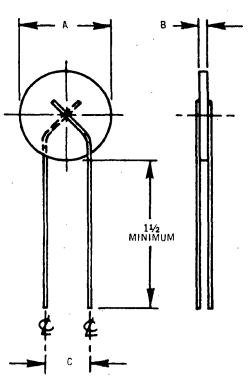
Rod thermistors are manufactured by extruding and firing a suitable ceramic mixture. For a given type of thermistor, low-, medium-, or high-sensitivity, a number of mixtures are available: in general, a mixture yielding a higher resistivity product also yields a higher beta or temperature sensitivity.

Standard rod thermistors are shown in the following table. They have a resistance tolerance of ±10% at 25°C, and they are neither coated nor marked. Special rod thermistors may be ordered with intermediate resistance values, other resistance tolerances, other calibration temperatures, coating, marking, special lead preparation, etc. Parts without wire leads are also available.

DISC THERMISTORS

Disc thermistors are manufactured by pressing and firing a suitable ceramic mixture. Carborundum offers six standard mixtures of various resistivity and beta.

Standard disc thermistors are shown in the following table. They have a resistance tolerance of ±10% at 25°C, and they are neither coated nor marked. Special disc thermistors may be ordered with intermediate resistance values, other resistance tolerances, other calibration temperatures, coating, marking, special lead preparation, etc. Parts without wire leads are also available.



CARBORUNDUM

Carborundum Resistant Materials Company
Electric Products Division, Post Office Box 339, Niagara Falls, N.Y. 14302
Tel: (716) 278-2521 • Telex: 91-555 (CARBO GLO NGF)

CARBORUNDUM THERMISTORS

Specifications	Type A	Type B	Type C	Types D & L	Type M
R @ 25°C / R @ 125°C	28.5	14.2	18.7	35.3	62.0
β (K) ±5% (25.0°C - 73.2°C)	3980	3070	3415	4200	4900
Temp. Coef. (α) %/°C @ 25°C	−4.4	−3.4	−3.8	−4.7	−5.4

ROD THERMISTORS

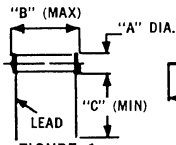


FIGURE 1

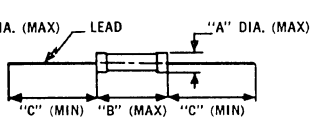


FIGURE 2

Style	Figure	Dimensions (inches) A	B	C	AWG	Dissipation Constant (mw/°C)	Time Constant (seconds)
0325F5- 0325H5-	1	0.12	0.30	1.00	24	6.0	10
0540F4- 0550H4-	2 2	0.20 0.20	0.50 0.63	1.25 1.25	20 20	9.5 11.0	22 25
0550F5- 0550H5-	1	0.22	0.63	1.38	20	11.0	25
1099F5-	1	0.38	1.13	1.38	20	24.0	90

		MEDIUM TEMPERATURE COEFFICIENT Type "F" Rods Beta ±10%			HIGH TEMPERATURE COEFFICIENT Type "H" Rods Beta ±5%	
Resistance Ohms ±10% @ 25°C	Dash Number	Style 0325F5	Styles 0540F4- 0550F5-	Style 1099F5-	Style 0325H5-	Styles 0550H4- 0550H5-
2.2	-402	—	—	1300	—	—
3.3	-403	—	—	1350	—	—
4.7	-404	—	1300	1400	—	—
6.8	-406	—	1350	1450	—	—
10.0	-410	1300	1400	1500	—	—
15.0	-411	1350	1450	1550	—	—
22.0	-412	1400	1500	1600	—	—
33.0	-413	1450	1550	1600	—	—
47.0	-414	1500	1600	1650	—	—
68.0	-416	1550	1600	1650	—	—
100	-420	1600	1650	1700	—	—
150	-421	1600	1650	1700	—	—
220	-422	1650	1700	1750	—	—
330	-423	1650	1700	1750	—	—
470	-424	1700	1750	1800	—	—
680	-426	1700	1750	1800	—	—
1,000	-430	1750	1800	1850	—	3000
1,500	-431	1750	1800	1850	—	3100
2,200	-432	1800	1850	1900	3000	3150
3,300	-433	1800	1850	1900	3100	3200
4,700	-434	1850	1900	1950	3150	3300
6,800	-436	1850	1900	1950	3200	3400
10,000	-440	1900	1950	2000	3300	3500
15,000	-441	1900	1950	2000	3400	3600
22,000	-442	1950	2000	2050	3500	3700
33,000	-443	1950	2000	2050	3600	3800
47,000	-444	2000	2050	2100	3700	3900
68,000	-446	2000	2050	2100	3800	4000
100,000	-450	2050	2100	2150	3900	4100
150,000	-451	2050	2100	2150	4000	4150
220,000	-452	2100	2150	2200	4100	4200
330,000	-453	2100	2150	2200	4150	4250
470,000	-454	2150	2200	2200	4200	4300
680,000	-456	2150	2200	—	4250	4350
1,000,000	-460	2200	2200	—	4300	4400
1,500,000	-461	2200	—	—	4350	—
2,200,000	-462	2200	—	—	4400	—

Order by the style number followed by the dash number. For example, part number 0540F4-404 is a thermistor of style 0540F4-, of 4.7 ±10% ohms resistance, and with a beta of 1300 ±10% K.

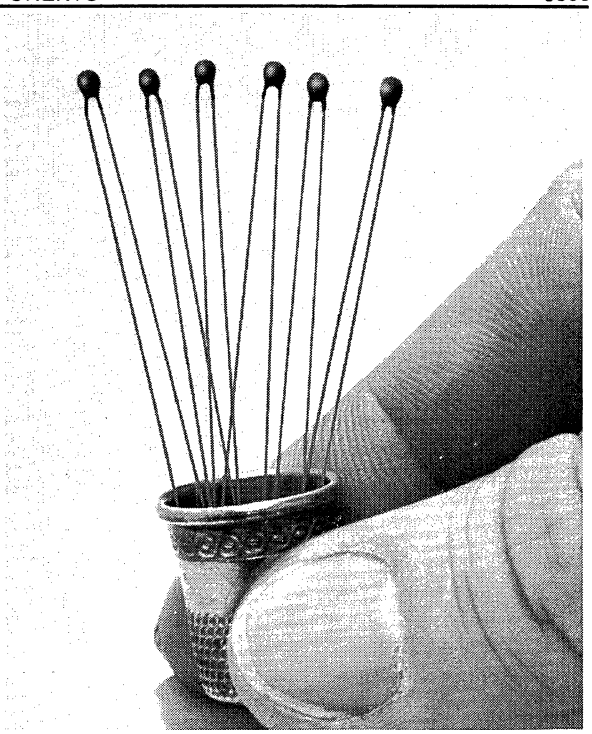
HIGH SENSITIVITY NTC DISCS

TYPICAL PARTS

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "A" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
A3306J-16	50 ±20%	0.82	0.06	3/8	18	29.0	100
A2606J-16	75 ±20%	0.65	0.06	3/8	20	20.0	80
A2004J-16	100 ±10%	0.50	0.04	1/4	20	15.0	60
A3311J-16	100 ±20%	0.82	0.11	3/8	18	29.0	150
A2207J-16	120 ±20%	0.55	0.07	1/4	20	17.0	75
A3312J-16	120 ±20%	0.82	0.12	3/8	18	29.0	150
A1604J-16	150 ±10%	0.40	0.04	1/4	20	9.0	38
A1203J-16	200 ±10%	0.30	0.03	1/4	24	8.0	30
A2612J-16	200 ±20%	0.65	0.12	3/8	20	22.0	100
A1204J-16	300 ±10%	0.30	0.04	1/4	24	8.0	30
A0803J-16	500 ±10%	0.20	0.03	1/8	24	7.0	20
A1612J-16	500 ±10%	0.40	0.12	1/4	20	11.0	60
A0805J-16	750 ±10%	0.20	0.05	1/8	24	7.0	23
A0807J-16	1,000 ±10%	0.20	0.07	1/8	24	7.2	26
A1212J-16	1,000 ±10%	0.30	0.12	1/4	24	9.0	40
A0809J-16	1,500 ±10%	0.20	0.09	1/8	24	7.5	30
A0810J-16	2,000 ±10%	0.20	0.10	1/8	24	7.5	30
TYPE "B" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
B3306J-16	2.0 ±20%	0.82	0.06	3/8	18	29.0	100
B2605J-16	3.0 ±20%	0.65	0.05	3/8	20	20.0	80
B1804J-16	3.8 ±20%	0.45	0.04	3/8	22	12.0	48
B2004J-16	5.0 ±10%	0.50	0.04	1/4	20	15.0	60
B3312J-16	5.0 ±20%	0.82	0.12	3/8	18	29.0	150
B1604J-16	7.5 ±10%	0.40	0.04	1/4	20	9.0	38
B1203J-16	10.0 ±10%	0.30	0.03	1/4	24	8.0	30
B2612J-16	10.0 ±20%	0.65	0.12	3/8	20	22.0	100
B1205J-16	15.0 ±10%	0.30	0.05	1/4	24	8.5	35
B1206J-16	20.0 ±10%	0.30	0.06	1/4	24	8.5	35
B2012J-16	20.0 ±10%	0.50	0.12	1/4	20	16.0	80
B0804J-16	30.0 ±10%	0.20	0.04	1/8	24	7.0	20
B0807J-16	50.0 ±10%	0.20	0.07	1/8	24	7.2	26
B1212J-16	50.0 ±10%	0.30	0.12	1/4	24	9.0	40
B0809J-16	75.0 ±10%	0.20	0.09	1/8	24	7.5	30
B0810J-16	100.0 ±10%	0.20	0.10	1/8	24	7.5	30
TYPE "C" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
C2604J-16	10.0 ±10%	0.65	0.04	3/8	20	20.0	80
C2004J-16	15.0 ±10%	0.50	0.04	1/4	20	15.0	60
C1603J-16	20.0 ±10%	0.40	0.03	1/4	20	9.0	38
C3312J-16	20.0 ±20%	0.82	0.12	3/8	18	29.0	150
C1605J-16	30.0 ±10%	0.40	0.05	1/4	20	9.0	38
C1205J-16	50.0 ±10%	0.30	0.05	1/4	24	8.5	35
C2012J-16	50.0 ±10%	0.50	0.12	1/4	20	16.0	80
C0803J-16	75.0 ±10%	0.20	0.03	1/8	24	7.0	20
C0804J-16	100.0 ±10%	0.20	0.04	1/8	24	7.0	20
C1612J-16	100.0 ±10%	0.40	0.12	1/4	20	11.0	60
C0807J-16	150.0 ±10%	0.20	0.07	1/8	24	7.2	26
C0808J-16	200.0 ±10%	0.20	0.08	1/8	24	7.2	26
C1212J-16	200.0 ±10%	0.30	0.12	1/4	24	9.0	40
C0810J-16	300.0 ±10%	0.20	0.10	1/8	24	7.5	30
TYPE "D" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
D2604J-16	100 ±20%	0.65	0.04	3/8	20	20.0	80
D2003J-16	150 ±10%	0.50	0.03	1/4	20	15.0	60
D1804J-16	200 ±10%	0.45	0.04	1/4	20	12.0	48
D3312J-16	200 ±20%	0.82	0.12	3/8	18	29.0	150
D1604J-16	300 ±10%	0.40	0.04	1/4	20	9.0	38
D1204J-16	500 ±10%	0.30	0.04	1/4	24	8.0	30
D2612J-16	500 ±20%	0.65	0.12	3/8	20	22.0	100
D1206J-16	750 ±10%	0.30	0.06	1/4	24	8.5	35
D1207J-16	1,000 ±10%	0.30	0.07	1/4	24	8.5	35
D1612J-16	1,000 ±10%	0.40	0.12	1/4	20	11.0	60
D0806J-16	1,500 ±10%	0.20	0.06	1/8	24	7.0	23
D0807J-16	2,000 ±10%	0.20	0.07	1/8	24	7.2	26
D1212J-16	2,000 ±10%	0.30	0.12	1/4	24	9.0	40
D0810J-16	3,000 ±10%	0.20	0.10	1/8	24	7.5	30
TYPE "L" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
L1205J-16	3,000 ±10%	0.30	0.05	1/4	24	8.5	35
L1209J-16	5,000 ±10%	0.30	0.09	1/4	24	9.0	40
L0805J-16	7,500 ±10%	0.20	0.05	1/8	24	7.0	23
L0807J-16	10,000 ±10%	0.20	0.07	1/8	24	7.2	26
L0810J-16	15,000 ±10%	0.20	0.10	1/8	24	7.5	30
TYPE "M" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
M1203J-16	7,500 ±10%	0.30	0.03	1/4	24	8.0	30
M1204J-16	10,000 ±10%	0.30	0.04	1/4	24	8.5	35
M2012J-16	10,000 ±10%	0.50	0.12	1/4	20	16.0	80
M1207J-16	15,000 ±10%	0.30	0.07	1/4	24	8.5	35
M0803J-16	20,000 ±10%	0.20	0.03	1/8	24	7.0	20
M1209J-16	20,000 ±10%	0.30	0.09	1/4	24	9.0	40
M0805J-16	30,000 ±10%	0.20	0.05	1/8	24	7.0	23
M0809J-16	50,000 ±10%	0.20	0.09	1/8	24	7.5	30
M0810J-16	75,000 ±10%	0.20	0.10	1/8	24	7.5	30

DALE® THERMISTORS

Interchangeable and Custom Negative Temperature Coefficient (NTC)



NTC Thermistors are the most sensitive temperature sensors known to exist for temperature measurement and control between −50°C and +150°C. Dale Thermistors are rugged, reliable, predictable and are easily assembled in small housings to meet a multitude of temperature measurement and control requirements. The effects of "noise", which may be a factor with other sensors, and conductor resistance resulting from the installation of thermistors in remote locations, has minimal effect on system accuracy.

Interchangeable Thermistors provide greater temperature measurement and control accuracy over wider temperature ranges. In addition, they allow the use of multiple thermistor sensors with a single readout or control system and save money by eliminating costly calibration procedures. Dale Thermistors are backed by more than a decade's experience in manufacturing smaller, low-cost NTC styles which are used in a variety of temperature measurement and control equipment worldwide.

Resistance values and tolerances. The following charts list "standard" thermistor resistance values and tolerances. Contact us for additional information and assistance in developing custom thermistors and sensor assemblies to meet your application requirements.

SPECIFICATIONS

Point-Matched Tolerance: NTC Thermistors may be ordered with a temperature or a resistance tolerance at a temperature point. Parts listed are specified at 25°C:

Ω TOLERANCE	TEMPERATURE TOLERANCE
±10%—no suffix	±1.0°C— -A
± 5%— -5	±0.5°C— -B
± 3%— -3	±0.2°C— -C
± 1%— -1	

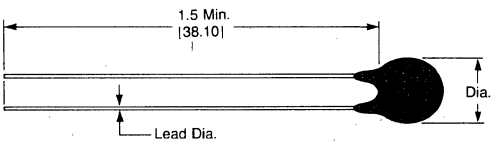
Interchangeable Tolerance: To simplify specification in ordering interchangeable Thermistors, they are specified to a temperature tolerance over a temperature range. The temperature tolerance corresponds to a resistance tolerance based on the temperature coefficient at each temperature point within the specified range (see definition of NTC).

INTERCHANGEABLE TOLERANCES AVAILABLE

	0° to 70°C	
TOLERANCE		SUFFIX
±1.0°C	—	A3
±0.5°C	—	B3
±0.2°C	—	C3

To specify, add the appropriate suffix to the part number selected from the "Most Specified NTC Thermistors" chart. *Example:* 1M1002-B3, Curve 1, 10KΩ @25°C, *interchangeable to* ±.5°C from 0° to 70°C. Asterisk (*) indicates ±0.2°C tolerance available for interchangeable thermistors.

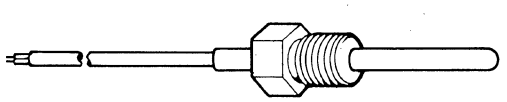
R_{25} Values ±10% listed are typical. 40Ω to 40 megohm @ 25°C available. Add -5 for ±5%, -2 for ±2%, etc. to part number for closer tolerance at temperature T.

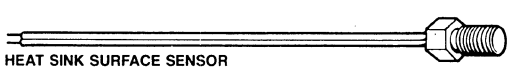


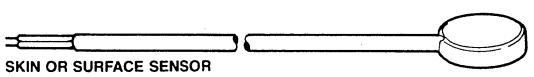
Leads: T series thermistors have Teflon insulated leads 3" [76.20] ± .25 [6.35]. All others are solid tinned copper 1.5 [38.10] ± .2 [5.08] long unless otherwise specified.

Coating: "Baked-on phenolic" for durability and improved long term stability. Other coatings are available.

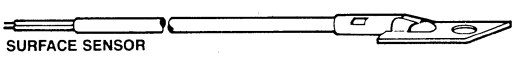
TYPICAL SENSOR ASSEMBLIES

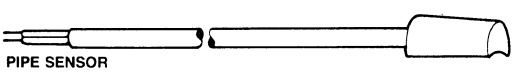

IMMERSION PROBE WITH THREADED HEX FITTING


HEAT SINK SURFACE SENSOR


SKIN OR SURFACE SENSOR

GENERAL PURPOSE SENSOR


SURFACE SENSOR


PIPE SENSOR

Sensor Assemblies are designed to enhance applicability, protect and appropriately locate thermistors for maximum efficiency, whether used in liquids, solids or gases. They may be designed to meet the stringent requirements of automotive, energy, industrial, computer, aerospace, consumer appliance, medical and ecology related industries. "Standard" sensor-assemblies are available; however, most are manufactured to customer specifications. Contact our engineers for design assistance and quotations.

For additional information and engineering assistance, contact
DALE ELECTRONICS, INC., Western Thermistor Division, 2300 Riverside Blvd., Norfolk, NE 68701 • Phone 402-371-0080

Most Specified NTC THERMISTORS

$R_{25}\Omega$	P/N	CURVE	NOMINAL D.C.	NOMINAL T.C.	MAX. DIA.	LEAD DIA.
100,000	7C1003	7	3	12	.095	.0125
50,000	7C5002	7	3	12	.095	.0125
30,000	4C3002	4	2.5	12	.095	.0125
20,000	4C2002	4	3	12	.095	.0125
10,000	1C1002*	1	3	12	.095	.0125
8,000	1C8001	1	3	12	.095	.0125
5,000	1C5001	1	3	12	.095	.0125
3,000	1C3001*	1	3	12	.095	.0125
2,000	1C2001	1	3.5	16	.095	.0125
1,000	2C1001	2	3	12	.095	.0125
500	2C5000	2	3	12	.100	.0125
200	2C2000	2	3.5	18	.150	.0125
100	2C1000	2	4	20	.195	.0125
30,000	9F3002*	9	.8	5	.072	.008
15,000	1F1502*	1	.8	5	.072	.008
10,000	1F1002*	1	.8	5	.072	.008
5,000	1F5001*	1	.8	7	.072	.008

$R_{25}\Omega$	P/N	CURVE	NOMINAL D.C.	NOMINAL T.C.	MAX. DIA.	LEAD DIA.
200,000	7M2003	7	2	12	.095	.010
100,000	4M1003*	4	2	12	.095	.010
50,000	4M5002*	4	2	10	.085	.010
30,000	4M3002*	4	2	10	.085	.010
20,000	9M2002*	9	2	10	.085	.010
10,000	9M1002*	9	2	12	.095	.010
10,000	1M1002*	1	2	10	.085	.010
6,000	1M6001	1	2	10	.085	.010
5,000	1M5001*	1	2	10	.085	.010
2,252	1M2251*	1	3	12	.095	.010
1,000	2M1001	2	3	12	.085	.010
30,000	4T3002*	4	2	12	.095	.010
20,000	9T2002*	9	2	12	.095	.010
10,000	9T1002*	9	2	14	.095	.010
10,000	1T1002*	1	2	12	.095	.010
5,000	1T5001*	1	2	12	.095	.010
2,252	1T2251*	1	2	14	.095	.010

.03937 in. = 1 mm.

*Indicates ±0.2°C tolerance available for interchangeable thermistors.

Contact factory for information on resistance values not listed.

RESISTANCE vs. TEMPERATURE CONVERSION TABLES (Ratio = $R_T \div R_{25}$)

TEMP. °C	CURVE 1			CURVE 2			CURVE 4			CURVE 7			CURVE 9		
	Ratio	MT±%	NTC	Ratio	MT±%	NTC	Ratio	MT±%	NTC	Ratio	MT±%	NTC	Ratio	MT±%	NTC
−55	96.44	4.5	7.4	53.40	6.3					132.15	6.0				
−50	67.06	3.9	7.2	38.99	6.1	6.2				90.49	5.0	7.5	44.13	3.9	
−40	33.66	3.3	6.7	21.45	5.5	5.8	40.16	5.3		43.92	4.2	7.0	23.98	3.3	5.9
−30	17.70	2.6	6.2	12.27	4.8	5.4	20.64	4.3	6.5	22.26	2.9	6.7	13.52	2.6	5.6
−20	9.712	2.1	5.8	7.278	4.0	5.1	11.03	3.5	6.1	11.73	2.7	6.2	7.891	2.1	5.2
−10	5.534	1.5	5.5	4.459	3.2	4.7	6.119	2.6	5.7	6.418	2.1	5.9	4.754	1.5	4.9
0	3.266	1.1	5.1	2.815	2.3	4.5	3.510	1.8	5.4	3.632	1.4	5.5	2.949	1.1	4.6
10	1.990	0.6	4.8	1.826	1.4	4.2	2.078	1.0	5.1	2.121	0.9	5.2	1.879	0.6	4.4
20	1.249	0.1	4.5	1.215	0.5	4.0	1.267	0.2	4.8	1.276	0.2	5.0	1.226	0.1	4.2
25	1.000	0.0	4.4	1.000	0.0	3.8	1.000	0.0	4.7	1.000	0.0	4.8	1.000	0.0	4.0
30	.8058	0.2	4.3	.8276	0.5	3.7	.7942	0.4	4.6	.7889	0.4	4.7	.8194	0.2	3.9
37	.6016	0.6	4.1				.5814	1.0	4.4				.6258	0.6	3.8
40	.5326	0.7	4.0	.5758	1.4	3.5	.5105	1.1	4.3	.5003	0.9	4.4	.5592	0.7	3.7
50	.3602	1.1	3.8	.4086	2.3	3.3	.3359	1.8	4.1	.3249	1.5	4.2	.3893	1.1	3.5
60	.2488	1.3	3.6	.2954	3.1	3.2	.2259	2.4	3.9	.2147	1.9	4.1	.2760	1.3	3.4
70	.1751	1.8	3.4	.2172	4.1	3.0	.1550	2.9	3.7	.1447	2.4	3.8	.1990	1.8	3.2
80	.1256	2.1	3.3	.1622	5.1	2.8	.1084	3.4	3.5	.09941	2.7	3.7	.1458	2.1	3.1
90	.09164	2.3	3.1	.1229	5.5	2.7	.0771	3.9	3.3	.06949	3.2	3.5	.1084	2.3	2.9
100	.06792	2.6	2.9	.09446	6.7	2.6	.0557	4.4	3.2	.04938	3.6	3.3	.08168	2.6	2.8
110	.05108	2.7	2.8	.07350	7.4	2.4	.0408	4.9	3.0	.03564	4.0	3.2	.06235	2.7	2.6
120	.03894	3.2	2.7	.05788	8.5	2.3	.0303	5.3	2.9	.02610	4.4	3.0	.04818	3.2	2.5
125	.03416	3.3	2.6	.05158	8.7	2.3	.0263	5.5	2.9	.02246	4.5	3.0	.04253	3.3	
130	.03006	3.4	2.5	.04609	8.9	2.2	.0228	5.7	2.8	.01939	4.7	2.9	.03764	3.4	2.4
140	.02348	3.7	2.4	.03708	9.7	2.1	.0173	6.0	2.7	.01459	5.0	2.8	.02972	3.7	2.3
150	.01854			.03012			.0133			.01112			.02370		

DEFINITIONS

$R_T \div R_{25}$ ratio is Resistance at temperature T divided by resistance at 25°C. To determine the resistance of a NTC thermistor at temperatures other than 25°C, multiply the ratio selected from the appropriate curve column above by resistance at 25°C, e.g., Curve 1, 10KΩ @ 25°C, 1256Ω @ 80°C. Call us for 1°C ratio tables.

NTC (−%/°C) is negative temperature coefficient of resistance at temperature (T) expressed in % resistance change per °C. Since one NTC resistance change is approximately equivalent to a 1°C temperature change, NTC is useful in developing Interchangeable thermistor specifications, e.g., Curve 1, 10,000Ω ± 4.4% @ 25°C, 32,660Ω ± 5.1% @ 0°C, 1751Ω ± 3.4% @ 70°C results in a ±1°C Interchangeable Thermistor 0° to 70°C, .5 NTC = ±.5°C, etc.

Maximum Temperature for thermistors listed is 150°C; however, continuous operation or cycling above 125°C, or above specified temperature range for Interchangeable thermistors, may cause thermistors to exceed originally specified tolerances.

MT±% is manufacturing tolerance at temperature. Add to resistance tolerance specified at 25°C, e.g., Curve 1 10K ± 10% @ 25°C, 1256Ω ± 12.1% @ 80°C. Not applicable to Interchangeable Thermistors.

Dissipation Constant (D.C.) is the amount of power, in milliwatts, which will raise the thermistor 1°C above its environment while suspended by its leads in still air at 25°C.

Time Constant (T.C.) is the time, in seconds, required for the thermistor dissipating zero power to change 63% of the difference between its initial temperature value and that of a new temperature environment, while supported by its leads in still air.

Thermistor Resistance Measurements must be made at precisely controlled temperature while applying essentially zero power to assure measurement accuracy.

For additional information and engineering assistance, contact

DALE ELECTRONICS, INC., Western Thermistor Division, 2300 Riverside Blvd., Norfolk, NE 68701 • Phone 402-371-0080

Elmwood Sensors
Precision Controls
1653 Elmwood Avenue, Cranston, R.I. 02907
Phone (401) 781-6500 • TWX (710) 381-6413

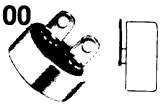
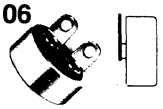
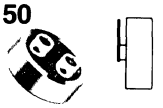
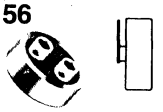
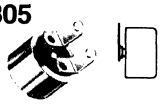
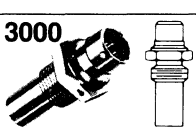
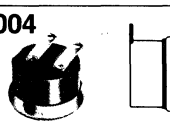
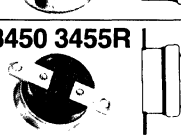
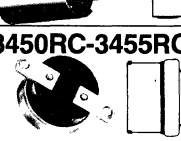
Elmwood Sensors, Ltd. North Shields, Tyne & Wear, NE29 8SA England
Phone (063) 25-82821 • TELEX: 53284

SUB-MINIATURE SNAP-ACTION THERMOSTATS

Elmwood thermostats are precision-engineered for quick, reliable response in high limit or control applications. Many meet military specifications, as well as U.L., C.S.A. and European requirements. Exposures are from −65°F to +550°F, ratings to 15 Amps, with narrow or wide differentials as required. A variety of brackets and terminals are available, as well as custom packaging. Write or phone for complete catalog.

DIAL PROTOTYPE

For fast service on prototypes and thermocouples call our precision sales department at 401-781-6500.

DESCRIPTION	ELECTRICAL RESISTIVE RATINGS	INCLUDING TOL. SET POINT RANGE	NARROWEST TOLERANCE ALLOWABLE	NARROWEST DIFFERENTIAL AVAILABLE	AGENCY LISTINGS	TYPICAL APPLICATIONS
3100  Hermetically sealed, all welded construction long life, narrow or wide tolerances and differentials.	6 Amp 120 VAC 7 Amp 30 VDC/AC 3 Amp 240 VAC	−20° to 500°F −28.89° to 260°C	±3°F ±1.7°C	6°F max. 3.3°C max.	U.L.* C.S.A.	High-temp control for copy machines, computers, aircraft, electronic controls
3106  Similar to 3100 but with gold alloy cross-point contacts.	120 VAC 100 MA 50 VDC 500 MA	−20°F to 400°F −28.8°C to 204°C	±3°F ±1.7°C	6°F max. 3.3°C max.		Dry Circuit applications
3150  Hermetically sealed, all welded const. Similar to 3100 except low silhouette .301" max. design	6 Amp 120 VAC 6 Amp 30 VDC/AC 1.5 Amp 240 VAC	-20° to 350°F −28.89° to 177°C	±3°F ±1.7°C	6°F max. 3.3°C max.	U.L.*	Copy machines, computers, aircraft, electronic controls where space is critical.
3156  Similar to 3150 but with gold alloy cross-point contacts.	120 VAC 100 MA 50 VDC 500 MA	−20°F to 350°F −28.89°C to 177°C	±3°F ±1.7°C	6°F max. 3.3°C max.		Same as 3106 but where space is limited.
3305  Subminiature .430" dia., hermetically sealed, tolerances to ±3°F and narrow differentials.	2 Amp 120 VAC 1 Amp 30 VDC	125° to 250°F 52° to 121°C	±4°F ±2.2°C	6°F max. 3.3°C max.		Crystal ovens, gyros, electronics overheat protection where subminiature thermostat is required.
3000  Custom package housings.	Consult factory for Approvable Models	0°F to 400°F −18°C to 204°C	±4°F ±2.2°C	10°F max. 5.6°C max.	See other models	Aircraft bleed air duct sensing, hydraulic oil temp control, liquid bath control, heater control.
3001 Non-hermetic, utilizing 3100 design with phenolic and metal housing.	6 Amp 120 VAC 3 Amp 240 VAC	0° to 335°F −17.8° to 168.3°C	±4°F ±2.2°C	8°F max. 4.4°C max.	U.L.* C.S.A	Computers, copy machines, radar equipment, where low height .281" is required.
3004  Non-hermetic, utilizing 3100 design. Rivet insert sleeve construction for International listings.	8 Amp 120 VAC 4 Amp 250 VAC	0° to 335°F −17.8° to 168.3°C	±4°F ±2.2°C	8°F max. 4.4°C max.	U.L. C.S.A. BSI VDE	Similar to 3001, where increased European spacing is required.
3450 3455R  Non-hermetic, with 15 Amp 120 VAC rating. U.L. and C.S.A. listings for 100,000 cycles.	15 Amp 120 VAC 12 VDC* 10 Amp 240 VAC	32° to 335°F 0° to 168.3°C	±5°F ±3°C	20°F 11°C min. below set point.	U.L. C.S.A. International	Power supplies, communication, medical equipment, computers where high amp loads are present. 3455R is used where increased spacing and rivet construction for European requirements are needed.
3455RBV Epoxy overmold constr. of 3455R. For elec. insulation of terminal or moist conditions.	15 Amp 120 VAC 10 Amp 240 VAC	0° to 221°F −20° to 105°C	±5°F ±3°C	20°F 11°C min. below set point.	U.L. C.S.A. International	Similar to 3455R with epoxy overmold for protection of terminals and sealing of unit.
3450RC-3455RC  High temperature, with 15 Amp 120 VAC rating. Rivet insert sleeve construction for International listings.	15 Amp 120 VAC 12 VDC 10 Amp 277 VAC	32° to 500°F 0° to 260°C	±5°F ±3°C	20°F 11°C min. below set point.	U.L. C.S.A. International	Similar to above, where high temperatures are present.
3455RM Non-hermetic manual reset. Will not recycle automatically at room temperature.	15 Amp 120 VAC 10 Amp 240 VAC	125° to 300°F 52° to 149°C	±8°F ±5°C	Man. reset Auto. reset below 40°F 4.44°C	U.L. C.S.A. International	Where manual reset is required. 3455RM meets increased spacing for European requirements.

*These models are also available as U.L. Recognized Components. Please consult factory and specify Rating Required. Consult factory for C.S.A. listings.
Views are not to scale. Note product description on respective page.

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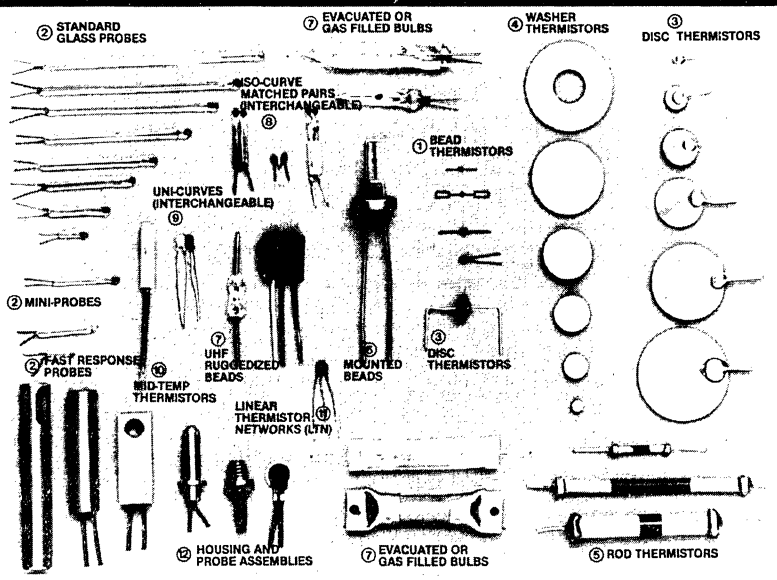


THE MOST COMPLETE LINE OF PRECISION THERMISTORS

THERMISTOR CONFIGURATIONS

1. Glass Coated Beads — used where small size, fast response, high precision, stability, and temperatures to 300°C are required.

2. Glass Probes — medium-small in size. Many of the advantages of beads but rugged, more easily mounted, useful in liquid media.

3. Discs — used where medium power dissipation is a requirement and space not a problem. Useful to 150°C.

4. Washers — used where high power dissipation is a prime requirement.

5. Rods — these units have power dissipation intermediate between discs and washers and are also used where their physical shape is an asset.

6. Mounted Beads — provide ease in using glass beads in such applications as gas chromatography, flow and vacuum measurement, etc.

7. Vacuum and Gas Filled Assemblies — high power sensitivity for specialized circuit applications.

INTERCHANGEABLE THERMISTORS

8. Iso-Curve® Interchangeable Thermistors — these units available in bead or glass probe configurations, follow standard L-2B curves over wide temperature range, and are completely interchangeable. Units match standard curves as close as ± ¼% of resistance or as required. Bulletin L-2B.

9. Uni-Curve® Interchangeable Thermistors — completely interchangeable units having an accuracy of + 0.2%C over a temperature range of 0°C to 70°C and available on special order to other tolerances and ranges. Bulletin L-6B

MID-TEMP THERMISTORS

10. Mid-Temp Thermistors — Bead and probe thermistors designed for useage at the higher Mid-Temp range from 200°C to 600°C. Ask for bulletin L-10.

LINEAR THERMISTOR NETWORKS(LTN)

11. Linear Thermistor Networks (LTN™) — precision resistors and thermistors which are designed to produce a resistance change or voltage output that varies linearly with temperature over the selected temperature range. Ask for Bulletin L-9A.

THERMISTOR PROBES

12. Probe Assemblies — standard catalog types or built to specific military or commercial requirements. We are experienced in design of probe assemblies for all fields of application including industrial control and indication, aerospace — specializing in telemetry applications, and oceanographic — featuring fast response, very high pressure, and interchangeability using our Iso-Curve and Uni-Curve Thermistors. Ask for Catalog L-5A.

FREE...technical THERMISTOR LITERATURE

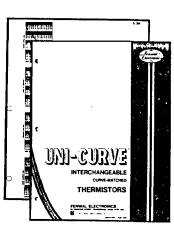
THERMISTOR MANUAL (EMC-6B) Most complete up-to-date listing of thermistors available. Theory, engineering data, complete specifications.

THERMISTOR HOUSING MANUAL (L-5A). Detailed information on how Fenwal Electronics can build thermistor sensor assemblies to fit your requirements.

THERMISTOR APPLICATION AND TECHNICAL DATA NOTES: "Designing Linear Temperature Read-Out Circuits" AN-1A; "Using Thermistors to Compensate for Transistor Temperature Sensitivity" AN-2A; "Stability & Reliability Characteristics" TD-1A; "Considerations in Testing of Thermistors" TD-2A.

LINEAR THERMISTOR NETWORKS (LTN™) precision resistors and thermistors which are designed to produce a resistance change or voltage output that varies linearly with temperature over the selected temperature range. Ask for Bulletin L-9A.

INTERCHANGEABLE THERMISTORS: ISO-CURVE manual (L-2B) and UNI-CURVE manual (L-6B) provide in-depth data pertaining to precision and low-cost RT, curve-matched interchangeable thermistors.



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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

SYLVANIA Control Devices **GTE** **THERMASTER™**

PTC's (Positive Temperature Coefficient Thermistors) To Heat, Sense and Control

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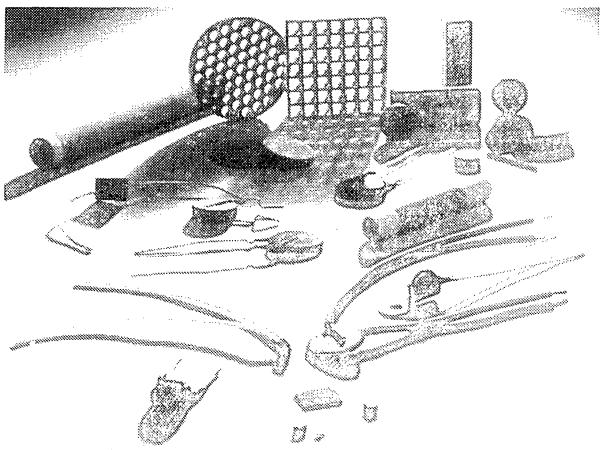
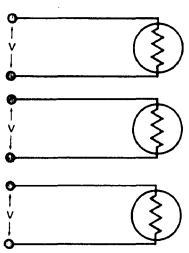
Whatever your product application, there will be problem areas where the unique characteristics of Thermaster™ PTC thermistors can provide a reliable and cost-effective solution. These versatile components can be used as self-regulating heaters, temperature sensors or control elements. Applications occur in all industries, including transportation, consumer products, office data processing equipment, industrial controls, instrumentation and communications. The advantages of Thermaster components include simplicity, solid-state reliability, versatility, stability, sensitivity and resolution. They are producible in a wide range of ratings and package styles. Isn't it time you looked into their capabilities? Ask for literature.



APPLICATIONS

HEATERS

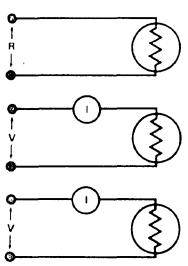


ADVANTAGES

- No overtemperature protection required
- Fixed temperature operation, wide range of temperatures producible
- Stable characteristics over wide voltage range

Cost Effective—The ability of the PTC thermistor to auto-stabilize over wide variety of operating temperature precludes the need for temperature regulators and/or over temperature protectors in most heater applications.
Producible in a number of shapes and packages for heating liquids, solids or gases.

SENSORS

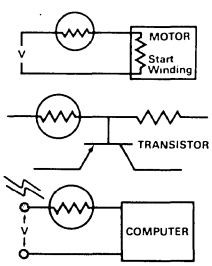


ADVANTAGES

- Small size
- Low power levels required
- Broad resistance range producible

Versatile—PTC's are offered in a wide range of switching temperatures and resistances for maximum design flexibility.
Producible with attached leads for PC board mounting; as discs for surface mounting; as chips for hybrids; and in various other shapes.

CONTROLLERS (Protectors)



ADVANTAGES

- No moving parts
- Small size
- Wide range of packages
- High reliability

Control PTC thermistors provide a simple means to protect loads against fault conditions; i.e.; voltage surges such as line crosses; undesireable temperature rises; or to protect circuits from excessive current.
They have no moving parts, are rugged, and are available in a number of sizes and resistance ranges for almost any application.

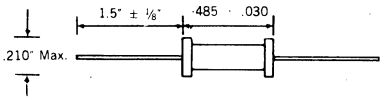
HEADQUARTERS
Sylvania Control Devices, Division of GTE Products Corporation
Route 35, Standish, ME 04084
(207) 642-4535

SALES OFFICE
MICHIGAN
10800 Ford Road
Dearborn, Michigan 48126
Phone: (313) 582-8754

OHIO
333 West First Street
Dayton, Ohio 45402
Phone: (513) 223-6227

Keystone CARBON COMPANY

ROD TYPE THERMISTORS



Leads: T.C. AWG #20
Tolerance: ±10% at 25°C
Time Constant: 45 seconds approx.
Max. Operating Temperature: 125°C
Dissipation Constant: 9MW/°C Approx.

LOW/MEDIUM TEMPERATURE COEFFICIENT

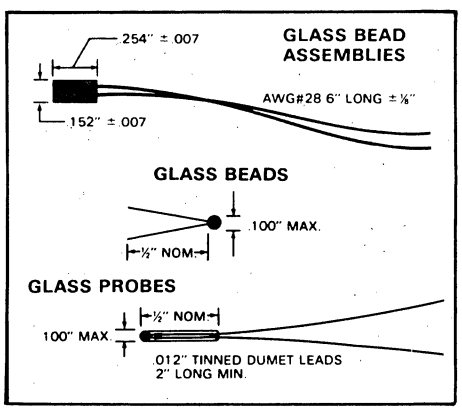
TYPE	RESISTANCE AT °C							BETA ±10%	R @ 25°C	Neg. Temp.
	0	25	37.8	50	75	104.4	125	(37.8-104.4°C)	R @ 125°C	Coef. @ 25°C
15-20-35-S1	30.6	20	16.4	13.8	9.90	7.01	5.65	1500	3.5	1.59
15-50-42-S1	80.6	50	40.1	32.9	22.6	15.3	11.9	1700	4.2	1.78
15-100-42-S1	161	100	80.2	65.8	45.3	30.6	23.8	1700	4.2	1.78
15-200-42-S1	322	200	160	132	90.6	61.2	47.7	1700	4.2	1.78
15-500-50-S1	847	500	391	314	206	133	100	1900	5.0	1.98
15-1K-50-S1	1690	1K	782	628	413	266	201	1900	5.0	1.98
15-2K-52-S1	3430	2K	1560	1240	808	515	387	1950	5.2	2.03
15-5K-54-S1	8680	5K	3860	3060	1980	1240	924	2000	5.4	2.07
15-10K-54-S1	17.4K	10K	7730	6130	3950	2480	1850	2000	5.4	2.07
15-20K-59-S1	35.6K	20K	15.3K	12K	7560	4640	3400	2100	5.9	2.17
15-50K-62-S1	90K	50K	37.9K	29.5K	18.5K	11.2K	8120	2150	6.2	2.22

HIGH TEMPERATURE COEFFICIENT

TYPE	RESISTANCE AT °C							BETA ±10%	R @ 25°C	Neg. Temp.
	0	25	37.8	50	75	104.4	125	(37.8-104.4°C)	R @ 125°C	Coef. @ 25°C
15-5K-181-S1	13.7K	5K	3150	2100	979	450	276	3425	18.1	3.74
15-10K-192-S1	28.2K	10K	6240	4100	1890	855	520	3500	19.2	3.83
15-20K-292-S1	67.2K	20K	11.6K	7140	2920	1190	685	4000	29.2	4.46
15-50K-292-S1	168K	50K	28.9K	17.8K	7320	2980	1710	4000	29.2	4.46
15-100K-404-S1	372K	100K	55K	32.4K	12.2K	4540	2080	4400	40.4	4.86
15-200K-424-S1	753K	200K	109K	63.9K	23.9K	8740	4720	4450	42.4	4.91
15-500K-482-S1	1.95meg	500K	268K	154K	55.6K	19.7K	10.4K	4600	48.2	5.03
15-1meg-583-S1	4.06meg	1meg	523K	294K	100K	33.7K	17.1K	4830	58.3	5.22

GLASS BEADS • GLASS PROBES • GLASS BEAD ASSEMBLIES

Glass bead thermistors are exceptionally stable because the glass seal protects the thermistor from hostile environments.



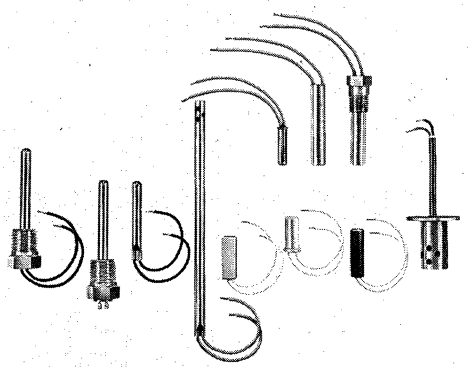
RESISTANCE/TEMPERATURE CHARACTERISTICS

TYPE	−21.5°C	0°C	25°C	37.8°C	50°C	104.4°C	150°C	232°C	TEMP. COEFF. AT 25°C
RL0504-8783-95-G ___*	154.5K	48.48K	15K	8783	5484	924.5	290.3	59.55	−4.36%
RL0504-11.64K-97-G ___	217.8K	65.76K	20K	11.64K	7205	1200	370.3	73.91	−4.42%
RL0504-16.92K-112-G ___	370.3K	105.3K	30K	16.92K	10.18K	1511	426.9	83.08	−4.67%
RL0504-27.76K-120-G ___	643.1K	182.2K	50K	27.76K	16.50K	2313	642.0	109.7	−4.80%
RL0504-55.53K-120-G ___	1.286 meg	364.5K	100K	55.53K	32.99K	4628	1284	219.5	−4.80%
RL0504-111.3K-125-G ___	2.699 meg	743.5K	200K	111.3K	65.78K	8904	2415	407.4	−4.85%
RL0504-272.6K-142-G ___	7.391 meg	1.976 meg	500K	272.6K	158.6K	19.20K	4706	682.0	−5.04%
RL0504-530.5K-148-G ___	15.04 meg	3.939 meg	1 meg	530.5K	301.7K	35.84K	8780	1252	−5.14%
RL0504-798.3K-150-G ___		5.894 meg	1.5 meg	798.3K	454.7K	53.22K	12.85K	1820	−5.18%
RL0504-1.294Meg-176-G ___	40.98 meg	10.34 meg	2.5 meg	1.294 meg	716.7K	73.52K	15.95K	1.812K	−5.34%
RL0504-2.588Meg-176-G ___	81.96 meg	20.68 meg	5 meg	2.588 meg	1.434 meg	147.0K	31.90K	3.624K	−5.34%

*Not presently available in Glass Probes.
Tolerance on resistance values ± 20% @25°C. Closer tolerances available.
Beads have a maximum operating temperature of 260°C.

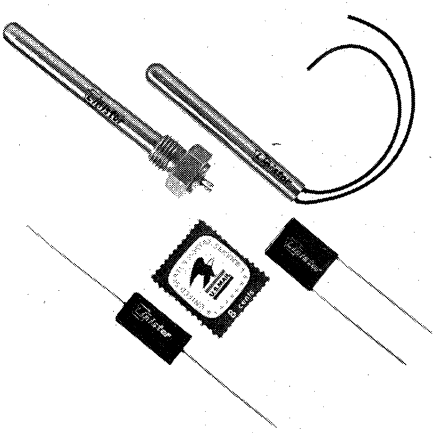
-G1 for Glass Beads with platinum leads
-G15 for Glass Probes
-G20 for Glass Bead Assemblies

THERMISTOR PROBES



The probes illustrated above include stainless steel, aluminum, and chrome-plated materials in a variety of configurations. In addition, a variety of other designs are available. These probes are used in conjunction with solid state circuitry for liquid level measurement, and for use as sensors to measure the temperature of liquids or surface temperatures. Write for probe catalog TP-739.

LINISTOR® ASSEMBLIES

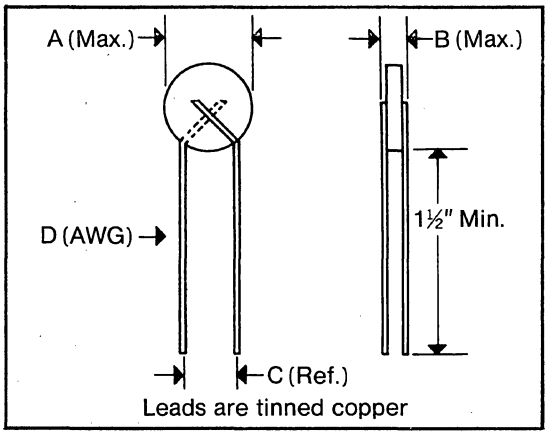


Keystone developed Linistor assemblies to give an accurate resistance response over a temperature span of 0° to 100° C. Because Linistor assemblies have flattened out the thermistor resistance curve to a constant and predictable straight-line plot, they are valuable in a wide range of applications. Four standard encasements are available. Tolerance on resistance of Linistor is ± 2% at 25°C. Write for Linistor Bulletin L-601.

Keystone CARBON COMPANY
Thermistor Division • St. Marys, Pa. 15857
814-781-1591 • Telex No. 91-4517

Keystone CARBON COMPANY

DISC TYPE THERMISTORS WITH CROSSED LEADS



KCC TYPE	R @ 25°C	Tol. ±%	A Max.	B Max.	C Ref.	D AWG	Dissipation Constant (MW °/C)	Time Constant (Sec)	Temp. Coef. at 25°C % per °C
RL1004-65.6-59-D1	100	20	.110"	.120"	.100	26	2.5	9	−3.38
RL1003-312-73-D1	500	10	.110"	.110"	.100	26	2.5	9	−3.83
RL1007-624-73-D1	1000	10	.110"	.160"	.100	26	2.8	10	−3.83
RL1003-1746-97-D1	3000	10	.110"	.110"	.100	26	2.5	9	−4.39
RL1004-2910-97-D1	5000	10	.110"	.120"	.100	26	2.5	9	−4.39
RL1009-5820-97-D1	10,000	10	.110"	.180"	.100	26	3.0	10	−4.39
RL1007-13770-120-D1	25,000	10	.110"	.160"	.100	26	2.8	10	−4.84
RL1003-26670-140D1	50,000	10	.110"	.110"	.100	26	2.5	9	−5.08
RL1006-53330-140-D1	100,000	10	.110"	.145"	.100	26	2.8	10	−5.08
RL1004-104550-155-D1	200,000	10	.110"	.120"	.100	26	2.5	9	−5.22
RL2004-16.4-59-D1	25	20	.220"	.125"	.156	24	6.5	20	−3.38
RL2007-32.8-59-D1	50	20	.220"	.165"	.156	24	6.5	30	−3.38
RL2003-62.4-73-D1	100	10	.220"	.115"	.156	24	6.5	20	−3.83
RL2005-124.8-73-D1	200	10	.220"	.140"	.156	24	6.5	20	−3.83
RL2008-187.1-73-D1	300	10	.220"	.175"	.156	24	6.5	30	−3.83
RL2013-312-73-D1	500	10	.220"	.230"	.156	24	7.2	50	−3.83
RL2004-582-97-D1	1000	10	.220"	.125"	.156	24	6.5	20	−4.39
RL2006-657-69-D1	1000	20	.220"	.150"	.156	24	6.5	20	−3.58
RL2007-1164-97-D1	2000	10	.220"	.165"	.156	24	6.5	30	−4.39
RL2009-1446-97-D1	2500	10	.220"	.185"	.156	24	6.5	30	−4.39
RL2010-1746-97-D1	3000	10	.220"	.195"	.156	24	7.0	35	−4.39
RL2006-2753-120-D1	5000	10	.220"	.150"	.156	24	6.5	20	−4.84
RL2012-5506-120-D1	10,000	10	.220"	.220"	.156	24	7.2	50	−4.84
RL2006-13330-140-D1	25,000	10	.220"	.150"	.156	24	6.5	20	−5.08
RL2012-26660-140-D1	50,000	10	.220"	.220"	.156	24	7.2	50	−5.08
RL2008-52270-155-D1	100,000	10	.220"	.175"	.156	24	6.5	30	−5.22
RL3004-6.56-59-D1	10	20	.320"	.125"	.250	24	7.0	35	−3.38
RL3504-31.2-73-D1	50	10	.370"	.125"	.250	24	7.5	45	−3.83
RL4004-174.6-97-D1	300	10	.420"	.125"	.250	24	8.0	50	−4.39
RL4504-3.28-59-D1	5	20	.475"	.130"	.328	22	10.0	60	−3.38
RL4504-15.6-73-D1	25	10	.475"	.130"	.328	22	10.0	60	−3.83
RL4504-116.4-97-D1	200	10	.475"	.130"	.328	22	10.0	60	−4.39
RL7605-6.24-73-D1	10	20	.795"	.150"	.328	20	16.0	70	−3.83
RL7605-58.2-97-D1	100	10	.795"	.150"	.328	20	16.0	70	−4.39

Maximum operating temperature—125°C

Keystone also offers a line of Disc-Type Thermistors ranging in sizes from .100 inch to 1.00 inch in diameter. Thirty-four different slopes are available (temperature coefficients from −3.75% per °C at 25°C to −5.22% per °C at 25°C). Resistance values range from 11.16 ohms to 518,400 ohms at 25°C. Write for short form catalog T-504 or complete catalog BW2.

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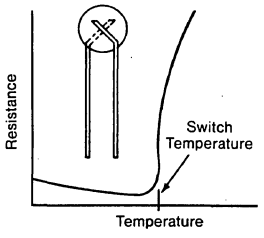
PTC—POSITIVE TEMPERATURE COEFFICIENT THERMISTORS



Positive Temperature Coefficient (PTC) thermistors are characterized by an extremely large resistance change in a small temperature span. The figure at left depicts a generalized resistance temperature plot for a PTC. The temperature at which the resistance begins to increase rapidly is referred to as the switching temperature. This point can be changed from below 0°C to above 120°C.

TYPICAL PTC APPLICATIONS

• Automatic Color TV Degaussing • Air Flow Measurement • Non-Destructive Fuse • Single Phase Motor Starting • Liquid Level Sensing • Combination Heater-Thermostat • Arc Suppression • Time Delay Fusing.

For detailed application notes, write for Bulletin P-780.

Type No.	Switch Point	Res. in Ohms @ 25°C ±30%	Oper. Voltage 2	Ref. Dimensions (in.) A	B	C	D	E	Lead Mat'l. 1	D.C. MW/°C	T.C. (Sec.)	Figure No.
RL3006-50-30-25-PTO	30°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-40-25-PTO	40°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-50-25-PTO	50°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-60-25-PTO	60°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL5506-5-65-50-PTO	65°C	5.00	50	.55	.06	1.5	.33	20	TC	14.0	50	1
RL5510-25-65-120-PTO	65°C	25.0	120	.55	.10	.5	.33	22	TAS	15.0	90	2
RL3006-50-70-25-PTO	70°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-80-25-PTO	80°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-90-25-PTO	90°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-100-25-PTO	100°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3006-50-110-25-PTO	110°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL5510-32-110-50-PTO	110°C	32.0	50	.55	.10	1.5	.33	20	TC	20.0	80	1
RL3006-20-120-25-PTO	120°C	20.0	25	.30	.06	1.5	.25	22	TC	8.0	30	1
RL3006-50-120-25-PTO	120°C	50.0	25	.30	.06	1.5	.25	24	TC	7.0	35	1
RL3312-200-120-50-PTO	120°C	200.0	50	.33	.12	1.5	.25	20	TC	12.0	40	1
RL5505-2.5-120-20-PTO	120°C	2.50	20	.55	.05	1.5	.33	20	TC	14.0	50	1
RL5505-5-120-20-PTO	120°C	5.00	20	.55	.05	1.5	.33	20	TC	14.0	50	1
RL6306-11-120-20-PTO	120°C	11.0	20	.63	.06	1.5	.33	20	TC	15.0	70	1
RL8206-4-120-30-PTO	120°C	4.00	30	.82	.06	1.5	.33	18	TC	20.0	80	1

TYPICAL CONFIGURATIONS

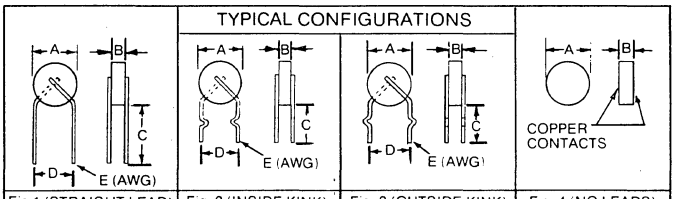


Fig 1 (STRAIGHT LEAD) | Fig 2 (INSIDE KINK) | Fig 3 (OUTSIDE KINK) | Fig 4 (NO LEADS)

NOTE: 1. Lead Material: TC = Tinned Copper. TAS = Tinned Annealed Steel.
2. Operating Voltage: D.C. or 60Hz A.C. (for higher voltage req.—contact factory).
3. The specifications and configurations shown above are typical of standard items. Special characteristics, designs and alternate physical sizes are available upon request.

Keystone CARBON COMPANY

Thermistor Division • St. Marys, Pa. 15857
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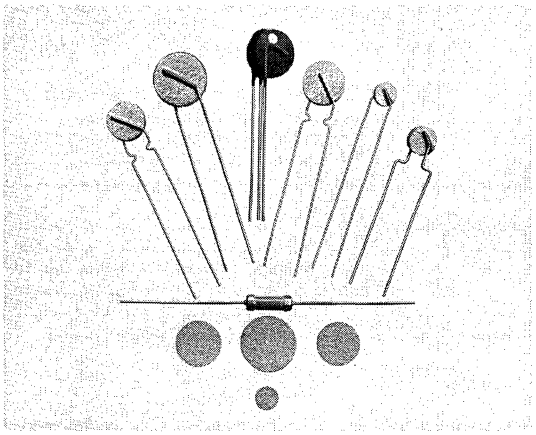
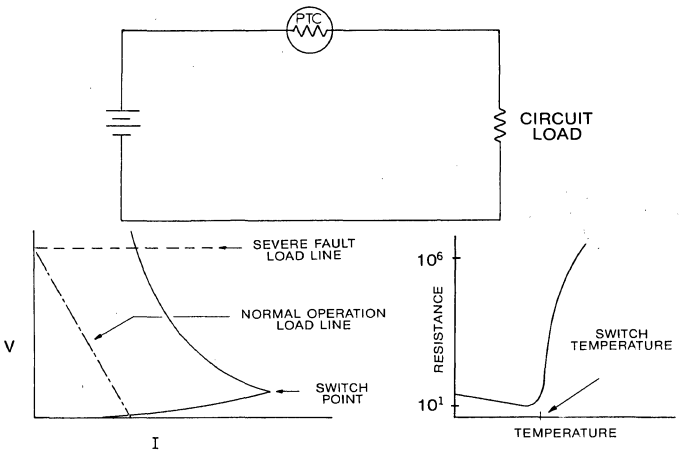
POPULAR PTC CIRCUIT APPLICATIONS



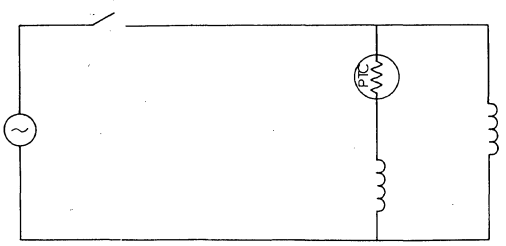
A large resistance change in a small temperature span best describes PTC thermistors. The temperature at which the resistance begins to increase rapidly is known as the "switching temperature." Because of this transformation, PTC's are an ideal component for circuits where the built-in switching temperature can be used to advantage. A few of the many applications are shown on this page.

NON-DESTRUCTIVE FUSE



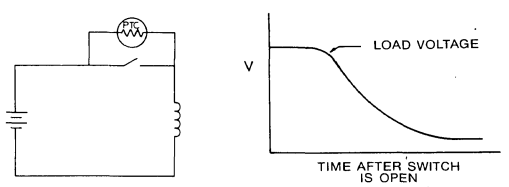
In normal operation the PTC dissipates minimal power keeping its body temperature well below the switch temperature. If a fault of sufficient magnitude occurs, additional power drives the temperature of the PTC up to the switch temperature. At this point additional power becomes available to the PTC, and the only stable operating point is at a much higher resistance than the switch temperature resistance as shown in the illustration above.

MOTOR STARTING



In the above circuit the PTC thermistor replaces the troublesome starting switch in a single-phase motor. When the circuit is energized the PTC has a low resistance and permits most of the line voltage to be applied to the starter winding. As the motor starts, the PTC heats up until the switch temperature is reached at a rate determined by the thermal inertia of the PTC and current flowing through the starting winding. At this point, the thermistor rapidly changes from a low resistance device to a high resistance unit, and the steady state power applied to the PTC is very low causing the current through the starting winding to be negligible.

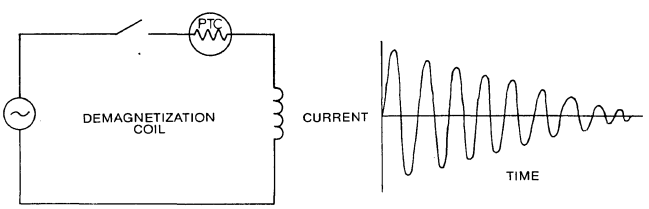
ARC SUPPRESSION



In the above illustrations the PTC switches from a low resistance to a high resistance when the switch is opened. The low resistance of the PTC provides effective arc suppression, and the subsequent PTC switching action transfers essentially all of the power supply voltage from the inductive load to the PTC element.

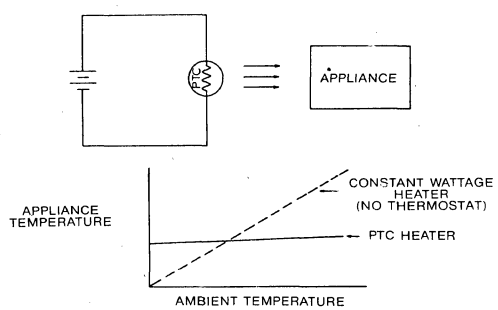
Write for PTC Bulletin P-780 and technical article "Heat switches the PTC Thermistor."

AUTOMATIC DEGAUSSING



When the switch on the above circuit is closed, a high percentage of the line voltage is impressed across the demagnetization coil. Within a short period of time, the PTC self-heats, switching from a low resistance level to a high resistance, and thereby decreasing the demagnetization coil current to near zero. The length of time for this switching action to occur is a function of the power applied to the PTC and its thermal inertia

COMBINATION HEATER-THERMOSTAT



PTC thermistors provide an economical method of temperature control by combining the function of the heater and thermostat in one ceramic pellet. This thermostatic action is accomplished by the steep PTC characteristic. As the ambient temperature rises, the resistance of the PTC is increased, thus reducing the input power to the circuit maintaining a relatively constant temperature.

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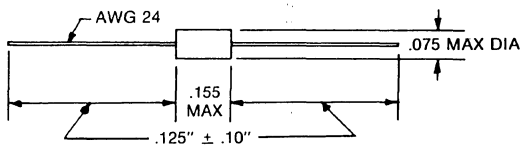
Thermistor Division • St. Marys, Pa. 15857
814-781-1591 • Telex No. 91-4517

Keystone CARBON COMPANY

GLASS ENCAPSULATED THERMISTORS

Style 1 Configurations Type No.	R @ 25°C	Ratio 0°C/50°C	Ratio 25°C/125°C	Temp. Coeff. %/°C @ 25°C
AL03006-624-73-G1	1K±10%	7.15	19.12	−3.93
AL03006-1248-73-G1	2K±10%	6.85	19.22	−3.93
AL03006-5818-97-G1	10K±10%	9.13	29.27	−4.42
AL03006-11.7K-98-G1	20K±10%	8.87	29.70	−4.47
AL03006-29090-97-G1	50K±10%	9.13	29.27	−4.42
AL03006-58180-97-G1	100K±10%	9.13	29.27	−4.42
AL03006-110K-130-G1	200K±10%	11.29	44.90	−4.96
AL03006-535K-145-G1	1 Meg±10%	12.69	52.90	−5.13

Miniature negative temperature coefficient thermistors with broad resistance values. Hermetically sealed glass cases provide excellent environmental protection from physical and chemical disturbances at temperatures to 204° C (400° F).



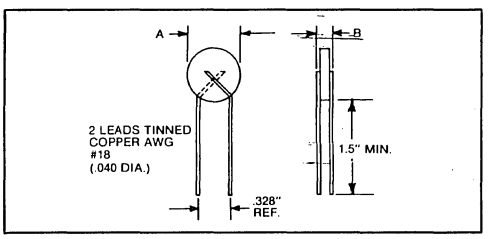
Configurations	Time Const. (Seconds)	Diss. Const. (MW/°C)	Max. Temp.
Style 1	3	2.0	204°C (400°F)

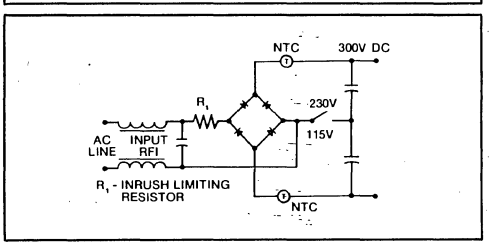
INRUSH CURRENT LIMITERS

Protect against high peak current surges at turn-on until the inrush has subsided. Keystone's NTC Thermistors are available in disc style with crossed leads in eight types with "cold" resistance values @ 25° C from .5 to 120 ohms. All parts are insulated.

Type	No Load Res. @ 25°C (Ohms)	Steady State Current (Amps)	(25°C Ambient) Approx. Resistance Under Load (Ohms)	Max. Dia.
CL-10	7	6 8 10 12	120 095 085 030	80 inch
CL-20	1.3	4 5 6	110 080 060	60 inch
CL-30	2.5	6 7 8	090 070 060	80 inch
CL-40	5	5 6	140 110	80 inch
CL-50	7.0	3 4 5	300 200 160	80 inch
CL-60	10	2 3 4 5	650 390 260 200	80 inch
CL-70	16	3 4	350 140	80 inch
CL-80	47	2 3	850 500	80 inch
CL-90	120	1 2	3.000 1.200	95 inch
CL-100	.5	4 8 12 16 20	100 050 030 020 010	95 inch
CL-120	10.0	6 1.3 1.7	1.020 420 280	45 inch
CL-140	50.0	3 5 1.0	4.560 2.380 1.010	50 inch
CL-160	5.0	8 2.0 2.8	740 270 180	60 inch
CL-180	16.0	5 8 1.0 1.7	2.170 1.280 990 560	60 inch
CL-200	25.0	4 8 1.0 1.7	3.060 1.310 1.000 850	60 inch

NOTE: The load characteristics listed above are offered as a guideline only. The results may differ due to mounting, ambient, etc.





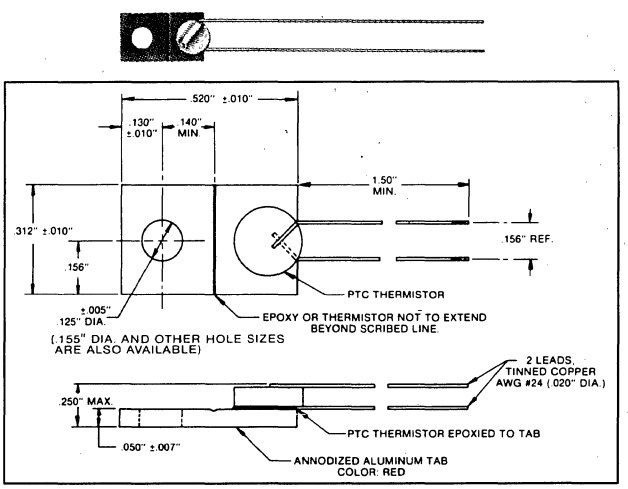
PTC OVERTEMPERATURE PROTECTOR for TRANSISTORS

Positive Temperature Coefficient (PTC) thermistors — act as solid-state switches. They are conveniently wired into a circuit board to prevent destruction of a power transistor.

PTC's are bonded to a tab which is mechanically mounted to the power transistor package. The PTC thermistor measures the surface temperature of the transistor. When the temperature of the transistor case reaches a critical point, the PTC switches and turns off the drive circuitry for the transistor. This action prevents it destruction. Then, as the transistor cools, so does the thermistor, automatically resetting itself to once again guard the power transistor.

PTC SURFACE TEMPERATURE SENSORS

TYPE NUMBER	SWITCH TEMP. °C.	TYPE NUMBER	SWITCH TEMP. °C.
RL2006-100-30-30-PT1	30	RL2006-100-80-30-PT1	80
RL2006-100-40-30-PT1	40	RL2006-100-90-30-PT1	90
RL2006-100-50-30-PT1	50	RL2006-100-100-30-PT1	100
RL2006-100-60-30-PT1	60	RL2006-100-110-30-PT1	110
RL2006-100-70-30-PT1	70	RL2006-100-120-30-PT1	120



SPECIFICATIONS:

1. Resistance @ 25° C: 100Ω ± 30% (70Ω-130Ω).
2. Switch temperature per table is defined as temperature at which the measured resistance is two times the measured resistance @ 25° C.
3. Maximum voltage that can be applied to the device in DC or 60Hz sinusoidal wave form AC is 30 volts.
4. Maximum operating temperature 140° C.
5. Dielectric withstand between PTC element and aluminum tab is 50 VDC min.
6. Basic construction: .200" dia. x .060" thk. PTC disc with radial leads attached to an anodized aluminum tab.
7. Physical design — per Figure 1.
8. Optional resistance values, switch temperatures and physical designs are available upon request.

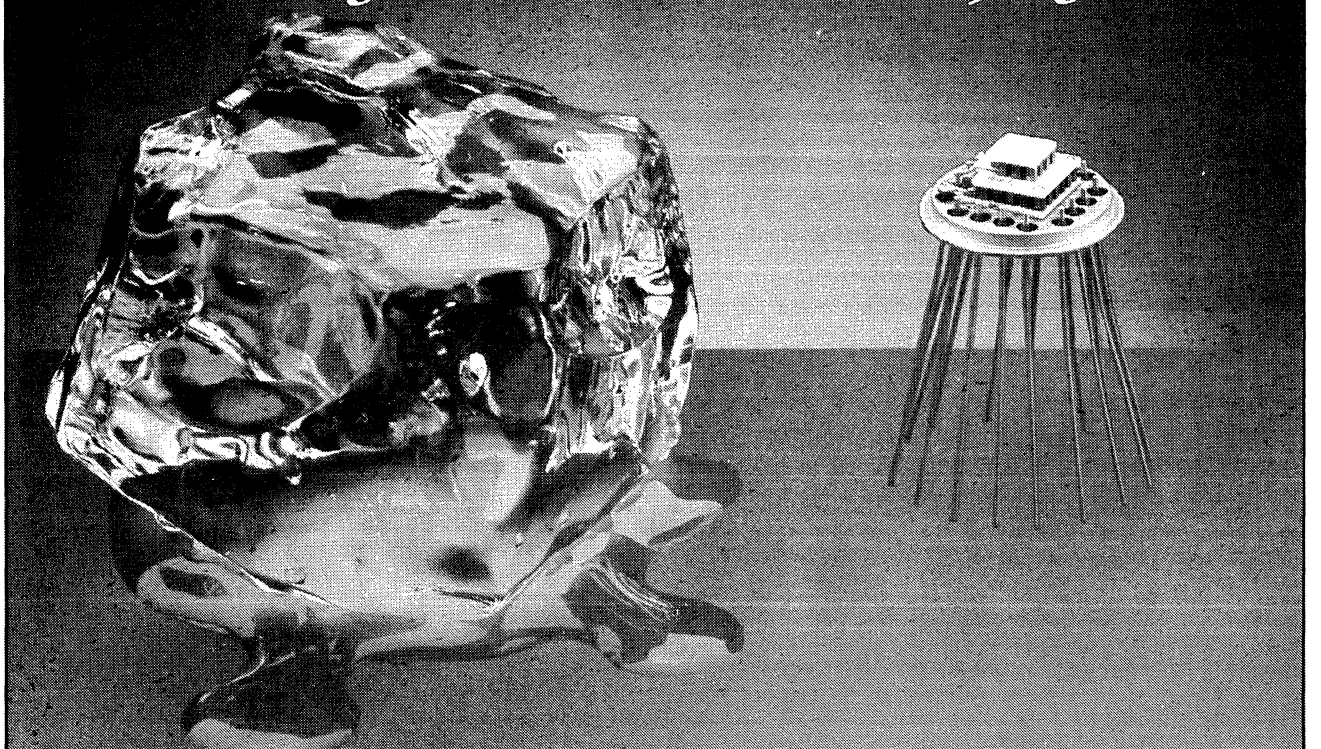
Keystone CARBON COMPANY
Thermistor Division • St. Marys, Pa. 15857
814-781-1591 • Telex No. 91-4517

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.

TEMPERATURE CONTROL 1883

TEMPERATURE CONTROL 1983



Temperature control has come a long way in the last century. Marlow Industries is the world leader in the design and manufacture of high-performance thermoelectric coolers. Through the years our innovative approach to thermoelectric technology has established our reputation for excellence with the aerospace, military and other industries. We have developed proven reliability criteria, through extensive testing, to meet the stringent requirements of this highly specialized market. Our experience covers a broad spectrum in the thermoelectric field, including:

- **Laser Diode Cooling**
- **CCD Cooling**
- **Fast Transient Cooling**
- **Infrared Detector Cooling**
- **Medical Instrumentation Cooling**
- **Consumer Product Cooling**
- **High Reliability Coolers**
- **Power Supply / Temperature Control**
- **Accessories (Flux, Solder, Grease, Epoxy, Sensors, Headers, etc.)**

Marlow Industries has made major contributions in these areas by working closely with our customers and their engineers to solve difficult application problems. Through this close cooperation our technical staff has assembled new data, information and specific application notes. We will be happy to share the accumulation of this information at your request.

Call or write Marlow Industries today and see how far thermoelectric technology has really come.

mi **marlow industries** incorporated

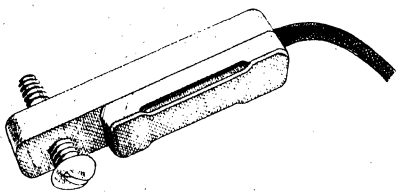
1021 S. Jupiter Road, Garland, Texas 75042, U.S.A. Phone 214-494-2521 TWX 910-860-5161

TEMPERATURE SENSING SWITCH

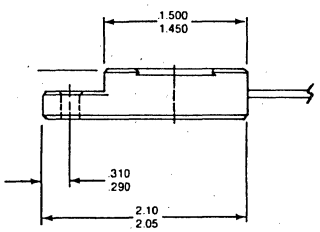
TEMPERATURE SENSING REED SWITCHES
PMS SERIES

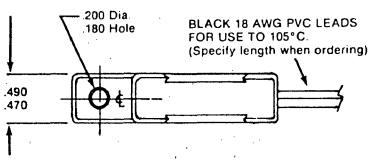
Midwest Components, Inc. has now packaged the reliable temperature sensing reed switch in a convenient and easy to use housing. The molded plastic body offers the additional advantages of complete moisture and dust protection at an economical price.

This rugged switch can be quickly mounted with a screwdriver. An indentation on the housing also facilitates attachment by ordinary hose clamps or clip hardware supplied by the user. Type A (normally open) or Type B (normally closed) switches may be used in this new package.



CONTACT ARRANGEMENT	SPST Form B (NC)	SPST Form A (NO)
CONTACT RATING	Watts — 10W maximum Volt Amps. — 12 V.A. maximum	Watts — 10W maximum Volt Amps — 12 V.A. maximum
VOLTAGE	Volts D.C. — 100 VDC maximum Volts A.C. — 120 VAC maximum	Volts D.C. — 100 VDC maximum Volts A.C. — 120 VAC maximum
CURRENT	Carry — 1 amp maximum Break — 1 amp maximum Make — .5 amp maximum	Carry — 1 amp maximum Break — 1 amp maximum Make — .5 amp. maximum
SWITCH TEMPERATURE — NOMINAL	5° increments starting at 0°C	5° increments starting at 0°C
TOLERANCE	±5°C	±5°C
RESET DIFFERENTIAL	10°C maximum	10°C maximum



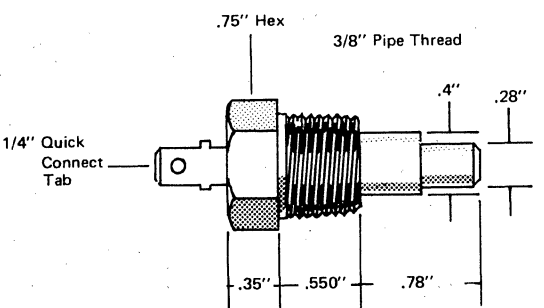


KEY TO ORDERING:

PMS	XXX	A or B	XX
Temp Switch	Temp In °C	Form	Lead Length in Inches

TEMPERATURE SENSING REED SWITCH PROBES

Now Available . . .
The ultra reliable temperature sensing reed switch in a convenient probe assembly. Probe is designed for liquid temperature sensing on auto, truck, compressor, or equipment cooling systems. Rugged brass body is hermetically sealed against harsh environments. Switching temperatures are available from -10°C to 150°C. 3 million operations are possible at full rated load.



PHYSICAL DIMENSIONS

SPECIFICATIONS

CONTACT ARRANGEMENT	SPST Form B (Normally Closed) *
CONTACT RATING	Watts – 10W maximum Volt Amps–12 V.A. maximum
VOLTAGE	Volts D.C. – 100 VDC maximum Volts A.C. – 120 VAC maximum
CURRENT	Carry – 1 amp maximum Break – 1 amp maximum Make – .5 amp maximum
TOLERANCE	±10°C
RESET DIFFERENTIAL	10°C maximum

KEY TO ORDERING:

TS	XXX	B	P
Temp. Switch	Activation Temp. (°C)	Form	Probe

EXAMPLE: TS100BP

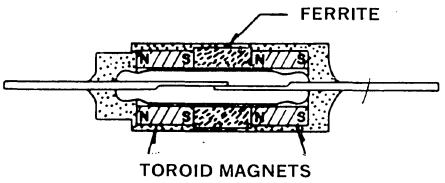
MIDWEST COMPONENTS INC.

MIDWEST COMPONENTS INC.
P.O. Box 787/1981 Port City Boulevard
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

TEMPERATURE SENSING SWITCH

CONVENIENT AND RELIABLE TEMPERATURE CONTROL

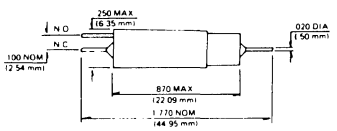
Miniature temperature switches use an electro-ceramic element instead of a bimetallic switch. The Reed Switch Temperature Sensor works on these two principles: a reed switch actuation occurs because of changes in strength of a magnetic field in the vicinity of the contact gap; and certain materials exhibit great changes in magnetic reluctance when the temperature is varied in the vicinity of the material's curie temperature.



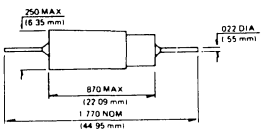
The unit has good response time, and is operable in a variety of atmospheres and solutions. Variations in configurations suitable for installation in automotive engine crankcases and automatic transmissions, or mountings for use in computer cabinets are possible. Other applications include oven over-heat alarms, corrosive liquid temperature control, food freezer thaw warning and cooling fan stop indication. This switch replaces many thermally actuated devices now used where increased life is required or protection of the switching contacts from adverse environments is deemed desirable.

EPOXY PACKAGED SWITCHES

Switches feature small size for fast response. Eopxy package resists most chemicals and is good for use up to 125°C. Standard units from 0°C to ±125°C are available in five degree nominal increments.



SPDT Form C



SPST Form B (NC)
SPST Form A (NO)

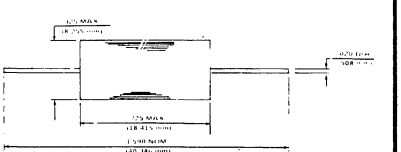
SPECIFICATIONS

	SPST Form B (NC)	SPST Form A (NO) SPDT Form C
CONTACT RATING	Watts – 10W maximum Volt Amps – 12 V.A. maximum	Watts – 10W maximum Volt Amps – 12 V.A. maximum
VOLTAGE	Volts D.C. – 100 VDC maximum Volts A.C. – 120 VAC maximum	Volts D.C. – 100 VDC maximum Volts A.C. – 120 VAC maximum
CURRENT	Carry – 1 amp maximum Break – 1 amp maximum Make – .5 amp maximum	Carry – 1 amp maximum Break – 1 amp maximum Make – .500 amp maximum
OPEN TEMPERATURE – NOMINAL	5° increments starting at 0°C	5° increments starting at 0°C
TOLERANCE	±5°C	±5°C
RESET DIFFERENTIAL	10°C maximum	10°C maximum

FREEZE SENSORS

The Solar Freeze Sensor, Catalog Number TS-5B1, was developed to provide controller activation before freezing conditions damage collector. This activation will then provide recirculation or drain down to protect system. To meet the needs of high temperature exposure, the switch is packaged to withstand 400°C. Switch has also found application as road surface freeze indicator, refrigerated van warning sensor and is widely used as a frost sensor in the agricultural industry.

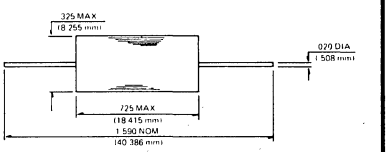
CONTACT ARRANGEMENT	SPST Form B (Normally Closed)
CONTACT RATING	Watts 10W maximum Volt Amps 12 V A maximum
VOLTAGE	Volts D C 100 VDC maximum Volts A C 120 VAC maximum
CURRENT	Carry 1 amp maximum Break 1 amp maximum Make 5 amp maximum
ACTIVATION (TEMPERATURE FALL)	1-7°C
RESET (TEMPERATURE RISE)	10°C maximum
OVERALL LENGTH	1 590" nominal
DIAMETER	325" maximum
WEIGHT	1 6 grams



HIGH TEMP. SWITCHES

In addition to the three standard temperature switches, we now offer a high temperature Form B version. This new high temperature version is available from 0°C to 250°C. Typical applications include sensing temperature increases in temperature chambers, instrumentation, liquids, semi-solids or solids.

CONTACT ARRANGEMENT	SPST Form B (Normally Closed)
CONTACT RATING	Watts 10W maximum Volt Amps 12 V A maximum
VOLTAGE	Volts D C 100 VDC maximum Volts A C 120 VAC maximum
CURRENT	Carry 1 amp maximum Break 1 amp maximum Make 5 amp maximum
TOLERANCE	±10°C
RESET DIFFERENTIAL	10°C maximum
OVERALL LENGTH	1 590" nominal
DIAMETER	325" maximum
WEIGHT	1 6 grams



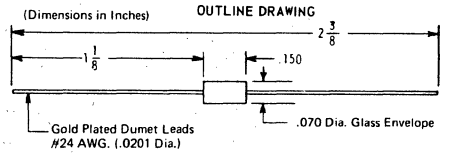
MIDWEST COMPONENTS INC.

MIDWEST COMPONENTS INC.
P.O. Box 787/1981 Port City Boulevard
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

NTC THERMISTORS

• HIGH TEMPERATURE SENSORS

H-Series Hermetically Sealed Thermistors are small, rugged, and good for use up to 400°C. Uniform dimensions make them desirable for automatic insertion in printed circuit boards. Dumet leads are weldable and/or solderable.



• PRECISION H SERIES

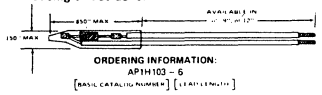
Developed from our standard H-Series device is an ultra-precision sensor for applications needing tracking ability over a wide temperature range. Tighter tolerance assures less error and interchangeability from sensor to sensor. H-Series Hermetically Sealed Thermistors are small, rugged, and good for use up to 400°C. Gold plated Dumet leads are weldable and/or solderable.

Typical Characteristics / SPECIFICATIONS — Catalog Number	1H-104	1H-503	1H-203	2H-103	2H-502	2H-202	4H-105	4H-504	4H-204
Zero Power Resistance @ 25°C, OHMS ± 10%	100,000	50,000	20,000	10,000	5,000	2,000	1,000,000	500,000	200,000
R25°C / Resistance Ratio: R125°C	29.85	29.85	29.85	19.88	19.80	19.80	48.78	48.78	48.78
Dissipation Constant (δ): milliwatts / °C	2	2	2	2	2	2	2	2	2
Thermal Time Constant (τ): (sec.)	8	8	8	8	8	8	8	8	8
Maximum Operating Temperature: (°C) / (°F)	400 / 752	400 / 752	400 / 752	400 / 752	400 / 752	400 / 752	400 / 752	400 / 752	400 / 752

Typical Characteristics / SPECIFICATIONS — Catalog Number	PIH104	PIH903	PIH803	PIH703	PIH603	PIH503	PIH403	PIH303	PIH203	PIH103
Zero Power Resistance @ 25°C, OHMS ± 2%	100K	90K	80K	70K	60K	50K	40K	30K	20K	10K
R25°C / Resistance Ratio: R125°C	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85
Dissipation Constant (δ): milliwatts / °C	2	2	2	2	2	2	2	2	2	2
Thermal Time Constant (τ): (sec.)	8	8	8	8	8	8	8	8	8	8
Maximum Operating Temperature.	400	400	400	400	400	400	400	400	400	400

• PRECISION INTERCHANGE PROBES

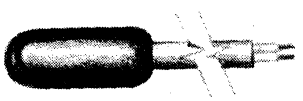
The stringent needs of the solar heating industry are met with M.C.I.'s precision sensor. This sensor provides an interchangeability of ±1°C or better. The sensor element can withstand continuous temperatures of 400°C without damage caused by high static conditions. Solder joints are eliminated in this probe to provide greater temperature exposure capabilities and increased reliability. Only teflon leads and insulation are used throughout the assembly making this device ready to mount in the manufacturer's probe housing or use as is.



Typical Characteristics — Catalog Number	AP-1H104	AP-1H903	AP-1H803	AP-1H703	AP-1H603	AP-1H503	AP-1H403	AP-1H303	AP-1H203	AP-1H103
Zero Power Resistance @ 25°C, OHMS ± 2%	100K	90K	80K	70K	60K	50K	40K	30K	20K	10K
R25°C / Resistance Ratio: R125°C	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85
Dissipation Constant (δ): milliwatts / °C	2	2	2	2	2	2	2	2	2	2
Thermal Time Constant (τ): (sec.)	8	8	8	8	8	8	8	8	8	8

• PLASTIC MOLDED SENSORS

The plastic molded sensor is designed for high accuracy, ease of assembly, and ruggedness. Its resistance changes with temperature to provide accurate inputs to electronic controls. Applications include energy management, solar, and industrial controls. Molded body resists extreme environments.



LOW PROFILE

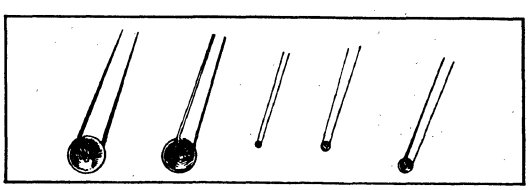
STANDARD

CATALOG NUMBER	STANDARD	9RT1H-510	9RT1H-520	9RT1H-530	9RT1H-540	9RT1H-550	9RT1H-560	9RT1H-570	9RT1H-580	9RT1H-590	9RT1H-600
	LOW PROFILE	9RT1H-610	9RT1H-620	9RT1H-630	9RT1H-640	9RT1H-650	9RT1H-660	9RT1H-670	9RT1H-680	9RT1H-690	9RT1H-700
Zero Power Resistance @ 25°C; OHMS ± 2%		10K	20K	30K	40K	50K	60K	70K	80K	90K	100K
Resistance Ratio; $\frac{R_{25°C}}{R_{125°C}}$		29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85
Max. Operating Temp.		105°C	105°C	105°C	105°C	105°C	105°C	105°C	105°C	105°C	105°C

• TEMPERATURE COMPENSATION AND SENSING

Type	Ohms @ 25°C	Res. Ratio 25°C/125°C	Diss. Const. MW/°C	Time Const.	Dia. In.
4D101	100K	48.78	4	12	.1
4D103	50K	48.78	4	8	.1
1D051	20K	29.85	2	4.5	.05
1D101	10K	29.85	4	12	.1
1D103	5K	29.85	4	8	.1
1D201	3K	29.85	8	34	.2
1D501	1K	29.85	19	140	.5
2D054	1K	19.80	2	3	.05
2D102	1K	19.80	4	10	.1
2D104	500	19.80	4	6	.1
2D202	300	19.80	8	24	.2
3D504	5	12.95	15.5	70	.5
4D051	200K	48.78	2	4.5	.05

Disc Series Thermistors are small rugged Thermistors with close electrical tolerances. Their small mass gives short thermal time constants, yet they are not so small that it is difficult to handle them. The tinned copper leads are easily soldered into electrical circuits.

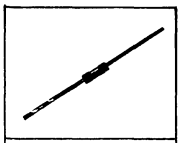


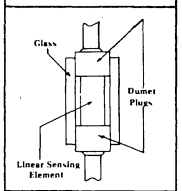
MIDWEST COMPONENTS INC.

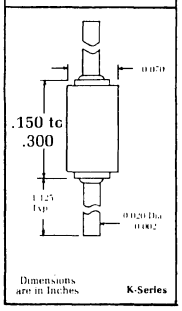
MIDWEST COMPONENTS INC.
P.O. Box 787/1981 Port City Boulevard
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

TEMPSISTOR

TEMPSISTOR© TEMPERATURE COMPENSATOR







The Tempsistor© is a temperature compensator designed to offset the temperature drift of metallic and silicon based semi-conductors. Applications include pressure transducers, opto amplifiers, inductive motor controllers, and automatic gain controls. Small size can replace 1/8 watt or larger resistors.

The Tempsistor© is available in resistances from 10 to 15,000 ohms at 25°C.

Resistance Ratio Temperature Characteristics					
Temp.		R / R Multiplier			
		RESISTANCE VALUES (Ohms)			
°C	°F	10-56Ω	68-820Ω	1-2.7KΩ	3.3-10KΩ
-25	-13	.73	.65	.65	.61
0	32	.86	.82	.81	.83
25	77	1.00	1.00	1.00	1.00
50	122	1.15	1.21	1.19	1.19
75	167	1.32	1.44	1.39	1.37
100	212	1.49	1.68	1.58	1.52
125	257	1.68	1.94	1.75	
150	302	1.89	2.21		

BEAD PROBES

Glass coated bead Thermistors feature SMALL SIZE, FAST RESPONSE, and improved HIGH-TEMPERATURE STABILITY. Leads are fired-in platinum-iridium. Bead probes, incorporating the bead in the tip of a glass probe, offer the additional advantages of more rugged construction in an easy to mount package which can be used in liquid media. Tinned Dumet leads are supplied on probes. The maximum operating temperature for beads and bead probes is 400°C.

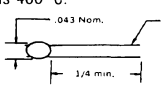


FIGURE 1

Outline Drawings (Dim. in inches)

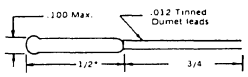


FIGURE 2

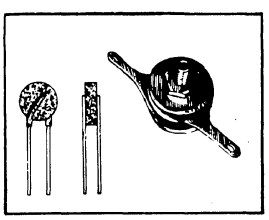
'Bead probes also available in 2" lengths.

TYPE	Zero Power Resistance at 25°C ohms ± 20%	Catalog Number	Resistance Ratio R25°C/R125°C ± 5%	Dissipation Constant (6) Milliwatts/ C	Thermal Time Constant (τ) Seconds	Figure Number
Bead Probe	2,000	81G-20250	19.8	1	15	2
	10,000	81G-10350	29.85			
	15,000	81G-15350	29.85			
	50,000	81G-50350	35.0			
	150,000	81G-15450	39.7			
	500,000	81G-50450	46.5			
	1,000,000	81G-10550	51.5			

SUPPRESSORS

INRUSH CURRENT SUPPRESSORS FOR SWITCHING POWER SUPPLIES.

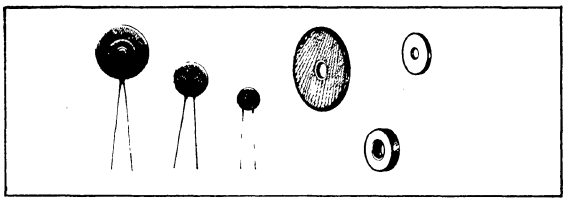
Switching power supplies present high initial currents due to filter capacitor impedance upon turn-on. The use of Midwest's NTC (Negative Temperature Coefficient) devices limits this current to a low valve. After current flow their resistance becomes negligible and offers little voltage drop.



MCI P/N	Description	FIG.	Size	Cold Resistance at 25°C	Maximum Applied Current	Hot Resistance At Specified Current
D204CS	Radial Leaded Disc	A	2" Dia	10 Ohms	1 Amp	75 Ohms
D304CS	Radial Leaded Disc		3" Dia	10 Ohms	2 Amps	50 Ohms
D504CS	Radial Leaded Disc		5" Dia	5 Ohms	3 Amps	24 Ohms
D752CS	Radial Leaded Disc		75" Dia	2.5 Ohms	4 Amps	18 Ohms
E752CS	Radial Leaded Disc		75" Dia	2.5 Ohms	5 Amps	12 Ohms
1A8CS	Assembly	B	75" Dia	3.15 Ohms	7.5 Amps	14 Ohms
1A9CS	Assembly		75" Dia	1 Ohm	10 Amps	055 Ohms
2A0CS	Assembly		75" Dia	1 Ohm	12 Amps	045 Ohms
3A9CS	Assembly		75" Dia	1 Ohm	15 Amps	032 Ohms

VARISTORS

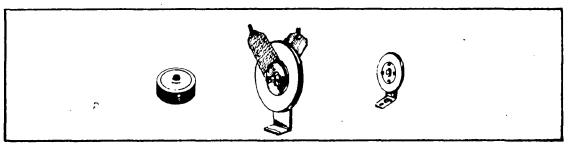
Midwests' Varistors offer inexpensive answers to problems of transient, surge, and lighting suppression. Energy handling capabilities are limitless depending upon size and construction of devices.



SMALL TYPE DISCS DESIGNED FOR PROTECTION OF CONTACTORS, RELAYS, AND SOLID STATE COMPONENTS

3" (76.2) AND 6" (152.4) DIAMETER DISCS FOR MEDIUM POWER APPLICATIONS ALLOW FOR CUSTOM ASSEMBLIES FOR POWER SUPPLY COMPONENTS

Catalog Number	Maximum Values: Continuous Operating Voltage (Volts) (DC)	(AC)	Continuous Power Rating (Watts)	Discharge Capacity (Watt-Seconds)	Peak Discharge -Voltage for Given DC Discharge Current (Amps)	(Volts)	Specifications: DC Test Voltage & Current (Volts ±20)%	(Amps)
.5" (12.7) DIA.								
70D5010	150	135	.25	30	.10	400	175	.001
68D5010	60	54	.25	30	.10	200	75	.0025
67D5010	30	27	.25	30	.25	100	35	.005
65D5010	15	13.5	.25	20	.25	60	15	.010
.75" (19.05) DIA.								
71D7000	150	135	.75	50	.125	400	175	.005
68D7000	60	54	.75	50	.25	185	70	.0125
66D7000	30	27	.75	50	.25	185	70	.0125
63D7000	15	13.5	.75	50	.50	100	35	.025
1.0" (25.4) DIA.								
71D10000	300	270	1.5	275	.25	1000	350	.005
68D10000	150	135	1.5	275	.50	575	175	.010
66D10000	60	54	1.5	275	1.0	305	70	.025
63D10000	30	27	1.5	275	1.5	175	35	.050
3" (76.2) DIA.								
71W30100	1500	1350	3.5	9,250	10	7500	1800	0.0025
69W30100	300	270	3.0	5,100	1.5	1350	520	0.050
68W30100	150	135	3.0	5,100	2.5	800	230	0.050
67W30100	60	54	3.0	1,700	5.0	250	85	0.100
66W30100	30	27	3.0	1,700	5.0	150	36	0.100
63W30100	15	13.5	3.0	1,350	10	100	25	0.500
62W30100	7	6.3	3.0	1,100	10	40	9	0.500
6" (152.4) DIA.								
69W60100	275	250	10	22,500	10	1200	550	0.500
68W60200	200	180	10	22,500	12.5	990	400	0.500
68W60100	150	135	10	22,500	15	780	300	0.500



3" (76.2) AND 6" (152.4) ASSEMBLIES FOR HIGH ENERGY USES. ALL UNITS HAVE STANDARD BRACKET MOUNTS AND SOLDERLESS TERMINALS FOR FAST CONNECTION

Type	Catalog Number	Continuous DC Operating Voltage Rating (Volts)	Continuous Power Loss in Operation (Watts)	Discharge Capacity (Watt-Seconds)
BRACKET	9RV3A12	150	3	5,100
	9RV3A14	300	3	5,100
	9RV3A15	600	6	10,200
	9RV6A4	150	40	90,000
	9RV6A5	300	20	45,000
	9RV6A6	275	10	22,500
	9RV6A7	275	20	45,000
	9RV6A8	275	30	67,500
	9RV6A9	275	40	90,000
	9RV6A10	550	20	45,000
BOX	9RV6A65	550	120	270,000
	9RV6A55	550	240	540,000

MIDWEST COMPONENTS INC.

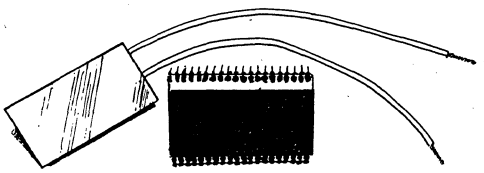
MIDWEST COMPONENTS INC.
P.O. Box 787/1981 Port City Boulevard
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

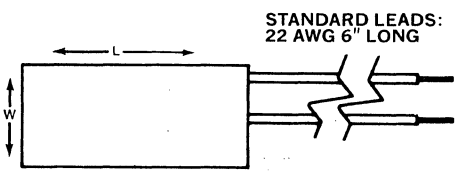
SPECIALTY CERAMICS

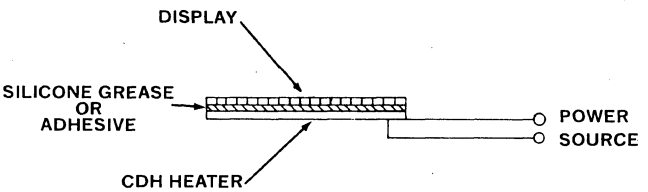
SELF REGULATING DISPLAY HEATER

The unique self-regulating heating effects of specially doped ceramics are utilized to create a new type heater for liquid crystal or other temperature sensitive displays. These devices produce heat at cold temperatures and curtail heating at normal or high temperatures. This feature allows its use in battery operated instruments due to low normal current drain. Use of this heater allows a broader application of displays by removing the adverse effects of temperature.

Heater is attached to reverse side of display with thermally conductive epoxies or silicone adhesives depending upon display's thermal coefficient of expansion or temperature to which it may be subjected. Actual performance of the display will depend upon manufacturers specifications.







ORDER NUMBER	SIZE* L X W	OPERATING VOLTAGE**	NOMINAL RESISTANCES	
			R@ - 35°C	R@ 50°C
CDH001	2.0" x .9"	12-28 AC or DC	5 OHMS	1500 OHMS MIN.
CDH002	3.1" x 1.1"	12-28 AC or DC	3 OHMS	1000 OHMS MIN.
CDH003	3.6" x 1.1"	12-28 AC or DC	2.5 OHMS	750 OHMS MIN

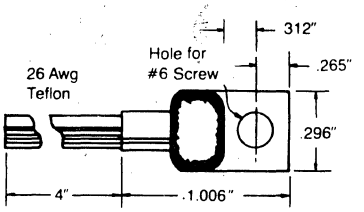
*Other sizes available — consult factory.

OVER TEMPERATURE PROTECTORS

MIDWEST COMPONENTS' Over Temperature Protector provides shutoff or regulation of expensive RF or AF Power Transistors. Protects against over heating that occurs from output stage component failure, antenna breakage, or short conditions.

Unlike fuses or bi-metal elements its action is recyclable and has no hysteresis effect.

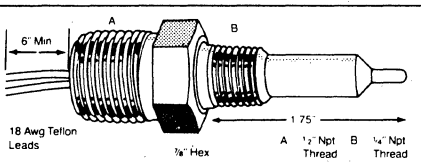
Also available:
- Other switching temperature or resistances compatible with package constraints.
- Special lead types or end terminations.
- Body styles for protection of TRIAC or SCR Rectifiers.

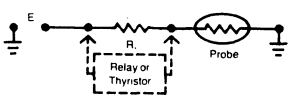


Order Number	Switching Temp. (Nom.)	Resistance at 25°C (Ohms)	Resistance at Switching Temperature	Max. Cont. Oper. Temp.
OTP60.11	60°C	100 ± 40%	250 OHMS (min.)	150°C
OTP70.11	70°C	100 ± 40%	250 OHMS (min.)	150°C
OTP80.11	80°C	100 ± 40%	250 OHMS (min.)	150°C
OTP100.11	100°C	100 ± 40%	250 OHMS (min.)	150°C
OTP120.11	120°C	100 ± 40%	250 OHMS (min.)	150°C
OTP125.11	125°C	100 ± 40%	250 OHMS (min.)	150°C

OVER TEMPERATURE PROBE 9RT1P—SERIES

This rugged Probe is designed for over temperature sensing on compressors, engines, or fluid transfer lines. When over temperatures occur its resistance increases by a factor of five or more. This large increase allows simple interface with relay or Thyristor controls. Probe functions on AC or DC without regard for polarity. Stainless steel is used to minimize corrosion.





Order Number	Resistance at 25°C (Ohms) ± 40%	Activation Temperature ± 5°C	Resistance at Activation Temperature
9RT1P106	2000	100°C	10,000
9RT1P101	2000	113°C	10,000
9RT1P107	2000	120°C	10,000
9RT1P108	2000	125°C	10,000

MIDWEST COMPONENTS INC.

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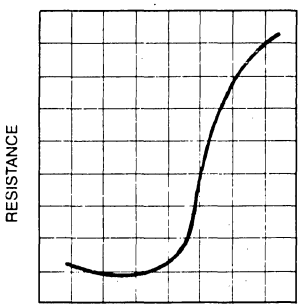
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

PTC SWITCHING THERMISTORS

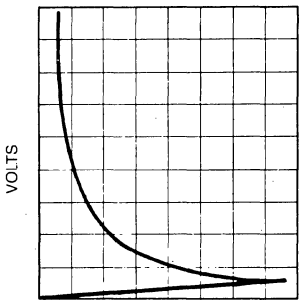
THE POSITIVE WAY TO SENSE, MEASURE, CONTROL, REGULATE AND PROTECT.

MIDWEST COMPONENTS INC. PTC switching thermistors are thermally sensitive resistors which exhibit large positive increases in resistance with temperature. At customer specified temperatures the resistance rises abruptly from a low value to a high value. This resistance shift is infinitely repeatable and has no hysteresis associated with its action.

TYPICAL PTC RESISTANCE VS. TEMPERATURE CURVE



TYPICAL VOLTAGE CURVE VS. CURRENT



• DISCRETE PTCS

Popular styles for current limiting or sensing. Most types come standard with protective coatings.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

ORDER NUMBER	FIG.	SWITCH TEMPERATURE	BASE RESISTANCE	TEST PARAMETERS	NOMINAL DIMENSIONS	Protective Coating (✓)
100D10112	1	0°C ± 5°C	100 ohms ± 40% @ −35°C	R @ 0°C ± 5°C 500 ohms ± 40%	.42" Dia .05" Thk	
108D10001	5	8°C ± 10°C	10 ohms ± 40% @ −35°C	R @ 50°C = 3000 ohms min	.65" Dia .05" Thk	
110Q20101	3	10°C ± 5°C	250 ohms ± 40% @ −35°C	R @ 10°C ± 5°C = 1250 ohms ± 40%	.30" x .10" x .15"	
130D25000	5	30°C ± 5°C	25 ohms ± 20% @ −5°C	R @ 30°C ± 5°C = 5 x R 25°C ± 20%	.78" Dia .08" Thk	
140D25001	1	40°C ± 5°C	25 ohms ± 50% @ 25°C	R @ 50°C = 125 ohms ± 50%	.38" Dia .065" Thk	
150Q80112	2	50°C ± 5°C	750 ohms ± 33% @ 25°C	R @ 50°C ± 5°C = 3,750 ohms ± 33%	.30" x .10" x .15"	
160D10116	1	60°C ± 5°C	100 ohms ± 40% @ 25°C	R @ 60°C ± 5°C = 5 x R 25°C Protective Current Level = 20 ma	.3" Dia .20" Thk	✓
165D15001	5	65°C ± 5°C	15 ohms ± 33% @ 25°C	R @ 65°C ± 5°C = 75 ohms ± 33%	.58" Dia .050" Thk	
165Q80113	2	65°C ± 5°C	750 ohms ± 33% @ 25°C	R @ 65°C ± 5°C = 3,750 ohms ± 33%	.30" x .10" x .15"	
170D10117	1	70°C ± 5°C	100 ohms ± 40% @ 25°C	R @ 70°C ± 5°C = 5 x R 25°C Protective Current Level = 40 ma	.3" Dia .20" Thk	✓
175Q15114	3	75°C ± 5°C	150 ohms ± 30% @ 25°C	R @ 75°C ± 5°C = 750 ohms ± 30%	.30" x .10" x .15"	
180D10113	1	80°C ± 5°C	100 ohms ± 40% @ 25°C	R @ 80°C ± 5°C = 5 x R 25°C Protective Current Level = 60 ma	.340" Dia .240" Thk	✓
180D15015	5	80°C ± 5°C	15 ohms ± 40% @ 25°C	R @ 80°C ± 5°C = 75 ohms ± 40%	.48" Dia .15" Thk	

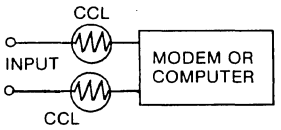
ORDER NUMBER	FIG.	SWITCH TEMPERATURE	BASE RESISTANCE	TEST PARAMETERS	NOMINAL DIMENSIONS	Protective Coating (✓)
180Q20206	2	80°C ± 5°C	2000 ohms ± 40% @ 25°C	R @ 80°C ± 5°C = 10,000 ohms ± 40%	.45" x .12" x .15"	
180W30115	4	80°C ± 5°C	300 ohms ± 50% @ 25°C	R @ 80°C ± 5°C = 1500 ohms ± 50%	.6"O.D. – .4"I.D. .17" Thk	
185D10102	1	85°C ± 5°C	100 ohms ± 20% @ 25°C	R @ 85°C ± 5°C = 500 ohms ± 20%	.25" Dia .15" Thk	✓
195Q80115	2	95°C ± 5°C	750 ohms ± 33% @ 25°C	R @ 95°C ± 5°C = 3,750 ohms ± 33%	.30" x .10" x .15"	
200D40012	1	100°C ± 5°C	40 ohms ± 40% @ 25°C	R @ 100°C ± 5°C = 200 ohms ± 40%	.30" Dia .20" Thk	✓
200D65011	1	100°C ± 5°C	65 ohms ± 38% @ 25°C	R @ 100°C ± 5°C = 5 x R 25°C Protective Current Level = 80 ma	.4" Dia .275" Thk	✓
220Q32214	2	120°C ± 5°C	3200 ohms ± 25% @ 25°C	R @ 120°C ± 5°C = 16,000 ohms ± 25%	.30" x .10" x .15"	✓
222W75101	4	122°C ± 5°C	750 ohms ± 33% @ 25°C	R @ 122°C ± 5°C = 3,750 ohms ± 33%	.6"O.D. – .38"I.D. .17" Thk	
223D80011	1	123°C ± 5°C	8 ohms ± 40% @ 25°C	R @ 123°C ± 5°C = 40 ohms ± 40%	.6" Dia .20" Thk	✓
225D10102	1	125°C ± 5°C	100 ohms ± 40% @ 25°C	R @ 125°C ± 5°C = 5 x R 25°C Protective Current Level = 100 ma	.40" Dia .25" Thk	✓
225D28011	1	125°C ± 5°C	28 ohms ± 27% @ 25°C	R @ 125°C ± 5°C = 140 ohms ± 27%	.28" Dia .23" Thk	
227D11212	1	127°C ± 5°C	1100 ohms ± 40% @ 25°C	R @ 127°C ± 5°C = 5500 ohms ± 40%	.1" Dia .160" Thk	
227D60010	1	127°C ± 5°C	60 ohms ± 40% @ 25°C	R @ 127°C ± 5°C = 5 x R 25°C Protective Current Level = 125 ma	.6" Dia .30" Thk	✓

ALL LEADS TINNED COPPER 1" MINIMUM

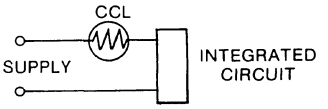
• CURRENT LIMITERS

The ceramic element protects circuits from destructive overcurrent conditions by switching to a high resistance which trims the current back to a safe level. The unit then recovers automatically when the overcurrent condition is corrected.

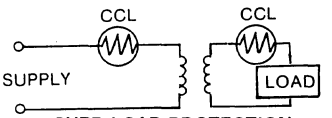
The ceramic current limiter is an inexpensive alternative to fuses and fixed resistors. It has obvious advantages over all of these since it has infinite life, is self resetting which eliminates field servicing and will not "flame out" eliminating the fire hazard of fixed resistors.



DATA COMMUNICATIONS LINE PROTECTOR



OVER-CURRENT PROTECTION



OVER-LOAD PROTECTION

ORDER NUMBER	MAXIMUM Ω @ 25°C	MAXIMUM VOLTS DC	NOMINAL CONTINUOUS CURRENT	RESIDUAL CURRENT @ APPLIED VOLTAGE 50VDC	100VDC	150VDC	NOMINAL DIMENSIONS IN INCHES
CCL020.01	140 Ω	125	20 MA	8 MA	6 MA	N/A	.23 dia. x .1 thk.
CCL060.01	86 Ω	150	60 MA	16 MA	10 MA	8 MA	.4 dia. x .3 thk.
CCL100.01	40 Ω	150	100 MA	19 MA	13 MA	11 MA	.4 dia. x .3 thk.
CCL140.01	80 Ω	150	140 MA	23 MA	15 MA	13 MA	.56 dia. x .25 thk.
CCL150.01	23 Ω	150	150 MA	24 MA	16 MA	14 MA	.65 dia. x .32 thk.
CCL300.01	10 Ω	70	300 MA	31 MA	N/A	N/A	.55 dia. x .14 thk.
CCL450.01	12 Ω	100	450 MA	40 MA	30 MA	N/A	.6 dia. x .07 thk.

MIDWEST COMPONENTS INC.

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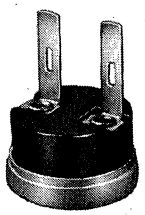
P.O. Box 787/1981 Port City Boulevard
Muskegon, MI 49443/(616) 777-2602/TWX: 510-394-4130

Therm-O-Disc makes disc-powered temperature controls with the reliability you need

Therm-O-Disc has specialized in building reliable temperature controls since 1948. We are the leader in the industry. We lead in the design of controls to solve customer problems. We lead in the development of manufacturing processes to insure reliability. And, because we have rigid standards of excellence, we insist on 100% calibration checking of the bimetal discs, and 100% operation checking of the completed controls before shipping.

There is no need to take chances on temperature controls for your products when you can get Therm-O-Disc reliability at no extra cost. Ask us for technical bulletins with complete electrical ratings recognized by UL, CSA, and international testing agencies. Samples and quotations will be supplied on request.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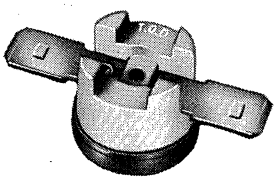
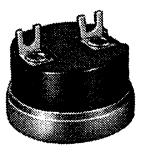

63TM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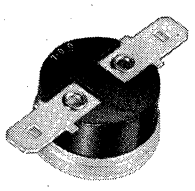
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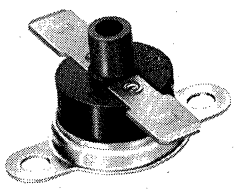
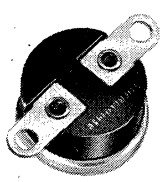

36T Manual Reset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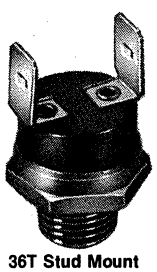
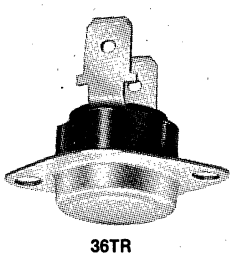
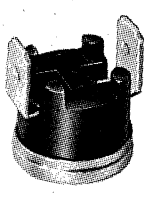
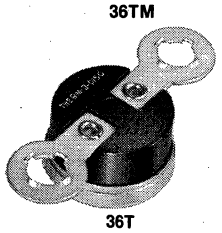

36T Stud Mount


36TR


36TM

(Controls shown actual size)


36T

HIGHLIGHT FEATURES

Impact Action: The bimetal disc of each control is factory calibrated at both the top and bottom temperatures. When the calibrated temperature is reached, the snap action of the disc impacts against the contacts thus giving high speed contact separation and long life.

Switch Actions: Automatic reset, manual reset, and single or "one-shot" operation.

Flexibility: There are many standard terminals and mounting brackets available. The 36TM and 63TM are designed for clamp mounting against a surface.

GENERAL RATING GUIDE & CALIBRATION CHARACTERISTICS

[100,000 Cycles]

Type & Max. Temp.	Resistive Amperes	Inductive FLA	Inductive LRA	Volts AC	Mean Differential Available	Standard* Mfg. Tolerance Top Set Point
36T Up to 350°F	13.75	5.8	34.8	120	15°F to 100°F	±5°F to ±12°F
	10.0	2.9	13.0	240		
63TM Up to 500°F	8.5	125 VA Pilot Duty		120	80°F to 100°F	± 25°F

*Manufacturing tolerances increase as the higher temperature calibrations and wider differentials are selected. For an extra charge, these tolerances can be reduced by approximately 30%.

Write, call or Telex for technical bulletins, samples and quotations.

EMERSON®

Therm-O-Disc®

THERM-O-DISC, INCORPORATED
Subsidiary of Emerson Electric Co.
Department E
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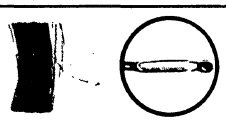
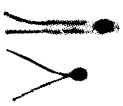
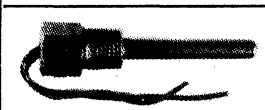
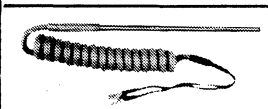
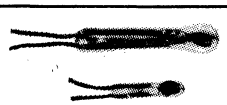
THERMISTORS

OUR STANDARD COMPREHENSIVE LINE OF QUALITY, STABLE, LOW COST THERMISTORS AND THERMISTOR ASSEMBLIES ARE AVAILABLE FROM STOCK OR SHORT DELIVERY.

		DESCRIPTION	APPLICATION	BULLETIN
	BEADS	Glass coated beads from .005" dia. to .055" dia.	Temp. measurement & control. Gas analysis. Circuit compensation. Flow, microwave power, small size, fast response.	B1 B3 B5 B7 B9
	PROBES	Enclosed bead at tip of glass cylinder: .020" dia. to .100" dia.	Temp. measurement & control. Circuit compensation. Liquid level & flow. Rugged, easily mounted. Fast response.	C-1 C-3 C-7
	RODS	Ruggedized bead in glass rod: .060" to .100" dia.	General application where opposite lead ruggedized configuration is required.	C-5
	FLAKES	Thin Flakes: .020" x .020" x .001" to .120" x .120" x .004". Matched units on mounts.	IR measurement. Non-contact temp. meas. Intruder alarms. Microcircuit applications.	D-1 D-3 D-5
	ULTRA-FAST RESPONSE	Response times to 3 ms. Probes, insulated lead assemblies.	Where ultra-fast thermal response is required, in flow, temp. measurement. Catheter applications.	F-1
	HI-TEMP	.055" dia. beads & .060" to .100" dia. glass probes, using special matls. & processing.	Where operating temperatures of 450°C continuous are required.	E-1 E-3
	ASSEMBLIES	Large variety of special & standard housings.	Protected thermistor assemblies.	H-1 H-3 H-5
	TEMPERATURE STANDARDS	Precision temperature standards: 0°C to 60°C with calibrations every 0.01°C.	Laboratory & field temperature standards. OEM applications.	I-1 I-3
	ULTRA-STABLE THERMISTORS	Glass probes .060" to .100" dia. Interchangeable matched pairs. Guaranteed stability to 0.02% or 0.005°C/year.	Precision temp. measurement & control. Laboratory standards.	C-7
NEW!	THERMISTOR CHIPS	.050"x .050" to .100" x .100" sizes; bare and epoxy coated; broad tolerance or interchangeable.	General temperature measurement and control applications, low cost.	

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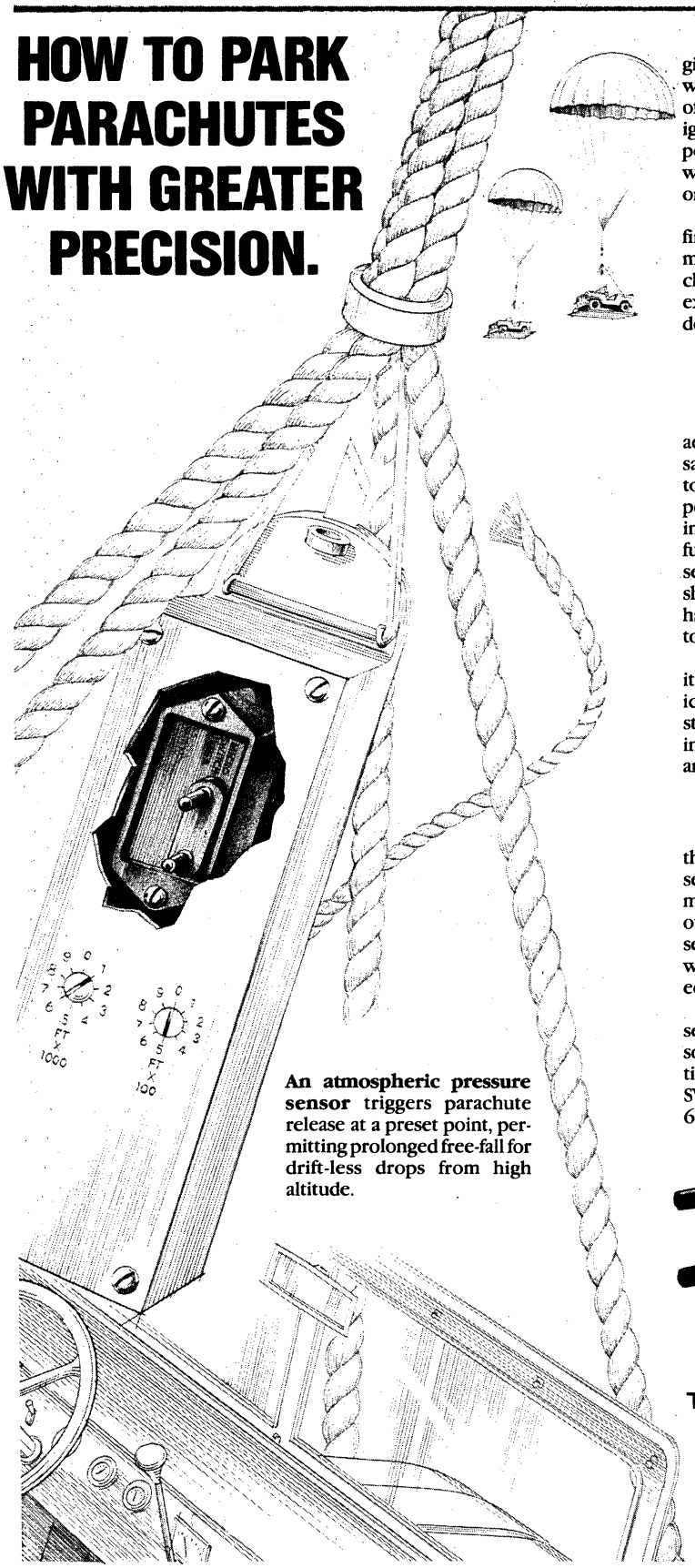
- PRECISION CALIBRATIONS TO 0.002°C
- SPECIAL APPLICATIONS INVITED

3rd in a series from The Sensor Consultants

HOW TO PARK PARACHUTES WITH GREATER PRECISION.



An atmospheric pressure sensor triggers parachute release at a preset point, permitting prolonged free-fall for drift-less drops from high altitude.

High overhead, safely out of antiaircraft range, a giant transport scatters its payload of jeeps to the wind. But trapped in the elevator shaft trajectory of a 12,000-foot free-fall, the jettisoned cargo ignores the wind, and dives more than 600 feet per second. Locked into long, involuntary cartwheels, the jeeps plunge like meteors hell-bent on a rendezvous with ruin.

Now only 1500 feet above ground, the jeeps finally - suddenly - get a brake. Solid state sensors monitoring atmospheric pressure waken parachutes just in time. Drop accuracy is the result of extended free-fall and a reliable signal for chute deployment at desired altitude.

Rely on superior sensor performance.

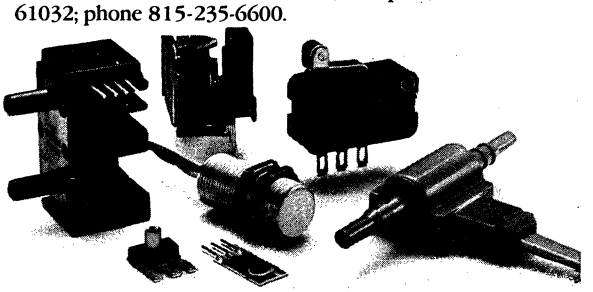
The altitude sentinel/deployment trigger for aerial cargo delivery is a Type 140PC sensor - the same product relied upon to monitor air pressure to pump the pioneer artificial heart. Blue-chip performance is due, in part, to a silicon chip sensing element with ion-implanted, instead of diffused, piezoresistors. And unlike other strain-sensitive sensors, this one shrugs off vibration and shock - as evidenced after a "no chute" dismount had left it implanted, but not diffused, in test-site topsoil.

Two-hour exposure at 50,000 feet doesn't faze it. Yet - despite withstanding thermal and mechanical stress per MIL-STD-810 - this sensor is stocked and priced for "commercial" application in automotive diagnostics, ventilation systems, and process control.

Tell us how we might help you.

Barometric pressure sensing is also a task for the temperature-compensated, 0-15 psia 140PC sensor in flight data "crash" recorders, and in military squib systems. But where price or size outweighs other considerations, the Type 130PC sensor is the popular choice ... as on one-shot weather balloons; portable, electronic surveying equipment; and desktop digital barometers.

We'd like to tell you more about our many sensors for measuring pressure, and about sensors for monitoring current, or signalling position. Just tell us how we can help. Contact MICRO SWITCH, The Sensor Consultants, Freeport, IL 61032; phone 815-235-6600.



Together, we can find the answers.

MICRO SWITCH
a Honeywell Division

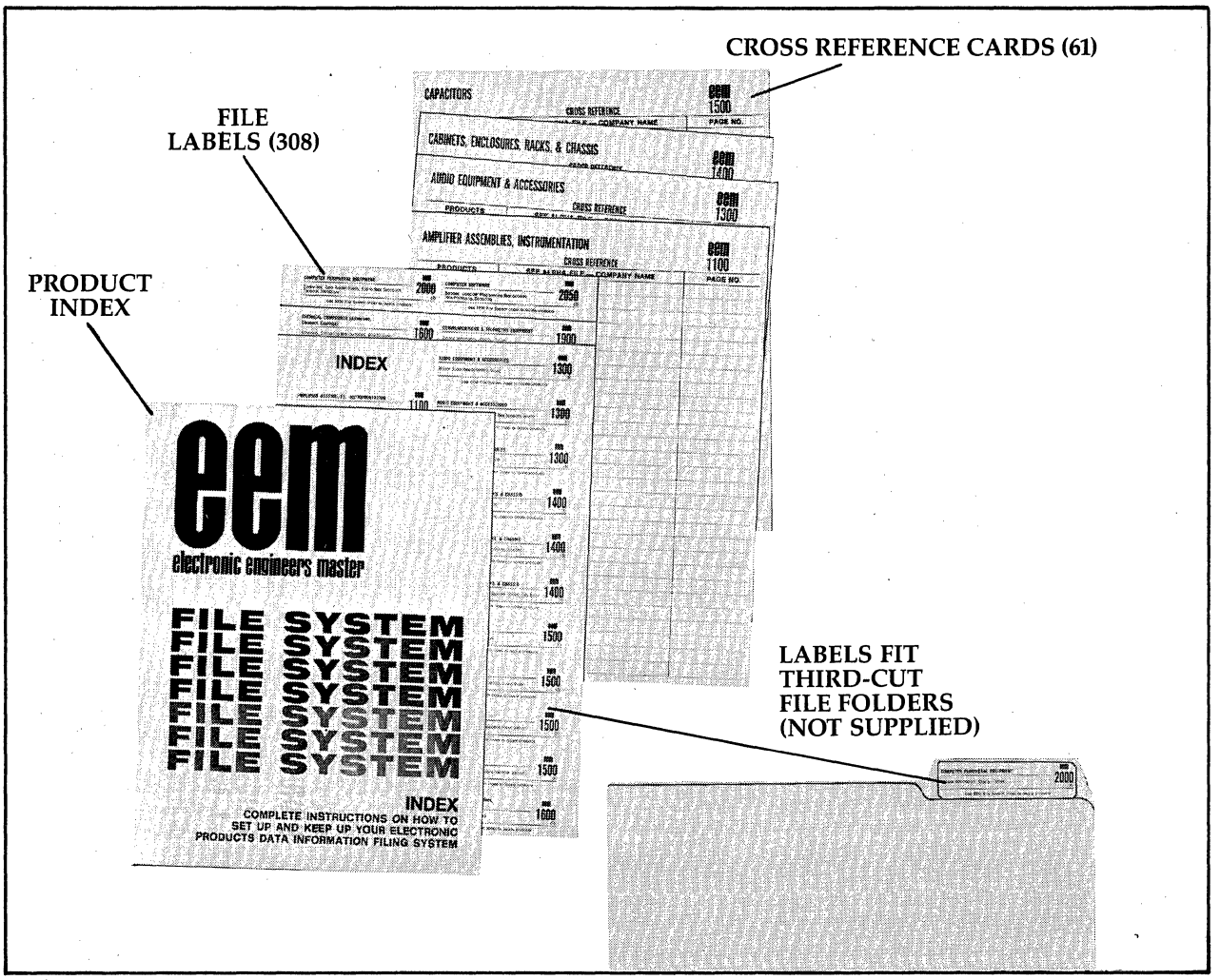
ENCODERS

Manufacturer	Position Shaft Angle, Absolute	Shaft Angle, Incremental	Optical	Contracting	Angle Indicators	LVDTS	Inclinometer	Transducers, Displacement	Transducers, Position, Linear	Transducers Ultrasonic
BEI Electronics	1•2459	1•2459	1•2459							
Blatek										1•2461
Celesco								1•2462	1•2462	
Datametrics/Dresser	1•2465	1•2465	1•2465							
Disc Instruments	1•2467		1•2467							
Endevco			1•2468							
Itek Measurement Sys.	1•2475	1•2475	1•2475							
Litton Encoder	1•2479	1•2479	1•2479	1•2479						
Schaevitz					1•2501			1•2498	1•2498	
Sequential	1•2508	1•2508	1•2508							
Transducers & Systems					1•2474	1•2474	1•2474		1•2474	
TSI								1•2510	1•2510	
U.S. Digital		1•2511	1•2511							
Vernitech			1•2513	1•2513	1•2513					

Manufacturer	Transducers, Velocity	Transducers, Magnetic Pickup	Pressure Transducers	Strain Gauge Transducers	Pressure & Flow Transmitters	Accelerometers	Vibration Transducers	Proximity Sensors	Proximity Switches	Force Transducers	Differential Transformers	Rotary Transformers	Signal Conditioner
Aeroflex Laboratories	1•2455	1•2455											
BBN						1•2458	1•2458						
Celesco	1•2462		1•2462	1•2463	1•2463								
Data Instr.			1•2464	1•2464						1•2464			1•2464
Entran			1•2472			1•2473	1•2473						
Endevco			1•2471			1•2468	1•2469						
Kavlico			1•2476										
Kulite			1•2477										
Microswitch/Honeywell			1•2480										
Paine			1•2497	1•2497							1•2497		
Schaevitz			1•2502	1•2502		1•2503				1•2501			1•2503
Setra Systems			1•2509	1•2509	1•2509	1•2509							
Transducers & Systems	1•2474		1•2474			1•2474		1•2474	1•2474	1•2474	1•2474	1•2474	1•2474
TSI	1•2510	1•2510							1•2510				
Vernitech			1•2513										
Wilcoxon						1•2514	1•2514			1•2514			

ELECTRICAL SENSORS

Manufacturer	Current, AC	Current, DC	Voltage	Watt & Var	Phase Angle	Frequency	Temperature
American Aerospace Controls	1•2456	1•2456	1•2456	1•2456			
Ohio Semitronics	1•2482		1•2482	1•2482			
Scientific Columbus	1•2506		1•2506	1•2506	1•2506	1•2506	1•2506



WONDERFILE!

All-new in '82! The EEM File System has been completely revised and updated. It's now easier than ever to control your files of manufacturers' catalogs.

The new EEM File System contains a complete Product Index. This Index tells you where to file which catalog. It also contains a cross-reference so you'll know where catalogs are filed.

In order to use the new EEM File System all you need is a supply of standard letter size, third-cut, manila file folders which are available locally. You then use the pressure-sensitive labels which are supplied with the File System to go into as much detail as you want (or need).

Each label fits the third-cut file folder exactly. There are 308 of these labels in one System: 1 for the Index, 1 each for the 61 EEM Product Sections, 24 for the alphabetical file of multiproduct catalogs, plus 222 additional labels for System expansion.

The System also includes 61 Cross Reference Cards so you can quickly and easily find multi-product catalogs.

The EEM File System is complete and can save you countless hours of time and thousands of dollars.

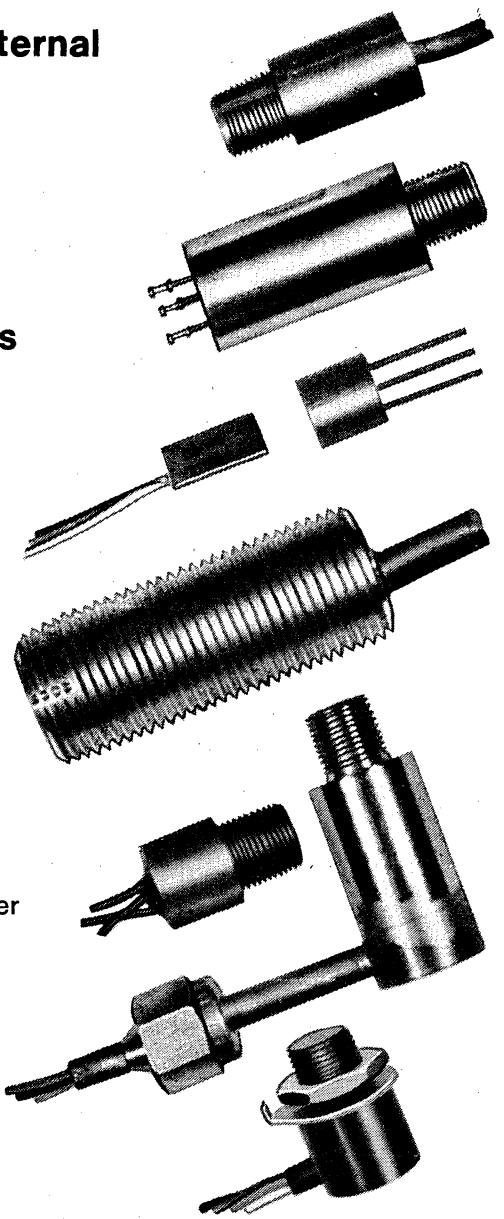
The price? Only $25.00. Send a check to: EEM File System, 645 Stewart Ave., Garden City, NY 11530 and we'll absorb postage and handling. Send a purchase order and add $2.00 for postage and handling. NY and CA residents, please add sales tax.

Use the card at the end of the Product Index in this EEM. Card missing? Write directly to EEM File System.

Speed-Independent Magnetic Pick-ups

Their output voltage amplitudes are totally independent of the rate of change to the external magnetic field. They provide

- **True zero speed sensing**
- **Contactless limit switches**
- **Translational and rotational velocity, direction and position sensing**
- **Counting, indexing, and timing functions**



Benefits:

- Simplify designs
- Low power consumption
- Rugged enough for engine environments
- Aerospace reliability
- Operate from logic power bus
- Freedom from EMI (no choppers or oscillators)
- Freedom from actuator mechanisms
- Can replace optical systems

Applications:

Computer peripherals—sensing of indexing marks for drive mechanisms in card readers / magnetic tape memories / paper roll drive, and character selection in printers

Transportation—wheel speed sensing (skid-controlled braking) / ignition system timing / vehicle sensing (traffic control)

Industrial — speed, position and limit sensing

Aerospace — wide applications

Other Products:

Solid state Push Button and Toggle Switches / Solid state current sensors / as well as brushless DC Motors and Torquers.

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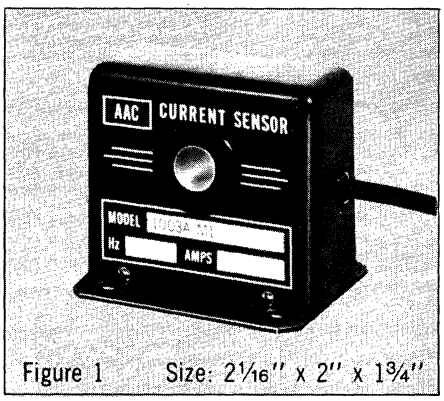


Figure 1 Size: 2 1/16" x 2" x 1 3/4"

AC CURRENT SENSORS

SERIES	FULL SCALE (FS) INPUT CURRENT RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
C	1, 2, 5, 10, 20A	+1mA DC	0.25%FS	400ms	6
1003AM1	2, 5, 10, 15, 20, 30, 50, 100A	+5VDC	1%FS	150ms	1
1004	2, 5, 10, 20, 50, 100A	+5VDC	1%FS	150ms	5
1002	5, 10, 25, 50, 100A	+5VDC	1%FS	50ms	—
1002M1	5, 10, 25, 50, 100, 150, 200, 250A	+5VDC	1%FS	50ms	5
1003AM2	30, 50, 75, 100, 150, 200, 250A	+5VDC	1%FS	150ms	—
1004M7	100, 150, 200, 250A	+5VDC	1%FS	150ms	5
1003AM3	150, 250, 500, 800, 1000, 1200, 1500A	+5VDC	1%FS	150ms	—
1001	150, 250, 500, 1000, 2000, 2500, 5000A	+5VDC	2%FS	150ms	4

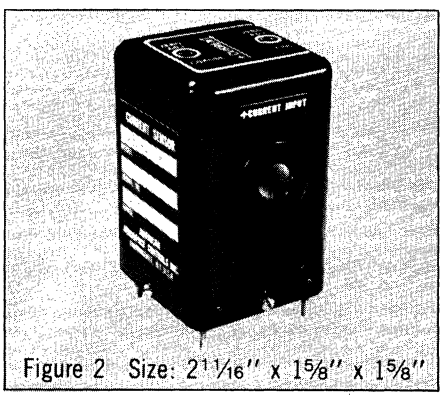


Figure 2 Size: 2 1/16" x 1 5/8" x 1 5/8"

DC CURRENT SENSORS

SERIES	FULL SCALE (FS) INPUT CURRENT RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
904B	.1, .2, .5, 1, 2, 5mA	+5VDC	1%FS	50ms	—
903B	5, 10, 20, 50, 100, 200, 500mA & 1, 2, 5A	+5VDC	1%FS	50ms	5
903C	5, 10, 20, 50, 100, 200, 500mA & 1, 2, 5A	+5VDC	2%FS	50ms	5
S209-903B	5, 10, 20, 50, 100, 200, 500mA & 1, 2, 5A	+1mA DC	1%FS	50ms	5
S218-903	100, 200, 500mA & 1, 2, 5A	+5VDC	1%FS	50ms	3
936	50 & 500mA	+5VDC	2%FS	100ms	—
937	10, 20, 30, 50, 100A	+5VDC	2%FS	200µs	—
913A	10, 20, 50, 100A	+5VDC	1%FS	1ms	2
913B	10, 20, 50, 100A	+5VDC	1%FS	1ms	5
913C	10, 20, 50, 100A	+5VDC	2%FS	1ms	5
S155-913B	10, 20, 35, 50, 75, 100A	+5VDC	1%FS	1ms	5
946	10, 15, 20, 25, 30, 50A	+5VDC	1%FS	30ms	—
950	10, 20, 30, 40, 50A	+5VDC	0.5%FS	10ms	5
951	10, 20, 30, 40, 50A	+5VDC	0.5%FS	30ms	5
952	100, 250, 400, 500, 1000, 1500, 2000A	+5VDC	0.5%FS	50µs	5
934	100, 200, 250, 300, 500, 750, 1000A	+5VDC	2%FS	200µs	5

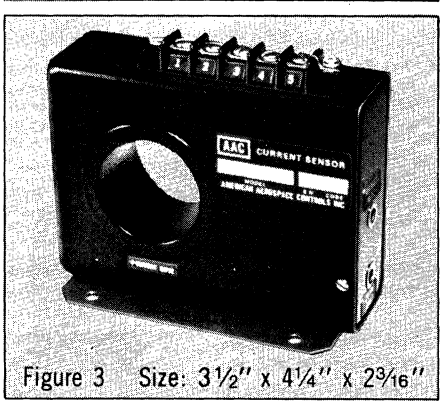


Figure 3 Size: 3 1/2" x 4 1/4" x 2 3/16"

BIDIRECTIONAL CURRENT SENSORS

SERIES	FULL SCALE (FS) INPUT CURRENT RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
905B	±50, 100, 200, 500mA & 1, 2, 5A	±5V	1%FS	50ms	5
905C	±50, 100, 200, 500mA & 1, 2, 5A	±5V	2%FS	50ms	5
925B	±10, 20, 50, 100A	±5V	1%FS	1ms	5
925C	±10, 20, 50, 100A	±5V	2%FS	1ms	5
907	±25, 50, 100, 150, 200, 250, 300A	±5V	2%FS	100µs	—
907A	±25, 50, 100, 150, 200, 250, 300A	±5V	2%FS	40µs	—
908	±25, 50, 100, 150, 200, 300A	±250mV	2.5%FS	5µs	—
910	±25, 50, 100, 150, 200, 250A	±250mV	2%FS	5µs	—
927B	±150, 200, 250, 300, 500, 750, 1000A	±5V	1%FS	100µs	5
927C	±50, 100, 150, 200, 250, 300, 500, 750, 1000A	±5V	2%FS	100µs	5
942A	±100, 200, 300, 500, 800, 1000, 2000A	±5V	1%FS	100µs	3
909	±150, 250, 500, 750, 1000, 1500, 2500, 5000A	±250mV	2.5%FS	200µs	4
909M4	±150, 250, 500, 750, 1000, 1500, 2000, 2500A	±5V	2.5%FS	200µs	4
921	±250, 500, 750, 1000, 2000A	±250mV	2%FS	20µs	5

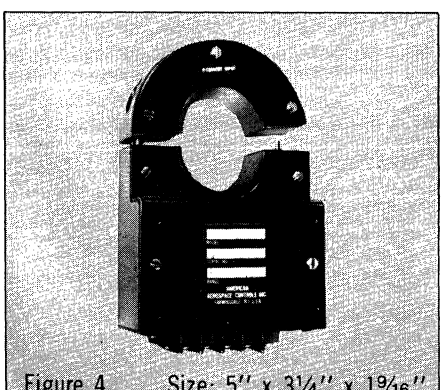


Figure 4 Size: 5" x 3 1/4" x 1 9/16"

CURRENT, VOLTAGE AND POWER INSTRUMENTATION

CALL 516-694-5100

AC & DC CURRENT LEVEL DETECTORS

SERIES	FULL SCALE (FS) INPUT CURRENT RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
850	1, 2, 5, 10, 15, 20, 50, 100, 200, 250A AC	RELAY	2%FS	500ms	—
S212-850	500mA AC (75A AC OVERLOAD)	RELAY	±75mA	200ms	5
901B	20, 50, 100, 250, 500mA & 1, 2, 5A DC	+5V & SW	1%FS	50ms	—
S204-800	100mA DC (10A DC OVERLOAD)	RELAY	N/A	3ms	5
S58-800	200mA DC (10A DC OVERLOAD)	SWITCH	N/A	1ms	5
S201-800	1A DC (100A DC OVERLOAD)	RELAY	±150mA	200ms	5

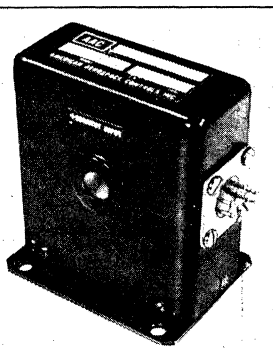


Figure 5 Size: 2⅞" x 2⁹⁄₁₆" x 2"

AC VOLTAGE SENSORS

SERIES	FULL SCALE (FS) INPUT VOLTAGE RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
109	120, 125, 135, 240, 250, 270VAC	+1mA DC	0.5%V max	300ms	—
110	120, 125, 135, 240, 250, 270VAC	+1mA DC	0.5%V max	300ms	—
108	130, 150, 270, 500, 600VAC (0 to FS)	+5VDC	2%FS	200ms	—
S190-108	130, 150, 270, 300, 600VAC (0 to FS)	+10VDC	2%FS	200ms	—
V	150, 300, 500VAC (0 to FS)	+1mA DC	0.25%FS	400ms	6
101M3	150VAC @ 60Hz (SUPPRESSED ZERO)	+5VDC	2%V max	17ms	—
102M3	175VAC @ 400Hz (SUPPRESSED ZERO)	+5VDC	2%V max	3ms	—
105	465, 490, 505, 540VAC (SUPPRESSED ZERO)	+5VDC	2%V max	17ms	—

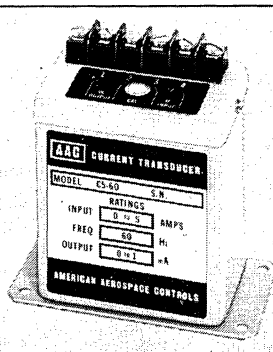


Figure 6 Size: 4" x 4" x 2"

WATT & VAR TRANSDUCERS

SERIES	FULL SCALE (FS) INPUT POWER RANGES	FS OUTPUT	ACCURACY	RESP.	FIG.
415A	1KW-100KW 120 or 220VAC 60Hz	+5VDC	2%FS	400ms	8
416A	4KW-200KW 440VAC 60Hz	+5VDC	2%FS	400ms	8
S217	2KW-80KW 220 & 440VAC 60Hz	+5VDC	2%FS	400ms	8
S73-413	1KW-50KW 120 or 220VAC 60Hz	+5VDC	2%FS	400ms	8
S206-415A	1KW-100KW 120 or 220VAC 400-1KHz	+5VDC	2%FS	150ms	8
W106	0.5KW-2KW (1 ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
W156	1KW-4KW (1½ ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
W206	1KW-4KW (2 ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
W256	1KW-4KW (2½ ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
W306	1KW-4KW (3 ele) 120, 220, or 440VAC	±1mA DC	0.25%FS	400ms	7
Q106	0.5-2KVAR (1 ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
Q156	1-4KVAR (1½ ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
Q206	1-4KVAR (2 ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
Q256	1-4KVAR (2½ ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
Q306	1-4KVAR (3 ele) 120, 220 or 440VAC	±1mA DC	0.25%FS	400ms	7
407	0.3-60KW DC 12-240VDC & 25-250A DC	250mV	2%FS	5μs	—
401	2.7-150KW DC 18-150VDC & 150-1000A DC	250mV	2.5%FS	200μs	4

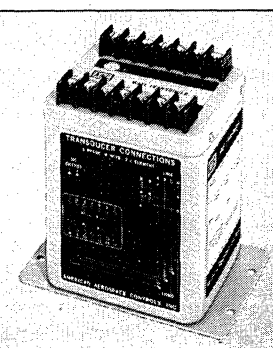


Figure 7 Size: 5⁷⁄₁₆" x 5⅛" x 3⅜"

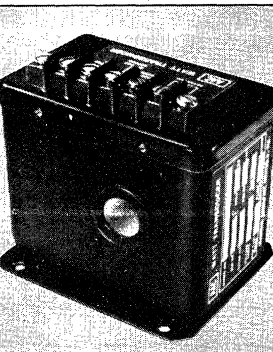


Figure 8 Size: 4" x 4⅛" x 3⅜"

***AAC** manufactures Current, Voltage and Power Sensing Instruments for Industrial, Military and Space Applications. Send for complete catalog. Our Application Engineering Staff is available to assist you.*

BBN Accelerometers and Vibration Monitors help you study motion.

500 SERIES Piezoelectric Accelerometers with Internal Electronics

Eliminates Cable Noise effects, cable length limitation and costly charge amplifiers.
Operating Temperature Range: – 65°F to 250°F (– 54°C to 121°C)

Accelerometer Model	Sensitivity	Amplitude Linearity	Frequency Response ±3 dB points	Mounted Resonant Frequency	Weight
501, miniature, low mass, high frequency	10 mV/g±10%	±1% to ±212 g peak	2 to 40,000 Hz	65 kHz	1.8 grams
501ER, extended frequency response and dynamic range	2 mV/g±15%	1% to ±1,000 g's peak	0.3 to 45,000 Hz	85 kHz	2.0 grams
506, miniature, low mass, high frequency, isolated	10 mV/g±10%	±1% to ±212 g peak	2 to 33,000 Hz	55 kHz	2.0 grams
505, miniature, low mass, triaxial, high frequency	10 mV/g±10% per axis	±1% to ±212 g peak	2 to 25,000 Hz	45 kHz	10 grams
505-ISO, miniature, low mass, triaxial, high frequency, isolated	10 mV/g±10% per axis	±1% to ±212 g peak	2 to 16,000 Hz	38 kHz	11 grams
***507,** high sensitivity, low noise floor	100 mV/g±5%	±1% to ±21 g peak	2 to 12,000 Hz	26 kHz	39 grams
507HS, high sensitivity low noise floor	200 mV/g±10%	±1% to ±10 g peak	2 to 8,000 Hz	20 kHz	60 grams
***507LF,** extended low frequency response	10 mV/g±5%	±1% to ±210 g peak	0.2 to 12,000 Hz	26 kHz	39 grams
507T, triaxial, high sensitivity	100 mV/g±5% per axis	±1% to ±21 g peak	2 to 12,000 Hz	26 kHz	150 grams
507TLF, triaxial, extended low frequency	10 mV/g±5% per axis	±1% to ±210 g peak	0.2 to 10,000 Hz	20 kHz	150 grams
***508B,** general purpose	10 mV/g±5%	±1% to ±212 g peak	2 to 30,000 Hz	40 kHz	12 grams
508S, shock	0.1 mV/g±10%	±1% to 10,000 g peak	3 to 20,000 Hz	N/A	12 grams
510, very low frequency	8 V/g±20%	±1% to ±0.3 g peak	0.03 to 200 Hz (32°F to 150°F)	500 Hz	485 grams
524, industrial, high sensitivity, OEM	100 mV/g±5%	±1%to±25 g pk ±3%to±50 g pk	2 to 12,000 Hz	30 kHz	100 grams
524-ISO, industrial, high sensitivity, OEM, isolated	100 mV/g±5%	±1%to±25 g pk ±3%to±50 g pk	2 to 12,000 Hz	30 kHz	100 grams
524LF, industrial, extended low frequency, OEM	10 mV/g±5%	±1%to±250 g pk ±3%to±500 g pk	0.2 to 12,000 Hz	32 kHz	100 grams
524LF-ISO, industrial, extended low frequency, isolated, OEM	10 mV/g±5%	±1%to±250 g pk ±3%to±500 g pk	0.2 to 12,000 Hz	30 kHz	100 grams
524T, triaxial, high sensitivity, OEM	100 mV/g±5% per axis	±1%to±25 g pk ±3%to±50 g pk	2 to 12,000 Hz	30 kHz	348 grams
524T-ISO, triaxial, high sensitivity, OEM, isolated	100 mV/g±5% per axis	±1%to±25 g pk ±3%to±50 g pk	2 to 12,000	30 kHz	348 grams
524TLF, triaxial, extended low frequency, OEM	10 mV/g±5% per axis	±1%to±250 g pk ±3%to±500 g pk	0.2 to 12,000 Hz	32 kHz	348 grams
524TLF-ISO, triaxial, extended low frequency, isolated, OEM	10 mV/g±5% per axis	±1%to±250 g pk ±3%to±500 g pk	0.2 to 12,000 Hz	30 kHz	348 grams
525, very high stability	25 mV/g±5%	±1% to±84 g pk	2 to 14,000 Hz	28 kHz	40 grams
525-ISO, very high stability, isolated	25 mV/g±5%	±1%to±84 g pk	2 to 14,000 Hz	28 kHz	40 grams
557, underwater	10 mV/g±10%	±1%to±212 g peak	0.3 to 6,000 Hz	20 kHz	175 grams
557-ISO, underwater, isolated	10 mV/g±10%	±1%to±212 g peak	0.3 to 6,000 Hz	20 kHz	175 grams
558, underwater, all-weather	10 mV/g±10%	±1%to±212 g peak	3 to 14,000 Hz	25 kHz	50 grams
559, underwater, biaxial	10 mV/g±10% each axis	±1%to±212 g peak	1 to 5,000 Hz	30 kHz	30 grams
559-ISO, underwater, biaxial, isolated	10 mV/g±10% each axis	±1%to±212 g peak	1 to 5,000 Hz	30 kHz	30 grams

***Option 01 provides a top mount connector**
Dynamic Output Impedance (at 70°F and 100 Hz), nominal: 1,500Ω
Noise Floor (max.): 20 μV **Equivalent g rms (max.) at 1 Hz to 25 kHz:** 0.0002 to 0.0020 g rms (0.000005 g rms 510 only)
Power Supplies: BBN Models **P-16, P-18, P-20, P-1018** and **P-1020** - 0.5mA Constant current, 1.5V rms maximum output; BBN Models **P-18/4** and **P-1018/4** - 4.0 mA constant current, 3.5 V rms maximum output.

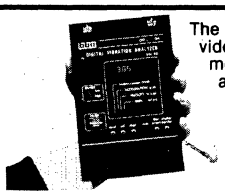
Use BBN piezoelectric accelerometers for the most accurate measurement of random or repetitive vibration phenomena. BBN manufactures a complete line of accelerometers with internal electronics to provide freedom from cable noise, cable length limitations and the need for costly charge amplifiers. High temperature, charge coupled accelerometers are available for operating in temperatures up to 750°F (400°C). Low-cost single and multi-channel power supplies and charge amplifiers provide an interface to display, recording and signal analysis devices.

400 SERIES Medium and High Temperature Piezoelectric Accelerometers

Operating Temperature Range: – 65°F to 750°F (– 54°C to 400°C) — 430 Series
– 65°F to 550°F (– 54°C to 288°C) — 420 Series

Accelerometer	Sensitivity	Amplitude Linearity	Frequency Response ±3 dB	Typical Resonant Frequency	Output Capacitance	Weight
424, medium temperature, high sensitivity	100 pC/g±10%	±1% to ±100 g's peak	0.7 to 11,000 Hz**	27 kHz	1000 pf	100 grams
424-ISO, isolated, medium temperature, high sensitivity	100 pC/g±10%	±1% to ±100 g's peak	0.7 to 10,000 Hz**	25 kHz	1000 pf	100 grams
426, medium temperature, high frequency	20 pC/g±10%	±1% to 50 g's peak	0.3 to 20,000 Hz** @70°F 10 to 20,000 Hz** @500°F	45 kHz	2000 pf	15 grams
426-ISO, isolated, medium temperature, high frequency	20 pC/g±10%	±1% to 50 g's peak	0.3 to 17,000 Hz** @70°F 10 to 17,000 Hz** @500°F	45 kHz	2000 pf	15 grams
430, nuclear hardened, high temperature	10 ±1 pC/g	±1% to ±100 g's peak	5 to 10,000 Hz (±1 dB)	27 kHz	1300 pf	75 grams
430-ISO, isolated, nuclear hardened, high temperature	10 ±1 pC/g	±1% to ±100 g's peak	2 to 8,000 Hz (±1 dB)	23 kHz	1300 pf	100 grams
431-ISO, isolated, nuclear hardened, high sensitivity	50 ±1 pC/g	±1% to ±100 g's peak	1 to 2,000 Hz (±1dB)	5 kHz	1500 pf	125 grams
432-ISO, isolated, nuclear hardened, high frequency	10 ±1 pC/g	±1% to ±100 g's peak	1 to 10,000 Hz (±1 dB)	25 kHz	500 pf	125 grams

****When used with BBN Model Q-18 or Q-1020 charge amplifier**



The 800 Series Digital Vibration Analyzer provides simple, inexpensive and accurate monitoring of rotating or reciprocating apparatus, machinery unbalance and laboratory test systems. The 800 Series measures and displays acceleration, velocity and displacement in English or Metric engineering units and has a family of plug-in filter modules which permit the selection of various frequencies for study. It interfaces with accelerometers which operate from – 65°F to 750°F (– 54°C to 400°C).

800 SERIES Digital Vibration Analyzers

MODEL 821			
OPERATING MODES	**ACCELERATION**	**VELOCITY**	**DISPLACEMENT**
Dynamic Range – low – high	0.01 to 9.99 g peak 0.1 to 99.9 g peak	0.01 to 9.99 in/sec peak 0.1 to 99.9 in/sec peak	0.1 to 99.9 mils pk-pk 1.0 to 999 mils pk-pk
Frequency Response	5 Hz to 10 kHz ±0.5 dB 3 Hz to 15 kHz ±3 dB	5 Hz to 10 kHz ±0.5 dB	8 Hz to 1 kHz ±0.5 dB
Accuracy at 100 Hz	±1%	±2.5%	±3.5%

MODEL 821 M (METRIC)			
OPERATING MODES	**ACCELERATION**	**VELOCITY**	**DISPLACEMENT**
Dynamic Range – low – high	0.01 to 9.99 g peak 0.1 to 99.9 g peak	0.01 to 9.99 cm/sec peak 0.1 to 99.9 cm/sec	5 to 999 μm (microns) pk-pk 0.01 to 9.99 mm pk-pk
Frequency Response	5 Hz to 10 kHz ±0.5 dB 3 Hz to 15 kHz ±3 dB	5 Hz to 10 kHz ±0.5 dB	8 Hz to 1 kHz ±0.5 dB
Accuracy at 100 Hz	±1%	±2.5%	±3.5%

BBN Instruments

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Phone: (617) 491-0091/Telex: 92-1470/Cable BBNCO

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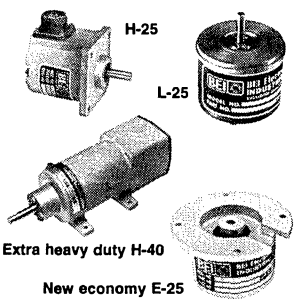

Our INDUSTRIAL ENCODER DIVISION guarantees 30-day delivery on standard model encoders with over 125 resolutions in stock from 1 to 50,000 CPT *incremental:* a wide choice of mechanical and electrical options.

Designed for the abusive machine tool environment. Rugged cast housing, heavy duty shaft and bearings. Available sealed against liquid entry and for shaft loads up to 200 lbs. and 200G shocks.

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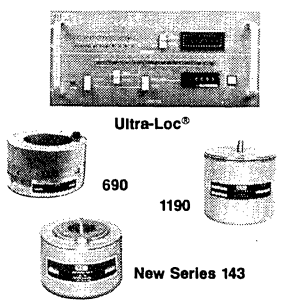

Our DIGITAL PRODUCTS DIVISION offers a wide choice of high accuracy optical rotary, *absolute, incremental* and *tachometer* encoders. Standard resolutions to 1,048,576 bits-per-turn. Special resolutions to 16,777,216 (2^{24}) bits per turn.

Also Ultra-Loc® direct drive programmable rate and position digital control servo system.

TYPICAL APPLICATIONS: Space rated, military high reliability, precision servo systems, pointing and tracking.

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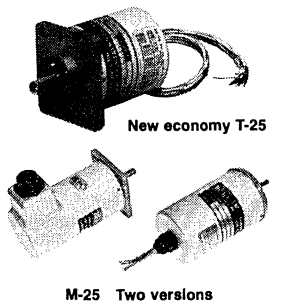

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TYPICAL APPLICATIONS: Robotic measurement, drive system components, process control, absolute machine tool, absolute pointing and tracking.

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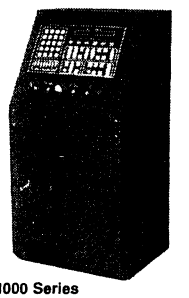

Our new GENERAL CONTROL SYSTEMS DIVISION offers end users an extremely cost-efficient turn-key programmable electronic motion control drive system for industrial automation applications.

The GC-1000 series is a modular low-cost system that can synchronize up to 16 axes of simultaneous motion and functions from one control panel. Standard drive system capability: ¼-5 HP. Optional: 7¼-300 HP.

TYPICAL APPLICATIONS: Webb process industries, winding processes, robotics with passthrough and contour path requirements, multi-axes machine tool, assembly, packaging equipment and transfer lines.

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BEI Electronics, Inc.

BEI

Specialists in Motion Control

COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

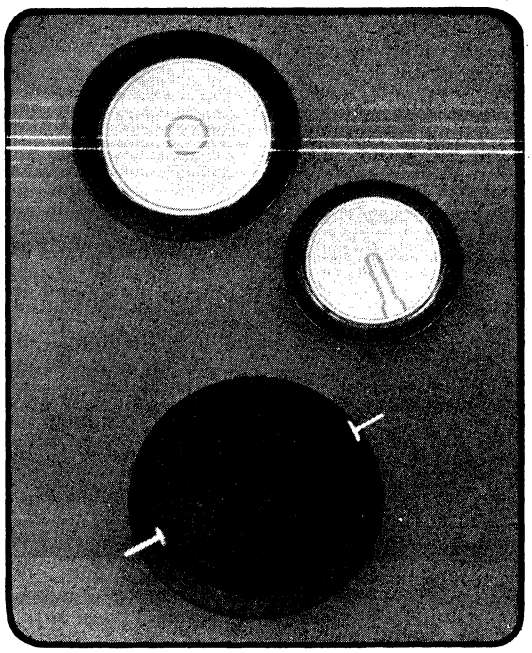
VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet



BLATEK AUDIO TRANSDUCERS

Blatek piezo ceramic audio transducers are available in three standard sizes, with or without feedback tab. All units can be provided with soldered-on lead wires at additional charge. Units requiring a stud mount or other special treatment will be quoted upon request.

MODEL	O.D.	RES. FREQ. (KHz)
6010 (6013)*	1.062″	4.8 ± 500
6020 (6023)	1.250″	3.5 ± 600
6030 (6033)	1.375″	3.0 ± 600

*Units in parenthesis designates feedback pattern. Special electrode patterns and frequency requirements quoted upon request. Small quantities from stock. Minimum order 30 pieces.

BLATEK SPECIAL PRODUCTS

Blatek provides specific customer design assistance and/or assembles special products for companies that do not have in-house capability.

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BLATEK AIR TRANSDUCERS

Blatek ultrasonic air transducers are designed for applications requiring a low or medium power 25 or 40 KHz transducer.

Both units have painted aluminum housings. Model 8010 is available with PC pins or phono plug. Model 8020 is available with PC pins or wire lead attachments. Small quantities from stock. Minimum order 5 pieces.

MODEL	DIMENSIONS	BANDWIDTH	POWER RATING	CAPACITANCE
8010-25KHz	1.0″ × .562″	.4 KHz	.2 watts	1500 pf
8010-40KHz	1.0″ × .562″	.4 KHz	.2 watts	1600 pf
8020-25KHz	1.5″ × .375″	.8 KHz	2 watts	3000 pf
8020-40KHz	1.5″ × .375″	1.0 KHz	2 watts	3000 pf

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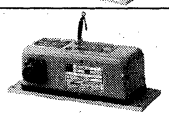
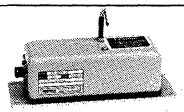
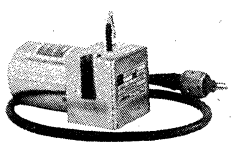
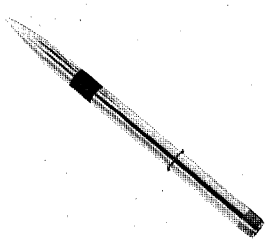
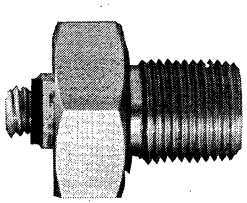
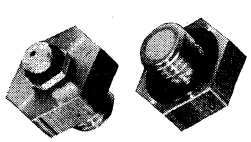
REV B-3-82

celesco POSITION TRANSDUCERS

	Model	Ranges	Resolution	Accuracy	Thermal Effects (Zero)	Thermal Effects (Span)
	PT101 Position/ Displacement Transducer: Provides an electrical signal proportional to the linear extension of a stainless cable through the use of a precision potentiometer.	0-2 inches to 0-500 inches	essentially infinitesimal (most ranges)	±0.1% full scale (linearity and repeatability)	0.01%/°F full scale	0.01%/°F
	VT201 Velocity Transducer: Generates a DC signal proportional to the velocity of cable extension or retraction.	0-2 inches to 0-500 inches	essentially infinitesimal	±3%, linear to 0.1%	not applicable	0.01%/°F
	**DV301 Position/ Velocity Transducer:** Combines linear tachometer with potentiometer, offering both displacement and velocity outputs.	0-2 inches to 0-500 inches	position and velocity: essentially infinitesimal (most ranges)	position: ±0.1% full scale (linearity and repeatability) velocity: ±3% linear to 0.1%	position:0.01%/°F full scale velocity: not applicable	position: 0.01%/°F velocity: 0.01%/°F
	**PT420 Position Transmitter:** Combines a position transducer with two-wire 4-20 ma electronics. Operates from 12-45 VDC across input.	0-2 inches to 0-500 inches	essentially infinitesimal (most ranges)	±0.15% full scale (linearity and repeatability)	±0.015%/°F full scale	±0.015%/°F
	**Model PT801 Underwater Transducer:** A position/displacement transducer useful in underwater or extremely hostile environments. Available in stainless steel or anodized aluminum.	0-2 inches to 0-150 inches	essentially infinitesimal (most ranges)	±0.1% full scale (linearity and repeatability)	0.01%/°F full scale	0.01%/°F

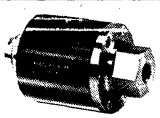
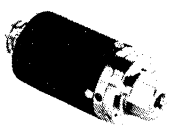
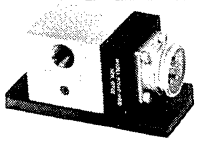
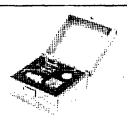
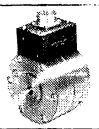
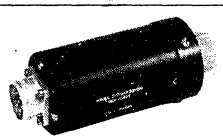
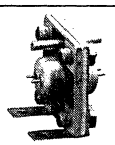
celesco PRESSURE TRANSDUCERS

Piezoelectric Pressure Transducers

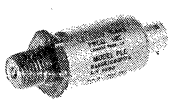
	Model	Sensitivity	Sensitivity	Charge Sensitivity	Capacitance	Maximum Pressure	Rise Time
	**LC-33 Blast Pressure Transducer:** High sensitivity; records a variety of dynamic pressure phenomena commonly found in free-field blast measurements, shock tunnel pressure-time profiles. Miniaturized LC-13 version available.	0.67V/psi	−101 db re 1V/μ bar	3000 pc/psi	4500 pf	500 psi	10 μ sec
	**LD-25 Blast Pressure Transducer:** Flush-mounted economy model for various measurements of dynamic pressure, acoustic phenomena; useful for high-pressure transients, low-level acoustics.	0.15V/psi	−113 db re 1V/μ bar	35 pc/psi	240 pf	3000 psi	1 μ sec
	**LC-70 and LC-71 Pressure Transducers:** Small, highly sensitive flush-mounted transducers for recording a variety of dynamic pressure and acoustic phenomena.	0.15V/psi	−113 db re 1V/μ bar	120 pc/psi	800 pf	300 psi	4 μ sec

celesco PRESSURE TRANSDUCERS

Variable Reluctance Pressure Transducers

	Model	Ranges	Linearity	Maximum Line Pressure	Over-pressure	Working Fluids	Output
	**P1 Pressure Transducer:** Operates reliably under adverse environmental conditions; ideal for aircraft/missile flight, ground-test applications. Compatible with most carrier systems.	±0.1 to ±1000 psi gage, absolute or differential	0.5% full scale, best straight line	2000 psi	200% of range in either direction	liquids and gases, both sides	25mv/V nominal full scale at 3000 Hz
	**P2 Pressure Transducer:** Highly shock resistant; ideally suited for corrosive media and accidental pressure overloads in water and hydraulic systems. Can be disassembled for field cleaning.	0-200 to 0-10,000 psi, gage or absolute	±0.5% full scale, best straight line	not applicable	200% of range or 12,000 psi, whichever is less	liquids, gases and solid suspensions	25mv/V nominal full scale at 3000 Hz
	P3D Differential Pressure Transducer: For precise measurement of low differential pressure at high line pressures; insensitive to shock and vibration, and suitable for corrosive fluids.	±0.1 to ±5000 psi, gage or differential	±0.5% full scale, best straight line	5000 psi	200% of range of 7500 psi, whichever is less (either direction)	liquids and gases, both sides	25mv/V nominal full scale at 3000 Hz
	**P7D Differential Pressure Transducer:** Ideal for low- and medium-pressure measurements of laboratory accuracy. Commonly used in aircraft and missile flight and in ground test and control applications.	±0.1 to ±500 psi, gage or differential	±0.5% full scale, best straight line	1000 psi	200% of range in either direction	liquids and gases, both sides	25mv/V nominal full scale at 3000 Hz
	**KP15 Pressure Transducer Kit:** Perfect for general laboratory use. Kit includes case, wrenches spare seals, accessories and diaphragms for five different ranges.	±1, ±5, ±25, ±100 and ±500 psi, gage or differential	±0.5% full scale, best straight line	2000 psi	200% of range in either direction	liquids and gases, both sides	25mv/V nominal full scale at 3000 Hz
	**P90D Differential Pressure Transducer:** Measures very low pressure differences at line pressures to 1000 psi. Has low acceleration sensitivity and wide dynamic response.	±1 in. H_2O differential (.036 psi)	±0.5% full scale, best straight line	vacuum to 1000 psi	±15 psid, with less than 0.5% full scale shift	liquids and gases, both sides	25mv/V nominal full scale at 3000 Hz
	**CP51 Pressure Transducer–DC Output:** Combines a variable reluctance pressure transducer and carrier demodulator in a single package. Operates from 28 VDC or 115 VAC (optional).	±0.1 to ±1000 psi, gage, absolute or differential	±0.5% full scale, best straight line	2000 psi	200% of range in either direction	liquids and gases, both sides	0-5 VDC or ±5 VDC full scale
	**LCVR Low Cost Differential Pressure Transducer:** Designed to fill the need for a low-cost, ultra-low range, lightweight transducer for medical and industrial markets.	0-2 cm H_2O to 0-1000 cm H_2O gage or differential	±0.5% full scale, best straight line	30 psia	300% of range with less than 1% full scale zero shift	air, oxygen, CO_2 or any inert gas	25mv/V nominal at 4000 Hz

Strain Gage Pressure Transducers

	Model	Ranges	Accuracy	Resolution	Overpressure	Working Fluids	Output
	**PLC Pressure Transducer:** General purpose transducer. Low-cost, accurate, rugged, compact. Weather resistant and temperature-compensated.	0-15 to 0-10,000 psi gage or absolute	±0.5% full scale (linearity, hysteresis and repeatability)	infinitesimal	200% of range	liquids and gases compatible with 17-4 pH stainless steel	10mv/V ±1%, zero balance ±1% full scale
	P2805 Pressure Transmitter: Ideal for most fluids or gases, for hydraulic and pneumatic systems, automotive and aircraft instrumentation. 5 VDC output. 19-32 VDC input.	0-15 to 0-5000 psi gage or absolute	±0.5% full scale (linearity, hysteresis and repeatability)	infinitesimal	200% of range	liquids and gases compatible with 17-4 pH stainless steel and Viton O-ring	0-5 VDC (0-10 VDC optional)
	Model P4420 Pressure Transmitter: Similar to P2805 except offers 4-20 ma, two-wire output. Compatible with a wide range of electronic receiving, readout equipment. Transmitter requires 12-45 VDC input.	0-15 to 0-5000 psi gage or absolute	±0.75% full scale (linearity, hysteresis and repeatability)	infinitesimal	200% of range	liquids and gases compatible with 17-4 pH stainless steel and Viton O-ring	two-wire, 4-20 ma

Supporting electronics available for display and signal conditioning. Contact factory for engineering assistance.

celesco Transducer Products, Inc.

7800 Deering Ave.; P.O. Box 1457
Canoga Park, CA 91304
Toll-Free: 800-423-5483 • In Calif: 213-884-6860
Telex: 67-3382 • TWX: 910-494-1951

hcc INDUSTRIES

PRESSURE TRANSDUCERS (617) 861-7450

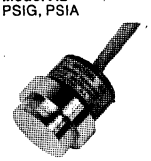
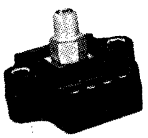
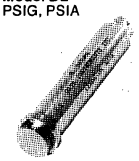
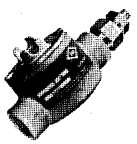
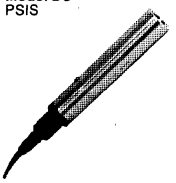
Features

- Pressure ranges: 0–5 to 20,000 PSI
- Output: voltage, frequency or current
- Unique stainless steel case-diaphragm compatible with most corrosive measurand
- Full calibration and temperature compensation
- Unit to unit interchangeability ±1%
- > 160 million full pressure cycles
- Rugged construction for long-term reliability
- Rated intrinsically safe

Options

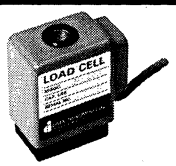
Various optional operating characteristics and mechanical features can be incorporated in Data Instruments' pressure transducers at additional costs. These are designated by a numerical code.

1. Absolute pressure version. Available in 15, 25 and 50 PSIA.
2. Improved zero and span temperature compensation to 1%/100°F (55.5°C) and improved accuracy (combined non-linearity, hysteresis and repeatability) from 1% to 0.5%.
3. Barbed fitting for attaching protective hose around cable. (Model AB only)
4. Install longer cable by splicing to existing 3 ft cable.
5. Install longer continuous cable.
6. Install Bendix PTIH-10-6P electrical connector with an extended case.
7. Extended Operating Temperature Range to 300°F (148.9°C) 6 and 15 PSI excluded. Includes Option 6.

	Model AB PSIG, PSIA	**Model EA & EAF** PSIG, PSIA, PSIS	**Model BF** PSIG, PSIA	**Model BL** PSIG, PSIA	**Series E** PSIG, PSIS	**Model DS** PSIS
						
	General Purpose	Rugged OEM Style	Amplified Output	Two-Wire Transmitter	Explosion Proof	Depth Sensor
Pressure Range	0-6, 15, 25, 50, 100, 200, 500, 1000, 2000, 3000, 5000, 10,000, 15,000, 20,000	0-6, 15, 25, 50, 100, 200, 300, 500, 1000, 2000, 5000	0-5, 15, 25, 50, 100, 200, 500, 1000, 2000, 3000, 5000, 10,000, 20,000	0-5, 15, 25, 50, 100, 200, 500, 1000, 2000, 3000, 5000, 10,000, 20,000	0-6, 15, 25, 50, 100, 200, 500, 1000, 2000, 3000, 5000, 10,000	0-100, 200, 500, 1000, 2000, 3000, 5000, 10,000
Accuracy	Within 1% from best fit line, including non-linearity, repeatability and hysteresis	Within 0.5% from best fit line, including non-linearity, repeatability and hysteresis	Within 1% from best fit line, including non-linearity, repeatability and hysteresis	Within 1% from best fit line, including non-linearity, repeatability and hysteresis	Within 1% from best fit line, including non-linearity, repeatability and hysteresis	Within 1% from best fit line, including non-linearity, repeatability and hysteresis
Sensitivity	20 mV/V				Selectable*	
Output Signal	100 mV at rated pressure ±1%	5Vdc ±2% 5kHz ±2%	5Vdc ±1%	4 to 20mA	Selectable*	4 to 20 mA
Excitation Voltage	5 Vdc or ac, 6V maximum	8 to 20 Vdc 10 to 20 Vdc	12 to 20 Vdc	14 to 50 Vdc	Selectable*	14 to 50 Vdc
Operating Temperature Range	−65°F to 200°F	−67°F to 257°F −40°F to 185°F	−50°F to 200°F	0°F to 200°F	Selectable*	0°F to 200°F
Compensated Temperature Range	30°F to 130°F	32°F to 185°F	30°F to 130°F	30°F to 130°F	30°F to 130°F	30°F to 130°F
Thermal Effect on Zero	<5% of full scale over compensated reading	±0.02% FSO/°C max. over compensated range	<2% of full scale over compensated range	<2% of full scale over compensated range	<2% of full scale over compensated range	<2% of full scale over compensated range
Thermal Effect on Sensitivity	<2% of reading over compensated range	±0 02% FSO/°C max. over compensated range	<1% of full scale over compensated range	<1% of full scale over compensated range	<1% of reading over compensated range	<1% of reading over compensated range
Options Available	1, 2, 3, 4, 5, 6, 7		1, 2	1, 2	1, 2	2

*Series E may contain AB, BF or BL transducers. Consult chart for specifications.
Case material: 316L stainless steel for ranges 50 PSI and under. 15-5 PH stainless steel for ranges 100 PSI and over.

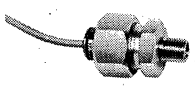
Load Cells



Features

Load ranges 0±10 lbs. to 0±2,000 lbs.
Universal loading, tension and compression
High output voltage
Small size
Low mechanical deflection
High accuracy

Adapters for Pressure Transducers



Various adapters are available.
These adapters are simple two-piece fittings which house the transducer. They not only interface with the working system but also shield the transducer from the mechanical environment.

Transducer Instrumentation

Series 100 and 200 Signal Conditioners and Controllers

Series 100 signal conditioners and Series 200 controllers interface strain gage pressure transducers, load cells, or transmitters with indicators, recorders, controls or alarms. Available in several models, the units provide excitation and signal amplification for almost any strain gage transducer.

Model DA Data Acquisition System

The DA Data Acquisition System is a multichannel signal conditioner with switching functions and a digital indicator. The standard system accommodates from four to ten Data Instruments signal conditioners which provide signals for the digital indicator, and an auxiliary output signal to drive remote indicators, recorders, controls, and computers. The system's flexibility allows the substitution of Data Instruments controllers for the signal conditioners (consult Factory for Model DAC).

Model RS and RB Meter Indicators

Model RS and Model RB are versatile indicators which combine a Model 100 signal conditioner or a Model 200 controller with a digital readout into a compact unit. They include transducer excitation supply, zero and span adjustment provisions, and analog output voltage signal.

Pressure Transducer Power Supplies

Models FVP-1 and FVP-2 provide a regulated 5 Vdc excitation signal for pressure transducers. The Model FVP-d provides a summing network for two transducers to perform differential pressure measurements using two standard Model AB transducers.

DATA INSTRUMENTS
4 Hartwell Place, Lexington, MA 02173, USA
(617) 861-7450 TWX 710-326-0672

OPTICAL SHAFT ENCODERS AND PROGRAMMABLE LIMIT SWITCHES

INCREMENTAL ENCODERS

	Pulses Per Rev.	Input Voltage (VDC)	Output Formats	Frequency Range (KHZ)	Shaft Dia. (Inches)	Outline Dimensions (Inches)	Features
Tru-Rota Instrumentation Encoder	10 to 1270	5 to 15	TTL, HTL, CMOS, sine wave	0 to 50	¼	2¼ DIA. x 1½ L	General purpose encoder with high output voltage capability. 10 to 1270 pulses per revolution; 3 to 15 VDC (light source) and 4.5 to 30 VDC (electronics) input voltage; square wave or amplified sine wave output; 0 to 50 kHz frequency range.
LC-23 Low Cost Encoder	30 to 1270	5 to 12	TTL, CMOS, sine wave, line driver	0 to 50	¼	2¼ DIA. x 1⅞ L	Very low cost, convenient size, with wide choice of electrical options and mounting configurations. 25 to 1270 pulses per revolution; 5 or 12 VDC input voltage; choice of square wave, line driver or amplified sine wave outputs; 0 to 50 kHz frequency range.
Tru-Mite Industrial Encoder	140 to 5000	5 to 15	TTL, HTL, CMOS, sine wave, line driver	0 to 100	⅜	2½ DIA x 2½ L	Rugged, high-resolution, wide-bandwidth encoder with heavy-duty shaft and bearings; 140 to 5000 pulses per revolution; 5, 12 or 15 VDC input voltage; square wave, line driver or amplified sine wave output; 0 to 100 kHz frequency range. Maximum shaft loading: 35 lbs. radial, 40 lbs. axial.
Tru-Tac Industrial Encoder	10 to 600	5 to 24	TTL, HTL, CMOS, line driver	0 to 30	⅜	3L x 3¼W x 3⅛H	Economical, rugged encoder with single or double-ended shaft. 100-lb. radial shaft loading, 40 lbs. axial; 7 to 600 (single channel) or 7 to 1200 (dual channel) pulses per revolution; 5 to 24 VDC input voltage; square wave or line driver output; 0 to 30 kHz frequency range.
Trim-Step Modular Encoder	50 to 250	5	TTL, HTL, CMOS, sine wave	0 to 25	N/A	2¼ DIA. x 1⅞ L	Uniquely designed to mount on stepper motors with large shaft end play (0.020"). Consists of a cylindrical, slotted rotor and concentric stator. 50 to 250 pulses per revolution; 5 VDC input voltage; triangular or square wave output; 0 to 25 kHz frequency range.
K3 Modular Encoder	50 to 1200	5 to 12	TTL, CMOS, sine wave	0 to 50	N/A	2 DIA. x ¾ L	Ultra low-cost encoder designed for easy installation on servo or stepper motors. Consists of an optically encoded disc on an aluminum hub and an LED light source/photocell/amplifier module. 50 to 1200 pulses per revolution; 5 or 12 VDC input voltage; square wave or amplified sine wave output; 0 to 50 kHz frequency range.

ABSOLUTE ENCODERS

	Resolution (Single Turn)	Input Voltage (VDC)	Output Codes	Output Formats	Frequency Range (KHZ)	Shaft Dia. (Inches)	Outline Dimensions (Inches)	Features
Model LR	9 Bit	5 to 24	BCD, Gray, natural binary	TTL, HTL, CMOS	0 to 50	⅜ or ⅝	5L x 3½ W x 3⅝H	Industrial duty, absolute encoder with BCD, Gray Code or natural binary output. Up to 512 steps per revolution; 5 to 24 VDC input voltage; open collector or passive pull-up output; 0 to 50 kHz frequency range. Maximum shaft loading: 35 lbs. radial, 40 lbs. axial.

PROGRAMMABLE LIMIT SWITCHES

	Number of "Cams"	Resolution (degrees)	Type of Output	Input Voltage	Shaft Dia. (Inches)	Outline Dimensions (Inches)	Features
Digi-Cam	1 to 12	1	TTL, HTL, CMOS	5 to 24 VDC	⅜ or ⅝	5L x 3½W x 3⅝H	Self-contained, solid-state dedicated electronic cam switch. Internal semiconductor memory can be factory programmed for up to 12 individual cam on/off profiles with 1° resolution and minimum dwell for 360° of shaft rotation. Same rugged mechanical construction and I/O voltages as Model LR Absolute Encoder.
Electronic Cam System	1 to 8 expandable to 24	1	Relay or Solid State	24, 115 or 230 VAC	Encoder ⅜ or ⅝ Programmer N/A	Encoder 5L x 3½W x 3⅝ H Programmer 13W x 5½H x 6D	Consists of a Model LR Absolute Encoder and a Programmer containing a digital readout, thumbwheel switches and mechanical or solid-state relays. It permits simple field adjustment of up to 8 (expandable to 24) on/off set points as a function of shaft position with 1° resolution. Absolute Encoder remembers shaft position after power interruption.

Datametrics • Dresser Industries, Inc., Dept. EM
340 Fordham Road, Wilmington, Mass. 01887
Tel: (617) 658-5410 TWX: 710-347-7672
Toll Free Rep. Info. 1-800-243-8160 (in CT 1-800-842-0225)

datametrics DRESSER

EEM PRODUCT SELECTION GUIDES

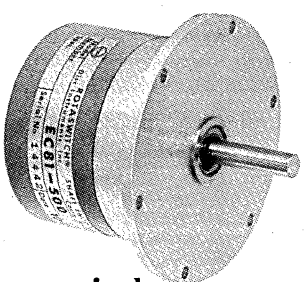
Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

LEADERS IN OPTICAL ENCODER TECHNOLOGY

Sub-miniature Incremental Encoders

820 Series

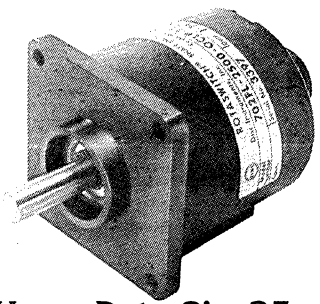
• 1" Diam. x 1.1" • Weight—3 Ounces • LED Source • Sine or Square Wave Output • Up to 625 Pulses/Rev.



Economical Optical Encoder

EC80 Series

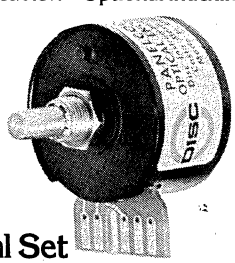
• Very Low Cost • Designed for OEM Use • LED Source • Up to 1024 Pulses/Rev. • Square Wave Output



Heavy-Duty, Size 25 Servo or Flanged Incremental Encoders

700 Series

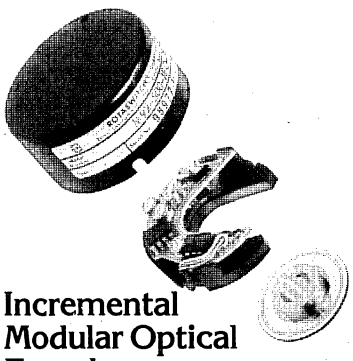
• Heavy-Duty Housing • Sealed for Industrial Applications • English/Metric Option • LED Source • Up to 2540 Pulses/Rev. • Optional Indexing



Manual Set Incremental Encoders

PANELCODER™ Series

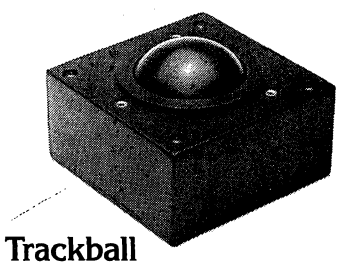
• Panel Mounting • Digital Output • Replaces Potentiometers • Long Service Life • LED Source • Circuit Board Connector • Photo Transistor Output



Incremental Modular Optical Encoder

M90 Series

• LED Light Source • Custom Comparitor, TTL, HTL, or CMOS Comp. • Die-Cast Photohead with 2-Hole 1.812" B.C. Mounting • Chrome-on-Glass Code Disc • Optional Index • Optional Metric Hub Bore Sizes



Trackball

LT 200 Series

• Low Cost • Field Serviceable • Heavy-Duty Ball • Long Life • LED Source

Disc Instruments Inc.
A Honeywell Subsidiary

The first name in Optical Encoders

Disc Instruments is unique in its ability to offer optical shaft position encoders in so wide a range of performance characteristics and prices. One primary reason is our total in-house capability to produce master and duplicate discs in sizes from sub-miniature to more than 30". We invite you to call us on any special encoder requirements.

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DISC INSTRUMENTS, INC.
Costa Mesa, California

ENDEVCO® PIEZOELECTRIC ACCELEROMETER CHARACTERISTICS

Application	Precision Isobase®	Small Size, Lightweight, Shear					General Purpose		Shock Measurement			Triaxial			Very High Temperature	
Model Number	(1) 2271A (2) 2275	22 Picomin®	2220C	(1) 2221D (2) 2221E (3) 2221F	2222C	(1) 2226C (2) 2229C	2224C	2233E	2225	2291	2292	23 Picotriax®	2223D	2228C	2273A Isobase®	2276 Isobase®
ELECTRICAL and DYNAMIC																
Charge Sensitivity, pC/g	11.5	0.4	2.7	(1) 17 (2) 9 (3) 10	1.4	2.8	11	60	0.7	0.0035	0.14	0.4	12	2.8	3	10
Voltage Sensitivity, mV/g*	5	1.6	3	(1) 17 (2) 7.5 (3) 9	3.0	5.1	10.5	45	0.7	0.01	0.5	1.6	11	5.1	15	12
Transducer Capacitance, pF	2000	240	750	900	420	400	800	1100	750	11.5	80	240	900	400	100	660
Frequency Response, Hz, ±5% charge:	2 to 5500	5 to 10,000	5 to 10,000	(2) 2 to 10,000	20 to 8000	3 to 6000	3 to 6000	4 to 8000	5 to 15,000***	20 to 50,000	20 to 20,000	5 to 10,000	3 to 4000	3 to >4000	2 to 6000	2 to 5000
Voltage, with 100 MΩ load	2 to 5500	5 to 10,000	5 to 10,000	(2) 2 to 9000	30 to 8000	2 to 5000	2 to 6000	4 to 6000	5 to 15,000***	—	—	5 to 10,000	2 to 3400	6 to >4000	20 to 6000	—
Mounted Resonance Frequency, Hz	27,000	54,000	50,000	(1) 30,000 (2) 45,000	32,000	24,000	32,000	32,000	80,000	250,000	125,000	50,000	17,000	24,000	30,000	27,000
Transverse Sensitivity, %, maximum	2†	5‡		3†	5‡	(1) 3 (2) 5	3†	3†	5‡	5	5	5	5‡	5	3†	3
Amplitude Linearity, Range (g):	0 to 10,000	0 to 4000	0 to 5,000	(1) 2500 (2) 2000	0 to 2000	0 to 2000	0 to 1000	0 to 1000	0 to 20,000	0 to 100,000	0 to 20,000	0 to 2000	0 to 1000	0 to 2000	0 to 10,000	0 to 3000
Sensitivity incr. approx. 1% per (g):	1000	250	500	(1) 250 (2) 500	200	500	250	150	2000	10,000	2000	250	250	500	500	1000
Strain Sens., equiv. g at 250 μ strain	0.50	2.0	12.0	(1) 3.0 (2)(3) 5.0	10.0	(1) 0.25 (2) 1.25	0.50	25.0	8.0	1000	1.50	2.0	0.50	2.0	1.0	0.50
PHYSICAL																
Size, inches	⅝ hex x .78h	.14 dia x .095h	⅜ dia x .21h	.60 dia x .314h	.25 dia x ⅛h	⅜ hex x .33h	9/16 hex x .64h	⅝ hex x .8h	.56 hex x .64h	.31 hex x .22h	.31 hex x .30h	.30 x .25 x .2h	1.0 x 1.0 x .66h	.74 x .74 x .46h	⅝ hex x .9h	⅝ hex x 1.0h
Weight, ounces (grams)	0.95 (27)	0.0049 (0.14)	0.08 (2.3)	0.43 (12)	0.018 (0.5)	(1) 0.1 (2.8) (2) 0.17 (4.9)	0.58 (16)	1.2 (32)	0.46 (13)	0.05 (1.3)	0.05 (1.3)	0.03 (0.85)	1.5 (41)	0.55 (15.3)	0.90 (25)	1.1 (30)
Crystal Material, Piezite® Type	P-10	P-8	P-8	P-8	P-8	P-8	P-8	P-8	P-8	P-10	P-8	P-8	P-8	P-8	P-14	P-14
Mounting	10-32 hole	adhesive	2-56 screw	6-32 screw	adhesive	(1) adhesive (2) 10-32 stud	10-32 hole	10-32 hole	10-32 hole	¼-28 stud	¼-28 stud	adhesive	3, 4-40 screws	2, 4-40 screws	10-32 hole	10-32 hole
Connector Location	side	side	side	side	side	top	top	side	top	top	top	one side	each axis	each axis	side	side
Cable Supplied, length, model	10 ft (3m), 3090B	6 ft (1.8m), 3095A	6 ft (1.8m), 3091D	(1)(2) 10 ft (3m), 3090A (3) 10 ft (3m), 3090B	1 ft (.3m) 3093	3 ft (.9m) 3060A	10 ft (3m), 3090A	10 ft (3m), 3090B	10 ft (3m), 3090B	18 in. (45 cm), 3001A	6 ft (1.8m), 3091D	3, 6 ft (1.8m), 3095A	3, 10 ft (1.8m), 3090A	3, 3 ft (.9m), 3060A	3 ft (.9m), 3070M6	3 ft (.9m), 3075M6
Signal Return, to Case:	(1) insulated (2) grounded	grounded	grounded	grounded	grounded	(1) grounded (2) insulated	grounded	grounded	grounded	grounded	grounded	grounded	YZ insulated X grounded	insulated	grounded	grounded
Case, to Structure:	grounded	insulated	grounded	insulated	insulated	grounded	grounded	grounded	grounded	grounded	grounded	insulated	insulated	insulated	grounded	grounded
ENVIRONMENTAL																
Vibration, pk g, maximum	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	500
Shock, pk g, maximum	10,000	10,000	5000	5000	10,000	2000	2000	2000	20,000	100,000	20,000	10,000	2000	2000	10,000	3000
Temperature Range, °C	−270 to +260	−73 to +150	−54 to +177	(1)(2) −54 to +177 (3) −54 to +260	−73 to +177	−54 to +177	−54 to +177	−54 to +260	−54 to +177	−54 to +121	−54 to +121	−73 to +150	−54 to +177	−54 to +177	−185 to +400	−54 to +482
°F	−450 to +500	−100 to +300	−65 to +350	(1)(2) −65 to +350 (3) −65 to +500	−100 to +350	−65 to +350	−65 to +350	−65 to +500	−65 to +350	−65 to +250	−65 to +250	−100 to +300	−65 to +350	−65 to +350	−300 to +750	−65 to +900
Seal	hermetic	silicone	epoxy	(1)(2) epoxy (3) hermetic	silicone	epoxy	epoxy	hermetic	epoxy	hermetic	hermetic	silicone	epoxy	epoxy	hermetic	hermetic

NOTE: Data are typical except where otherwise specified. Continued product improvement necessitates that Endevco reserve the right to modify these specifications without notice.

* Depends on external capacitance. † 1% availale. ‡ 3% available. ** See Tech Data 319 for other ISOSHEAR Models. *** ±10% response. # Model 3075 (hardline) available as option.

ENDEVCO
30700 RANCHO VIEJO ROAD • SAN JUAN CAPISTRANO, CA 92675 • TELEPHONE (714) 493-8181 • TWX 910-596-1415 • TELEX 68-5608

ENDEVCO® PIEZORESISTIVE ACCELEROMETER CHARACTERISTICS

MODEL NUMBER		2262-25 2262C-25	2262A-200 2262CA-200	(1) 2264A-2K-R, -5K-R, -10K-R, -20K-R, -50K-R	7264-200	7265A-HS	7265A	7231C-750 7232C-750	TRIAXIAL 7267A	TRIAXIAL 2263-5K	TRIAXIAL 2263-10K	TRIAXIAL 2263-20K
ELECTRICAL and DYNAMIC												
Range, g		±25 full scale	±200	±2000 to ±50,000	±200	±20	±100	±750	±1500	±5000	±10,000	±20,000
Overrange Limiting, g	(1)	±50 useful range	±300 to ±1200	none	±200 to ±500	±30 to ±80	±150 to ±400	none	none	none	none	none
	(2)	±60 to ±150										
Sensitivity, mV/g	(1)	20	2.5	0.250 to 0.010	2.5	25	5.0	.200	0.15	100μV	50μV	25μV
	(2)	10	1.25									
Input Resistance, Ω	(1)	2100	1800	500 ±225	3000	750	750	525	1000	600	700	500
	(2)	1000	1000									
Output Resistance, Ω	(1)	1400	1200	500 ±275	—	1100	1100	525	—	—	—	—
	(2)	1000	1000									
Fixed Resistors, Ω	(2)	1000 ±1%	1000 ±1%	500 ±20%	—	500 ±1%	500 ±1%	500 ±1%	—	—	—	—
Mounted Resonance or Natural Frequency, Hz		2500	7000	30,000 to 180,000	6000	1400	2700	20,000	12,000	40,000	70,000	100,000
Frequency Response, ±5%, Hz		0 to 750	0 to 3000	0 to 30,000	0 to 1200	0 to 500	0 to 800	0 to 2000	0 to 2000	0 to 8000	0 to 10,000	0 to 15,000
Damping Ratio, approximate		0.7	0.7	0.002	0.001	.55 to .85	.55 to .85	0.005	0.005	0.01	0.01	0.01
Transverse Sensitivity, % max.		3	3	5	3	5	5		3	3	3	3
PHYSICAL												
Size, inches		.62 hex x 1.00h	.62 hex x 1.0h	.51w x .2h x .48l	.4w x .18h x 4.1l	.63W x .305 x .500	.63W x .305 x .500	.75w x .75h x .900	.75w x .900h x .750l	.52w x .40h x .521	.52w x .40h x .521	.52w x .40h x .52l
(centimeters)		(15.7 x 25.4)	(15.7 x 25.4)	(1.3w x .5h x 1.2l)	(1.0w x .46h x 1.0l)	(16.0 x 7.74 x 12.7)	(16.0 x 7.74 x 12.7)	(19.05 x 19.05 x 22.86)	(191w x 23h x 191l)	(13.2w x 10.2h x 13.2l)	(13.2w x 10.2h x 13.21)	(13.2w x 10.2h x 13.21l)
Weight, ounces (grams)		1.0 (28)	1.0 (28)	0.053 (1.5)	0.035 (1.0)	0.208 (5.9)	0.166 (4.7)	0.85 (24) 1.4 (40)	1.76 (50)	.35 (10)	.35 (10)	.35 (10)
Sensing Element, Piezite® Type		P-11	P-11	P-16	P-11	P-11	P-11	P-9	P-9	P-11	P-11	P-11
Mounting		10-32 hole	10-32 hole	2, 4-40 screws	2, 0-80 screws	2, 2-56 screws	2, 2-56 screws	? 10-32 hole	2, 4-40 screws	4, 2-56 screws	4, 2-56 screws	4, 2-56 screws
Cable Supplied	(1)	30 in., 4 conductor	30 in., 4 conductor	48 in., integral	30 in., integral	30 in., integral	30 in., integral	? optional	factory installed	36 in., 5 conductor	36 in., 5 conductor	36 in., 5 conductor
	(2)	30 in., 6 conductor	30 in., 6 conductor									
ENVIRONMENTAL												
Acceleration, Static, g max.		±2000	2000	5000 to 100,000	1000	2000	2000	±1000	±4000			
Vibration, g max.		±1000	1000	1000	1000	200	1000	±1000	±1000	±10,000	±20,000	±40,000
Shock, g max.		±2000	2000	5000 to 100,000	1000	2000	2000	±2500	±4000			
Temperature, operating, °C		−18 to +93	−18 to +93	−18 to +66	−18 to +66	−18 to +66	−18 to +66	−23 to +66	−73 to +149	30 to 110°F	30 to 110°F	30 to 110°F
non-operating, °C		−29 to +104	−29 to +104	−54 to +93	−54 to +93	−54 to +85	−54 to +85	−73 to +149		−100 to +300°F	−100 to +300°F	−100 to +300°F
Seal		hermetic	hermetic	epoxy	epoxy	hermetic	hermetic	epoxy	hermetic	epoxy	epoxy	epoxy

All data are typical except where noted.

Rated excitation for all units is 10.0 Vdc.

(1) Four-active-arm accelerometer, not recommended for shunt calibration.

(2) Two-active-arm accelerometer with internal completion resistors, designed for shunt calibration and identified with suffix letter C or R.

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ENDEVCO ISOSHEAR® AND INTEGRAL ELECTRONICS ACCELEROMETER CHARACTERISTICS

ISOSHEAR® MODEL NUMBER	(1) 7701-50 (2) 7702-50 (3) 7703-50	(1) 7701-100	(3) 7707-200	(2) 7706-500	(1) 7705-1000 (2) 7707-1000
ELECTRICAL and DYNAMIC					
Charge Sensitivity, pC/g	50	100	200	500	1000
Transducer Capacitance, pF	2800	2800	5600	5600	5600
Frequency Response, Hz, ±5%*	1 to 7000	1 to 5000	1 to 4000	1 to 2000	1 to 2000
Mounted Frequency, Hz	26000	20,000	17,000	10,000	7500
Transverse Sensitivity, % maximum**	3	3	3	3	3
Amplitude Linearity Range, g	0 to 2000	0 to 2000	0 to 1000	0 to 500	0 to 250
Sensitivity Increase, ≈ 1% per ___g	500	250	250	200	100
Strain Sens., equiv. g at 250 μ strain	0.125	0.0625	0.050	0.025	0.0125
PHYSICAL					
Size, inches	⅝ hex x .78h	⅝ hex x .78h	1.0 hex x .90h	1.0 hex x .90h	1.0 hex x .90h
Weight, ounces (grams)	.9 (25)	1 (29)	2.17 (62)	2.8 (80)	4.23 (120)
Crystal Material, Piezite® Type	P-8	P-8	P-8	P-8	P-8
Mounting	10-32 stud	10-32 stud	10-32 stud	10-32 stud	10-32 stud
Connector Location	(1)(3) side (2) top	side	side	top	side
Cable Supplied, length, model	10 ft (3m), 3090B	10 ft (3m), 3090B	10 ft (3m), 3090B	10 ft (3m), 3090B	10 ft (3m), 3090B
Signal Return, to Case	(1)(2) grounded (3) isolated	grounded	isolated	grounded	(1) grounded (2) isolated
Case, to Structure	grounded	grounded	grounded	grounded	grounded
ENVIRONMENTAL					
Vibration, pk g, maximum	2000	1000	1000	500	500
Shock, pk g, maximum	10,0000	10,000	2000	2000	1000
Temperature, °F °C	−65 to +500 −54 to +260	−65 to +500 −54 to +260	−65 to +500 −54 to +260	−65 to +500 −54 to +260	−65 to +500 −54 to +260
Seal	hermetic	hermetic	hermetic	hermetic	hermetic

NOTE: All data are typical except where otherwise specified.

* Low frequency response is dependent on characteristics of signal conditioning.

** 1% available on special order.

INTEGRAL ELECTRONICS ACCELEROMETER MODEL NUMBER	2250A	2251A
DYNAMIC		
Sensitivity, mV/g	10 ±5%	10 ±3%
Range, Full Scale, g	±500	±500
Linearity <1% per ___g		500
Frequency Response, ±5%, Hz	4 to 15,000	5 to 8000
Mounted Resonance Frequency Undamped, Hz	80,000	40,000
Transverse Sensitivity, Maximum %	3	3
Temperature Response °F °C	±2% −58 to +257 −50 to +125	±2% −58 to +257 −50 to +125
ELECTRICAL		
Current Requirement	1 ma to 20 mA const. current, compliance voltage: >15	1 mA to 20 mA const. current, compliance voltage: >15
Output impedance, max.	100Ω with >3 mA supply current 300Ω with 1 mA	150Ω with >3 mA supply current 400Ω with 1 mA
Load, minimum	20 kΩ	20 kΩ
Zero offset, Vdc	+8	+8
Mounting Surface Noise Rejection, equivalent g, maximum per volt	0.015	0.020
Residual Electrical Noise, 2 kHz to 25 kHz, equivalent g rms	<0.015	<0.020
PHYSICAL		
Cable Supplied,length, model	6 ft (1.8m), 3006-72	6 ft (1.8m), 3006-72
Mounting	adhesive	Endevco P/N 21627 removable, captive 2-56 center bolt
Weight (excluding cable connector) ounces (grams)	0.010 (0.3)	.16 (4.5)
Size, inches (millimeters)	.230 (5.84)d .150 (3.81)h	.400 (10.16)d .31 (7.9) h
ENVIRONMENTAL		
Vibration pk g maximum (any direction)	±2000	±5000
Temperature Range °F °C	−58 to +257 −50 to +125	−58 to +257 −50 to +125
Strain Sensitivity, equiv. g at 250 μ strain	0.1	3.0
Seal	epoxy	hermetic

NOTE: All data are typical except where otherwise specified.

Continued product improvement necessitates that Endevco reserve the right to modify these specifications without notice.

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ENDEVCO PRESSURE TRANSDUCER CHARACTERISTICS

MODEL NUMBER	(1) 8506-2 (2) 8507-2 (3) 8510-2	(1) 8506-5 (2) 8507-5 (3) 8510-5	(1) 8506 15 (2) 8507-15 (3) 8510-15	(1) 8506-50 (2) 8507-50 (3) 8510-50	(1) 8510-100 (2) 8510-200 (3) 8510-500	(1) 8510-1000 (2) 8510-2000	(1) 8511A-5K (2) 8511A-10K (3) 8511A-20K	(1) 8514-10 (2) 8514-20 (3) 8514-50 (4) 8514-100	(1) 8530A-5 (2) 8530A-15 (3) 8530A-50 (4) 8530A-100	(1) 8530A-200 (2) 8530A-500 (3) 8530A-1000
ELECTRICAL and DYNAMIC										
Range	±2 psig	±5 psig	±15 psig	−15 to +50 psig	(1) −15 to +100 psig (2) −15 to +200 psig (3) −15 to +500 psig	(1) −15 to +1000 psig (2) −15 to +2000 psig	(1) 5000 psig (2) 10,000 psig (3) 20,000 psig	(1) ±10 psig (2) −15 to +20 psig (3) −15 to +100 psig (4) −15 to +100 psig	(1) 0 to 5 psia (2) 0 to 15 psia (3) 0 to 50 psia (4) 0 to 100 psia	(1) 0 to 200 psia (2) 0 to 500 psia (3) 0 to 1000 psia
Full Scale Output, (mV)	300	300	300	300	300	300	500	300	300	300
Sensitivity, mV/psi	157 ±45	63 ±18	21 ±6	6.3 ±1.8	(1) 3.15 ±0.09 (2) 1.57 ±0.45 (3) 0.63 ±0.18	(1) 0.315 ±0.090 (2) 0.157 ±0.045	(1) 0.100 ±0.030 (2) 0.050 ±0.015 (3) 0.025 ±0.008	(1) 30 ±10 (2) 15.75 ±4.5 (3) 6.3 ±1.8 (4) 3.15 ±0.9	(1) 68.0 ±18 (2) 21.0 ±6 (3) 6.3 ±1.8 (4) 3.15 ±0.09	(1) 1.57 ±0.45 (2) 0.63 ±0.18 (3) 0.315 ±0.090
Resonant Frequency, Hz typical	45,000	65,000	100,000	180,000	(1) 240,000 (2) 320,000 (3) 500,000	(1) 700,000 (2) 900,000	500,000	(1) 140,000 (2) 180,000 (3) 320,000 (4) 410,000	(1) 90,000 (2) 120,000 (3) 240,000 (4) 280,000	(1) 360,000 (2) 600,000 (3) 800,000
Sensitivity Shift, ± ___% Maximum, across 0 to 200°F	4	4	4	4	4	4	4	4	4	4
Thermal Transient Response psi/°F typical	0.003	0.003	0.003	0.003	(1) 0.003 (2) 0.001 (3) 0.01	(1) 0.05 (2) 0.16	(1) 1.1 (2) 1.5 (3) 0.4	(1) 0.001 (2) 0.003 (3) 0.005 (4) 0.01	(1) 0.015 (2) 0.004 (3) 0.003 (4) 0.0009	(1) 0.02 (2) 0.02 (3) 0.04
Zero Shift, ± ___% of FSO maximum, across 0 to 200°F range	3	3	3	3	3	3	3	3	3	3
Linearity To FSO, ± ___% of FSO typical	1	0.25	0.25	0.25	0.25	0.25	(1) 0.3 (2) 0.6 (3) 0.4	(1) 0.5 (2) 0.25 (3) 0.5	0.25	0.25
At 3 x FSO, ± ___% of 3 x FSO typical	(1) 3.0 (2) 3.0 (3) 2.5	2.0	1.0	1.0	1.0	1.0	(1) 0.3 (2) 0.8 (3) 1.0**	(1) 1.0 (2) 0.7 (4) 0.5	(1) 1.0 (2) 0.5 (3) 0.5 (4) 1.0	(1) 1.5 (2) 2.0 (3) 1.0
Acceleration Sensitivity Longitudinal (psi/g) typical	0.0005	0.0003	0.0003	0.0003	(1) 0.0003 (2) 0.0003 (3) 0.0004	(1) 0.0007 (2) 0.00027	(1) 0.003 (2) 0.004 (3) 0.008	(1) 0.00015 (2) 0.0002 (3) 0.0003 (4) 0.0006	(1) 0.0001 (2) 0.0002 (3) 0.0002 (4) 0.0003	(1) 0.0003 (2) 0.00001 (3) 0.0002
Lateral (psi/g) typical	0.00003	0.00003	0.00003	0.00009	(1) 0.00009 (2) 0.00009 (3) 0.00003	(1) 0.00005 (2) 0.00001	(1) 0.001 (2) 0.002 (3) 0.004	(1) 0.00006 (2) 0.00009 (3) 0.0002 (4) 0.0003	(1) 0.00001 (2) 0.00004 (3) 0.00004 (4) 0.00007	(1) 0.0002 (2) 0.000006 (3) 0.0001
Burst Pressure Diaphragm (± ___psi) minimum	40	100	150	200	(1) 500 (2) 1000 (3) 2500	(1) 5000 (2) 10,000	(1) 20,000 (2) 30,000 (3) 40,000	(1) 100 (2) 150 (3) 200 (4) 400	(1) 50 (2) 90 (3) 300 (4) 400	(1) 700 (2) 2000 (3) 4000
Common Mode Pressure Maximum (psi)	(1) 200 (2) 50 (3) 300	(1) 200 (2) 50 (3) 300	(1) 200 (2) 50 (3) 300	(1) 200 (2) 50 (3) 300	300	300	N/A	25	N/A	N/A
MECHANICAL										
Weight, Ounces (grams) typical	(1) 0.04 (1.0) (2) 0.01 (0.3) (3) 0.06 (1.8)	(1) 0.04 (1.0) (2) 0.01 (0.3) (3) 0.06 (1.8)	(1) 0.04 (1.0) (2) 0.01 (0.3) (3) 0.06 (1.8)	(1) 0.04 (1.0) (2) 0.01 (0.3) (3) 0.06 (1.8)	0.06 (1.8)	0.06 (1.8)	0.4 (11)	0.003 (.08)	0.04 (1.8)	0.04 (1.8)
Mounting Thread	(1) 6-32 (2) None (3) 10-32	(1) 6-32 (2) None (3) 10-32	(1) 6-32 (2) None (3) 10-32	(1) 6-32 (2) None (3) 10-32	10-32	10-32	⅜ x 24	None	10-32	10-32
Face Diameter, inches (millimeters)	(1) 0.09 (2.31) (2) 0.09 (2.34) (3) 0.15 (3.84)	(1) 0.09 (2.31) (2) 0.09 (2.34) (3) 0.15 (3.84)	(1) 0.09 (2.31) (2) 0.09 (2.34) (3) 0.15 (3.84)	(1) 0.09 (2.31) (2) 0.09 (2.34) (3) 0.15 (3.84)	0.15 (3.84)	0.15 (3.84)	0.32 (8.13)	0.062 ±0.003 (1.57 ±0.076)	0.15 (3.84)	0.15 (3.84)
ENVIRONMENTAL										
Vibration, pk g, maximum	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Shock, (g, 100 s, half sine) max	(1), (2) 10,000 (3) 20,000	(1), (2) 10,000 (3) 20,000	(1), (2) 10,000 (3) 20,000	(1), (2) 10,000 (3) 20,000	20,000	20,000	20,000	20,000	20,000	20,000
Temperature °F maximum °C maximum	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +225 −54 to +107	−65 to +250	−65 to +250	−65 to +250
Seal	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy

* Overrange is limited to 75,000 psi. A shift in calibration may occur after exposure to pressures above 50,000 psi.
** Overrange is limited to 40,000 psi.
Continued product improvement necessitates that Endevco reserve the right to modify these specifications without notice.

The advantages of being tiny.

At Entran, we've solved most of the problems you might encounter with pressure transducers by making them tiny. And nowadays, tiny is the state-of-the-art.

Being tiny means you don't interfere with the integrity of the system being measured.

Being tiny means less measuring surface to bear loads, and a more compact solid state density with no moving parts.

Being tiny means being insensitive to acceleration, vibration and shock, so you get flat pressure readings, both static and dynamic.

And, being tiny means greater handling ease in hard-to-get-at places. Which adds up to more applications flexibility.

Entran pressure tranducers can usually be interfaced directly with scopes, recorders and milliammeters.

Our transducers come complete and ready to use. All you need supply is the excitation voltage on two leads and read output on the other two leads.

All units give you direct linear output in millivolts/psi and read both static and dynamic pressures. There's no need for charge or voltage amplifiers. Calibrations are traceable to The National Bureau of Standards.

Write Entran Devices, Inc., 10 Washington Ave., Fairfield, N.J. 07006 (201) 227-1002, Telex 130-361.

$360.00

Must not be used in water or corrosive medium.

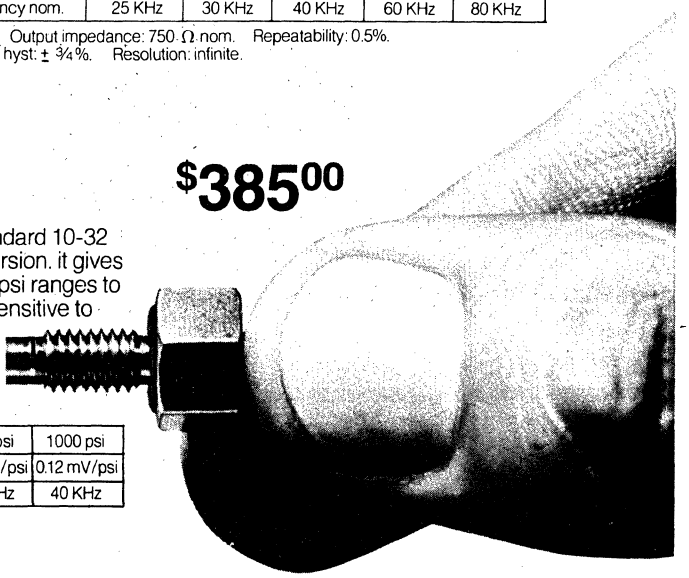
Only 0.080 in diameter (that's tiny), EPI-080.

This solid-state pressure transducer is 0.080" in diameter, 0.25" in length and occupies a volume of only 0.0013 cubic inches. Yet it gives accurate static and dynamic pressure readings like the big ones do. Its atomically bonded, diffused diaphragm with leads attached to the non-active area make this device virtually insensitive to acceleration, vibration and shock.

Typical ranges	25 psi	50 psi	100 psi	250 psi	500 psi
Sensitivity nom.	3 mV/psi	1.8 mV/psi	1.0 mV/psi	0.4 mV/psi	0.2 mV/psi
Useful frequency nom.	25 KHz	30 KHz	40 KHz	60 KHz	80 KHz

Excitation: 5V. Output impedance: 750 Ω nom. Repeatability: 0.5%.
Non-linear and hyst: ± ¾%. Resolution: infinite.

$385.00



Tiny but easy to handle, EPX-10

This easy to install pressure transducer is built with standard 10-32 UNF thread and is available in an optional M5 metric version. it gives flat pressure readings static and dynamic, in 5 to 5,000 psi ranges to as high as 90KHz. Has infinite resolution and is also insensitive to acceleration, vibration and shock. Made of stainless steel, and with its built-in "O" ring seal can be screwed in just about anywhere. However, for corrosive or water usage, order our "welded" version.

Typical ranges	5 psi	50 psi	100 psi	250 psi	1000 psi
Sensitivity nom.	3 mV/psi	1.5mV/psi	1.2 mV/psi	0.5 mV/psi	0.12 mV/psi
Useful frequency nom.	9 KHz	15 KHz	15 KHz	20 KHz	40 KHz

Combined non-linear and hyst: ± 1% below 100psi, ½% above 100 psi.
Excitation: 10V. Output impedance: 350 Ω nom.
Repeatability: 0.25%. Thread length: 7/16".

Entran® Pressure Transducers.

(Today, miniature makes sense.)

Call (201) 227-1002

The advantages of being tiny.

At Entran we build a line of accelerometers that can best be described as tiny.

Being tiny means you don't interfere with the integrity of the system being measured.

Being tiny gives you greater handling ease in hard-to-get-at places, which adds up to more applications flexibility. And, being tiny means less mass to distort your test scale, more room for other instruments. All at no sacrifice in test data.

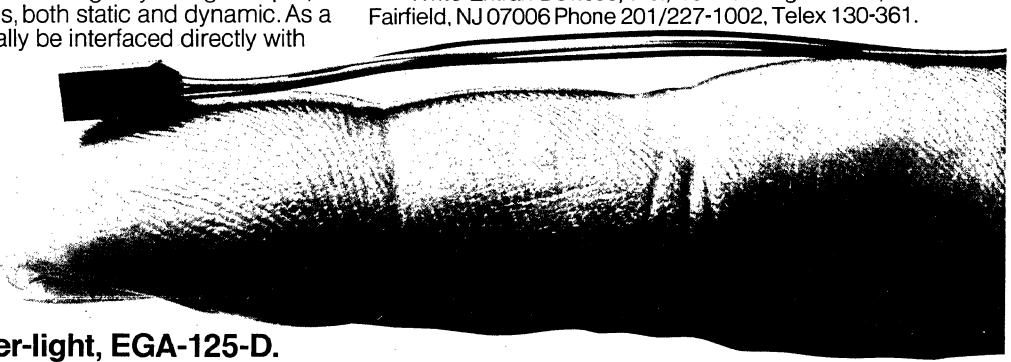
Entran accelerometers give you high output, low impedance readings, both static and dynamic. As a result they can usually be interfaced directly with scopes, recorders and milliammeters.

Entran accelerometers come complete and ready to use. All you supply is the excitation voltage on two leads and read output in millivolts on the other two leads.

All units give you direct linear output in millivolts/g and read both static and dynamic acceleration. There's no need for charge or voltage amplifiers. Calibrations are traceable to The National Bureau of Standards.

Write Entran Devices, Inc., 10 Washington Ave., Fairfield, NJ 07006 Phone 201/227-1002, Telex 130-361.

$299.00

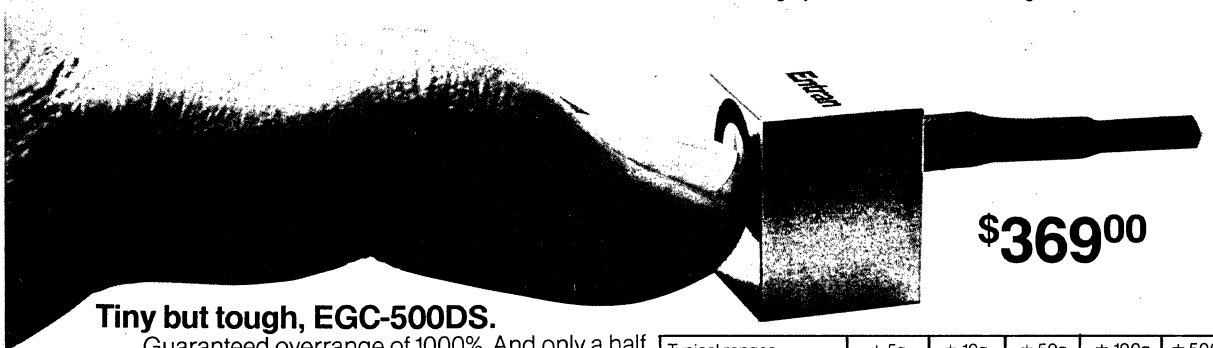


Tiny and feather-light, EGA-125-D.

This accelerometer weighs only one half a gram. Is less than 0.006 cu. inches in volume. Yet gives you static & dynamic readings of acceleration, vibration and shock. And comes with .7 critical damping to eliminate resonance. ("D" is for "damped.")

Typical ranges	± 5g	± 10g	± 50g	± 100g	± 500g
Sensitivity nom.	15 mV/g	12 mV/g	4 mV/g	2.5 mV/g	0.5 mV/g
Useful frequency nom.	150 Hz	200 Hz	500 Hz	600 Hz	1200 Hz

Excitation: 15V, Weight: ½ gram without leads, Linearity: ± 1%,
5 other mounting styles available at no extra charge.



$369.00

Tiny but tough, EGC-500DS.

Guaranteed overrange of 1000%. And only a half inch cube to boot.

Static & dynamic measurements of acceleration, vibration and shock in ranges from 5 to 1,000 g. Fully damped to eliminate resonance and fitted with mechanical stops to impede overload response.

Typical ranges	± 5g	± 10g	± 50g	± 100g	± 500g
Sensitivity nom.	25 mV/g	20 mV/g	4 mV/g	2 mV/g	0.5 mV/g
Useful frequency	150 Hz	200 Hz	600 Hz	1000 Hz	1500 Hz

Excitation: 15V, Damping: 0.7 cr. nom., Linearity: ± 1%
Output impedance: 450 Ω nom., Input impedance: 1000 nom.
Size: 0.5" x 0.5" 0.6" width, 10-32UNF tapped hole

Entran Accelerometers.

(Today, miniature makes sense.)

Call (201) 227-1002

TRANSDUCERS & SYSTEMS

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TRANSDUCERS & SYSTEMS

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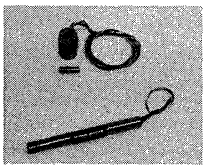
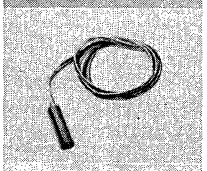


LINEAR VARIABLE DIFFERENTIAL TRANSDUCERS

- *DC in/DC out or AC in/AC out*
- *High accuracy and stability*
- *Low input power :<300mWdc*
- *±0.02" to ±10.00" full scale*

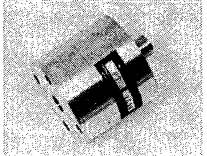
MDP/SD LVDTs provide self-contained signal conditioning. MA/MDP models offer small size, high accuracy, and high sensitivity. SA/SD models allow higher ranges and ruggedized design.



PROXIMITY SENSORS/SWITCHES

- *High repeatability*
- *0.004" to 0.25" full scale*
- *Sizes from 0.2" dia.*
- *AC/DC/switch types*

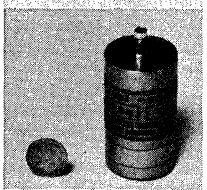
These inductive sensors are available for DC and for AC applications. High accuracy and repeatability provide excellent performance under continuous monitoring conditions.



PRESSURE TRANSDUCERS

- *Ranges from 1 to 2,000 psi*
- *AC and DC models*
- *High linearity and accuracy*
- *High repeatability*

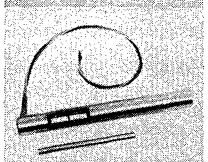
PT Series LVDT-type pressure transducers offer a broad selection of ranges, low hysteresis error and high linearity. Voltage, current, or frequency outputs are available.



LOW RANGE FORCE/WEIGHT TRANSDUCERS

- *AC and DC models*
- *Tension/compression from ±10 gms full range*
- *20ms full load response*

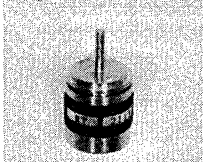
Applications include laboratory use, biomedical and pharmaceutical measurements, high speed weighing, aero/hydrodynamic modeling, and others where precise determination of low range forces is necessary. Closed loop versions are also available.



LINEAR VELOCITY TRANSDUCERS

- *0.5" to 20.0" ranges*
- *Single-piece high flux-density magnetic core*
- *1000 ips capability*

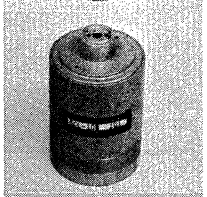
These LVTs provide outputs directly proportional to the rate of change of an object's position. The output also indicates the direction of motion. Rugged construction assures high tolerance to shock and vibration.



ROTARY VARIABLE DIFFERENTIAL TRANSFORMERS

- *AC and DC models*
- *Unlimited rotation*
- *±60° linear range*
- *Infinite resolution*

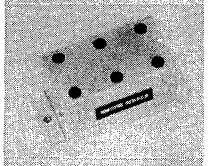
These angular position LVDTs offer unlimited rotation and non-contact measuring. They are available in AC and DC models, and with an independent stator and rotor.



ACCELEROMETERS

- *±1G to ±100G full scale*
- *0.1% typical linearity*
- *±5Vdc full scale output*
- *AC models available*
- *Sizes from 0.625" dia.*

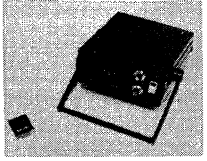
These small, rugged accelerometers offer high accuracy and good frequency response. Self-contained signal conditioning provides high output. Also available are closed loop (force-balance) models with higher accuracies and extended frequency response.



INCLINOMETERS

- *±1° to ±90° full scale*
- *Measure to 0.1 second of arc*
- *Linearity to ±0.02%*
- *AC models available*

These inclinometers provide a DC output proportional to the sine of the angle of tilt, resolving changes in angle as small as 0.1 second of arc, and changes in tilt as low as 0.000006 inch/foot. AC and closed loop version also available.



SIGNAL CONDITIONING MODULES & CONTROL BOXES

Signal conditioning modules for our AC-LVDTs, and all of our AC transducers, are available for AC or DC inputs/outputs, with options such as zero adjustment ranges to 100%, output currents to 500mA, preset limits, frequency outputs, and a choice of several methods of interconnection. Control boxes, including digital displays, printers, and other output instrumentation are also available.

..... AND SYSTEMS

TRANSDUCERS AND SYSTEMS INC.

A PRIME TECHNOLOGY COMPANY

ITEK ENCODERS ON TARGET: HIGH PERFORMANCE IN A SMALL PACKAGE

Individual data sheets of any Itek Absolute and Incremental encoder or display are immediately available on request. Modifications to your specific encoder requirements can be accommodated.

MicroSeries® Ultra-Small Absolute Encoders For Military Fire Control

MODEL	SIZE (Inches) O.D.	SHAFT DIAM.	RESOLUTION (QUANTA/REV.) BINARY (2^{xx})				BCD
μS_/16	1.6	.25	12	13	14	15	6.4K
μS_/23	2.3	.25	13	14	15	16	

Features: Small Size • High Accuracy • Direct Digital Transducer • Absolute Whole Word Output • MIL Environments—Gun, Ship, Aircraft, Spacecraft (Vibration 20g, Shock 1000g, 0.8ms) • LED Illuminators • High Reliability.

Digisec® Encoders—RA series

Rotary Absolute Encoders

	Model	O.D.	Shaft Diam.	Resolution (Quanta/Rev.) Binary (2^{xx})	BCD
SOLID SHAFT	15	1.5	.187	C 11 · C 12 · C 13 · T 16 · T 17 · T 18 · T 19 · T 20	
	23	2.3	.25	C 12 · C 13 · C,S 14 · C,S 15 · C,S 16 · C,S 17 · S 18	S 3.6K · S 36K
	35	3.5	.375	S 16 · S 17 · S 18 · S 19 · S 20	
THRU-HOLE	55	O.D. 5.5	I.D. .75	S 16 · S 17 · S 18 · S 19 · S 20 · S 21	S 36K · S 360K
	60	6.0	2.25	S 16 · S 17 · S 18 · S 19 · S 20 · S 21	S 36K · S 360K
	100	10.0	2.75	S 16 · S 17 · S 18 · S 19 · S 20 · S 21	S 36K · S 360K
	106	10.0	6.0	S 19 · S 20 · S 21	
	117	11.0	7.0	S 20 · S 21 · S 22	
	158	15.0	8.0		

OD—Outside Diameter ID—Inside Diameter C—Self-contained Electronics S—Separate electronic enclosure T—2 speed geared paired configurations

Features: • Parallel whole word unambiguous output • TTL/DTL compatible • Resolution to 0.31 arc-seconds (22 bits) • Highest accuracies available anywhere • Operating temperature −40° to +71°C • Military Specification rated • Instant on-the-fly readout • LED light sources • Separate Electronics—no electronics in optical unit (thru-hole systems)

Available Options: • Serial readout • Line driver output • Redundancy • Chrome slit and disc (standard on size 23 and size 158) • Binary lamp display • Subtractor card for electronic zeroing

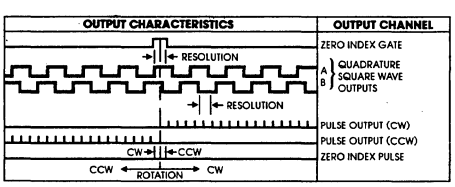
RI series

Rotary Incremental Encoders

Model	O.D.	Shaft Diam.	Resolution (Quanta/Rev.) Binary (2^{xx})	Decimal
15	1.5	.187	C 8 · C 9 · C 10 · C 11 · C 12 · C 13	C 0.5K · C 1.0K · C 1.8K · C 2.0K · C 3.6K · C 4.0K · C 5.0K · C 6.4K · C 8.0K
23	2.3	.25	C 13 · C 14 · C 15 · C 16 · C 17 · C 18 · C 19	C 20K · C 32K · C 36K · C 40K · C 50K · C 64K · C 72K · C 100K · C 128K · C 180K · C 200K · C 320K · C 360K · C 640K
35	3.5	.375		
55	5.5	.75	C 16 · C 17 · C 18 · C 19 · S 20	
60	6.0	2.25		
100	10.0	2.75	C 17 · C 18 · C 19 · C 20 · S 21	C 360K
106	10.0	6.0		
117	11.0	7.0		
158	15.0	8.0	C 20 · C 21 · S 22	

Features: • Quadrature square wave or pulse output, zero index • TTL/DTL compatible • Resolution to 0.31 arc-seconds (22 bits) • Self-contained electronics • Operating temperature −40° to +71°C • Military Specification rated • LED light sources

Available Options: • Line driver output • Pigtail cable • Square wave or pulse output



Environmental Ratings. All DIGISEC® encoders are designed to meet rigid military specifications. The following environmental specifications are typical: Temperature: −40° to +71°C Vibration: 10-20g Humidity: 0 to 98% Shock: 50g, 11 milliseconds (higher on solid shaft models)

Spacecraft Encoders: Absolute & Incremental

Model	Type	Diam. (inches)	Resolution (Quanta/Rev.)	Accuracy	Weight (lbs.)	Power (watts)	Features
RA21/1510	Absolute	15.0	2^{21}	2.6 sec	20.0	3.0	10 Inch Thru-hole Electrical Redundancy.
RA18/60	Absolute	6.0	2^{18}	10.0 sec	8.5	3.0	Elect. & Mech. Redundancy.
RI13/35	Incremental	3.5	2^{13}	2.6 min	3.0	2.0	Commutator Outputs.
RI20/63	Incremental	6.3	2^{20}	1.5 sec	1.7	0.5	Unhoused. Commutator Outputs.
RI36K/40	Incremental	4.0	36,000	2.5 sec	3.0	0.3	Electrical Redundancy.
RI14.4K/23	Incremental	2.3	14,000	1.5 min	.75	0.4	Commutator Outputs.

Features: LED Illuminators • Resolution to 0.31 Arc Seconds (22 Bits) • Highest Accuracy Available Anywhere. Available with bearings (housed) or without (unhoused).

Specifications subject to change without notice.

Itek Measurement Systems
A Division of Itek Corporation
27 Christina Street Newton, Massachusetts 02161 Telephone: 617-969-7300 TWX: 710-335-6783

Itek

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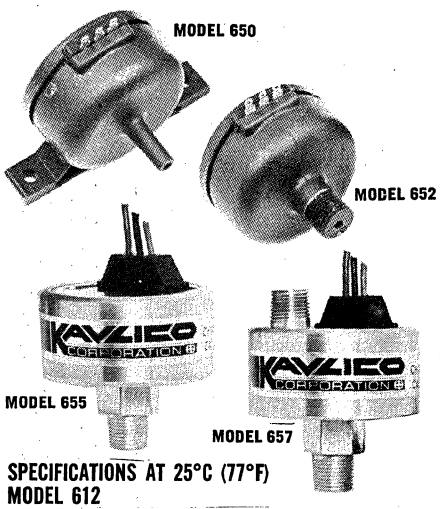
Providing excellent performance at minimum cost, the P600 Series is intended for custom, OEM pressure measurement applications. This series features exceptional repeatability, low hysteresis, accurate operation over a broad temperature range, and the ability to perform without zero shift when subjected to high overpressures. These characteristics, combined with long term stability, make the series ideal for microprocessor-based applications.

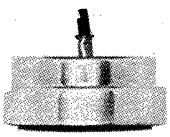
Key to the uniform performance and low cost features of this series is Kavlico's patented ceramic sensing element with its integral signal conditioning that employs a reliable solid state, custom hybrid circuit. Temperature compensation and calibration is provided through use of computer-controlled laser trimming of hybrid circuit components. As a result, uniformity from unit-to-unit is assured and there is no need for adjustment or recalibration by the user. In addition, the P600 Series maintains repeatable performances even after extraordinary overpressures, which has been demonstrated in over five years of automotive sevice.

The P600 Series provides a high level output voltage, permitting it to interface easily with a variety of circuits, indicators, or alarms. In addition, its ratiometric output is ideal for digital monitoring. By using the supply voltage as the reference for the conversion circuit, measurement accuracy is maintained regardless of supply voltage variations.

The P600 Series provides a choice of rugged die cast aluminum or high dielectric strength Valox housings. Seal materials are available to meet a variety of applications.

In electrically noisy environments, reliability and performance are assured with protection against electromagnetic interference (EMI) and line voltage transients as a standard feature on most models.





SPECIFICATIONS AT 25°C (77°F)
MODEL 612

@ STANDARD V_s = 9 VDC	STANDARD PRESSURE RANGE			
PARAMETER	MIN	TYP	MAX	UNITS
Full Scale Output (Pos. Pressure)	5.9	5.92-6.08	6.1	VDC
Null Offset ±1, ±5 PSID 0-1, 0-5, 0-15 PSID 0-1 PSIG, 0-5, 0-15	 3.9 2.35 1.9	 3.92-4.08 2.4-2.6 1.92-2.08	 4.1 2.7 2.1	 VDC
Span* ±1, ±5 PSID 0-1, 0-5, 0-15 PSID 0-1 PSIG, 0-5, 0-15	 1.8 3.2 3.8	 1.84-2.16 3.32-3.68 3.84-4.16	 2.2 3.75 4.2	 VDC
Linearity(Best Fit)		±0.3	±0.5	%Span
Hysteresis		±0.003	±0.01	%Span
Repeatability		±0.005	±0.05	%Span
Temperature Error (−30° to +100°C) Null Span		 ±1.6 ±1.0	 ±3.0 ±1.5	 %Span %Span
Stability (1 year)		±1.0		%Span
Supply Voltage (V_s)‡	7.5		15	VDC
Supply Current (Quiescent) 10K Load		8	15	mA
EMI Change In Output Due to RF Field of 200V/M, 10KHz to 1GHz (By Special Order)		±0.2	±1.0	VDC
Transient Voltage On V_s			50	V/1 mSec
Common Mode Pressure			15	PSI
Pressure Overload (Pos. Pressure)** ±1, ±5 PSID 0-1, 0-5, 0-15 PSID 0-1 PSIG, 0-5, 0-15 (Neg. Pressure) ±1, ±5 PSID 0-1, 0-5, 0-15 PSID 0-1 PSIG, 0-5, 0-15			 20X 10X 10X 2X 1X	 Rated Pressure
Burst Pressure (Pos. Pressure)** ±1, ±5 PSID 0-1, 0-5, 0-15 PSID 0-1 PSIG, 0-5, 0-15 (Neg. Pressure) ±1, ±5 PSID 0-1, 0-5, 0-15 PSID			 50X 10X 10X 2X 1X	 Rated Pressure

SPECIFICATIONS AT 25°C (77°F)
MODEL P650

@ STANDARD V_s = 9 VDC	STANDARD PRESSURE RANGE			
PARAMETER	MIN	TYP	MAX	UNITS
Full Scale Output	5.9	5.94-6.06	6.1	VDC
Null Offset	1.9	1.94-2.06	2.1	VDC
Span*	3.8	3.94-4.06	4.2	VDC
Linearity(Best Fit)		±0.3	±0.5	%Span
Hysteresis		±0.003	±0.01	%Span
Repeatability		±0.005	±0.05	%Span
Temperature Error (−30° to +100°C) Null Span		 ±1.6 ±1.0	 ±3.0 ±1.5	 %Span %Span
Stability (1 year)		±1.0		%Span
Supply Voltage (V_s)‡	7.5		15	VDC
Supply Current (Quiescent) 10K Load		8	15	mA
EMI Change In Output Due to RF Field of 200V/M, 10KHz to 1GHz (By Special Order)		±0.2	±1.0	VDC
Transient Voltage On V_s			50	V/1 mSec
Pressure Overload 0-5, 0-15 PSI 0-30 PSI 0-75, 0-150 PSI		 10X 5X	 1.5X	Rated Pressure
Burst Pressure 0-5, 0-15 PSI 0-30 PSI 0-75, 0-150 PSI	 15X 9X 1.5X			Rated Pressure

MODEL P655

Full Scale Output	5.92	5.96-6.04	6.08	VDC
Null Offset	1.92	1.96-2.04	2.08	VDC
Span*	3.84	3.96-4.04	0.16	VDC
Linearity(Best Fit)		±0.3	±0.5	%Span
Hysteresis		±0.003	±0.01	%Span
Repeatability		±0.005	±0.05	%Span
Temperature Error (−30° to +100°C) Null Span		 ±1.6 ±1.0	 ±3.0 ±1.5	 %Span %Span
Stability (1 year)		±1.0		%Span
Supply Voltage (V_s)‡	7.5		15	VDC
Supply Current (Quiescent) 10K Load		8	15	mA
EMI-Standard All Models Change in Output Due to RF Field of 200V/M, 10KHz to 1GHz		±0.2	±1.0	VDC
Transient Voltage On V_s			50	V/1 mSec
Pressure Overload 0-5, 0-15 PSI 0-30, 0-75 PSI 0-150, 0-300, 0-500† PSI			 10X 5X 2X 1.2X†	 Rated Pressure
Burst Pressure 0-5, 0-15 PSI 0-30, 0-75 PSI 0-150, 0-300, 0-500† PSI	 20X 10X 2.5X			Rated Pressure

* Span is the Algebraic Difference Between End Points (Null Offset and Full Scale Output)
‡ 5VDC V_s Available by Special Order, Contact Kavlico
**RATING SUBJECT TO USERS MOUNTING DESIGN

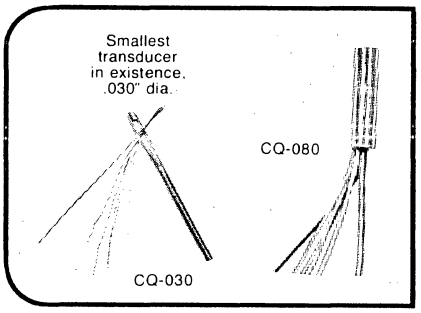
SPECIFICATIONS AT 25°C (77°F)
MODEL 652

@ STANDARD V_s = 9 VDC	STANDARD PRESSURE RANGE			
PARAMETER	MIN	TYP	MAX	UNITS
Full Scale Output (Pos. Pressure) ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG	 5.9 5.9	 5.92-6.08 5.94-6.06	 6.1 6.1	 VDC
Null Offset ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG	 3.9 1.9	 3.92-4.08 1.94-2.06	 4.1 2.1	 VDC
Span* ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG	 1.8 3.8	 1.84-2.16 3.88-4.12	 2.2 4.2	 VDC
Linearity(Best Fit) ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG		 ±0.5 ±0.3	 ±1.0 ±0.5	 %Span
Hysteresis		±0.003	±0.01	%Span
Repeatability		±0.005	±0.05	%Span
Temperature Error (−10° to +60°C) Null Span		 ±1.6 ±1.0	 ±3.0 ±1.5	 %Span %Span
Stability (6 mos.)		±1.0		%Span
Supply Volt (V_s)‡	7.5		15	VDC
Supply Current (Quiescent) 10K Load		8	15	mA
EMI Change In Output Due to RF Field of 200V/M, 10KHz to 1GHz (By Special Order)		±0.2	±1.0	VDC
Transient Voltage On V_s			50	V/1 mSec
Pressure Overload (Pos. Pressure) (Neg. Pressure)			 20X 5X	 Rated Pressure
Burst Pressure (Pos. Pressure) (Neg. Pressure)			 50X 5X	 Rated Pressure

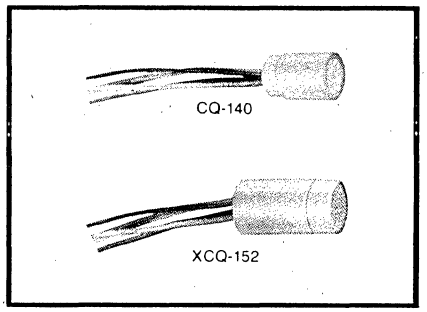
MODEL 657

Full Scale Output (Pos. Pressure)	5.9	5.95-6.05	6.1	VDC
Null Offset ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG	 3.9 3.8	 3.95-4.05 3.9-4.1	 4.1 4.2	 VDC
Span* ±10″ H_2O, ±0.5, ±1.0 PSID 0-0.5, 0-1 PSIG	 1.8 3.8	 1.9-2.1 3.9-4.1	 2.2 4.2	 VDC
Linearity(Best Fit)		±0.3	±0.5	%Span
Hysteresis		±0.003	±0.01	%Span
Repeatability		±0.005	±0.05	%Span
Temperature Error (−10° to +80°C) Null Span		 ±1.6 ±1.0	 ±3.0 ±1.5	 %Span %Span
Stability (6 mos.)		±1.0		%Span
Supply Volt (V_s)‡	7.5		15	VDC
Supply Current (Quiescent) 10K Load		8	15	mA
EMI-Standard All Models Change in Output Due to RF Field of 200V/M, 10KHz to 1GHz		±0.2	±1.0	VDC
Transient Voltage On V_s			50	V/1 mSec
Pressure Overload (Pos. Pressure) (Neg. Pressure)			 50X 5X	 Rated Pressure
Burst Pressure (Pos. Pressure) (Neg. Pressure) ±10″ H_2O, ±0.5, ±1.0 PSID			 75X 5X	 Rated Pressure

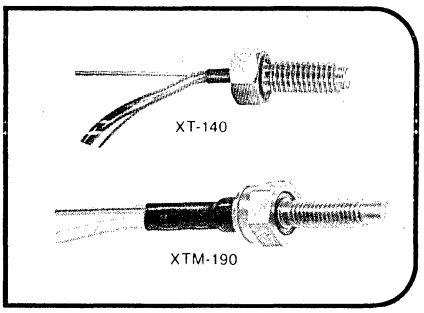
Miniature Pressure Transducers



CQ-030 XCQ-080 Series Smallest available pressure transducers. Diaphragm diameters from .030" to .080" (.76mm to 2mm). High frequency. Bulletin: KU-1000B



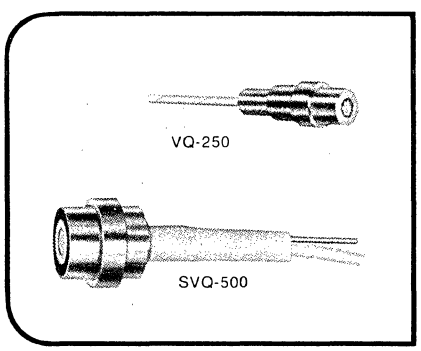
CQ-140 XCQ-152 Series Diaphragm diameter .140" to .155" (3.1mm to 3.5mm). Excellent dynamic and solid-state characteristics. Bulletin: KU-1000B



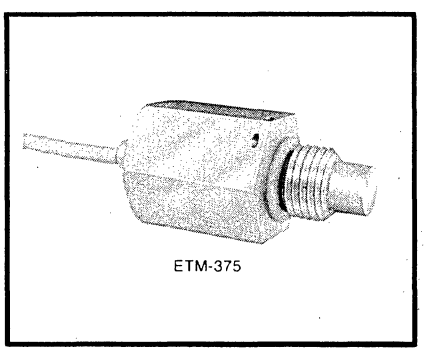
XT XTM Series Thread mount pressure transducers may be supplied with either silicon or metal diaphragms, allow user ease of mounting while retaining high performance of CQ Series. Bulletin: KM-1000C & KS-1000B

MODEL NO.	RANGE PSI (A), (G), (D)	INPUT VDC	OUTPUT FS (NOM) (mV)	NON-LINEARITY AND HYSTERESIS %	EXCITATION	OPERATING TEMPERATURE RANGE (°F)	NATURAL FREQUENCY (APPROX) KHz	UNIT PRICE*
CQ-030 XCQ-062	100-500 G, D 25-500 G, D	5	40 65-75	±1	5VDC/AC	0 to 250	1500 500-1400	$835 $625
XCQ-080	25-500 G, D	5	65-100	±0.25-±0.75	5VDC/AC	−65 to 250	230-940	$495
CQ-140 XCQ-152	5-2000 G, D	10, 20	50-100	±0.5	5VDC/AC	0 to 250	70-650	$410 $395
XT-140	25-500 A, G, D	5	75-100	±0.5	5VDC/AC	0 to 250	125-420	$465
XT-190 XTM-190	5-2000 A, G, D 25-5000 A, G, D	10-20	50-100 75	±0.3 ±0.5	5VDC/AC 10 VDC/AC(XTE)	0 to 250 XTE to 525	70-650 30-400	$395 $410

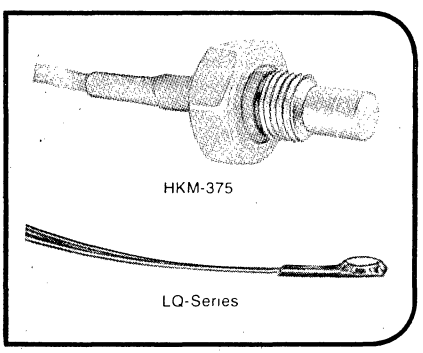
*Quantity discounts available.



VQ SVQ Series Scanivalve compatible pressure transducers for use where steady state accuracy is of prime importance. Bulletin: KPS-VQ-3C



ET ETM Series Smallest available pressure transducer with built-in amplifier and signal conditioning. Flight qualified for use on aircraft and missiles. Available in 3- and 4-wire versions. Bulletin: KM-1000C & KS-1000B



HKM HEM Series High pressure transducers with metal diaphragm compatible with most pressure medias — high temperature operation +500°F (+260°C) Bulletin: KM-1000C

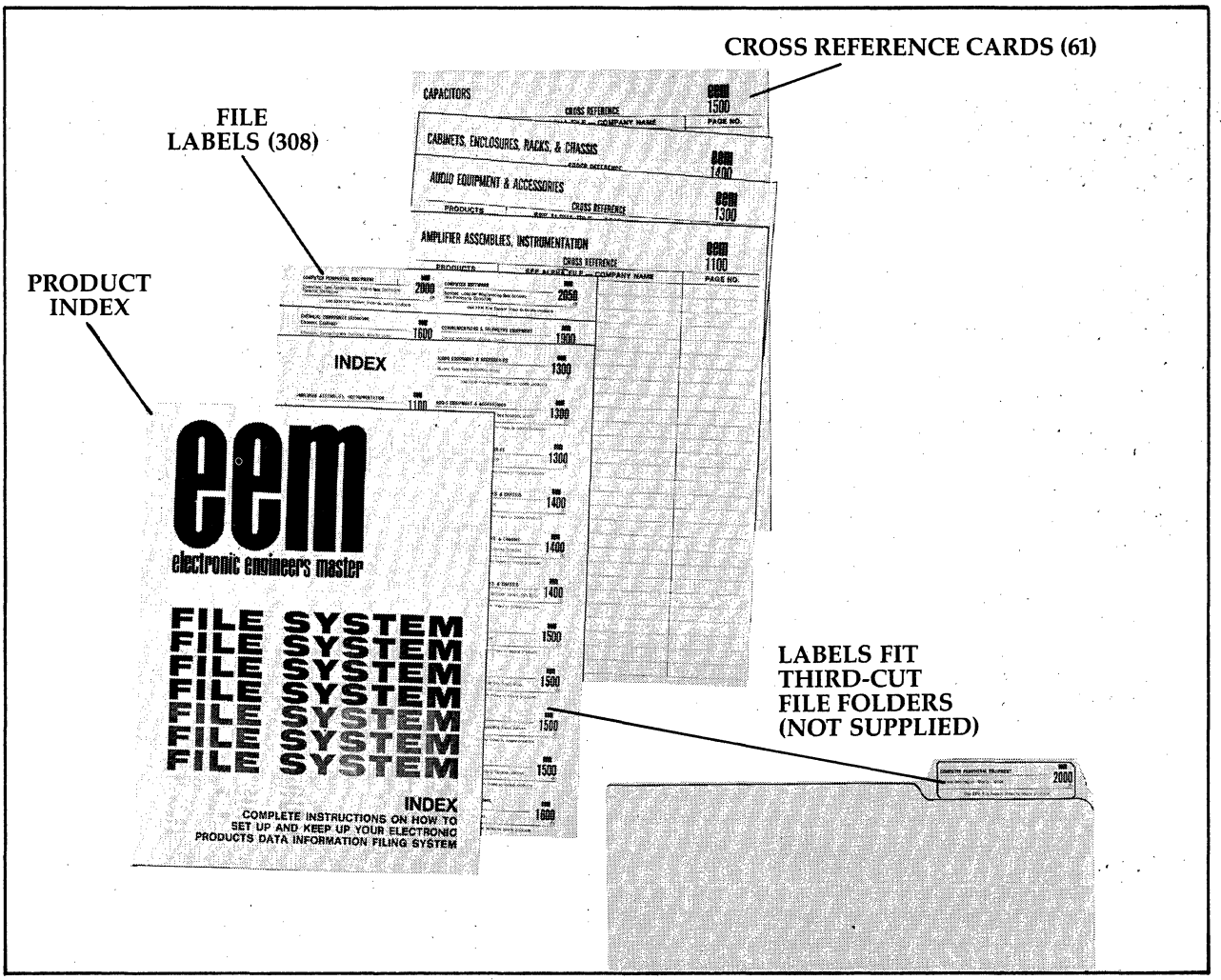
LQ Series Thin-line pressure transducer for use on turbine blade and airfoil applications. Bulletin: LQ-3C

MODEL NO.	RANGE PSI (A), (G), (D)	INPUT VDC	OUTPUT FS (NOM) (mV)	NON-LINEARITY AND HYSTERESIS %	EXCITATION	OPERATING TEMPERATURE RANGE (°F)	NATURAL FREQUENCY (APPROX) KHz	UNIT PRICE*
VQ-250 SVQ-500	5-2000 A, G, D	10, 20	50-100	±0.3	10VDC to 20VDC	0 to 250 VEM to 525	70-200	$425 $395
HKM-375 HEM-375	25-30,000 A, G	10	75	±1	10VDC/AC	0 to 250 −65 to 500	50-395	$415 $575
ET-375 ETM-375	5-200 A, G 25-20,000 A, G	28 ± 4	5,000	±1	28VDC ± 4VDC	−65 to 250	70-200 50-395	$725 $725
LQ-080	25-200 G	5	65-100	±0.5	5VDC/AC	0 to 250	230-590	$440
LQ-125 LE-125	5-500 G 25-500 G	10, 20 10, 15	55-100	±0.5 ±1	5VDC/AC	0 to 250 −65 to 525	70-350 100-350	$395 $700

*Quantity discounts available.

kulite

KULITE SEMICONDUCTOR PRODUCTS INC. 1039 Hoyt Avenue, Ridgefield, New Jersey 07657 Telephone: (201) 945-3000



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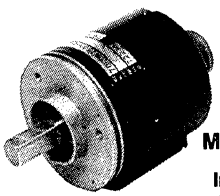
Litton

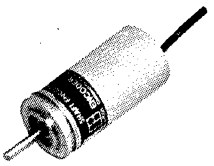
ENCODERS

Litton

INCREMENTAL

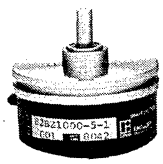


MODEL 70
Optical
Industrial
2.5″ dia.

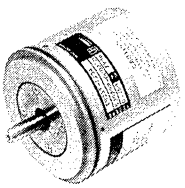


MODEL 75
Size 8

MODEL 81
Low Cost
1.5″ dia.

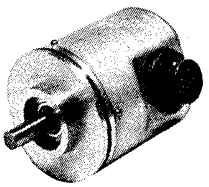


MODEL 82
Low Cost
2.2″ dia.

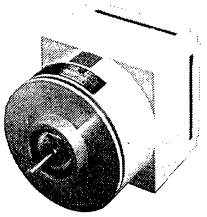


SIZE 23 & 35
Optical
Commercial &
Military

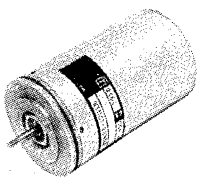
ABSOLUTE



MODEL 76
Low Cost Optical
2.5″ dia.

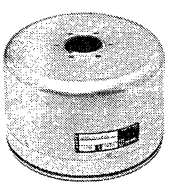


Multi-Turn
Heavy Duty
4.3″ dia.

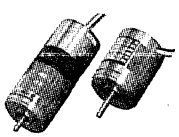


SIZE 23 & 35
Optical
Commercial &
Military

ABSOLUTE / INCREMENTAL

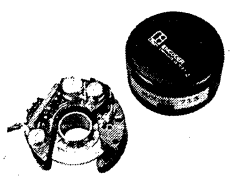


SIZE 60
6″ dia.

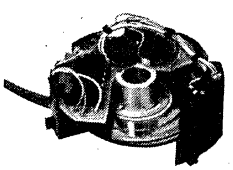


SIZE 11
Pin Contact

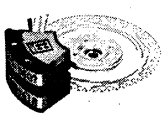
MODULAR



MODEL 715
Incremental
Optical
1.5″ dia.

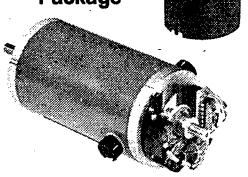


MODEL 720
Incremental
Optical
2″ dia.



Absolute
Optical
2″ dia.

Motor/Encoder
Package



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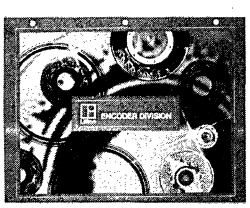
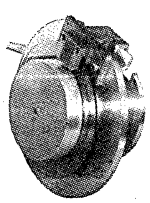
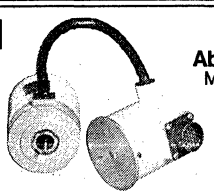


SPECIALS / CUSTOM DESIGN



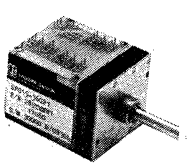
Aerospace

TRACKBALL
Commercial &
Military
4″ sq.



Absolute
Military

New! Low Cost
TRACKBALL
Commercial
3″ sq.



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MICRO SWITCH

PRESSURE SENSORS

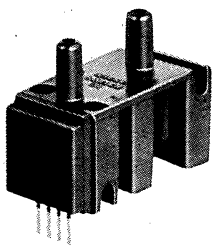
MICRO SWITCH solid state pressure sensors are ideally suited to applications that require exact measurement of pressure. They provide the important benefits of repeatability, low hysteresis, and long term stability.

The sensing element in each sensor is a square silicon chip with integral sensing diaphragm and ion implanted piezoresistors. Pressure applied on the diaphragm causes it to flex, changing the resistance, which results in an output proportional to pressure.

NON-SIGNAL CONDITIONED SENSORS

There are four series of non-signal conditioned sensors. They provide a low level output (typically 40 to 250 mV). Each series includes the basic sensor version, and a version with laser trimmed resistors (for close tolerances on null and sensitivity) and a thermistor for limited temperature compensation.

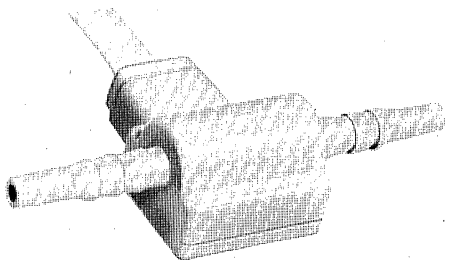
120PC



120PC series are small plastic packages equipped with printed circuit board terminals. 124PC is the basic sensor, and 126PC is trimmed and has limited temperature compensation.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
124PC	0-5	D	115 mV ±35	10 VDC or 2 mA
	0-15	D	250 mV ±75	
	0-30	D	195 mV ±85	
126PC	0-5	D	50 mV ±1.5	16 VDC max.
	0-15	D	100 mV ±1.5	
	0-30	D	79 mV ±4	

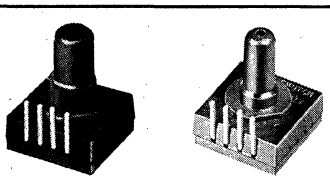
150PC



150PC series are specifically designed to measure flow-thru pressure media. The remote pressure reference is inside the termination cable. 154PC is the basic sensor, while 156PC is trimmed and temperature compensated.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
154PC	0-5	G	115 mV ±35	10 VDC or 2 mA
	0-15	G	99 mV ±41	
	0-30	G	195 mV ±85	
156PC	0-5	G	250 mV ±75	14 VDC max.
	0-15	G	40 mV ±1.5	
	0-30	G	79 mV ±4	

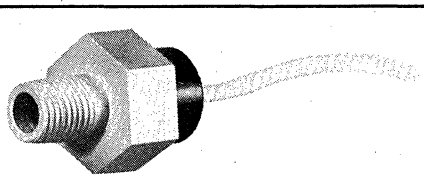
130PC



130PC series are miniature plastic packages, also equipped with printed circuit board terminals. 134PC is the basic sensor version. 136PC and 137PC are trimmed and temperature compensated. 136PC is voltage excited, while 137PC is current excited.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
134PC	0-5	A, G	115 mV ±35	10 VDC or 2 mA
	0-15	A, G	250 mV ±75	
	0-30	A, G	195 mV ±85	
136PC	0-5	A, G	50 mV ±1.5	16 VDC max.
	0-15	A, G	100 mV ±1.5	
	0-30	A, G	79 mV ±4	
137PC	0-5	A, G	50 mV ±1.5	2 mA max.
	0-15	A, G	100 mV ±1.5	
	0-30	A, G	79 mV ±4	

230PC



230PC series are stainless steel housed Gage type sensors, compatible with a wide range of pressure media. The atmospheric pressure reference is inside the termination cable to reduce the chance of contaminants entering the enclosure.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
234PC	0-15	G	250 mV ±75	10 VDC or 2 mA
	0-30	G	195 mV ±85	
	0-60	G	135 mV ±45	
	0-100	G	225 mV ±75	
236PC	0-15	G	100 mV ±1.5	16 VDC max.
	0-30	G	79 mV ±4	
	0-60	G	60 mV ±2	
	0-100	G	100 mV ±2	

* Type: A — Absolute; D — Differential; G — Gage.

** F.S.O. is the algebraic difference between end points (output at minimum and maximum pressure).

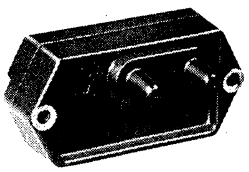
MICRO SWITCH

PRESSURE SENSORS

SIGNAL CONDITIONED SENSORS

The three signal conditioned series provide amplified high-level outputs (5V or ±2.5V). They are hybrid IC devices, with integral temperature compensation circuitry optimized on each unit as part of the calibration procedure. Null and full scale output are similarly controlled.

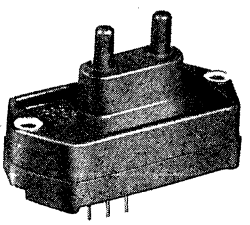
140PC



140PC series are plastic packages, equipped with printed circuit board terminals (color-coded leadwires are optional). They may be used to measure positive pressures, or for positive/negative pressure measurement. This series includes a two-wire pressure-to-current transducer, which senses industry standard 3-15 psi and provides a 4-20 mA output proportional to pressure.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
142PC	0-5 0-15 0-30	D, G A, D, G A, D, G	5 VDC ±.15 1 VDC Null	7-16 VDC
143PC	±2.5 ±5 ±15	D D, G D, G	±2.5 VDC 3.5 VDC Null	7-16 VDC
149PC	3-15	D	4-20 mA	10-40 VDC

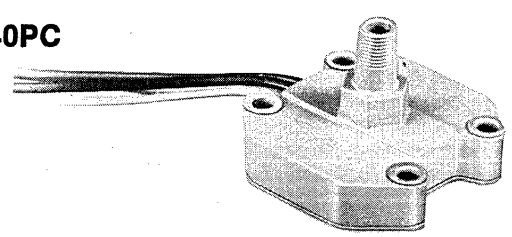
160PC



160PC series pressure sensors measure extremely low pressures, and feature high reliability. The package is similar to the 140PC series.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
162PC	0-1	D, G	5 VDC ±.20 1 VDC Null	4.8-12 VDC
163PC	±5″ H_2O	D, G		
164PC	0-10″ H_2O	D, G		

240PC



240PC series sense positive pressures up to 250 psi, in addition to positive/negative pressures up to ±15 psi. They are protected by die-cast aluminum housings with O-ring sealing for contamination resistance.

Series	Pressure Range (psi)	Type*	Full Scale Output (F.S.O.)**	Electrical Excitation
242PC	0-15 0-30 0-60 0-100 0-150 0-250	G G G G G G	5 VDC ±.20 1 VDC Null	7-16 VDC
243PC	±2.5 ±5 ±15	G G G	±2.5 VDC 3.5 VDC Null	7-16 VDC

Request MICRO SWITCH PC literature for specifications and Order Guides.

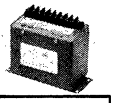
* Type: A — Absolute; D — Differential; G — Gage.
** F.S.O. is the algebraic difference between end points (output at minimum and maximum pressures).

MICRO SWITCH, a Honeywell division

AC WATT TRANSDUCER PC5 SERIES

SINGLE PHASE 50/60 Hz MODELS

SUPPLIED WITH INTERNAL SENSOR

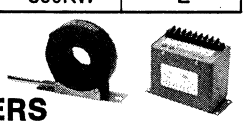


MODEL NUMBER PC5-	EFFECTIVE RANGE		WATTS AT RATED OUTPUT 1mA	CURRENT SENSOR
	VOLTS	AMPS		
1B	0 to 150	0 to 5	500W	Internal
2B	0 to 300	0 to 5	1KW	Internal
3B	0 to 600	0 to 5	2KW	Internal
10B	0 to 150	0 to 10	1KW	Internal
11B	0 to 300	0 to 10	2KW	Internal
12B	0 to 600	0 to 10	4KW	Internal
19B	0 to 150	0 to 15	1.5KW	Internal
20B	0 to 300	0 to 15	3KW	Internal
21B	0 to 600	0 to 15	6KW	Internal
103B	0 to 150	0 to 1	100W	Internal
104B	0 to 300	0 to 1	200W	Internal
105B	0 to 600	0 to 1	500W	Internal
106B	0 to 150	0 to 2.5	250W	Internal
107B	0 to 300	0 to 2.5	500W	Internal
108B	0 to 600	0 to 2.5	1000W	Internal

SUPPLIED WITH CURRENT TRANSDUCERS

28B	0 to 150	0 to 50	5KW	C†
29B	0 to 300	0 to 50	10KW	C†
30B	0 to 600	0 to 50	20KW	C†
31B	0 to 150	0 to 100	10KW	C
32B	0 to 300	0 to 100	20KW	C
33B	0 to 600	0 to 100	40KW	C
34B	0 to 150	0 to 200	20KW	D
35B	0 to 300	0 to 200	40KW	D
36B	0 to 600	0 to 200	80KW	D
37B	0 to 150	0 to 400	40KW	D
38B	0 to 300	0 to 400	80KW	D
39B	0 to 600	0 to 400	160KW	D
40B	0 to 150	0 to 600	60KW	E
41B	0 to 300	0 to 600	120KW	E
42B	0 to 600	0 to 600	240KW	E
43B	0 to 150	0 to 1K	100KW	E
44B	0 to 300	0 to 1K	200KW	E
45B	0 to 600	0 to 1K	400KW	E
46B	0 to 150	0 to 2K	200KW	E
47B	0 to 300	0 to 2K	400KW	E
48B	0 to 600	0 to 2K	800KW	E

SUPPLIED WITH CURRENT TRANSFORMERS



49B	0 to 150	0 to 50	5KW	W†
50B	0 to 300	0 to 50	10KW	W†
51B	0 to 600	0 to 50	20KW	W†
58B	0 to 150	0 to 100	10KW	W
59B	0 to 300	0 to 100	20KW	W
60B	0 to 600	0 to 100	40KW	W
67B	0 to 150	0 to 200	20KW	W
68B	0 to 300	0 to 200	40KW	W
69B	0 to 600	0 to 200	80KW	W
76B	0 to 150	0 to 400	40KW	X
77B	0 to 300	0 to 400	80KW	X
78B	0 to 600	0 to 400	160KW	X
85B	0 to 150	0 to 600	60KW	X
86B	0 to 300	0 to 600	120KW	X
87B	0 to 600	0 to 600	240KW	X
94B	0 to 150	0 to 1K	100KW	Y
95B	0 to 300	0 to 1K	200KW	Y
96B	0 to 600	0 to 1K	400KW	Y

NOTE: † indicates 2 turns thru the external transducer or transformer window.

FOR DIMENSIONS REQUEST CATALOG #983

FEATURES AND APPLICATIONS:

- Accurate measurement of electric power consumed by equipment
- Accurate for any conditions of phase, voltage unbalance, current unbalance and power factor
- Output is proportional to true power delivered to the load
- Transducers with sensors internal and C, D, & E provide excellent current transient response for measuring SCR controls, chopped waveforms or application where harmonics are present
- Highly-accurate, without worrying about the inaccuracies of current transformers and potential transformers
- Split sensors available
- Current sensors are included and are calibrated with the watt transducer (where required)
- For interface with meters, recorders, data loggers, computer or other instrumentation, select options "A" through "F"
- Wide frequency range: 48 to 70 Hz
- Standard 1 mA output, other options available

P5 SERIES SPECIFICATIONS:

INPUT:

Voltage: See Tables..

Current: See Tables

Frequency Range: 50 to 70 Hz

Power Factor Range: Any

Response (Transient 90%): <100 microseconds with models using internal sensors or sensors C, D, or E
1 millisecond with models using current sensors W, X, and Y

Burden:
Voltage: 1.25 VA
Current: 1.25 VA
Option Amplifier: 2 Watts

Current Overload:
1 thru 15 Ampere models and those using current sensors W, X, and Y
2 times rating (continuous)
6 times rating (10 sec)
Models using external current sensors C, D and E
50 times rating (continuous)

Dielectric Test: (Input/Output/Case): 1500 VAC (RMS)

Surge: Withstands IEEE SWC Test

Specifications continued on next page

OHIO SEMITRONICS, INC. DEPT EM, 1205 CHESAPEAKE AVENUE, COLUMBUS, OHIO 43212
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SPECIFICATIONS (cont.):

OUTPUT:

B: Standard, 1 mA DC at Rated Output (Requires 115 VAC instrument power)
Option A: 1 mA DC at Rated Output (See Note 1)
Option C: 10 VDC at Rated Output (See Note 1)
Option D: 10 VDC at Rated Output (Requires 115 VAC instrument power)
Option E: 4-20 mA DC. 20 mA DC at Rated Output, 4 mA DC at Zero
Millivolt Options Available Consult Factory
Output Ripple: <1% of R.O.
Output Calibration: The output is proportional to real power delivered to the load. $P = EI \cos \phi$
Response Time: 250 milliseconds
Output Loading:
Standard Model: 0-10K ohms
Options A: 0-10K ohms
Options C & D: >2K ohms
Option E: 0-1500 ohms
Calibration Adjustment Range: ±10% Min.
Temperature Effect (−10°C to +60°C): ±1% of Reading, ±0.1% R.O.

ACCURACY:

±0.5% at Rated Output
(including power factor, linearity, repeatability initial set point, and current sensor).

NOTE (1) Self powered input voltage ranges for models with options A and C are limited as follows: 85 to 135V for 0 to 150V models 200 to 280V for 0 to 300V models, and 380 to 550V for 0 to 600V models.

3 PHASE 3 WIRE 50/60 Hz MODELS

SUPPLIED WITH INTERNAL SENSOR

MODEL NUMBER PC5-	EFFECTIVE RANGE VOLTS	AMPS	WATTS AT RATED OUTPUT 1mA	CURRENT SENSOR*
4B‡	0 to 150	0 to 5	1KW	Internal
5B	0 to 300	0 to 5	2KW	Internal
6B	0 to 600	0 to 5	4KW	Internal
13B‡	0 to 150	0 to 10	2KW	Internal
14B	0 to 300	0 to 10	4KW	Internal
15B	0 to 600	0 to 10	8KW	Internal
22B‡	0 to 150	0 to 15	3KW	Internal
23B	0 to 300	0 to 15	6KW	Internal
24B	0 to 600	0 to 15	12KW	Internal

SUPPLIED WITH CURRENT TRANSDUCERS

31-2B‡	0 to 150	0 to 100	20KW	C†
32-2B	0 to 300	0 to 100	40KW	C†
33-2B	0 to 600	0 to 100	80KW	C†
34-2B‡	0 to 150	0 to 200	20KW	D
35-2B	0 to 300	0 to 200	40KW	D
36-2B	0 to 600	0 to 200	80KW	D
37-2B‡	0 to 150	0 to 400	40KW	D
38-2B	0 to 300	0 to 400	80KW	D
39-2B	0 to 600	0 to 400	160KW	D

SUPPLIED WITH CURRENT TRANSFORMERS

52B‡	0 to 150	0 to 50	10KW	W†
53B	0 to 300	0 to 50	20KW	W†
54B	0 to 600	0 to 50	40KW	W†
61B‡	0 to 150	0 to 100	20KW	W
62B	0 to 300	0 to 100	40KW	W
63B	0 to 600	0 to 100	80KW	W
70B‡	0 to 150	0 to 200	40KW	W
71B	0 to 300	0 to 200	80KW	W
72B	0 to 600	0 to 200	160KW	W
79B‡	0 to 150	0 to 400	80KW	X
80B	0 to 300	0 to 400	160KW	X
81B	0 to 600	0 to 400	320KW	X
88B‡	0 to 150	0 to 600	120KW	X
89B	0 to 300	0 to 600	240KW	X
90B	0 to 600	0 to 600	480KW	X
97B‡	0 to 150	0 to 1K	200KW	Y
98B	0 to 300	0 to 1K	400KW	Y
99B	0 to 600	0 to 1K	800KW	Y

* 50 Amps and above, 2 External Sensors supplied.
‡ May be used in 120V, 1ϕ, 3 Wire Edison Systems.
NOTE: † indicates 2 turns thru the external transducer or transformer window.

3 PHASE 4 WIRE 50/60 Hz MODELS

SUPPLIED WITH INTERNAL SENSOR

MODEL NUMBER PC5-	EFFECTIVE RANGE VOLTS (Line to Neutral)	AMPS	WATTS AT RATED OUTPUT 1mA	CURRENT SENSOR**
7B	0 to 150	0 to 5	1.5KW	Internal
8B	0 to 300	0 to 5	3KW	Internal
16B	0 to 150	0 to 10	3KW	Internal
17B	0 to 300	0 to 10	6KW	Internal
25B	0 to 150	0 to 15	4.5KW	Internal
26B	0 to 300	0 to 15	9KW	Internal

** 50 Amps and above, 3 External Sensors supplied.
† Indicates 2 turns through external transformer window.

SUPPLIED WITH CURRENT TRANSFORMERS

MODEL NUMBER PC5-	EFFECTIVE RANGE VOLTS (Line to Neutral)	AMPS	WATTS AT RATED OUTPUT 1mA	CURRENT SENSOR**
55B	0 to 150	0 to 50	15KW	W†
56B	0 to 300	0 to 50	30KW	W†
64B	0 to 150	0 to 100	30KW	W
65B	0 to 300	0 to 100	60KW	W
73B	0 to 150	0 to 200	60KW	W
74B	0 to 300	0 to 200	120KW	W
82B	0 to 150	0 to 400	120KW	X
83B	0 to 300	0 to 400	240KW	X
91B	0 to 150	0 to 600	180KW	X
92B	0 to 300	0 to 600	360KW	X
100B	0 to 150	0 to 1K	300KW	Y
101B	0 to 300	0 to 1K	600KW	Y

FOR DIMENSIONS REQUEST CATALOG #983

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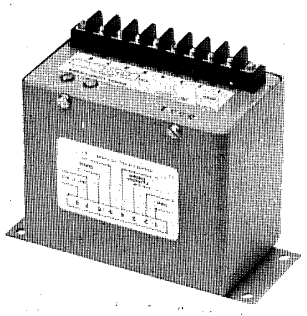
OSI ELECTRONIC PRECISION AC VAR TRANSDUCER EV5 SERIES

ACCURACY ±0.2% OF READING



SINGLE PHASE 60 Hz MODELS

MODEL NO. EV5-	EFFECTIVE RANGE		VARs AT RATED OUTPUT (1 mA)	CONNECTION	ELEMENTS
	VOLTS	AMPS			
1B	0 to 150	0 to 6.25	500	1φ2W	1
2B	0 to 300	0 to 6.25	1K	1φ2W	1
3B	0 to 600	0 to 6.25	2K	1φ2W	1
10B	0 to 150	0 to 10	1K	1φ2W	1
11B	0 to 300	0 to 10	2K	1φ2W	1
12B	0 to 600	0 to 10	4K	1φ2W	1
19B	0 to 150	0 to 20	2K	1φ2W	1
20B	0 to 300	0 to 20	4K	1φ2W	1
21B	0 to 600	0 to 20	8K	1φ2W	1

3 PHASE 3 WIRE 60 Hz MODELS

4B	0 to 150	0 to 6.25	1K	3φ3W	2
5B	0 to 300	0 to 6.25	2K	3φ3W	2
6B	0 to 600	0 to 6.25	4K	3φ3W	2
13B	0 to 150	0 to 10	2K	3φ3W	2
14B	0 to 300	0 to 10	4K	3φ3W	2
15B	0 to 600	0 to 10	8K	3φ3W	2
22B	0 to 150	0 to 20	4K	3φ3W	2
23B	0 to 300	0 to 20	8K	3φ3W	2
24B	0 to 600	0 to 20	16K	3φ3W	2

3 PHASE 4 WIRE 60 Hz MODELS

7B	0 to 150	0 to 6.25	1.5K	3φ4W	3
8B	0 to 300	0 to 6.25	3K	3φ4W	3
16B	0 to 150	0 to 10	3K	3φ4W	3
17B	0 to 300	0 to 10	6K	3φ4W	3
25B	0 to 150	0 to 20	6K	3φ4W	3
26B	0 to 300	0 to 20	12K	3φ4W	3
7½B	0 to 150	0 to 6.25	1.5K	3φ4W	2½

NOTE: On 3 phase 4 wire models, phase to neutral voltage is specified.
Optional for 50 Hz operation add "X-127" to model number.

FEATURES AND APPLICATIONS:

- Provides ±0.2% of reading accuracy and 0 to 1 mA current output proportional to reactive power
- Models available in 1, 2, 2½, and 3 element configurations to meet monitoring and control needs
- Measures forward or reverse reactive power flow
- Each unit is precalibrated at the factory to provide 1 mA at the Rated Output (RO) against standards which are traceable to NBS
- Accuracy specifications include influences of variation in voltage, current, power factor and load changes
- Temperature effects are less than ±0.005% per degree C over the range of −20°C to +60°C

EV5 AND EW5 SERIES SPECIFICATIONS:

INPUT:

VOLTAGE
Effective Range: See Tables
Burden: Less than 0.1 VA at 120V, 240V, or 480V
Overload: Max continuous 175V, 350V, or 600V

CURRENT
Effective Range: See Tables
Burden (max.): 0.28 VA per element
Overload: (continuous) 2X rating for 6.25A or 10A, 1X rating for 20A
(Transient) 50A for 10 sec. per hour, 250A for 1 sec. per hour

OUTPUT:

Rated Output (RO): ±1 mA DC
Output Loading: 0 to 10K ohms
Compliance: 12.0 volts DC minimum
Open circuit output voltage limited to ±15 VDC
Response Time (99%): Less than 400 milliseconds

ACCURACY:

(±0.2% of reading, ±0.05% of RO)
Includes the effects of voltage, current, load and power factor within the effective ranges

Specifications continued on next page

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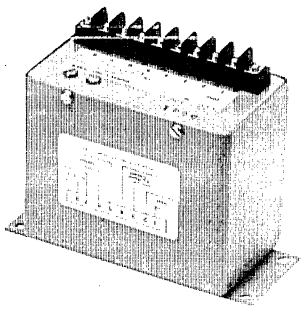
OSI ELECTRONIC PRECISION AC WATT TRANSDUCER EW5 SERIES

ACCURACY ±0.2% OF READING



FEATURES AND APPLICATIONS:

- Provides ±0.2% of reading accuracy and 0 to 1 mA current output proportional to electrical power delivered to a load
- Models available in 1, 2, 2½, and 3 element configurations to meet monitoring and control needs
- Measures forward or reverse power flow
- Each unit is precalibrated at the factory to provide 1 mA at the Rated Output (RO) against standards which are traceable to NBS
- Accuracy specifications include influences of variation in voltage, current, power factor and frequency, and load changes
- Temperature effects are less than ±0.005% per degree C over the range of −20°C to +65°C

SPECIFICATONS (cont.):

Frequency, VAR Only: 60 Hz, 50 Hz Models (optional)
Frequency, Watt Only: 58 to 62 Hz, 48 to 52 Hz on 50 Hz Models (optional)
Power Factor: Any
Temperature Range: −20°C to +60°C
Temperature Effect: ±0.005% per degree C Typical
Operating Humidity: 0 to 95% non-condensing
Dielectric Test: Input/Output/Instrument Power/Case — 1500 VAC (RMS)
Surge: Withstands IEEE SWC Test
Calibration Adjustment: ±2% minimum
Instrument Power: 90 to 135 VAC, 50 to 70 Hz Burden less than 2 VA at 115 VAC
Weight: 3.1 lbs. Maximum

FOR DIMENSIONS REQUEST CATALOG #983

SINGLE PHASE 60 Hz MODELS

MODEL NO. EW5	EFFECTIVE RANGE		WATTS AT OUTPUT RATED (1 mA)	CONNECTION	ELEMENTS
	VOLTS	AMPS			
1B	0 to 150	0 to 6.25	500	1φ2W	1
2B	0 to 300	0 to 6.25	1K	1φ2W	1
3B	0 to 600	0 to 6.25	2K	1φ2W	1
10B	0 to 150	0 to 10	1K	1φ2W	1
11B	0 to 300	0 to 10	2K	1φ2W	1
12B	0 to 600	0 to 10	4K	1φ2W	1
19B	0 to 150	0 to 20	2K	1φ2W	1
20B	0 to 300	0 to 20	4K	1φ2W	1
21B	0 to 600	0 to 20	8K	1φ2W	1

3 PHASE 3 WIRE 60 Hz MODELS

4B	0 to 150	0 to 6.25	1K	3φ3W	2
5B	0 to 300	0 to 6.25	2K	3φ3W	2
6B	0 to 600	0 to 6.25	4K	3φ3W	2
13B	0 to 150	0 to 10	2K	3φ3W	2
14B	0 to 300	0 to 10	4K	3φ3W	2
15B	0 to 600	0 to 10	8K	3φ3W	2
22B	0 to 150	0 to 20	4K	3φ3W	2
23B	0 to 300	0 to 20	8K	3φ3W	2
24B	0 to 600	0 to 20	16K	3φ3W	2

3 PHASE 4 WIRE 60 Hz MODELS

7B	0 to 150	0 to 6.25	1.5K	3φ4W	3
8B	0 to 300	0 to 6.25	3K	3φ4W	3
16B	0 to 150	0 to 10	3K	3φ4W	3
17B	0 to 300	0 to 10	6K	3φ4W	3
25B	0 to 150	0 to 20	6K	3φ4W	3
26B	0 to 300	0 to 20	12K	3φ4W	3
7½B	0 to 150	0 to 6.25	1.5K	3φ4W	2½

NOTE: On 3 phase 4 wire models, phase to neutral voltage is specified.
Optional for 50 Hz operation add "X-127" to model number.

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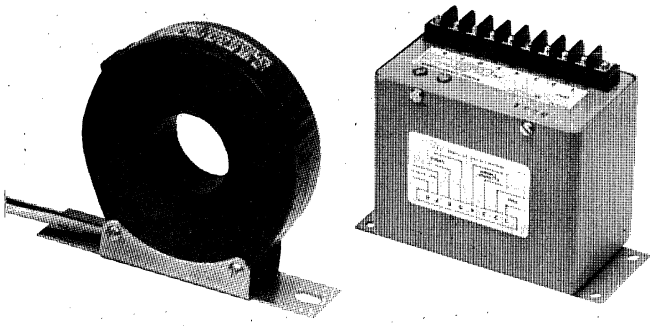
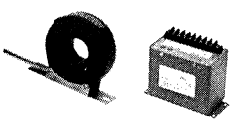
AC POWER FACTOR, AND WATT TRANSDUCER PC11 SERIES



FEATURES:

- True power and power factor measurements for distorted sine wave inputs
- Two separate output signals of 0 to 1 milliampere corresponding to watts and power factor
- Direct reading of power factor, not phase angle for sinusoidal waveforms or distorted waveforms
- Power factor computed by dividing real power by apparent power

SPECIFICATIONS:



INPUT:

Voltage: See Tables

Current: See Tables

Frequency Range: 50 to 70 Hz

Power Factor Range: Unity to Lead or Lag 0

Response: 100 microseconds to 90%

Burden: Voltage: 1.25 VA
Current: 1.5 VA

Current Overload:
2 times continuous
6 times for 10 Sec.

Dielectric Test: (Input/Output/Case) 1500 VAC

Instrument Power Required: 115 VAC ±10% 50/60 Hz

OUTPUT:

Watts: 1 mA at Rated Output

Power Factor: +1 mA at Unity PF, 0 mA at Lead or Lag 0

Response Time: 250 mSec.

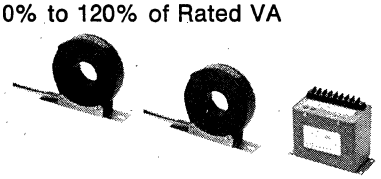
Output Loading: 0 to 10KΩ

Temperature Effects (−10°C to +60°C): ±1%

ACCURACY:

Watts: ±0.5% RO

Power Factor: From 10% to 120% of Rated VA
±0.01 PF



FOR DIMENSIONS REQUEST CATALOG #983

SINGLE PHASE 50/60 Hz

MODEL NO. PC11-	EFFECTIVE RANGE VOLTS	EFFECTIVE RANGE AMPS	WATTS AT RATED OUTPUT	EXTERNAL CURRENT SENSOR
1	0 to 150	0 to 5	500	Internal
2	0 to 300	0 to 5	1K	Internal
3	0 to 600	0 to 5	2K	Internal
10	0 to 150	0 to 10	1K	Internal
11	0 to 300	0 to 10	2K	Internal
12	0 to 600	0 to 10	4K	Internal
19	0 to 150	0 to 15	1.5K	Internal
20	0 to 300	0 to 15	3K	Internal
21	0 to 600	0 to 15	6K	Internal
103	0 to 150	0 to 1	100	Internal
104	0 to 300	0 to 1	200	Internal
105	0 to 600	0 to 1	500	Internal
106	0 to 150	0 to 2.5	250	Internal
107	0 to 300	0 to 2.5	500	Internal
108	0 to 600	0 to 2.5	1000	Internal
49	0 to 150	0 to 50	5K	W†
50	0 to 300	0 to 50	10K	W†
51	0 to 600	0 to 50	20K	W†
58	0 to 150	0 to 100	10K	W
59	0 to 300	0 to 100	20K	W
60	0 to 600	0 to 100	40K	W
67	0 to 150	0 to 200	20K	W
68	0 to 300	0 to 200	40K	W
69	0 to 600	0 to 200	80K	W
76	0 to 150	0 to 400	40K	X
77	0 to 300	0 to 400	80K	X
78	0 to 600	0 to 400	160K	X
85	0 to 150	0 to 600	60K	X
86	0 to 300	0 to 600	120K	X
87	0 to 600	0 to 600	240K	X
94	0 to 150	0 to 1K	100K	Y
95	0 to 300	0 to 1K	200K	Y
96	0 to 600	0 to 1K	400K	Y

3 PHASE 3 WIRE

4	0 to 150	0 to 5	1K	Internal
5	0 to 300	0 to 5	2K	Internal
6	0 to 600	0 to 5	4K	Internal
13	0 to 150	0 to 10	2K	Internal
14	0 to 300	0 to 10	4K	Internal
15	0 to 600	0 to 10	8K	Internal
22	0 to 150	0 to 15	3K	Internal
23	0 to 300	0 to 15	6K	Internal
24	0 to 600	0 to 15	12K	Internal
52	0 to 150	0 to 50	10K	W†
53	0 to 300	0 to 50	20K	W†
54	0 to 600	0 to 50	40K	W†
61	0 to 150	0 to 100	20K	W
62	0 to 300	0 to 100	40K	W
63	0 to 600	0 to 100	80K	W
70	0 to 150	0 to 200	40K	W
71	0 to 300	0 to 200	80K	W
72	0 to 600	0 to 200	160K	W
79	0 to 150	0 to 400	80K	X
80	0 to 300	0 to 400	160K	X
81	0 to 600	0 to 400	320K	X
88	0 to 150	0 to 600	120K	X
89	0 to 300	0 to 600	240K	X
90	0 to 600	0 to 600	480K	X
97	0 to 150	0 to 1K	200K	Y
98	0 to 300	0 to 1K	400K	Y
99	0 to 600	0 to 1K	800K	Y

NOTE: 50 Amps and above, 2 External Sensors supplied.
† Indicates 2 turns thru the external transformer window.
Power Factor is determined from the ratio of real power to apparent power, therefore leading or lagging power factor is not indicated.

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DC TO 400 Hz WATT TRANSDUCER PC8 SERIES

FEATURES AND APPLICATIONS:

- DC to 400 Hertz
- Ideal for variable frequency applications
- Accurate monitoring of power that contains DC, AC and non-sinusoidal waveforms
- Response less than 50 microseconds
- Ideal for use in SCR and other AC or DC switching circuits
- Output isolated from input

ORDERING INFORMATION:

The part numbers listed in the selection tables are incomplete. The voltage and current designation code must be added.

Part Number PC8- * — △

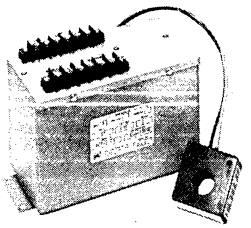
Example: PC8-3-01, which would be a PC8 transducer with 125VDC @ 100 amperes.

"*" Voltage Designation

CODE	FS VOLTS	RANGE
1	25	0 to 30
2	50	0 to 60
3	125	0 to 135
4	250	0 to 275
5	400	0 to 450
6	500	0 to 550
7	600	0 to 650

"△" Current Designation

CODE	FS CURRENT	RANGE
01	100	0 to 100
02	200	0 to 200
03	300	0 to 300
04	400	0 to 400
05	600	0 to 600
06	1000	0 to 1000
07	2000	0 to 2000



SPECIFICATIONS:

INPUT:

Voltage: Check code designation for FS voltage ranges from 25 to 600 volts (peak AC or DC)
Burden: >1 megohm
Current: Check code designation (specify FS range from 100 ampere to 2000 ampere, lower range uses 100 ampere transducer with ampere turns)
DC Insertion Loss: None
Overrange Without Damage: 10 times rating
Frequency Range: DC to 400 Hz
Response Time: <50 microseconds

OUTPUT:

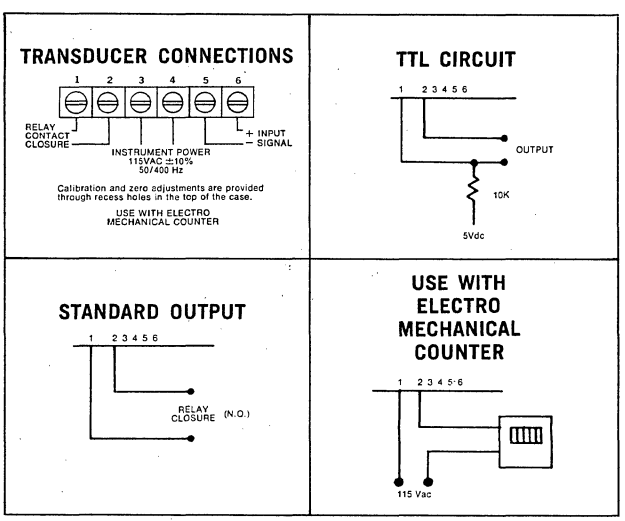
Full Scale Output: 1 mA DC (0 to 10K ohm)
Response: 250 milliseconds
Ripple: <1% Full Scale at 60 Hz
Accuracy: (FS Voltage X FS Current) ±1.0% FS
Temperature Effect: (0 to 40°C) ±0.1% of FS ±1% of Reading
Isolation: Input/Output/Case 1000 VDC
Instrument Power: 115 VAC ±10% 50/400 Hz

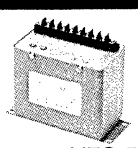
FOR DIMENSIONS REQUEST CATALOG #983

PRECISION INTEGRATOR VFC SERIES ANALOG TO PULSE CONVERTER

FEATURES:

- Output is a switch closure for activating external circuits
- Switch closure can be directly related to a specific integrated quantity
- Output can be preset at the factory





SPECIFICATIONS:
(common to all)

INPUT:

Impedance: >1 megohm except VFC-50, 100 ohms
Usable Range: Up to 1.25 x FS
Frequency: DC with up to 100% ripple at 120 Hz or higher

OUTPUTS:

Linearity: ±0.1% FS
Accuracy: ±0.25% FS
Relay: Normally open, SPST
Relay Contact Rating: 10 VA Max., 120V Max., 0.5A Max.
Relay Closed Period: 100 milliseconds, typ.
Temperature Effect: (−10°C to +60°C) ±0.5%
Instrument Power: 115 VAC ±10%, 50/400 Hz
Isolation (Input/Output/Case): 1000 Volts DC

MODEL	INPUT	OUTPUT RELAY CLOSURE RATE*
VFC-10	0 to +50 mV	0 to 10,000 per hour
VFC-20	0 to +100 mV	0 to 10,000 per hour
VFC-30	0 to +150 mV	0 to 10,000 per hour
VFC-50	0 to +1 mA	0 to 10,000 per hour
VFC-60	0 to +10V	0 to 10,000 per hour

* NOTE: Option 1 — Output closure rate can be set between 1K and 12K counts per hour at no charge.

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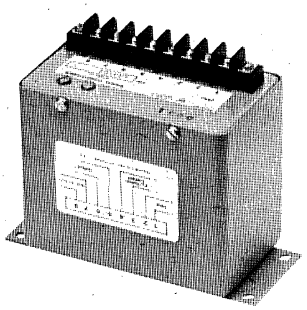
DC & RMS SIGNAL CONDITIONERS CTA SERIES



FEATURES AND APPLICATIONS:

- Designed for use with OSI current transducers
- Suitable for monitoring or control purposes
- CTA113 through CTA215E provide an output directly proportional to the true RMS value
- Calibration and zero adjustments provided

SPECIFICATIONS:

AMPLIFIER:

Linearity: 0.1% RO
Frequency Range: DC to 5 KHz
Output Response: to 90% 40 μsec.
(RMS Models) 200 msec.
Ripple: <.25% RO
Crest Factor: 3 within rating
7 within 1%
Short Circuit Protected: Yes
Isolation: Input/Output isolated from case

EXCITATION CURRENT:

Regulation: Line/Load ±0.01%
Output Voltage at Full Load: 6 VDC

TEMPERATURE EFFECTS:

(0-70°C) ±0.005%/°C

INSTRUMENT POWER:

115 VAC ±10%, 5W, 50-400 Hz
24/28 VDC ±10%, 8W, DC
(Positive to Terminal 8)

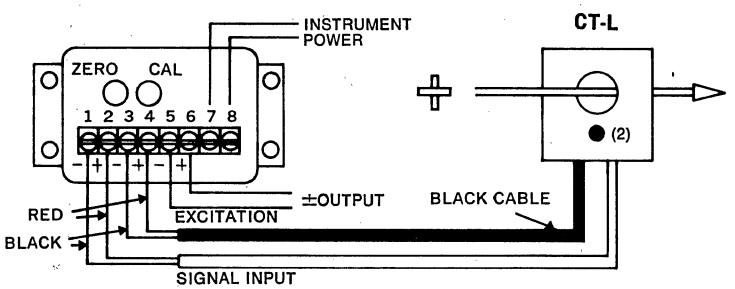
MODEL	RATED INPUT SIGNAL	RATED OUTPUT SIGNAL	EXCITATION CURRENT OUTPUT	CAL ADJUSTMENT		LOAD ON OUTPUT	INSTR. POWER
				AMPLIFIER GAIN	EXCITATION CURRENT		
CTA101	±50 mV	±10V	100 mA	Fixed	±30%	>2KΩ	115VAC
CTA201	±50 mV	±10V	200 mA	Fixed	±10%	>2KΩ	115VAC
CTA112	±50 mV	4-20 mA	100 mA	±20%	Fixed	0-500Ω	115VAC
CTA212	±50 mV	4-20 mA	200 mA	±20%	Fixed	0-500Ω	115VAC
CTA124	±50 mV	±10V	100 mA	Fixed	±30%	>2KΩ	24VDC‡
CTA224	±50 mV	±10V	200 mA	Fixed	±10%	>2KΩ	24VDC‡
CTA128	±50 mV	±10V	100 mA	Fixed	±30%	>2KΩ	28VDC‡
CTA228	±50 mV	±10V	200 mA	Fixed	±10%	>2KΩ	28VDC‡
CTA1173	±50 mV	±4 mA	200 mA	Fixed	±30%	0-2.5K	115VAC
RMS MODELS							
CTA113	50 mV RMS	+10VDC	100 mA	±20%	Fixed	>2KΩ	115VAC
CTA213	50 mV RMS	+10VDC	200 mA	±20%	Fixed	>2KΩ	115VAC
CTA114	50 mV RMS	+1 mA DC	100 mA	±20%	Fixed	0-10KΩ	115VAC
CTA214	50 mV RMS	+1 mA DC	200 mA	±20%	Fixed	0-10KΩ	115VAC
CTA115E	50 mV RMS	4-20 mA DC	100 mA	±20%	Fixed	0-500Ω	115VAC
CTA215E	50 mV RMS	4-20 mA DC	200 mA	±20%	Fixed	0-500Ω	115VAC

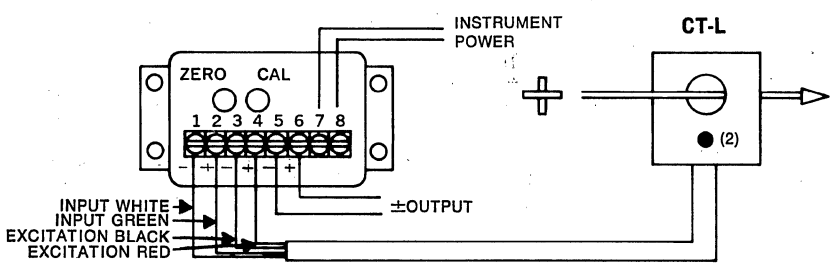
INPUT OPTIONS: (OPTION LETTER INDICATES A NON STANDARD INPUT)
Option (H) 75 mV Input
Option (P) 100 mV Input
Option (K) 150 mV Input

APPLICATION NOTES:

(1) When using an OSI current transducer, the output shield should be tied to terminal 3 on the signal conditioner.
(2) For a positive amplified output, connect the current transducer with the red polarity dot toward the most positive voltage terminal. See connections below.
(3) All RMS models provide a DC output proportional to the true RMS input.

CONNECTIONS





FOR DIMENSIONS REQUEST CATALOG #983

OHIO SEMITRONICS, INC. DEPT EM, 1205 CHESAPEAKE AVENUE, COLUMBUS, OHIO 43212
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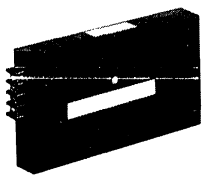
CURRENT TRANSDUCERS CT-L SERIES

DC TO 5 KILOHERTZ RESPONSE


CT1KHT

CT50LT

CT200LT

CT1KLTS SPLIT-CORE OPTION

FEATURES AND APPLICATIONS:

- 5000 Volt line-to-output isolation
- DC to 5 kilohertz response
- Bi-directional operation
- Linearity 0.5%, 50 to 2000 Amp
- ±1% operation over temperature range
- Less than 50 microsecond response time for 50 to 2000 Ampere units
- Sustained overload capability to 50 times rating
- Stable during severe vibration
- Easy installation
- Split-core models available
- Suited for variable frequency AC systems with DC components or chopped wave
- Replace shunts
- No insertion loss

SPECIFICATIONS FOR STANDARD MODELS

MODEL	ENCLOSED CURRENT AMPS	EXCITATION CURRENT mA (NOM.)	OUTPUT mV (TYP.)	LINEARITY % FS	TEMPERATURE EFFECT ON OUTPUT	TEMPERATURE RANGE °C	RESISTANCE TYP. IN Ω	RESISTANCE TYP. OUT Ω
CT50L	50 RMS	100	30	0.5	−0.15%°/C	−40 +65	4	3
CT50LTT	50 RMS	100	20	0.5	±1%	0 +40	4	25
CT50LT	50 RMS	100	20	0.5	±1%	−40 +65	4	25
CT100L	100 RMS	100	50	0.5	−0.15%°/C	−40 +65	4	3
CT100LTT	100 RMS	100	50	0.5	±1%	0 +40	4	25
CT100LT	100 RMS	100	50	0.5	±1%	−40 +65	4	25
CT200L	200 RMS	100	75	0.5	−0.15%°/C	−40 +65	4	3
CT200LTT	200 RMS	100	50	0.5	±1%	0 +40	4	25
CT200LT	200 RMS	100	50	0.5	±1%	−40 +65	4	25
CT400L	400 RMS	100	50	0.5	−0.15%°/C	−40 +65	4	3
CT400LTT	400 RMS	100	50	0.5	±1%	0 +40	4	25
CT400LT	400 RMS	100	50	0.5	±1%	−40 +65	4	25
CT600L	600 RMS	100	75	0.5	−0.15%°/C	−40 +65	4	3
CT600LTT	600 RMS	100	50	0.5	±1%	0 +40	4	25
CT600LT	600 RMS	100	50	0.5	±1%	−40 +65	4	25
CT1KL	1000 RMS	200	75	0.5	−0.15%°/C	−40 +65	25	6
CT1KLTT	1000 RMS	200	50	0.5	±1%	0 +40	25	25
CT1KLT	1000 RMS	200	50	0.5	±1%	−40 +65	25	25
CT2KL	2000 RMS	200	150	0.5	−0.15%°/C	−40 +65	25	6
CT2KLTT	2000 RMS	200	100	0.5	±1%	0 +40	25	25
CT2KLT	2000 RMS	200	100	0.5	±1%	−40 +65	25	25
CT3KLT	3000 peak	300	100	0.5	±1%	−40 +65	25	25

TRANSDUCERS LISTED BELOW FOR BUSS BAR APPLICATIONS

CT4KLT	4000 peak	200	150	1.0	±1%	−40 +65	25	25
CT5KLT	5000 peak	200	150	1.0	±1%	−40 +65	25	25
CT8KLT	8000 peak	200	75	1.0	±1%	−40 +65	12	25
CT1KHT	1KA peak	100	75	1.0	±1%	−40 +65	25	25
CT1.2KHT	1.2KA peak	100	75	1.0	±1%	−40 +65	25	25
CT2KHT	2KA peak	100	100	1.0	±1%	−40 +65	25	25
CT2.2KHT	2.2KA peak	100	100	1.0	±1%	−40 +65	25	25
CT3KHT	3KA peak	100	100	1.0	±1%	−40 +65	25	25
CT4KHT	4KA peak	100	100	1.0	±1%	−40 +65	25	25
CT5KHT	5KA peak	100	75	1.0	±1%	−40 +65	25	25

NOTES: The split core option is available on all Models except the 50 Ampere size. To order, add the letter "S" to the Model Number.
The electrical isolation (line to output) is at least 5000 volts for all Models, except the 50 Ampere size which is rated at 600 volts.

FOR DIMENSIONS REQUEST CATALOG #938

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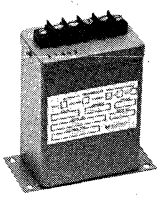
AC VOLTAGE AND CURRENT TRANSDUCERS VT SERIES CT SERIES

FEATURES AND APPLICATIONS:

- Inexpensive
- Accurate
- Self powered
- Wide frequency range
- Isolated Output
- Reliable



VOLTAGE TRANSDUCERS

MODEL	VOLTAGE (VAC) RANGE	OUTPUT CAL
VT120	0 to 150	1 mA @ 150V
VT240	0 to 300	1 mA @ 300V
VT480*	0 to 575	1 mA @575V

* Includes OSI 226-145 Potential Transformer

SPECIFICATIONS (common to all):

Accuracy (Calibration, linearity @ 25°C): ±0.5% FS

Frequency Range: 50 to 500 Hz

Response Time: 400 msec.

Temperature Effect (from calibrated value):
−20°C to +60°C ±1% of Reading

Ripple: <1% FS

Full Scale Output: 1 mA DC

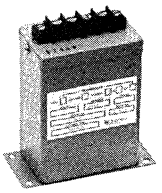
Output Loading: 0-10K ohms

Overload (Continuous):
Voltage: Full Scale Rating
Current: 2X Rating except CT10-1 & CT20-1,
1.25 Rating — 1 Second Transients, 50 X Rated Input

Burden:
Voltage: 2.8 VA FS
Current: 1 VA FS

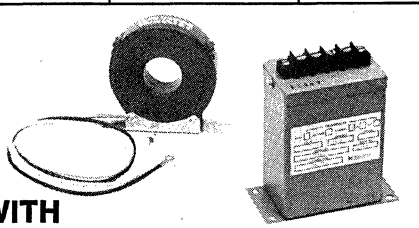
Operating Range (Extended):
Voltage: Full Scale
Current: 1.2 X Rating

Dielectric Test (Input/Output/Case): VT and CT
1500 VA



CURRENT TRANSDUCERS DIRECT CONNECTED

MODEL	CURRENT (AMPS AC) RANGE	OUTPUT CAL	CURRENT SENSOR DRAWING
CT1-1	0 to 1	1 mA @ 1A	Internal
CT5-1	0 to 5	1 mA @ 5A	Internal
CT10-1	0 to 10	1 mA @ 10A	Internal
CT20-1	0 to 20	1 mA @ 20A	Internal

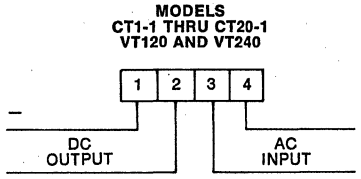


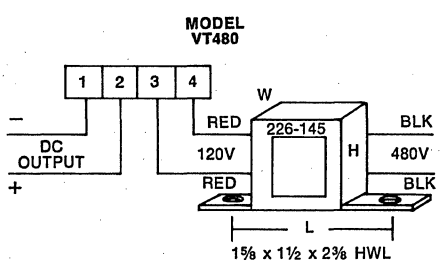
SUPPLIED WITH CURRENT TRANSFORMER

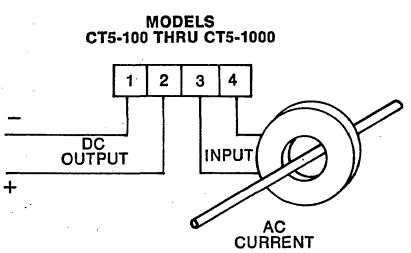
CT5-100	0 to 100	1 mA @ 100A	W
CT5-200	0 to 200	1 mA @ 200A	W
CT5-300	0 to 300	1 mA @ 300A	W
CT5-400	0 to 400	1 mA @ 400A	X
CT5-600	0 to 600	1 mA @ 600A	X
CT5-1000	0 to 1000	1 mA @1000A	Y

FOR DIMENSIONS REQUEST CATALOG #980

VOLTAGE AND CURRENT TRANSDUCER CONNECTIONS







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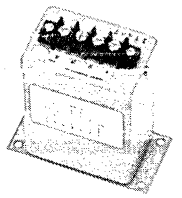
AC VOLTAGE AND CURRENT TRANSDUCERS CT-E SERIES VT-E SERIES

FEATURES AND APPLICATIONS:

- 4 to 20 milliampere output proportional to 0 to full scale
- Inexpensive
- Reliable
- Accurate
- Wide frequency range
- Isolated output



VOLTAGE TRANSDUCERS

MODEL	VOLTAGE (VAC) RANGE	OUTPUT CAL
VT120E	0 to 150	20 mA @ 150V
VT240E	0 to 300	20 mA @ 300V
VT480E*	0 to 575	20 mA @ 575V

* Includes OSI 226-145 Potential Transformer

SPECIFICATIONS (common to all):

Accuracy (Calibration, linearity @ 25°C): ±0.5% FS

Frequency Range: 50 to 500 Hz

Response Time: 400 msec.

Temperature Effect (from calibrated value):
−20°C to +60°C ±1% of Reading

Ripple: <1% FS

Zero: 4 mA DC

Full Scale Output: 20 mA DC

Output Loading: 0-1500 ohms

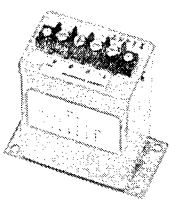
Overload (Continuous):
Voltage: Full Scale Rating
Current: 2X Rating except CT10-1E & CT20-1E,
1.25 Rating — 1 Second Transients, 50 X Rated Input

Burden:
Voltage: 2.8 VA FS
Current: 1 VA FS

Operating Range (Extended):
Voltage: Full Scale
Current: 1.2 X Rating

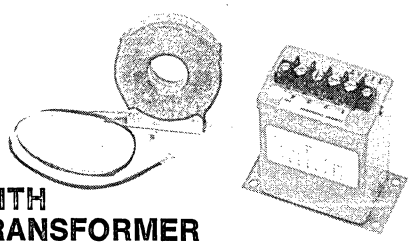
Dielectric Test (Input/Output/Case): VT and CT
1500 VA

Instrument Power: 115 VAC ±10% 50 to 60 Hz



CURRENT TRANSDUCERS DIRECT CONNECTED

MODEL	CURRENT (AMPS AC) RANGE	OUTPUT CAL	CURRENT SENSOR DRAWING
CT1-1E	0 to 1	20 mA @ 1A	Internal
CT5-1E	0 to 5	20 mA @ 5A	Internal
CT10-1E	0 to 10	20 mA @ 10A	Internal
CT20-1E	0 to 20	20 mA @ 20A	Internal



SUPPLIED WITH CURRENT TRANSFORMER

CT5-100E	0 to 100	20 mA @ 100A	W
CT5-200E	0 to 200	20 mA @ 200A	W
CT5-300E	0 to 300	20 mA @ 300A	W
CT5-400E	0 to 400	20 mA @ 400A	X
CT5-600E	0 to 600	20 mA @ 600A	X
CT5-1000E	0 to 1000	20 mA @ 1000A	Y

FOR DIMENSIONS REQUEST CATALOG #980

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RMS VOLTAGE & CURRENT TRANSDUCERS CT-R SERIES VT-R & CT-RT SERIES

FEATURES AND APPLICATIONS:

- Accuracy 0.25%
- Output directly proportional to the RMS value
- Can be overranged 20% with accuracy
- Current Transducers: 20 to 2000 Hertz range
- Voltage Transducers: 50 to 400 Hertz range
- CT1R and CT1RV, DC to 2 KHz

SPECIFICATIONS:

Accuracy and Linearity: ±0.25% at calibration frequency. Specify if other than 60 Hz

Accuracy & Linearity: ±0.5% 48 to 420 Hz

Frequency Range:
Voltage: 48 to 420 Hz
Current: DC, 20 to 2 KHz

Inputs:
Voltage: See Tables
Current: See Tables

Overload:
Voltage: See Table
Current: (Transient) 50A for 10 Sec. Per Hour, 250 A for 1 Sec. Per Hour, excluding CT1R and CT1RV

Input Signal Burden:
Voltage: 0.12 VA FS
Current: 0.28 VA FS

Dielectric Test (Input/Output/Case):
Voltage: 1500 VAC RMS

Output Response: 200 milliseconds to 90%

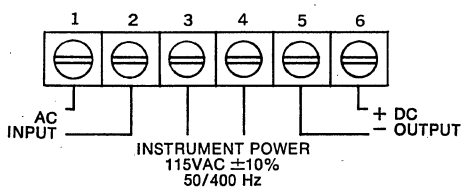
Ripple: <1% FS

Output Short Circuit Protected

Temperature Effect: ±0.5% (−10°C to +60°C)

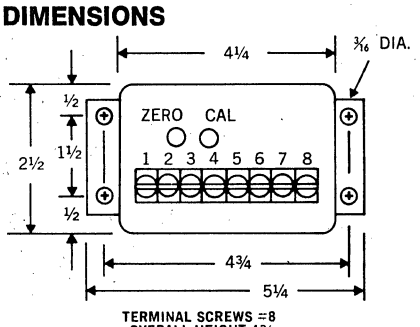
External Power: 115 VAC ±10%, 50 to 400 Hz

VOLTAGE AND CURRENT TRANSDUCER CONNECTIONS

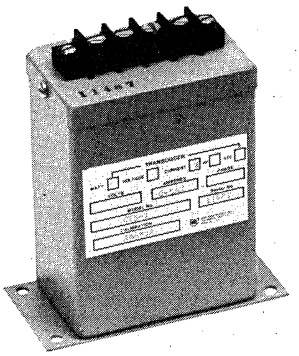


Calibration and zero adjustments are provided through recess holes in the top of the case.

CASE DIMENSIONS



TERMINAL SCREWS =8
OVERALL HEIGHT 4⅜



MODEL	INPUT SIGNAL	CALIBRATION OUTPUT	LOAD OHMS
VT1R	0 to 150V	1 mA DC @ 120V	0-10K
VT2R	0 to 300V	1 mA DC @ 240V	0-10K
VT4R	0 to 600V	1 mA DC @ 480V	0-10K
VT1RV	0 to 150V	10 VDC @ 120V	>2K
VT2RV	0 to 300V	10 VDC @ 240V	>2K
VT4RV	0 to 600V	10 VDC @480V	>2K
ISOLATED 0.25% ACCURACY			
CT1TR	0 to 1A	1 mA DC @ 1A	0-10K
CT1TRV	0 to 1A	10 VDC @ 1A	>2K
CT5TR	0 to 5A	1 mA DC @ 5A	0-10K
CT5TRV	0 to 5A	10 VDC @ 5A	>2K
CT10TR	0 to 10A	1 mA DC @ 10A	0-10K
CT10TRV	0 to 10A	10 VDC @ 10A	>2K
CT15TR	0 to 15A	1 mA DC @ 15A	0-10K
CT15TRV	0 to 15A	10 VDC @ 15A	>2K
CT20TR	0 to 20A	1 mA DC @ 20A	0-10K
CT20TRV	0 to 20A	10 VDC @ 20A	>2K
CT1R	0-5A	1 mA DC @ 5A	0-10K
CT1RV	0-5A	10 VDC @ 5A	>2K

* NOTE:

(1) CTR Series output is NOT isolated from input. Use instrumentation which is isolated from source. Caution is advised when making connections.

(2) All models have been calibrated at the factory to give the correct output at the specified input rating. The "CAL" adjustment is set at the factory and should not be adjusted unless recalibration is required. The "ZERO" adjustment is provided to correct for an output offset "at zero input conditions," without affecting the calibration of the unit.

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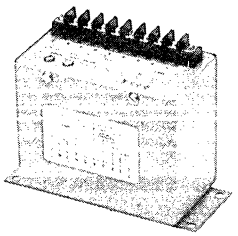
DC & RMS VOLTAGE TRANSDUCERS VT7 & VT8 SERIES



FEATURES AND APPLICATIONS:

VT7 SERIES:

- DC to 5 KHz Frequency Response
- Provides an output isolated signal proportional to DC input voltage
- 50 or 100 millivolt shunt model available
- 1500 V isolation input to output

ORDERING INFORMATION:

Add the "Code Designation" to the Model Number below for the Type, Rated Voltage, and Rated Output desired.

Example: VT7-01B: DC Input of 0 to 50 MVs and output 0 to 1 mA.

MODEL NO. VT * — O X

*CODE	TYPE
7	DC, Input
8	AC, AC/DC Input

O CODE	RATED VOLTAGE
(1) 01	50 mV
(1) 02	100 mV
1	12V
2	25V
3	50V
4	100V
5	150V
6	200V
7	300V
8	400V
9	500V
10	600V
11	700V
12	800V
13	900V
14	1000V

External multiplier resistance box is supplied.

X CODE	RATED OUTPUT SIGNAL
B	1 mA
D	10 Volts
E	4-20 mA

NOTES:
(1) 50 or 100 millivolt model is available in the VT7 Series only.
(2) Models with the rated input voltage above 600 volts require an external multiplier resistance box, which will be supplied with the unit.

FOR DIMENSIONS REQUEST CATALOG #980

FEATURES AND APPLICATIONS:

VT8 SERIES:

- DC to 5 KHz frequency response
- Output signal proportional to RMS value of AC, or AC/DC
- 1500 Volt isolation between the input and output

SPECIFICATIONS:

INPUT:

Voltage: (Check code designation for rated input)

Overvoltage: 2 times rated input or 1500V whichever is smaller

Burden: >100K ohm

Frequency Range: DC to 5 KHz

Response Time (99%): 50 μsec.

Isolation (Input/Output/Case/Instrument Power): 1500 VAC

Instrument Power Required: 115 VAC ±10%, 50-400 Hz

OUTPUT: (Short Circuit Protected)

Output Signal:
For VT7: 0 to ± mA, 0 to ±10 volts or a 4 to 20 mA signal which is directly proportional to the rated DC input voltage

For VT8: 0 to +1 mA, 0 to +10 volts or 4 to 20 mA DC signal which is directly proportional to the rated RMS input voltage

Response Time:
VT7 Models: 50 microseconds
VT8 Models: 200 milliseconds

Load on Output:
1 mA, 0 to 10K ohms
10 Volts, >2K ohms
4-20 mA, 0 to 500 ohms

Temperature Effects on Output (−10°C to +60°C): ±1%

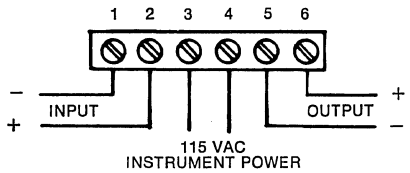
ACCURACY:

±0.5% RO
(including set point, linearity and repeatability)

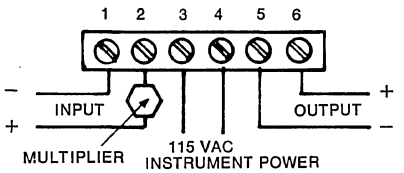
Calibration: Each unit is calibrated at the factory for Rated Output Signal is equal to the Rated Input Voltage

CONNECTIONS

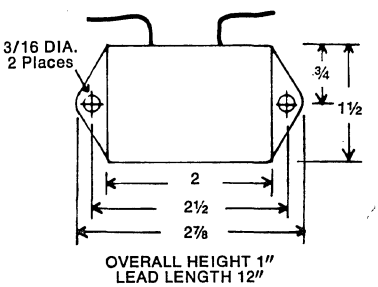
STANDARD MODELS



MODELS REQUIRING MULTIPLIER



MULTIPLIER BOX



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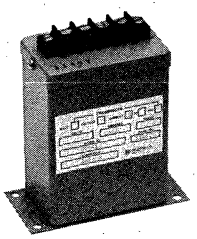
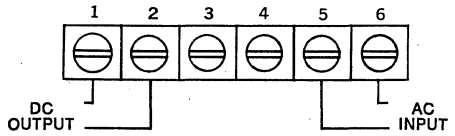
FREQUENCY TRANSDUCERS FT50, FT60 & FT400 SERIES



FEATURES AND APPLICATIONS:

- Analog output proportional to narrow frequency range
- Voltage or current output models available
- 50, 60, or 400 Hertz models available
- Rugged for industrial use
- Terminal block connections

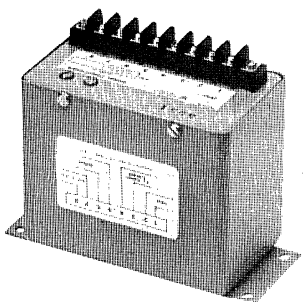
TRANSDUCER CONNECTIONS



SPECIFICATIONS:

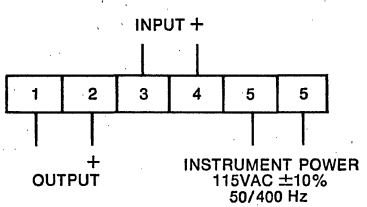
	FT50	FT60	FT400
Input Voltage	95-135V	95-135V	95-135V
Over Voltage	150V	150V	150V
Frequency Range	45-55 Hz	55-65 Hz	375-425 Hz
Output	0-1 mA	0-1 mA	0-1 mA
Load on Output	0-10KΩ	0-10KΩ	0-10KΩ
Accuracy	±0.1 Hz	±0.1 Hz	±0.2 Hz
Temperature Range	−20°C +60°C	−20°C +60°C	−20°C +60°C
Temperature Effect	.005% / °C	±.005% / °C	±.005% / °C
Response Time	400 mSec.	400 mSec.	400 mSec.
Burden	4 VA	4 VA	4 VA

PRECISION CURRENT CONVERTER SC-E SERIES



FEATURES AND APPLICATIONS:

- Provides 4 to 20 mA process control signal
- Excellent accuracy ±0.1% FS
- Models available for most common analog inputs
- Rugged for industrial application
- Terminal block connections



SPECIFICATIONS: (common to all):

INPUT:

Range: See Table
Overload (without damage): 10 times input
Isolation: (input is not isolated from output)
Load Impedance: 0 to 1500 ohms

OUTPUT:

Range: 4 to 20 mA DC
Load Impedance: 0 to 1500 ohms
Response Time 99%: 100 μSec.
Ripple: >1% FS
Accuracy and Linearity: ±0.1% FS
Calibration:
Rated input signal = 20 mA DC
Zero input signal = 4 mA DC
Temperature Effect: −20°C to +65°C, ±1%
Instrument Power: 115 VAC ±10%, 50-400 Hz
Adjustments:
"Zero" adjust for 4 mA offset
"Cal" adjust for 20 mA full scale

MODEL	INPUT SIGNAL	BURDEN ON INPUT
SC-E	0-1 mA DC	1KΩ
SC-E100	0-10VDC	10KΩ
SC-E.5	0-50 mV DC	>100KΩ
SC-E1.0	0-100 mV DC	>100KΩ
SC-E1.5	0-150 mV DC	>100KΩ

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HALL EFFECT SENSORS HR & HP SERIES

HALLTRON, MAGNETIC FIELD SENSORS

FEATURES AND APPLICATIONS:

- For magnetic sensing
- Measuring applications
- High linearity
- Excellent stability
- Rugged and reliable
- Low noise

MODEL NO.	HALL OUTPUT V_H, MILLIVOLTS ±25% B = 10Kg, Ic = (NOMINAL)	NOMINAL CONTROL CURRENT Ic, mA	OHMIC RESIDUAL V_{RO}, MILLIVOLTS (B=0 Ic - 10 mA)	OHMIC RESIDUAL V_{RO}, MILLIVOLTS (B=0 Ic - 100 mA)	INPUT RESISTANCE R/in, OHMS (NOMINAL)	OUTPUT RESISTANCE R/out, OHMS (NOMINAL)	DIMENSIONS L/W/T INCHES (NOMINAL)	LEAD INSULATION	TEMPERATURE COEFFICIENT OF VH IN %/°C (AVG.)
HP316*	100	100	—	0.5	2	1	.125 dia. .250 L	PVC	−0.2
HP318*	250	100	—	0.5	5	4	.250 dia. .5 L	Teflon	−0.2
HP325	200	25	0.5	—	15	10	.187 0.75 .020	Enamel	−0.25
HP330	150	25	0.5	—	15	7.5	.040 .040 .012	Enamel	−0.25
HP340	100	25	0.2	—	3	2	.250 .125 .020	Enamel	−0.2
HP374	200	25	0.5	—	15	10	.300 .150 .030	PVC	−0.25
HR36	350	350	—	0.15	1.5	1.5	.500 .375 .028	PVC	−0.1
HR38	200	25	0.2	—	8	8	.500 .375 .028	PVC	−0.25
HR66	500	200	—	0.5	5	4	.200 .250 .028	Enamel	−0.15
HR67	200	25	0.2	—	9	5	.300 .150 .020	Teflon	−0.25
HR70	340	200	—	0.5	2	2	.200 .250 .028	PVC	−0.1
HR72	700	100	0.2	—	9	6	.200 .250 .028	Enamel	−0.25
HR77	550	100	—	1	10	10	.200 .250 .030	Enamel	−0.25
HR78	80	100	—	0.15	2	1.5	.100 .300 .020	Enamel	−0.10
HR88	400	300	—	4	2.5	2	.340 .375 .023	Enamel	−0.15
HR120	75	100	—	0.5	1.5	1.5	.200 .250 .030	Enamel	−0.05
HR125A	100	100	—	0.5	2.5	2.0	.200 .250 .028	Enamel	−0.05
HR170	10	100	—	0.03	0.7	0.6	.200 .250 .025	Enamel	−0.005
HS55	250	100	—	0.5	1.2	1	.500 .375 .025	PVC	—

* Denotes Axial Type Probes. All others are Transverse.

Operation Temperature Range: −65°C to +85°C

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

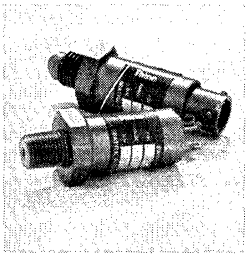
WPS word processing software

Y

YIG yttrium iron garnet

Paine® BONDED STRAIN GAGE PRESSURE TRANSDUCERS FOR INDUSTRY & AEROSPACE

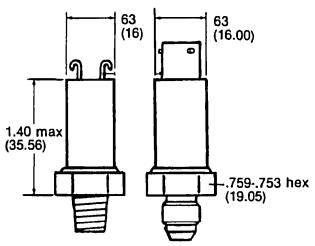
SERIES 210-30



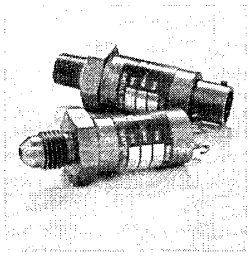
Series 210-30: 0-500 to 0-5000 PSIA and PSIS. When you need a rugged transducer for hydraulic systems with non-corrosive media applications see 210-35.

This series is ideally suited for the rigorous environments found in test stand work and wet industrial applications.

This series is available with either hooked terminals or electrical connectors.



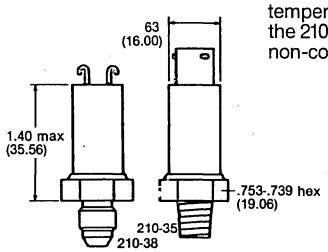
SERIES 210-35 AND 210-38



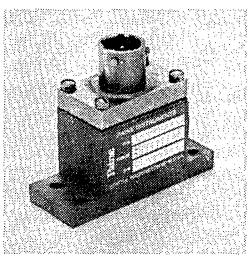
Series 210-35 and 210-38: 0-2000 through 1-10,000 PSI. A very rugged transducer for use in all industrial corrosive materials are present.

This series features all welded, all stainless steel construction to provide a high degree of compatibility and system integrity.

Both series are available with either MS Bayonet lock connectors or hooked terminals. The 210-35 is temperature compensated while the 210-38 is lower in cost and non-compensated.



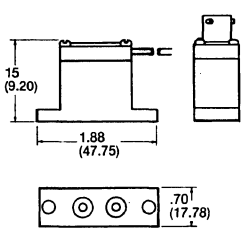
SERIES 210-60 AND 216-65



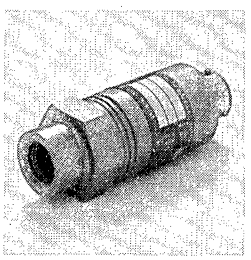
Series 210-60 and 210-65: ±500 to ±10,000 PSI. This is a full line differential pressure transducer designed for hydraulic systems. (Available in an all-welded, all-stainless steel version for corrosive media).

These transducers are unique because of their small size. The units have two separate sensing elements to measure the pressure at the input ports. Each sensor has two strain gage legs. These two sensors are connected to provide a fully balanced bridge. This sensing method provides an output directly proportional to the pressure difference at the two ports.

The series 210-60 is temperature compensated while the lower cost 210-65 is non-compensated. The 210-65 is particularly suited to rate derivation.



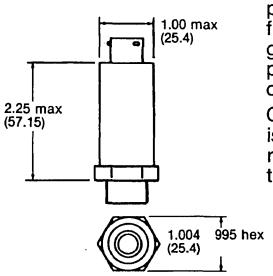
SERIES 212 ISOLATED



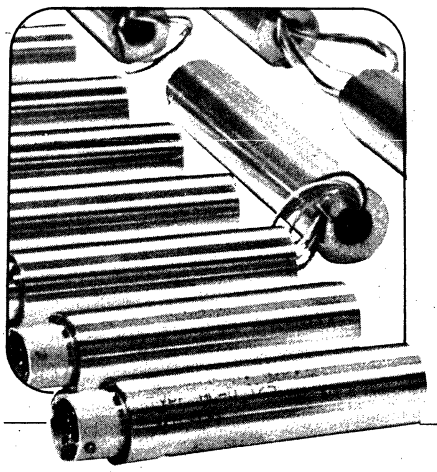
Series 212 Isolated: 0-10 through 0-10,000 PSI. When you need input to output isolation for system flexibility.

The Series 212 Isolated is a rugged, lightweight, all stainless steel, welded pressure transducer. It's tough enough to withstand harsh industrial environments. It's an easy transducer to install and features input/output isolation which decouples any interplay between power and signal, allowing flexibility in signal and power grounding connections. This also protects the transducer against output short circuits.

Output is 0 to 5 volts and the series is available in 18 different pressure ranges for incremental coverage of the full pressure spectrum.



Paine® **For more details, call toll free: 800/426-0366.**
Instruments, Inc. 2401 South Bayview St. Seattle, WA 98144



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The Name in Transducer Technology

Displacement Transducers

Series		Application	Linear Range, Inches
AC	HR	General Purpose	±0.050 to ±10.0
	MP	Hostile Environments, Ruggedized Housing	±0.050 to ±10.0
	MHR	Small Size	±0.005 to ±1.0
	HPA	Hostile Environments (Hermetically Sealed)	±0.050 to ±10.0
	HCA		±0.050 to ±10.0
	E	Low-Cost	±0.10 to ±10.0
DC	DC-D	Shock and Vibration	±0.050 to ±10.0
	HCD	Hostile Environments (Hermetically Sealed)	±0.050 to ±10.0
	HPD		±0.050 to ±10.0
	HR-DC	Low-Cost	±0.050 to ±5.0

Linear Variable Differential Transformers

Schaevitz precision LVDTs incorporate many features not available in other transducer types. Features like frictionless measurement, infinite resolution, separated coil and core, state-of-the-art materials, infinite mechanical life, and extremely stable and repeatable null positions. As a result, they are well suited to a wide variety of applications including those in which high performance, low cost, long life, and adverse environments are of prime importance. Displacement ranges are from ±0.005 inch to ±25 inches. Typical linearities are ±0.25 percent of full range output.

Schaevitz AC operated LVDTs can be used with practically any type of LVDT signal-conditioning instrumentation and readout equipment. The operating temperature range of most standard AC LVDTs is −65° F to 300° F. Economy units operate from −65° F to 200° F.

DC LVDTs contain built in solid state circuitry. They accept DC inputs and produce DC outputs to operate meters, recorders, and control instrumentation. The operating temperature range of these units is −65° F to 200° F.

Displacement Transducers continued on next page.

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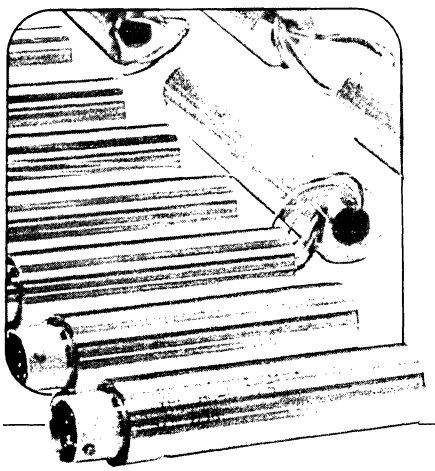

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The Name in Transducer Technology

Displacement Transducers

Series	Application	Linear Range, Inches
XS-A	Large Bore, Small Core	±0.250 to ±5.0
XS-B	Subminiature	±0.005 to ±0.250
XS-C	Pressure Sealed (to 4500 psi)	±0.050 to ±1.0
XS-D	Large Displacement, Limited Size	±1.0 to ±25.0
XS-Z	Cryogenic (to −450°F)	±0.10 to ±2.0
XS-ZT	High-Temperature (to 1100°F)	±0.10 to ±2.0
XS-ZTR	Radiation Resistant	±0.10 to ±2.0
PT	Proximity (Non-contact Measurement)	±0.005 to ±0.050 (inches gap)
VT-Z	Linear Velocity (Dynamic Measurement)	±0.5 to ±20.0 (inches travel)

Special LVDTs

Schaevitz displacement transducers are available from stock for hard-to-measure applications. Typical applications include high pressure operation, and measurements involving extreme thermal and radioactive environments. They are characterized by distinctive configurations and incorporate special materials to enhance the reliability under the conditions encountered.

Series	Application	Range, Degrees
R30A	AC Operation	40°
R36A	AC Operation	40°
R30D	DC Operation	40°

Rotary Variable Differential Transformers

A counterpart of the LVDT, the Schaevitz RVDT is an angular-position transducer designed to measure angular displacement up to ±60 degrees. The shafts of these RVDTs are supported on precision bearings and are capable of continuous rotation.

RVDTs typically have a linearity of ±0.50 percent of full range. The operating temperature range of AC units is −65° F to 300° F; of DC units, −65° F to 200° F.

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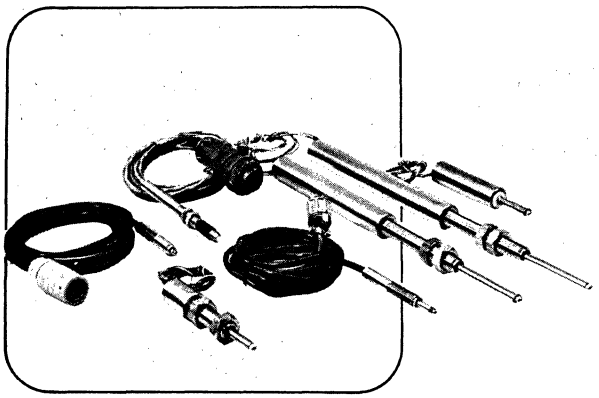

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The Name in Transducer Technology

Dimensional Gaging Transducers

Series		Application	Gaging Range, Inches
AC	PCA-100	Precision	±0.020 to ±1.0
AC	PCA-200	Ultra-Precision	±0.005 to ±0.1
AC	GPA/GCA	Precision (Hermetically Sealed LVDT)	±0.050 to ±1.0
DC	GPD/GCD	Precision (Hermetically Sealed LVDT)	±0.050 to ±1.0

Schaevitz gage heads permit measurements that are otherwise difficult and often impossible to obtain even with very precise mechanical measuring devices.

LVDT Gage Heads

The PCA-100 Series comprise low-cost precision gage heads designed for production-line and laboratory measurements as well as OEM applications. The units offer linearities of ±0.25 percent of full range and are capable of repeating measurements to 50 millionths of an inch. The series includes units designed for use in adverse environments and extra-short gage heads for applications in which space is limited.

The PCA-200 Series are ultra-precise gage heads with available linearities up to ±0.05 percent of full range and repeatabilities up to 4 millionths of an inch. The units are available with either spring-actuated or air-actuated plungers.

The G Series precision gage heads are designed for AC or DC operation with hermetically sealed LVDTs. Typically used in applications where low cost and ease of installation are paramount considerations, typical linearity is ±0.25 percent of full range and repeatability is 25 millionths of an inch.

Series		Gaging Range, Inches
PPA	Non-contact Measurement, Thickness Variations	±0.050 to ±1.0
PPD		±0.050 to ±1.0

Non-contacting LVDT Gage Heads

Schaevitz non-contacting gage heads accurately measure variations in thickness of metal, plastic, paper, film and other non-porous materials without marring or tearing. These units can measure thickness variations to ±1 inch and resolve changes in thickness down to 5 millionths on an inch.

All Schaevitz non-contacting gage heads can be furnished with special nozzles for unusual applications.

Series		Gaging Range, Inches
ABG	Superb Repeatability	±0.02

Air Bearing Gage Heads

The Schaevitz ABG Series gage heads combine an LVDT and air-bearing structure which provides virtually friction-free operation. Linearity is ±0.25 percent of full range, and repeatability is 2 millionths of an inch.

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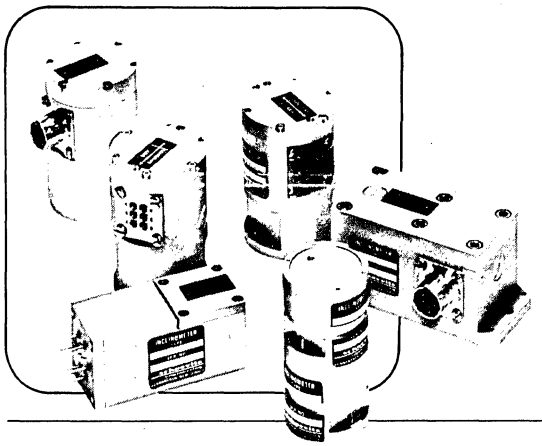

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The Name in Transducer Technology

Transducers to Measure Slope, Tilt, Angle

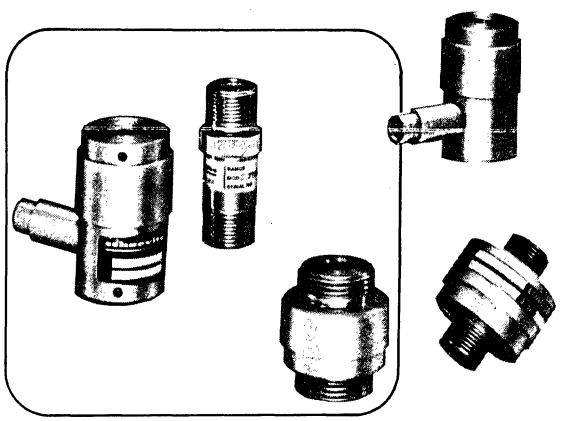
Model	Application	Measurement Range, Degrees
LSO	General Level or Angle Measurement	±1° to ±90°
LSV	Tilt Measurement (Horizontal Bore Holes)	±1° to ±90°
LSR	Tilt Measurement (Limited Spaces)	±1° to ±90°
LSF	X, Y Tilt Meter (Bore Holes)	±1° to ±90°

Inclinometers

Schaevitz inclinometers are extremely sensitive transducers that measure horizontal angle or vertical deviation with virtually infinite resolution. They are ideal for a variety of applications including setting the tilt of road grading and paving machines, leveling ships, barges, and pipelines, mapping bore holes, aligning boring equipment, and improving the accuracy of mechanical scales.

These self-contained DC-powered units respond to changes of slope as small as 0.000006 in./ft. and changes in angle as small as 0.1 second of arc. The operating temperature range is −65° F to 200° F.

A wide variety of options and external packages are available.



Weight and Force Transducers

FTA/FTD Series	Application	Measurement Range
U	General Purpose, Tension or Compression	100 to 1,000 lb.
G	Tension or Compression	10 to 10,000 gm
T	Tension	20 to 1,000 lb.

Force Transducers

Schaevitz FT Series force transducers (load cells) are compact, rugged units that permit accurate measurement of tensile or compressive forces ranging from 10 gm to 1,000 lb full scale. Various end adapters and load fittings are available. The operating temperature range for the FTA Series is −65° F to 200° F, and FTD Series is 25° F to 140° F.

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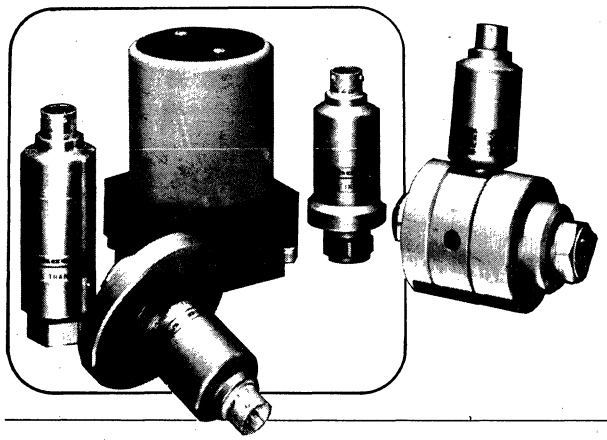

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The Name in Transducer Technology

Pressure Transducers

Series	Application	Full Scale Pressure, psi
P500	Low Pressure	1.5 to 5 psi
P700	High Accuracy	10 to 10,000 psi
P710	Highest Accuracy	10 to 10,000 psi
P720	General Industrial	10 to 10,000 psi
P740	High Level Output	10 to 10,000 psi
P750	Unregulated 12VDC Input	10 to 10,000 psi
P760	Unregulated 24VDC Input	10 to 10,000 psi
PT780	2 Wire Current Output	10 to 10,000 psi
P790	±15VDC Input	10 to 10,000 psi
P1100	Unidirectional Differential Pressure	10 to 500 psid
P2000		1.5 to 5 psid
P2100	Differential Pressure	10 to 3500 psid
P2500	General Purpose	500 to 10,000 psi
P3000	General Purpose, Low Pressure (DC operated)	0- 5 to 0-200 inches of water 15-100 psi

Strain Gage Pressure Transducers

Schaevitz offers a complete line of diaphragm-type high reliability, high performance, strain-gage pressure transducers. These units feature welded stainless-steel construction and incorporate positive overload stops to protect the diaphragm from overpressure. They can be furnished to measure either gage or absolute pressure up to 10,000 psi. Units are also available to measure low differential pressure at high line pressure. The series includes pressure transmitters for process control applications.

LVDT Pressure Transducers

LVDT-type Schaevitz pressure transducers are designed to measure very low pressure of a variety of liquids and gases. They are available to measure either gage, absolute, or differential pressure down to 5 inches of water pressure.

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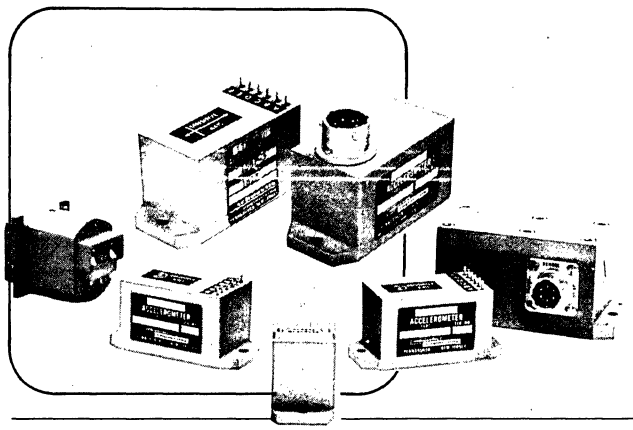

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The Name in Transducer Technology

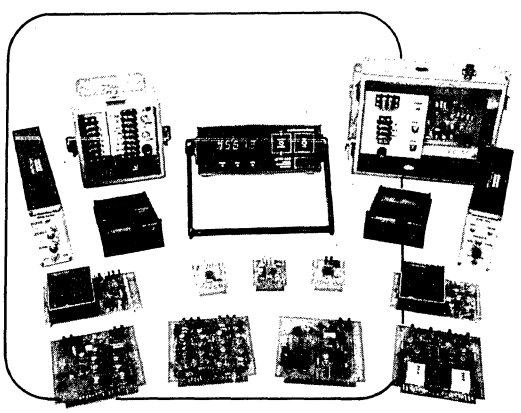
Transducers to Measure Acceleration

Series		Application	Measurement Range
Linear	LSB	General Purpose	0.25 to 50
	LSM	Miniaturized	0.25 to 50
	LSQ	Avionics	0.25 to 10 g
	LSX		0.25 to 50 g
Angular	ASB	General Purpose	50 to 1500 rad/sec^2
	ASM	Miniaturized	50 to 1500 rad/sec^2

Linear and Angular Accelerometers

Schaevitz servo accelerometers are closed-loop force-balance transducers that combine rugged acceleration sensors with solid state circuitry in a wide variety of configurations. These devices satisfy the requirements of applications involving acceleration measurement, inertial guidance, aircraft control and stabilization, railroad vibration analysis, and other commercial applications.

Models are available to measure linear acceleration in ranges from ±0.25 g to ±50 g, with linearities of 0.05 percent of full scale. Often models measure angular acceleration in ranges from ±50 rad/sec^2 to ±1500 rad/sec^2 with linearities of 0.1 percent of full scale.



Signal Conditioning and Readout Devices

Schaevitz produces a broad line of complementary signal conditioners and readouts for use with LVDTs, RVDTs, and strain gage transducers. This line includes modular signal conditioners for OEM users, bench or rack-mounted signal conditioners for laboratory or industrial users, complete digital transducer readouts for high accuracy and readability, and custom-designed signal conditioning systems based on a family of proprietary plug-in card modules.

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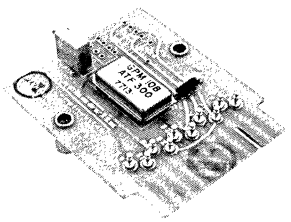
The Name in Transducer Technology

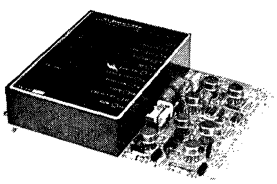
Signal Conditioning and Readout Devices



OEM Modules

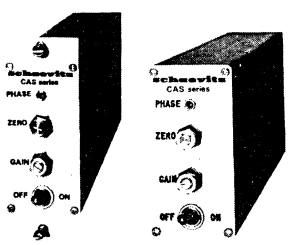
Basic DC Modules

The SMS/GPM modules are very basic LVDT signal conditioners powered from ±15VDC. They utilize the same hybrid microcircuit as the Schaevitz DC-LVDTs and can produce a ±10VDC output. The modules are supplied with a pc board mounted gain control and has provisions for a board-mounted zero control.



Line Powered Modules

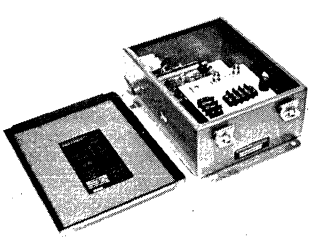
The LPM-210 modules are economical signal conditioners designed primarily for OEM applications. Operating from conventional power lines, they supply excitation to an LVDT, and then amplify its output. Gain and zero controls are usually supplied by the user. Standard full-scale output is ±10VDC, but a 4-20 mA current output version is available. Also available is a LPM-700 module to power strain gage transducers.



Signal Conditioners

CAS Types

CAS signal conditioners are premium performance carrier amplifier-type instruments for all types of laboratory and industrial applications. They feature high stability and high gain with low noise and low output ripple. This makes them particularly suitable for operation with low output LVDTs. The nominal full scale output of a CAS is ±10VDC. Models are available with either bench top or rack-mounting enclosures, but all models have front panel mounted gain, zero, and phase adjustments.



IEM/CAS Types

The IEM/CAS is a carrier amplifier type signal conditioner packaged in a NEMA-12 enclosure. It is especially designed for users in the process industries, featuring the stability and performance of the CAS series, but with a 4-20 mA current output.

Continued on next page.

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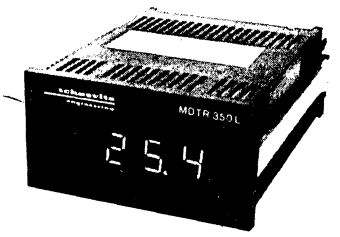
The Name in Transducer Technology

Signal Conditioning and Readout Devices

Self-Contained Digital Readouts

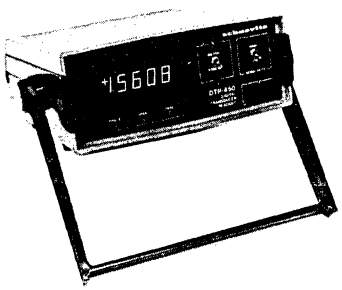
MDTR-350L

The MDTR-350L is a self-contained, line powered LVDT signal conditioner with a 3½ digit readout. Full scale display is ±1999, and the decimal point is changeable in the field. Gain and zero adjustments are provided, but no phase adjustment is necessary. The unit is designed for panel mounting in a standard DIN cut-out, and has parallel BCD output available at the rear connector. Also available is the MDTR-3505 for use with strain gage transducers.



DTR-450

The DTR-450 is a fully self contained, power line operated, high stability LVDT signal conditioner with a 4½ digit readout. Full scale display is ±19999. It is an extremely versatile instrument that features a front panel switch for 10 times range expansion and another to change the display from prescaled English units to prescaled metric units. The scaling for each set of units and the decimal point locations can be preset in the field. The DTR-450 is enclosed in an electrostatically shielded case with a handle that functions as a tilting stand. Other features include RFI shielded power input and simultaneous BCD output and 0-10VDC analog output.

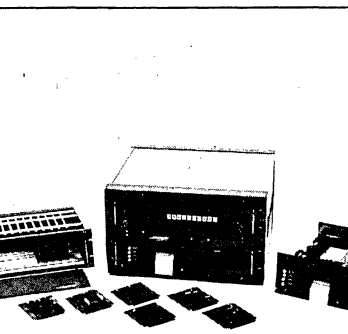


Modular Systems

PCB System

A PCB system is built around the concept of a single power supply and card cage combined with a family of versatile plug-in card modules for signal conditioning, signal processing, and control functions. The result is a cost-effective way to assemble a custom designed system of any number of channels. The system can be designed to display or record measurements made with transducers and can be used to control processes monitored by the transducers. Interface with a computer is even possible. Among the plug-in card functions available are:

- Carrier excitation
- Amplifier/demodulator
- High-low limit
- BCD (TTL logic).
- Sum/difference
- Auto-zero
- Peak signal-hold
- Multiplexer
- Operational amplifier
- Current output
- Programmable relay
- V/f or f/V



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74240 Gaillard, France
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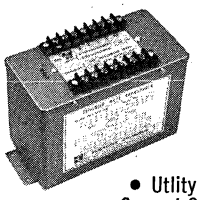
For Detailed Information, please call our EEM Hotline (609) 662-8008.

SCIENTIFIC COLUMBUS
AN ESTERLINE COMPANY

SCIENTIFIC COLUMBUS, INC.
1900 ARLINGATE LANE, COLUMBUS, OHIO 43228 TEL. (614) 274-7160 TELEX 245-426



DIGILOGIC WATT TRANSDUCERS DL-A2 SERIES

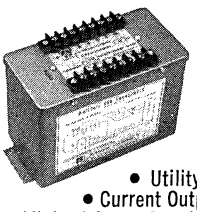
• Utlity Tested and Approved
• Current Output
• Long Term Stability
• Measure Forward or Reverse Power Flow
Accuracy ±0.1% of Reading

SPECIFICATIONS

Potential Input Range*: 0-150V. **Current Input Range:** 0-10A. **Watt Input Range:** See table below (Effective Range). **Frequency Input:** 58-62 Hz. **Power Factor:** Any. **Load Resistance, R_L:** 0-10 Kilohms 11 Volt Compliance. **Ambient Temp.:** 25 ±5°C. **Auxiliary Power:** 85 to 135V. **Temperature:** ±0.005%/°C from −20°C to +70°C.

* Signal range when used for auxiliary power is 120V nominal limited to 85 to 135V maximum.

Model	Element	Voltage	Load	Conection	Cal. Watts	Effective Range
DL5C5A2	1	—	—	Single Phase	500	0-1000 Watts
DL5C51½A2	1½	Balanced	Balanced	3 Phase 3 Wire	1000	0-2000 Watts
DL31K5A2	2	Unrestricted	Unrestricted	3 Phase 3 Wire	1000	0-2000 Watts
DL31K52½A2	2½	Balanced	Unrestricted	3 Phase 4 Wire	1500	0-3000 Watts
DL342K5A2	3	Unrestricted	Unrestricted	3 Phase 4 Wire	1500	0-3000 Watts



DIGILOGIC VAR TRANSDUCERS DLV-A2 SERIES

• Utility Tested and Approved
• Current Output • Long Term Stability
• Minimal Space Requirements • Measure Forward or Reverse Reactive Power Flow
Accuracy ±0.15 of Reading

SPECIFICATIONS

Potential Input Range*: 0-150V. **Current Input Range:** 0-10A. **VAR Input Range:** See table below (Effective Range). **Frequency Input:** 60 Hz. **Power Factor:** Any. **Load Resistance, R_L:** 0-10 Kilohms, 11 Volt Compliance. **Ambient Temp.:** 25 ±5°C. **Auxiliary Power:** 85 to 135V. **Temperature:** ±0.005%/°C from 0-50°C.

* Signal range when used for auxiliary power is 120V nominal limited to 80 to 135V maximum.

Model	Element	Voltage	Load	Connection	Cal. Vars	Effective Range
DLV5C5A2	1	—	—	Single Phase	500	0-1000 Vars
DLV5C51½A2	1½	Balanced	Balanced	3 Phase 3 Wire	1000	0-2000 Vars
DLV31K5A2	2	Unrestricted	Unrestricted	3 Phase 3 Wire	1000	0-2000 Vars
DLV31K52½A2	2½	Balanced	Unrestricted	3 Phase 4 Wire	1500	0-3000 Vars
DLV342K5A2	3	Unrestricted	Unrestricted	3 Phase 4 Wire	1500	0-3000 Vars

EXCELTRONIC™ WATT TRANSDUCERS XL-A2 SERIES

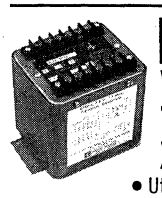
• Utility Tested and Approved
• Current Output • Zero Drift • Minimal Space Requirements • Measure Forward or Reverse Power Flow • Long Term Stability
Accuracy ±0.2% of Reading

SPECIFICATIONS

Potential Input Range*: 0-150V. **Current Input Range:** 0-10A. **Watt Input Range:** See table below (Effective Range). **Load Resistance, R_L:** 0-10 Kilohms. **Compliance:** 11.0 Volts Min. (See overrange note). **Output Ripple Peak:** <0.5% of RO. **Frequency Input:** 58-62 Hz. **Power Factor:** Any. **Temperature:** −20°C to +70°C.

Overrange: 500 to 1000 Watts/Element no additional errors within compliance rating. Reduce R_L as required.

Model	Element	Voltage	Load	Connection	Cal. Watts	Effective Range
XL5C5A2	1	—	—	Single Phase	500	0-1000 Watts
XL5C51½A2	1½	Balanced	Balanced	3 Phase 3 wire	1000	0-2000 Watts
XL31K5A2	2	Unrestricted	Unrestricted	3 Phase 3 wire	1000	0-2000 Watts
XL31K52½A2	2½	Balanced	Unrestricted	3 Phase 4 Wire	1500	0-3000 Watts
XL342K5A2	3	Unrestricted	Unrestricted	3 Phase 4 Wire	1500	0-3000 Watts



EXCELTRONIC™ VAR TRANSDUCERS XLV-A2 SERIES

• Utility Tested and Approved
• Current Output • Zero Drift, Long Term Stability • Minimal Space Requirements
• Measure Forward or Reverse Reactive Power Flow
Accuracy 0.2% of Reading

SPECIFICATIONS

Potential Input Range*: 0-150V. **Current Input Range:** 0-10A. **VAR Input Range:** See table below (Effective Range). **Load Resistance, R_L:** 0-10 Kilohm. **Compliance:** 11.0 Volts Min. (See overrange note). **Output Ripple Peak:** <0.5% of RO. **Frequency Input:** 60 Hz. **Power Factor:** Any. **Temperature:** −20°C to +60°C.

Overrange: 500 to 1000 Watts/Element no additional errors within compliance rating. Reduce R_L as required.

Model	Element	Voltage	Load	Connection	Cal. Vars	Effective Range
XLV5C5A2	1	—	—	Single Phase	500	0-1000 Vars
XLV5C51½A2	1½	Balanced	Balanced	3 Phase 3 Wire	1000	0-2000 Vars
XLV31K5A2	2	Unrestricted	Unrestricted	3 Phase 3 Wire	1000	0-2000 Vars
XLV31K52½A2	2½	Balanced	Unrestricted	3 Phase 4 Wire	1500	0-3000 Vars
XLV342K5A2	3	Unrestricted	Unrestricted	3 Phase 4 Wire	1500	0-3000 Vars

EXCELTRONIC™ WATT/VAR TRANSDUCERS packaged in one case XLWV-A2 SERIES

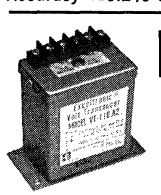
• Utility Tested and Approved • Current Outputs
• Zero Drift, Long Term Stability • Minimal Space Requirements • Measure Forward or Reverse True and Reactive Power Flow
Accuracy ±0.2% of Reading

SPECIFICATIONS

Potential Input Range*: 0-150V. **Current Input Range:** 0-10A. **Watt or VAR Input Range:** See table below (Effective Range). **Load Resistance, R_L:** 0-10 Kilohms. **Compliance:** 11.0 Volts Min. (See overrange note). **Output Ripple Peak:** <0.5% of RO. **Frequency Input:** 60 Hz. **Power Factor:** Any. **Temperature:** −20°C to +60°C.

Overrange: 500 to 1000 Watts/Element no additional errors within compliance rating. Reduce R_L as required.

Model	Element	Voltage	Load	Connection	Cal. Watts or Vars	Effective Range Watts or Vars
XLWV5C5A2	1	—	—	Single Phase	500	0-1000
XLWVC5C51½A2	1½	Balanced	Balanced	3 Phase 3 Wire	1000	0-2000
XLWV31K5A2	2	Unrestricted	Unrestricted	3 Phase 3 Wire	1000	0-2000
XLWV31K52½A2	2½	Balanced	Unrestricted	3 Phase 4 Wire	1500	0-3000
XLWV342K5A2	3	Unrestricted	Unrestricted	3 Phase 4 Wire	1500	0-3000



EXCELTRONIC™ CURRENT AND VOLTAGE TRANSDUCERS

Average Sensing • True RMS • 3 in 1 Packaging
Accuracy 0.1%-0.25%

SPECIFICATIONS FOR MODELS VT110A2, VT110A4, RMS 3567

Model	4044 CT510A2	CT510A4	RMS 4074
Full Scale Current	5a	*	*
Burden	0.25 VA	*	*
Temperature Range	−20°C to +60°C	*	*
Maximum Temperature Effects on Accuracy	±0.5%	*	*
Output Load Required	0-10K ohm	*	*
Dielectric Test	1500 rms	*	*

SPECIFICATIONS FOR MODELS CT510A2, CT510A4, RMS 4074

Model	3588 VT110A2	VT110A4	RMS 3567
Full Scale Voltage	150V	*	*
Burden @ 120V	2.5 VA	*	*
Temperature Range	−20°C to +60°C	*	*
Maximum Temperature Effects on Accuracy	±0.5%	*	*
Output Load Required	0-10K ohm	*	*
Dielectric Test	1500 Vrms	*	*

* Specification shown in first column is the same for all models in this series.

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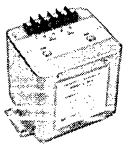
EXCELTRONIC™ PHASE ANGLE TRANSDUCER



DESCRIPTION

These transducers measure the phase angle between two voltage inputs (6314) or between one voltage and one current input (6330). All models have a ±180° phase detector preventing ambiguous readings when the input goes beyond full scale. The unique circuits use both zero-crossing times to measure the angle. They use phase locked loops to reduce the effects of noise interference and harmonics on the inputs.

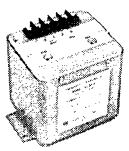
The units can be supplied for full scale ranges of ±45° up to ±180° and with outputs of ±1 mA, 0-1 mA, 1-5 mA or 4-20 mA.

SPECIFICATIONS

Full Scale Range: ±45° to ±180°. **Phase Angle Range without Ambiguous Readings:** ±180°. **Accuracy at 25°C, Normal Condition:** ±1%. **Additional Error Between −20°C and +60°C:** ±0.5°. **Potential Input(s):** 95-1135 VAC (nominal). **Overload, continuous:** 150V at 120V. **Burden:** 4 VA at 120V. **Current Input:** 0.5 to 5A (nominal). **Overload, continuous:** 10A. **Overload, 1/2 sec./hr:** 400A. **Frequency Range:** 60 Hz. **Adjustment (non-interacting), Zero:** ±3°. **Span:** ±5°. **Ripple:** 1% of maximum output (Peak). **Response Time:** 0.4 seconds to 99% of final value. **Protection Isolation:** Input/Output/Case. **Dielectric Test:** 1500V rms for 1 minute. **Surge Withstand:** Proposed IEEE SWC Test. **Outputs:** 0- ±1.0 mA into 0-10 kilohms. **Option — PA6:** 1-5 mA into 0-2.4 kilohms. **Option — PA7:** 4-20 mA into 0-1.2 kilohms. **For Model 6314 or 6330 add following suffix to complete model number:**

— 45	±45°, PF 1 to 0.7071
— 60	±60°, PF 1 to 0.5
— 75	±75°, PF 1 to 0.2588
— 180	±180°

EXCELTRONIC™ FREQUENCY TRANSDUCERS MODELS 6281B, 6283B, 6284B



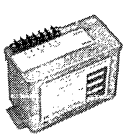
DESCRIPTION

These transducers develop a DC output signal which is proportional to input frequency, have an expanded scale output, and feature constant current output. This means, for a given input, no adjustment is necessary to compensate for various output signal loop characteristics.

SPECIFICATIONS

	6281B	6283B	6284B
Input Voltage	120V	120V	120V
Overload	150V	150V	150V
Frequency Range	45-55 Hz	375-425 Hz	55-65 Hz
Output	0-1 ma into 0-10K ohms	0-1 ma into 0-10K ohms	0-1 ma into 0-10K ohms
Accuracy	±0.02% of Center frequency at 25°C	±0.02% of Center frequency at 25°C	±0.02% of Center frequency at 25°C
Ambient Temperature Effect on Accuracy	±0.0025%/°C Max.	±0.0025%/°C Max.	±0.0025%/°C Max.
Adjustments	Zero, Span	Zero, Span	Zero, Span
Burden	4 VA	4 VA	4 VA
Ripple	1% maximum output peak	1% maximum output peak	1% maximum output peak
Temperature Range	−20°C to +60°C	−20°C to +60°C	−20°C to +60°C
Response	0.4 sec. to 99% of final value	0.4 sec. to 99% of final value	0.4 sec. to 99% of final value

EXCELTRONIC™ POWER TRANSDUCER "P SERIES" A6 1-5 ma, A7 4-20 ma, A8 10-50 ma



DESCRIPTION

Scientific Columbus has over 60 high output constant current transducers available for your selection. These transducers measure voltage, current, watts, vars, frequency and power factor with the popular outputs compatible with control equipment.

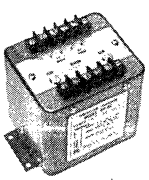
SPECIFICATIONS COMMON TO WATT AND VAR MODELS

Nominal Voltage Input: 120V. **Voltage Range:** 0-135V. **Permissible Voltage Overload:** 150V. **Voltage Burden (per Element):** 0.05 VA at 120V. **Nominal Current Input:** 5A. **Permissible Current Overload:** 10A cont., 250A for 1 sec. **Current Burden (per Element):** 0.10 VA at 5A. **External Power Required:** 100-130V, 50 Hz-500 Hz 12 VA. **Dielectric Test:** 1500 VRMS. **Frequency Range Watts:** 50-60 Hz. **Frequency Range Vars:** 60 Hz. **Power Factor Range:** Any. **Temperature Range:** 0-50°C. **Temp. Effects in Accuracy:** ±0.0075%/°C. **Accuracy/Linearity @ 25°C:** ±0.25%. **AC Component P to P:** 0.5% max. **Response Time:** 1 sec. max.

SPECIFICATIONS COMMON TO VOLT, CURRENT, POWER FACTOR, FREQUENCY, AND ISOLATION TRANSDUCERS

Nominal Voltage Input: 120V. **Permissible Voltage Overload:** 150V. **Voltage Burdens:** 3 VA max. **Current Circuits Nominal Input:** 5A. **Permissible Current Overload:** 10A Cont., 250 for 1 sec. **Current Circuit Burdens:** 3 VA max. **External Power Required:** 100-130V, 50 Hz-500 Hz 12 VA. **Dielectric Tests (Isolation unit):** 1500 VRMS. **Input Terminals:** 4000 VDC. **Temperature Range:** 0-50°C. **Temp. Effects on Accuracy:** ±1%. **Accuracy/Linearity @ 25°C:** ±0.5%. **AC Compinent P to P:** 0.5% max. **Response Time:** 1 sec. max.

EXCELTRONIC™ TEMPERATURE TRANSDUCER SERIES 9015N, 9016P, 9019C



DESCRIPTION

These transducers have true constant current output of 0-1 MA that will simplify your own calibrating or scaling networks, as well as allow-inging telemetering over long distances without line drop error.

SPECIFICATIONS

Constant Current Output: 0-1 mA for Full Range Input. **Load Resistance Range:** Any Load Between 0-10K Ohms. **Temperature Range:** −4°F to 140°F. **Ripple:** 1% RO (Peak). **Connections:** See Model 9015-49F, Model 9016 & 9019-49G. **Adjustments Span:** ±10%. **Zero:** ±3%. **Response Time:** <50 Milliseconds. **Dielectric:** 1500 VRMS @ 60 Hz for 1 Min. **Power Requirement:** 110 VAC ±20 VAC, 50 to 450 Hz, 3.5 Watts Max. **Temperature Influence on Accuracy (−4°F to +140°F):** ±.015%/°F (from 77°F). **Open Circuit Voltage:** 16 VDC. **Dimensions:** See Style II-Models 9016 & 9019, Style III-Model 9015.

Basic Model	RTD Type	Suggested Sensor Resistance	Temp. Span	Temp. Range	Max. Sensor Current
9015N	Nickel-Iron	676Ω @ 77°F	50°F or 150°F	−200°F to 500°F	< 3 Milliamps
9016P	Platinum	100Ω @ 32°F	150°F or 300°F	−320°F to 1000°F	< 5 Milliamps
9019C	Copper	10.0Ω @ 77°F	150°F or 300°F	−100°F to 300°F	<50 Milliamps

CALIBRATOR

PORTABLE TRANSDUCER MODEL 6444

- 40% Lighter • 40% Smaller • All Digital
- Replaces the 1369C • Watts • Vars • Amps
- Volts

SPECIFICATIONS

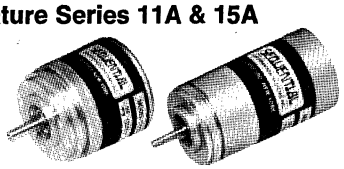
Function: AC watt, var, current and voltage transducer tester and calibrator. **Ranges:** 0-150 VRMS, 0-5A, 0-10 ARMS, Avg. Sensing. 0-750/0-1500W, 0-750/0-1500 Var. **Voltage Output:** VA rating 15 VA. **Current Output:** VA rating. Hi Range: Hi-24 VA @ 1. PF, 22V @ 0.5 PF. **Lo Range:** Lo-6 VA @ 1.0 PF., 2.4 VA @ 0.5 PF. **Load Power Factor:** Unity and 0.5 lag (approx.) **Transducer Signal Load:** 1 ohm to 100K ohms and infinity, selected by thumbwheel digital readout switches. **Standard Output Signal:** 0-10 volts dc for zero to full scale of test quantity (V, A, W, var). **Meters, all meters are 3½ digit liquid crystal display (LCD):** Volts 0-150, Amperes 0-5/0-10, Watts/Vars 0-750/0-1500, Error −20% - 0 - +20%. **Accuracy of Internal Std. Transducers:** ±0.1%. **Accuracy (Digital Indicating Meters):** Volt, Amp & Watt/Var indicators, ±0.15% of f.s. ±1 digit. **Accuracy (Standard Output):** ±0.1% (maximum). **Temperature Range:** +25°C ±10°. **Power to Operate Unit:** 120V ±10%, 60 Hz, Approx. 130 VA. **Terminations:** Five-way binding posts are mounted on the front panel of the instrument. Power receptacle is on the rear of the case. **Accessories:** No accessories are required for complete functional testing of transducer being checked. **Packaging:** Woodformica portable instrument case with carrying handle. **Dimensions:** 13″ high x 22″ wide x 9″ high (330 x 560 x 230 mm). **Weight:** 45 lbs. (20.4 kg).

SEQUENTIAL
OPTICAL ENCODERS

Sequential offers virtually every type of Optical Encoder, both self-contained and modular. Incremental and absolute units are available in industrial, instrument, high resolution and economy packages. PC type Encoders provide direct data input to Programmable Controllers and Process Computers without special interface logic. All models include more than 150 resolutions in stock with a wide variety of mechanical and electrical options.

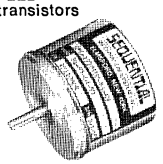
INCREMENTAL ENCODERS

Miniature Series 11A & 15A



Size: 1.1″ dia x 2″ L (11A); 1.5″ dia x 1⅜″ L (15A)
Resolution: to 1024 cyc/rev (11A); to 2048 cyc/rev (15A)
Output Formats: Single Channel, 2-Channel in Quadrature, 2-Channel Quadrature plus Zero Index
Output Levels: TTL or C-MOS Compatible
Illumination Source: Single LED
Detectors: Phototransistors

Low Cost Series 25L

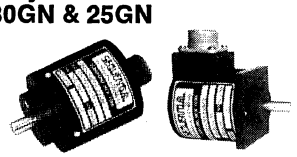


Size: 2.62″ dia x 2″ L
Resolution: to 1270 cyc/rev
Output Formats: Single Channel, 2-Channels in Quadrature, 2-Channel Quadrature plus Zero Index
Output Levels: TTL, C-MOS Compatible
Illumination Source: Single LED
Detectors: Phototransistors

High Accuracy & Resolution Series 25G

Size: 2.625″ dia x L (depends on output)
Resolution: to 4,000 cyc/rev (without Interpolation) to 20,000 cyc/rev (with Interpolation)
Output Format: Single Channel, 2-Channels in Quadrature, 2-Channels Quadrature plus Zero Index, Direction-sensing with 1X, 2X, 4X Multiplication Logic
Quadrature Accuracy: ±22½°
Frequency Response: 50 KHz standard, 100 KHz available
Illumination Source: Single LED or Lamp
Detectors: Phototransistors or Photocells
Output Levels: TTL, C-MOS, HTL, Differential Line Driver and Complementary Outputs, Open Collector (30 vdc, 40 ma, max)

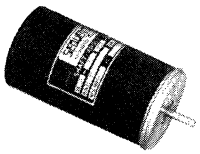
Heavy Duty NEMA 13 Series 30GN & 25GN



Size: 2.5″ dia x 2.5″ L (25GN); 3″ dia x 3″ L (30GN)
Mounting: Servo, Face (Bolt Circle) or Flange
Resolution: to 2540 cyc/rev
Output Format/Levels: Same as 25G
Shaft Dia: ⅜″ (25GN); ½″ (30GN)
Radial Shaft Loading: 35 lbs (25GN); 40 lbs (30GN)
Shaft Seal: Buna N rubber with garter spring
Illumination Source: Single LED
Detectors: Phototransistors

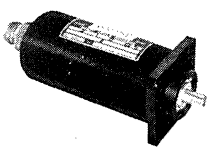
ABSOLUTE ENCODERS

Series 25H



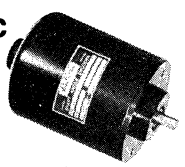
Size: 2.625″ dia x L (depends on output)
Resolution: to 13 cycle or Natural Binary, to 3599 Binary Coded Decimal
Output Codes: CB, NB, CBCD & BCD standard
Output Levels: TTL, C-MOS, Open Collector (30 vdc, 40 ma, max)
Output Options: Gated, Serial, Differential
Illumination Source: Single LED or Lamp
Detectors: Phototransistors or Photocells

Extra Heavy Duty NEMA 13 Series 30HR Enclosure



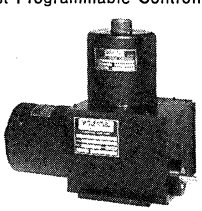
Configuration: (See Note) Input Shaft connected to any Series 25 Encoder through a flexible coupling
Size: 3″ dia x L (depends on options)
Shaft Dia: to ⅝″ (uses ⅝″ I.D. roller bearings)
Shaft Loading: 400 lbs radial, 200 lbs axial
Shaft Seal: Buna N rubber with garter spring
Note: For use with any Series 25 Absolute or Incremental Encoder.

NEMA 13 Programmable Controller Series 40HDN/PC



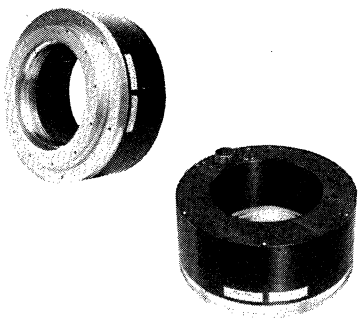
Size: 4″ dia x 9/16″ L
Resolution: 359 BCD, 999 BCD, 2^{10} NB
Output Levels: TTL, C-MOS, Open Collector (30 vdc, 40 ma, max)
Shaft Dia: ½″
Radial Shaft Loading: 40 lbs
Shaft Seal: Buna N rubber with garter spring
Illumination Source: Single LED
Detectors: Phototransistors
Note: Data Hold Input, Data Ready Output, Direction Input Select and Multiplex Control Input Signals for direct hand-shaking capability with most Programmable Controllers.

NEMA 13 Multi-Turn Encoders



Configuration: Both Encoders and Output Shaft isolated from gear train by flexible couplings
Resolution: 1,000 bits/turn x over 140 turns (140,000 total bits)
Output Code: BCD
Output Level: TTL or Open Collector (30 vdc, 40 ma, max)
Note: Data-Hold, Data-Ready signals for direct hand-shaking capability with most Programmable Controllers or Process Computers.

HI-RES ENCODERS

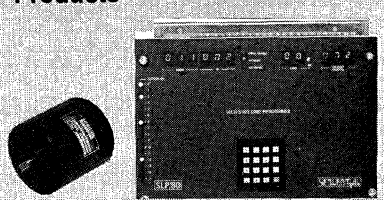


Sequential offers a full line of absolute encoders with resolutions to 21 bits. Package sizes range from 3.5″ to 12″ dia. Hollow-shaft models are available with thru-holes to 7″. Sequential Encoders offer the highest resolution and accuracy available today!

These encoders have been used by the military, NASA, other governmental agencies and industrial companies in a variety of applications including tracking mounts, radar and telemetry pedestals and measuring equipment.

Many units have been fully qualified for operation aboard military aircraft, ships, in space and in environments from desert to ocean. A full complement of options and accessories is available, including electrical zeroing, on-line automatic checkout, redundancy with automatic switchover, displays and readouts, flexible couplings and test sets.

Other Products



- Limit Programmers
- Selsyn Monitors
- Encoded Motors
- Industrial Control Systems
- Synchronous dc Motors
- Permanent Magnet dc Motors

SEQUENTIAL
INFORMATION SYSTEMS INC.

Sequential Information Systems, Inc.
249 North Saw Mill River Road, Elmsford, New York 10523
(914) 592-5930 TWX 710-567-1212

Setra systems HIGH ACCURACY PRESSURE & ACCELERATION MEASUREMENT & CONTROL

HIGH OUTPUT/ HIGH ACCURACY

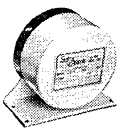
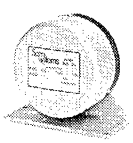
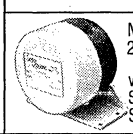
PRESSURE & VACUUM TRANSDUCERS/ TRANSMITTERS

Output: 5V DC or ±2.5V DC

Excitation: Normal 24V DC (unregulated)
Other voltages optional

Ambient Temperature: 0°F to 175°F
−65°F to 250°F available – some units

Two-wire transmitters (4-20mA) include Models C-204, C-204D, C-228, C-239

Model	Application	Full Scale Pressure Ranges from:	Pressure Media Compatibility	Accuracy	Temperature Effects Zero Shift ±% FS/100° F Sensitivity Shift ±% FS/100° F
 Model 204/204E 204D	**Absolute Pressure** **Gage Pressure** **Vacuum** **Differential Pressure**	25 to 10,000 psia 25 to 10,000 psig 0 to 14.7 psiv 10 to 10,000 psid	Gas or liquid compatible with Stainless Steel	0.11%	204 0.4 max 0.3 max 204E 3 max 2 max 204D 0.4 max 0.3 max
Model 205-2	**Gage Pressure** **Absolute Pressure**	25 to 5,000 psig 25 to 5,000 psia	Gas or liquid compatible with Stainless Steel	0.11%	2 max 1.5 max
Model 228	**Differential Pressure (can be wet both sides)**	Low diff. press. 1 to 50 psid ±0.5 to 25 psid at high line pressure to 2000 psig	Gas or liquid compatible with Stainless Steel (both pressure and reference sides)	0.25%	3 max 2 max
Model 237 *Fits Scanivalve*	**Absolute Pressure** **Differential Pressure**	1 and 5 psia ±0.1 to ±5 psid 0.2 to 10 psid	Gas compatible with Stainless Steel	0.27%	1.5 max 1 max
 Model 239/239E	**Absolute Pressure** **Gage Pressure** **Differential Pressure** **Vacuum**	1 and 5 psia 0.02 to 5 psig ±0.01 to ±5 psid 0.02 to 10 psid 0.2 to 10 psiv	Gas compatible with Stainless Steel, Aluminum	239 0.14% 239E 0.23%	239 1 max 1 max 239E 5 max 5 max
 Model 270/271 with SETRACERAM™ Sensor	**Barometric Pressure** **Absolute Pressure** **Gage Pressure** **Differential Pressure**	800-1100 mb 5 to 100 psia 5 to 100 psig 5 to 100 psid ±2.5 to ±20 psid	Wet or Dry Air	0.05%	0.1 max (0.2 Barometric) 0.1 max

HIGH OUTPUT/ HIGH ACCURACY

DIGITAL PRESSURE MEASUREMENT SYSTEMS

4½ Digit LED Display
BCD Output Option
Analog Output Standard

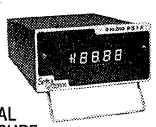
Digital Readouts/Indicators

300B DIGITAL PRESSURE READOUT

300C DIGITAL PRESSURE INDICATOR

Systems with separately mounted transducers.

Complete Systems



360 DIGITAL PRESSURE GAGE

361. DIGITAL BAROMETER

304/339 ELECTRONIC MANOMETER

Self-contained systems with integral pressure transducers.

Model	300B 300C	360	361	304	339
Gage Pressure	.02 to 10,000 psig	20 to 2000 psig	5 to 100 psig	25 to 100 psig	0.02 to 10 psig
Absolute Pressure	1 to 10,000 psia	20 to 2000 psia	5 to 100 psia	25 to 100 psia	1 to 5 psia
Differential Pressure	0.02 to 100 psid ±0.01 to ±50 psid				0.02 to 100 psid ±0.01 to ±50 psid
Vacuum	0.2 to 14.7 psiv			14.7 psiv	
Barometric Pressure	800 to 1100 millibars		800 to 1100 millibars		
Analog Outputs	0 to 5V or 0 to ±2.5V	0 to 5V	0 to 5V	0 to 5V or 0 to ±2.5V	
Accuracy % FS	Transducer accuracy	±0.1%	±0.05%	±0.11%	±0.14%

HIGH OUTPUT/ HIGH ACCURACY

LINEAR ACCELEROMETERS

Model	G Ranges (Full Scale Ranges ±G)	Comment
141	2, 4, 6, 8, 15, 30, 60, 600	Strain gage compatible

Setra systems
the transducer people

Available on GSA.
Write or call for Application Guide and Prices:
(617) 263-1400. 45 Nagog Park, Acton, MA 01720.

On-target sensors for position and speed control.

Choosing the right up-front sensor can make a big difference in position- and speed-control system requirements.

At TSI, if you need a non-contact pickup, with or without logic signal conditioning, with or without zero-speed and/or direction output, its performance will be strictly as specified, and its cost-saving advantages will be welcome news.

Pickups, proximity sensors and switches, LVDTs, and velocity transducers—all are manufactured in their entirety at TSI. Select from hundreds of standard models and custom designs.

Sensor Type	Variable-Reluctance Magnetic Pickups	DIGIMAG	DIGITRAC®	BITRAC™
Features	Non-contact, high frequency output capability, several output/resolution packages. High environmental adaptability.	Digital output, insensitive over a range of, and to variations in supply voltage and air-gap distance. Non-contact.	Zero-speed output, digital, good noise immunity, magnetoresistive sensing, non-contact.	Directional and zero-speed digital output from one differential magnetoresistive sensor. High noise immunity, easy installation, non-contact.
Output, General	Analog, logic signal conditioning available	TTL- and CMOS-compatible	TTL- and CMOS-compatible	TTL- and CMOS-compatible
Output Range	250 mV p-p to 300 V p-p	**at 5 Vdc supply*** 0.2 V low; 4.75 V high. **at 15 Vdc supply*** 0.2 V low; 14.25 V high *operates at 5-to-15 Vdc supply.	**at 5 Vdc supply** 0.2 V low; 4.75 V high. **at 12 Vdc supply** 0.2 V low; 11.4 V high	**at 10-14 Vdc supply** zero-speed and position output: 0.4 V low; 4.75 V high direction output: clockwise - 0.2 Vdc counterclockwise - 3.0 Vdc
Air-gap Range	0.2" max.	0.080" max.	0.060" max.	0.025" max.
Cut-off Frequency	1 MHz	20 kHz	20 kHz	20 kHz
Target Material	Ferromagnetic	Ferromagnetic	Ferromagnetic	Ferromagnetic

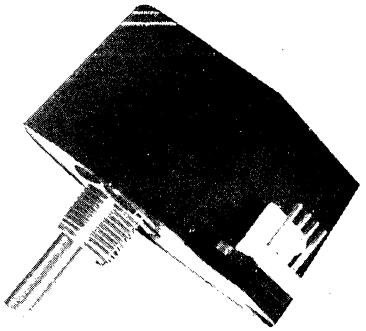
*Contact TSI for specifications on proximity transducers, proximity switches, LVDTs, and velocity transducers.

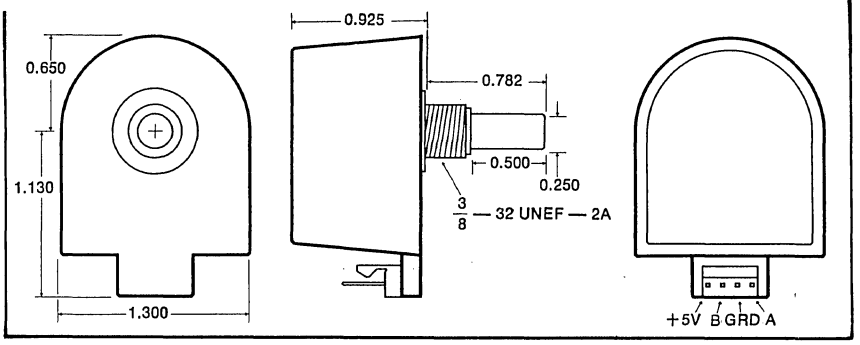
7870

TRANSDUCER SYSTEMS, INC.
1510 Delp Drive, P.O. Box 341 • Kulpsville, PA 19443 • 215-256-4611 • Telex 846078

DIGITAL
12371 KENSINGTON RD, LOS ALAMITOS, CA 90720 • (213) 594-0094

SOFTPOT DATA





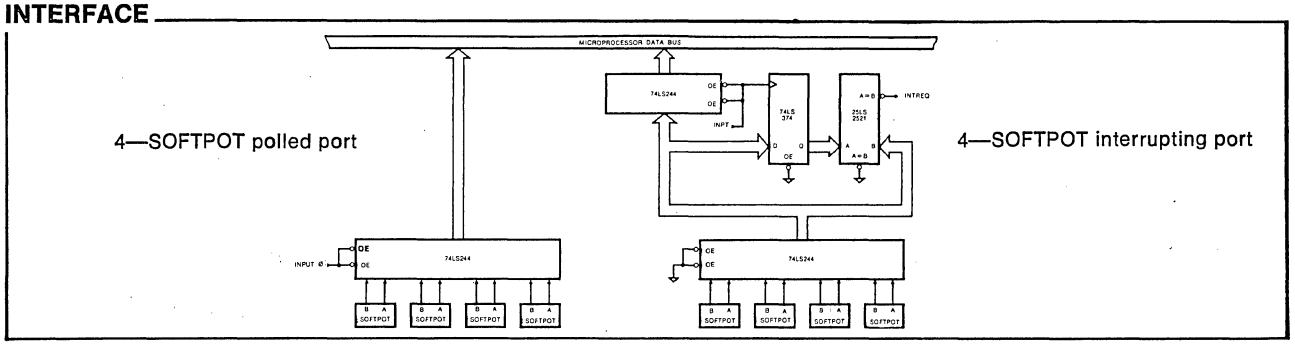
DESCRIPTION

The SOFTPOT is a front panel optical incremental encoder which converts mechanical action directly to digital output. Its low cost has made software programmable performance practical for new applications. Shaft tension provides the feel of a potentiometer but there are no stops. Since the SOFTPOT is an incremental device the absolute value of the controlled parameter may be maintained in memory by your microprocessor providing:

- Software presetable parameters
- Software definable limits
- Software programmable interaction

The two channel outputs are quadrature phase encoded to provide a resolution of 4 quadrants per cycle and 16 cycles per revolution yielding a code change every 5.6 degrees or 64 quadrants per turn. LED light sources assure low power consumption and a long reliable life. One external 74LS244 will interface four SOFTPOTS to standard TTL.

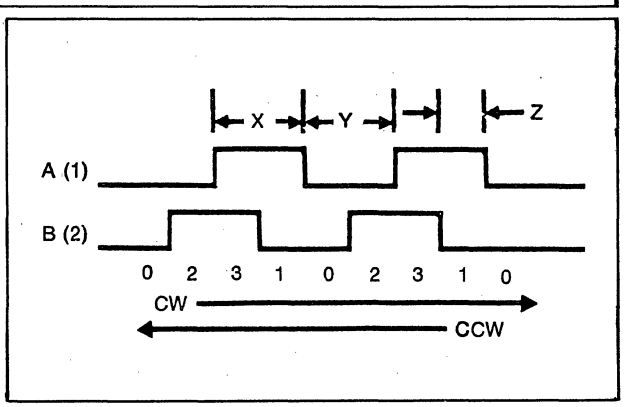
INTERFACE



ELECTRICAL SPECIFICATIONS

PARAMETER	MIN	NOM	MAX	UNITS	NOTE
Supply Voltage	4.75	5.0	5.25	Volts	
Supply Current		22	30	MA	
VoutH	3.5	5.0	5.25	Volts	2
VoutL		0.15	0.4	Volts	2
Iout (Vout=.5v)	0.5	2.0		MA	
Iout Short		8	18	MA	
Symmetry	150	180	210	Degrees	3, 4
Quadrature	60	90	120	Degrees	3, 5

NOTES:
1. A 74LS244 is recommended as the interface to TTL.
2. At 74LS244 input
3. At 74LS244 output
4. Symmetry is a measure of the relationship between (X) and (Y) In electrical degrees.
5. Quadrature is specified by (Z) and is the phase lag or lead between channels A and B in electrical degrees.
6. Channel B leads channel A for clockwise rotation.



MECHANICAL SPECIFICATIONS

Dimensions:	See above
Connectors:	Unit : AMP—640456—4 Mate : AMP—640441—4
Materials:	Housing : ABS# KJB4051 (fire retardant) Shaft : Brass Bushing : Brass
	Torque : 0.5 in. oz. +/−0.20 in. oz. Weight : 1.0 ounces
	Operating Temperature : −20 to 85 degrees C Storage Temperature : −40 to 85 degrees C
	Mounting Hole Size : .380 inch Panel Thickness : .125 inch max.

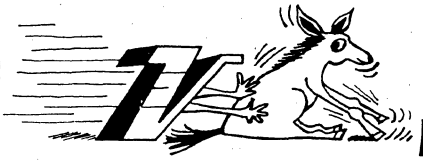
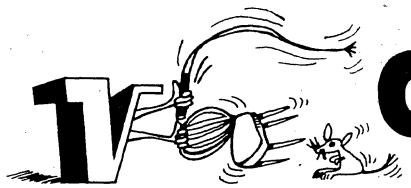
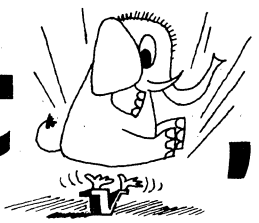
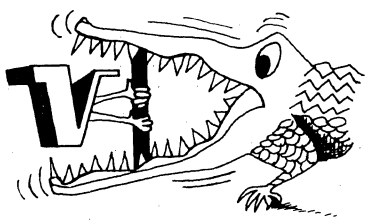
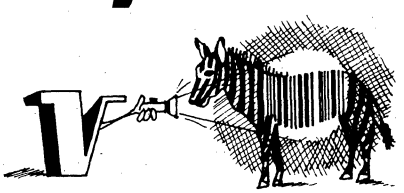
ORDERING INFORMATION

PRICING: $16.00/1000's $20.00/50's
$17.00/500's $22.00/10's
$18.00/100's $25.00/1's

MATING CONNECTORS: $.50

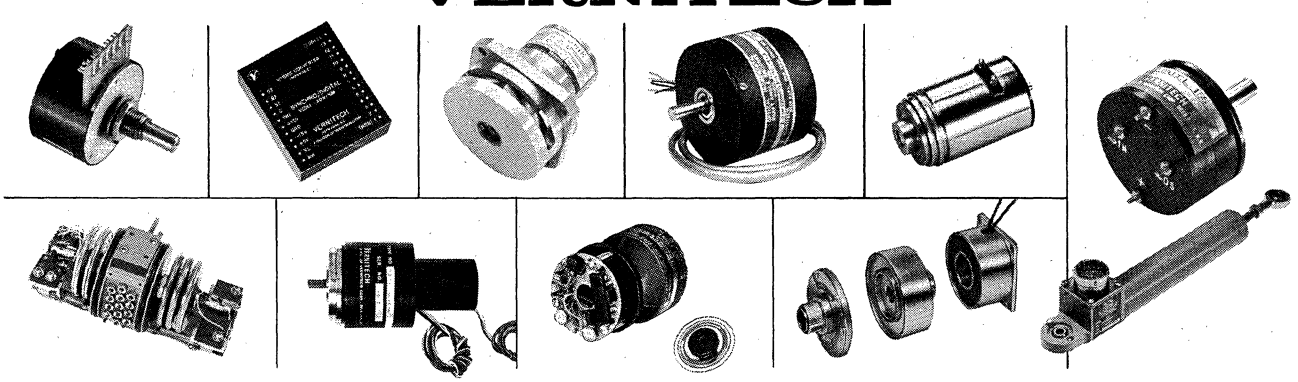
PART NUMBER : SP-16
F.O.B. : Los Alamitos, CA via U.P.S.
AVAILABILITY : Normal Shipment is Next Day
TERMS : 30 Days Upon Approval

If you want to move it, control it, sense it, stop it, or scan it, call Vernitech.

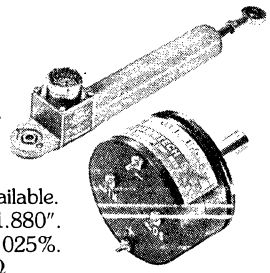
That is, if you're looking for instrument motors, optical and contacting shaft angle encoders, rotary and linear potentiometers, potentiometric pressure transducers, industrial precision brakes or clutches, or laser scanning motors, we'll probably have just what you're looking for. Just look on the opposite page. And if you *don't* find what you want, call Vernitech, give us the particulars, and we'll make it for you.

VERNITECH



VERNITECH, a division of Vernitron Corp., 300 Marcus Blvd., Deer Park, NY 11729 • 516-586-5100 • TWX 510-227-6089

POTENTIOMETERS



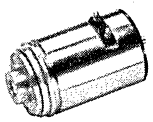
employing Vernitech's unique conductive film and precious metal wipers... respond to wiper motions as small as .000005".

Rotary Single Turn
Linear, non-linear, sine/cosine available.
Sizes 0.5", L 0.5" to Dia 5.0", L 1.880".
Linearity or conformity ±2% to 0.025%.
Resistance range 1KΩ to −250KΩ.

Rotary Multi-Turn
10 to 100 turns available.
Sizes Dia 0.5", L 1.5" to Dia 2.0", L 2.625".
Linearity or conformity ±0.5% to 0.015%.
Resistance range 1KΩ to 500KΩ.

Linear Motion
Electrical stroke lengths 1" to 60".
Linearity or conformity ±0.2% to 0.01%.
Resistance range 250Ω/in to 250KΩ/in.

CLUTCHES AND BRAKES (electromagnetic)



hundreds of models and sizes available from stock.

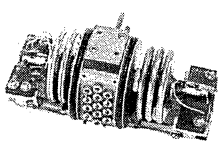
Precision Instrument Type
Sizes 5, 8, 11, 13, 15, and 18.
Standard length and wafer types. Spring and magnetic.
Meet MIL-E-5272C. Zero backlash.
Torque 5 to 150 oz. in. Response time 5 to 142 ms.

Industrial Types — open frame
Sizes 8, 12, 17, 22, 26. Torque to 75 in. lb.
Response time 6-30 ms at rated voltage.

Industrial Types — enclosed frame
Hybrid or special units designed for particular applications when MIL-SPECS and close tolerances are not essential, but where having a complete "self-contained" unit is desirable: cassette tape decks, analog devices actuators, etc.

Fail Safe
Braking action occurs 10 ms after coil is de-energized or power fails. Sizes 8, 17, 30, and 45.
Torque up to 50 in. lb. Zero backlash. Adjustable to compensate for wear.

PRESSURE TRANSDUCERS potentiometer type,



featuring infinite resolution, long life, and high reliability through the use of conductive film resistance elements, multiple wipers, and direct coupling of pressure sensing element to potentiometer wipers.

Pressure ranges from 0.1 to 10,000 psi in gage, absolute and differential types. Also available with high overpressure capability.

Linearity to ±0.3%. Air speed, altitude and low cost types available.

VERNITECH

MOTORS

Over 1500 Standard Designs or Custom Designed to your requirements.

Synchronous — for laser scanning
Sizes 5, 8, 11, 15, 18, 20, 25, 35.
Speeds 100 to 48,000 rpm.
5 through 1600 Hz. 2, 4, 8, 12 poles.

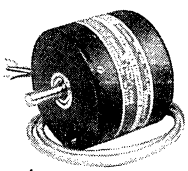
Servo
Viscous damped — sizes 8, 10, 11, 15, 18.
Speeds 3000 to 10,000 rpm.
Inertially damped — sizes 8, 11, 15, 18.
Speeds 3000 to 9500 rpm.

Stepper
Sizes 5, 8, 11, 15. Stepping angles 7.5°, 15°, 45°, 90°.
Stepping rates 100, 110, 125, 130, 175, 180, 225, 240, 260, 400, 725, 800, 1000 pps.

Precision Motor Generators Sizes 8, 10, 11, 15, 18, 23.

Integrating and Computer Motor Tachometers
Sizes 8, 10, 11, 15, 18, 23.

SHAFT ANGLE ENCODERS



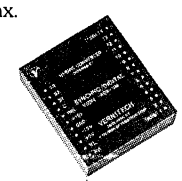
featuring precision chrome on glass discs for highest accuracy.

Optical Incremental
VOE 11 — Dia. 1.062", L. 1.80". To 1024 pulses
VOE 015 — Dia. 1.510", L. 0.88". To 1024 pulses (modular)
VOE M15 "Dial Coder" — panel mounted, 1.500" dia., L. 1.08" 127-256 pulses
VOE 023 — Dia. 2.25", L. 80". To 1250 pulses (modular)
VOE 23 — Dia. 2.250", L. 1.875". To 1250 pulses (available sealed)
VOE L23 "Thrift-Line" Dia. 2.250" L. 1.875". To 600 pulses
VOE 25 — Dia. 2.500", L. 2.500". To 3000 pulses (available sealed)

Optical Absolute
VOE 23: Binary, Gray or BCD to 512 counts per turn. Counting speed: 3000 rpm.
VOE 30: Single or multi-turn; Binary, Gray or BCD. To 1024 counts per turn. Max count (2^{19}) in 512 turns. Counting Speed: 30KHz.

Contacting Absolute
Sizes 11, 18, 23, & 31. Binary, Gray, and BCD. Single or multi-turn. Max count (2^{19}) in 2048 turns. 64 to 1024 counts per turn. Operating speed 200 rpm max.

SYNCHRO CONVERTER MODULES



Tracking Synchro-to-Digital and Resolver-to-Digital Converters
Economy Series VSD/VRD. Precision Series VSDH/VRDH Compact, solid state, high performance converters employing type 11 servo loops for lag free tracking at rates to 3600°/sec. Resolution 10 bits, 12 bits, or 14 bits.

Digital-to-Synchro and Digital-to-Resolver Converters Series VDS/VDR: Accept shaft angle data in digital form for conversion to analog at accuracies up to ±4'.

Tracking Synchro-to-Linear DC Converter Module
Series VSDCH/VRDCH: Accept 3-wire synchro or 4-wire resolver input data, convert it to DC analog voltage proportional to synchro angle of input. Accuracy ±6' (typ.).

Tracking Angle Position Indicator
VNST-104: Tracking Synchro-to-Digital Converter, can also be used as a control element. Four decade 0.8" red LED display. Display accuracy ±6' arc (typical). Tracking rate 3600°/sec max. Parallel binary or BDC output. Self contained line operated power supply.

Custom designs available to your specifications.

VERNITECH, a division of Vernitron Corp., 300 Marcus Blvd., Deer Park, NY 11729 • 516-586-5100 • TWX 510-227-6089

WR VIBRATION TRANSDUCERS

Wilcoxon Research specializes in the development and manufacturing of high quality instrumentation for use in the vibration test and monitoring field. A wide range of vibration transducers and related accessories are offered to fulfill most laboratory and industrial applications. Electromagnetic and high frequency piezoelectric shakers are offered to excite structures for vibrational analysis. Experienced technical assistance is available to aid in instrument selection and application.

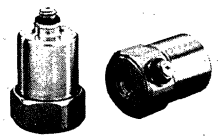
Internally Amplified Accelerometers

700 Series Accelerometer System

NEW

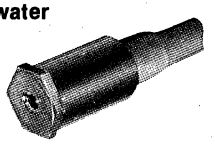
The New 700 Series Accelerometer System offers an array of internally amplified accelerometers, power supplies, post-amplifiers and vibration measurement kits. These are designed as interchangeable systems featuring ruggedness, ease of operation, virtually free from erroneous signals caused by conditions such as mechanical strain, mounting torque, thermal transients and cable motion. The extremely low noise floor and very wide measuring range are unparalleled features of the 700 Series.

720 Series



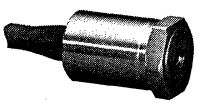
For general purpose vibration testing and monitoring. Low sensitivity to strain, torque, and thermal transients. Very low noise floor allows external velocity or displacement integration to low levels and low frequencies. Internal PIEZOFET® amplifier drives long cables. 10, 25 or 100 mV/g 1 to 10,000 Hz

740 Series Underwater Accelerometers



Designed for testing and monitoring of underwater structures. Geophysical cable is sealed into the transducer for operation to pressures greater than 1000 psi. Ultra low noise amplifier allows measurement to extremely low vibration levels. 10, 25 or 100 mV/g 1 to 10,000 Hz

760 Series Industrial Accelerometers

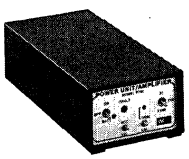


Designed to withstand the harsh environments found in industrial applications such as bearing, pump, turbine, and gear case monitoring. Rugged and shock protected for long term reliability. Special environmental and electrical isolation. 10, 25 or 100 mV/g 2 to 10,000 Hz

P700 Series Power Supplies & Amplifiers

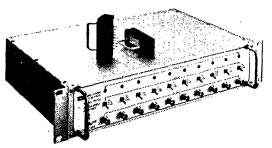
These units supply power to any of the 700 Series Accelerometers with integral amplifiers and allow operation directly into standard readout equipment. The new "smart" power supplies provide gain and monitor and signal to insure proper operation for increased measurement confidence.

Single Channel



- P702 Power Unit/Amplifier
- Power any 700 Series Accelerometer
- Gain trim to standardized sensitivity
- Overload/fault alarm — audible and visible
- Wide dynamic range
- Battery test light
- Amplifier gain of 1, 10, and 100 • Acceleration or velocity output
- Ultra low noise • Powered by 9V transistor batteries

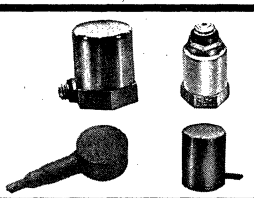
Multichannel Power Unit Racks



PR710 — Supplies power to ten 700 Series Accelerometers with low noise amplification of X1, X10 or X100. Fault indication warns of defective accelerometer or cabling.

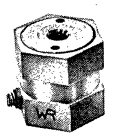
PR712 — Supplies power to twelve accelerometers and provides fault indication with no additional amplification.

High Impedance Accelerometers



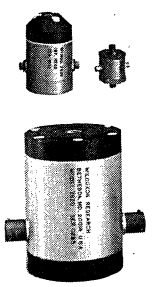
A variety of charge type (non-amplified) accelerometers are offered for use with external charge amplifiers. Charge type accelerometers have a wide dynamic range and high temperature capability. Low noise cables must be used. Modifications and special OEM units can be provided by our Custom Design Section. 1 pC/g to 10 V/g sensitivities

Force Gages



Piezoelectric force gages measure dynamic forces with high gage stiffness. Miniature and general purpose units are available. Low weight.

Impedance Heads



An impedance head combines a force gage and an accelerometer in a single unit. When driven by a shaker, this allows the measurement of force applied to the structure and the resulting motions.

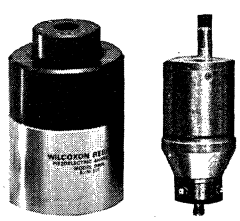
Electromagnetic Shakers

These small electromagnetic shakers are designed to attach to (or push against) a structure and generate a vibratory force. The mass reaction principle of operation allows the shakers to be mounted in any orientation. Available with built-in force gage and accelerometer (impedance head) for complete measurement capability.

Electromagnetic/Piezoelectric Shaker Combinations

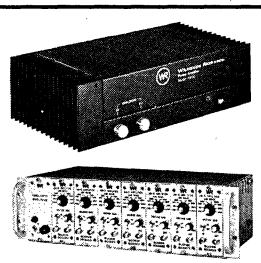
This new approach to structural excitation combines an electromagnetic shaker which drives at the lower frequencies and a piezoelectric (crystal) shaker which drives at high frequencies. The combinations are selected so that both shakers can be driven at the same time to cover a very wide frequency range.

Piezoelectric Shakers



Piezoelectric shakers are designed for high frequency structural excitation. A variety of models are available as mass-reaction force generators (F7, F8, F9) or in shake table configurations (D60, D125). Extremely high vibration levels may be attained with very low stray electromagnetic fields.

Signal Conditioners, Power Amplifiers & Accessories



Wilcoxon Research offers a selection of signal conditioners, shaker power amplifiers and accelerometer accessories to fully support our lines of transducers and shakers. This ensures system component compatibility from a single supplier.

WR WILCOXON RESEARCH
BOX 5798 • BETHESDA, MARYLAND 20814 • 301-770-3790 TELEX 898-342

TRANSFORMERS, POWER & CONTROL (* Indicates MIL Types)

Manufacturer	115/230V Input 50/60 Hz	115/230V Input 400 Hz	Filament	Rectifier	Isolation	Voltage Regulating	DC-to-DC Converter	Variable (Incl. Auto-transformer)	Power Distribution	High Voltage	Control: Synchro/Resolver/Synchro	Control: Servo	Current (Instrument)	Switch Mode
Abbott	1•2518*	1•2521*	1•2581*											
Amecon													1•2524	
Arstan	1•2525													
BH Electronics	1•2526						1•2526							
Dale Electronics	1•2528			1•2528			1•2530							
Del Electronics	1•2531		1•2531		1•2531					1•2531				
Endicott Coil	1•2532*													
EWC	1•2534													
Flex-Core													1•2543	
Freed Transformer	1•2544*	1•2544*	1•2544* 1•2547	1•2549	1•2547			1•2547						
Hipotronics								1•2548		1•2548				
Hisonic		1•2550*					1•2550				1•2550			
Hitran					1•2551				1•2551	1•2551				
Jefferson Electric						1•2553								
JM Transformer	1•2554	1•2554		1•2554	1•2554			1•2554						
Lenco	1•2556		1•2557		1•2557		1•2557	1•2556						
MCI Transformer	1•2558													
Magnetico		1•2573								1•2573	1•2573	1•2573	1•2573	1•2573
Microtran	1•2568	1•2572					1•2572							
Multi Products	1•2574									1•2574				1•2574
Murata-Erie										1•2575				
North Hills Electronics			1•2577							1•2577			1•2577	
NWL Transformers			1•2577	1•2577					1•2577	1•2577				
Pan Magnetics	1•2584			1•2584										
PC Transformer	1•2578		1•2578											
Pearson Electronics										1•2580			1•2580	
Perkin-Elmer											1•2588	1•2588		
Paraline	1•2589		1•2589											
Pico Electronics		1•2615*					1•2612							
Precision Components	1•2616		1•2616	1•2616			1•2616			1•2616				
Prem Magnetics	1•2617													
Shogyo	1•2618													
Signal Transformer	1•2620	1•2624		1•2622*	1•2630			1•2629						
Staco				1•2627	1•2632			1•2632						
Stancor	1•2533													
Sterling	1•2635	1•2636*			1•2635									
Superior Electric	1•2640							1•2640						
Technipower						1•2643		1•2643						
Technitrol					1•2645			1•2645			1•2645	1•2645	1•2645	
Thordarson	1•2646		1•2646					1•2646		1•2646				
Todd	1•2648*	1•2648*	1•2648*	1•2648*	1•2650*	1•2651		1•2651						
Toroid Corp.	1•2652			1•2652										
Torotel Products	1•2660	1•2658*												
Torwico Electronics		1•2663*												
Trans American Transformer	1•2665*	1•2665*									1•2665			1•2665
Triad-Utrad	1•2666	1•2672	1•2666	1•2669	1•2671			1•2669						
TRW Inductive Products	1•2674,* 1•2690*	1•2674,* 1•2690*	1•2674* 1•2693*	1•2690*	1•2674,* 1•2695*		1•2674,* 1•2690*							
Wayne Transformer	1•2701*		1•2701*		1•2701*					1•2701				

TRANSFORMERS, AUDIO & RF (* Indicates MIL Types)

Manufacturer	Audio	Driver	Input	Inter-stage	Matching	Microphone	Output	Isolation	RF-IF	Pulse (Incl. Trigger)	Telephone Coupling
BH Electronics	1•2526*									1•2526*	
Dale Electronics											1•2530
Freed Transformer	1•2544*		1•2544*	1•2544*	1•2544*		1•2544*			1•2544*	
Hisonic	1•2550*				1•2550				1•2550	1•2550*	
Lenco	1•4556		1•4557		1•4557		1•4557				
Microtran	1•2564		1•2565	1•2565	1•2564	1•2565	1•2565				1•2562
Multi Products	1•2574				1•2574				1•2574	1•2574	
North Hills Electronics					1•2576			1•2576			
Pan Magnetics	1•2581*									1•2581	1•2583
PC Transformer	1•2579		1•2579	1•2579			1•2579	1•2579			1•2579
Paraline	1•2591				1•2591						1•2591
Pico Electronics	1•2593*	1•2593*	1•2593*	1•2593*	1•2953*	1•2614*	1•2593*			1•2610	
Precision Components	1•2616				1•2616		1•2616			1•2616	1•2616
Prem Magnetics											1•2617
Sterling	1•2638*					1•2638					
Technitrol	1•2644		1•2645	1•2645		1•2645	1•2645	1•2645		1•2644*	
Thordarson	1•2646				1•2647					1•2647	
Todd								1•2650			
Torotel Products	1•2655*	1•2655*	1•2655*	1•2655*		1•2655*		1•2655*			
Triad-Utrad	1•2670				1•2671	1•2671					1•2671
TRW Inductive Products	1•2674-1•2689*	1•2674*	1•2674*	1•2674*			1•2674*			1•2674,* 1•2697*	1•2674,* 1•2681*

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides. There are 33 Guides in this edition of EEM. See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

abbott TRANSFORMERS

60 Hz Power Transformers

MODEL **6B**

SPECIFICATIONS

INPUT PRIMARY: 115 VAC standard. 230 VAC at 10% additional cost. Specify by suffixing "A" to model number. 115/230 VAC dual input at 10% additional cost. Specify by suffixing "B" to model number.

INPUT FREQUENCY: 50 to 400 Hz, 1 phase.

REGULATION: 15% max. from no load to full load (6% on units size 8 and larger).

SECONDARY VOLTAGE TOLERANCE: Within 5% of listed output voltage when measured at full load and 115 VAC input.

INSULATION TEST: 1500 VAC.

OPERATING TEMPERATURE: 80°C maximum ambient (70°C on units size 8 and larger).

APPROXIMATE EFFICIENCY: Ranges from 80% to 90%.

CONSTRUCTION: Commercial grade using Silicon Iron for core and heavy insulated synthetic film magnet wire with class "B" rating impregnated with a high quality insulating varnish having a class "H" rating. Other outputs and/or inputs available on request.

Output Volts (F.L.)	Output Current (Amps) Parallel Connection	Series Connection	Size	Weight Lbs. Typ.	Model Number
5V Parallel	2.0	1.0	1	1.2	6B5-10
10V C.T. Series	3.0	1.5	2	1.5	6B5-15
	6.0	3.0	3	2.2	6B5-30
	12.0	6.0	4	3.0	6B5-60
	18.0	9.0	5	4.3	6B5-90
	26.0	13.0	6	5.5	6B5-130
	32.0	16.0	7	7.0	6B5-160*
	60.0	30.0	8	13.0	6B5-300†
	100.0	50.0	9	23.0	6B5-500†
6.3V Parallel	1.60	0.80	1	1.2	6B6-10
12.6V C.T. Series	2.40	1.20	2	1.5	6B6-15
	4.80	2.40	3	2.2	6B6-30
	9.40	4.70	4	3.0	6B6-60
	14.4	7.20	5	4.3	6B6-90
	20.6	10.3	6	5.5	6B6-130
	25.4	12.7	7	7.0	6B6-160*
	48.0	24.0	8	13.0	6B6-300†
	95.0	47.5	9	23.0	6B6-600†
8V Parallel	1.20	0.60	1	1.2	6B8-10
16V C.T. Series	1.80	0.90	2	1.5	6B8-15
	3.60	1.80	3	2.2	6B8-30
	7.60	3.80	4	3.0	6B8-60
	11.2	5.60	5	4.3	6B8-90
	16.2	8.10	6	5.5	6B8-130
	20.0	10.0	7	7.0	6B8-160*
	37.5	18.75	8	13.0	6B8-300†
	75.0	37.50	9	23.0	6B8-600†
	100.0	50.0	10	26.0	6B8-800†
10V Parallel	1.0	0.5	1	1.2	6B10-10
20V C.T. Series	1.5	0.75	2	1.5	6B10-15
	3.0	1.5	3	2.2	6B10-30
	6.0	3.0	4	3.0	6B10-60
	9.0	4.5	5	4.3	6B10-90
	13.0	6.5	6	5.5	6B10-130
	16.0	8.0	7	7.0	6B10-160*
	30.0	15.0	8	13.0	6B10-300*
	60.0	30.0	9	23.0	6B10-600†
	85.0	42.5	10	26.0	6B10-850†
	100.0	50.0	11	36.0	6B10-1000†
12V Parallel	0.82	0.41	1	1.2	6B12-10
24V C.T. Series	1.24	0.62	2	1.5	6B12-15
	2.50	1.25	3	2.2	6B12-30
	5.0	2.50	4	3.0	6B12-60
	7.5	3.75	5	4.3	6B12-90
	10.82	5.41	6	5.5	6B12-130
	13.32	6.66	7	7.0	6B12-160*
	25.00	12.50	8	13.0	6B12-300*
	50.00	25.00	9	23.0	6B12-600†
	71.00	35.50	10	26.0	6B12-850†
	100.00	50.00	11	36.0	6B12-1200†

* Use Fig. 3 for layout †Use Fig. 4 for layout

SIZE	A	B	C	D	E	F	HOLE	FIG.
1	1.95	1.68	2.31	2.37	—	2.87	0.18	1
2	2.26	1.93	2.68	2.81	—	3.12	0.18	1
3	2.57	2.18	3.06	3.12	—	3.56	0.18	1
4	2.81	2.43	3.37	2.25	2.12	2.70	0.2 x 0.3	2
5	3.12	2.68	3.75	2.50	2.25	2.86	0.2 x 0.3	2
6	3.44	2.93	4.12	2.75	2.37	2.98	0.2 x 0.3	3
7	3.75	3.18	4.50	3.00	2.50	3.11	0.2 x 0.3	3 or 4
8	5.25	3.87	4.37	4.37	2.85	3.75	0.26 x 0.4	3 or 4
9	6.37	4.62	5.31	5.31	3.22	4.20	0.26 x 0.4	3 or 4
10	6.37	4.99	5.31	5.31	3.60	4.58	0.26 x 0.4	3 or 4
11	7.50	5.37	6.25	6.75	3.60	4.85	0.26 x 0.4	3 or 4

DIMENSIONAL TOLERANCE: ±0.06 except B is max.

TERMINATION: Less than 16A output — solder lugs. 16A or greater output — threaded screws on terminal board; screw height 1" above C dimension (see fig. 4).

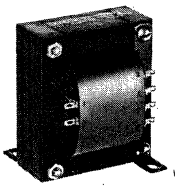


FIG. 1, 2, 3

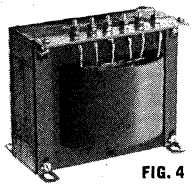
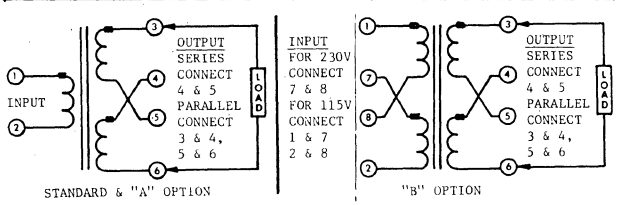


FIG. 4

Output Volts (F.L.)	Output Current (Amps) Parallel Connection	Series Connection	Size	Weight Lbs. Typ.	Model Number
17V Parallel	0.58	0.29	1	1.2	6B17-10
34V C.T. Series	0.88	0.44	2	1.5	6B17-15
	1.76	0.88	3	2.2	6B17-30
	3.52	1.76	4	3.0	6B17-60
	5.28	2.64	5	4.3	6B17-90
	7.64	3.82	6	5.5	6B17-130
	9.40	4.70	7	7.0	6B17-160*
	17.65	8.8	8	13.0	6B17-300*
	35.00	17.5	9	23.0	6B17-600†
	50.00	25.00	10	26.0	6B17-850†
	76.5	38.25	11	36.0	6B17-1300†
20V Parallel	0.5	0.25	1	1.2	6B20-10
40V C.T. Series	0.74	0.37	2	1.5	6B20-15
	1.5	0.75	3	2.2	6B20-30
	3.0	1.5	4	3.0	6B20-60
	4.5	2.25	5	4.3	6B20-90
	6.5	3.25	6	5.5	6B20-130
	8.0	4.0	7	7.0	6B20-160*
	15.0	7.50	8	13.0	6B20-300*
	30.0	15.0	9	23.0	6B20-600*
	42.5	21.25	10	26.0	6B20-850†
	65.0	32.50	11	36.0	6B20-1300†
28V Parallel	0.36	0.18	1	1.2	6B28-10
56V C.T. Series	0.52	0.26	2	1.5	6B28-15
	1.06	0.53	3	2.2	6B28-30
	2.14	1.07	4	3.0	6B28-60
	3.20	1.60	5	4.3	6B28-90
	4.64	2.32	6	5.5	6B28-130
	5.70	2.85	7	7.0	6B28-160*
	10.70	5.35	8	13.0	6B28-300*
	21.43	10.71	9	23.0	6B28-600*
	30.36	15.18	10	26.0	6B28-850*
	46.42	23.21	11	36.0	6B28-1300†
44V Parallel	0.22	0.11	1	1.2	6B44-10
88V C.T. Series	0.34	0.17	2	1.5	6B44-15
	0.68	0.34	3	2.2	6B44-30
	1.36	0.68	4	3.0	6B44-60
	2.04	1.02	5	4.3	6B44-90
	2.94	1.47	6	5.5	6B44-130
	3.62	1.81	7	7.0	6B44-160*
	6.82	3.41	8	13.0	6B44-300*
	13.64	6.82	9	23.0	6B44-600*
	19.32	9.66	10	26.0	6B44-850*
	29.54	14.77	11	36.0	6B44-1300*
60V Parallel	0.16	0.08	1	1.2	6B60-10
120V C.T. Series	0.250	0.125	2	1.5	6B60-15
	0.50	0.25	3	2.2	6B60-30
	1.0	0.50	4	3.0	6B60-60
	1.5	0.75	5	4.3	6B60-90
	2.16	1.08	6	5.5	6B60-130
	2.66	1.33	7	7.0	6B60-160*
	5.00	2.50	8	13.0	6B60-300*
	10.00	5.00	9	23.0	6B60-600*
	14.16	7.08	10	26.0	6B60-850*
	21.67	10.83	11	36.0	6B60-1300*



STANDARD & "A" OPTION "B" OPTION

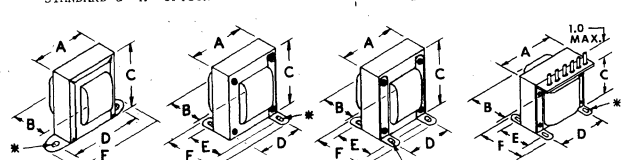


FIG. 1 FIG. 2 * FIG. 3 FIG. 4

ABBOTT TRANSISTOR LABORATORIES, INC.

Transformer Div. Western Offices: 639 S. Glenwood Pl., Burbank, CA 91506 (213) 841-3630. Telex: 69-6282

Eastern: 520 Main St., Ft. Lee, NJ 07024 (201) 461-4411. Telex: 13-5332 • New England: (617) 272-5676 • Southwest: 710 Kindred Lane, Richardson, TX 75080 (214) 437-0697

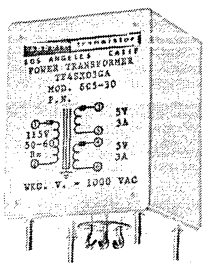
abbott TRANSFORMERS

60 Hz-400 Hz MIL-T-27D Transformers

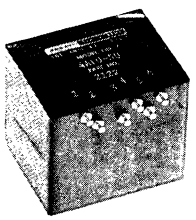
MODELS 6C 4A

SPECIFICATIONS

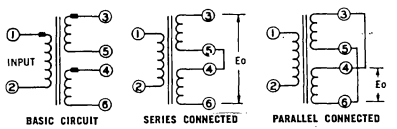
	6C Series	4A Series
INPUT PRIMARY:	115 VAC, 50 to 65 Hz, 1 Phase	115V, 400 Hz ±20 Hz, 1 Phase
REGULATION:	10% no load to full load	10% no load to full load
SECONDARY VOLTAGE TOLERANCE:	Within 3% when measured at full load and 115 VAC input	Within 5% when measured at full load and 115 VAC input
INSULATION TEST:	1500 VAC	1500 VAC
OPERATING TEMP.:	90°C maximum ambient operating temperature	95°C maximum ambient operating temperature
CONSTRUCTION	To MIL-T-27D, grade 4, class "S" life "X", (10,000 hrs.)	To MIL-T-27D, grade 5, class "S" life "X", (10,000 hrs.)
EFFICIENCY:	From 80% to 90%	From 90% to 93%
ENVIRONMENT	Encapsulated to meet MIL-STD-810C for vibration, shock, sand, dust, humidity, salt spray, fungus, sunshine, rain, explosion, and altitude (to a vacuum). NOTE: for high altitude operation, encapsulate terminals.	
OPTIONS AVAILABLE:	Other output voltages and 230 VAC input are available. Please consult our nearest office for complete information.	



MODEL 6C



MODEL 4A

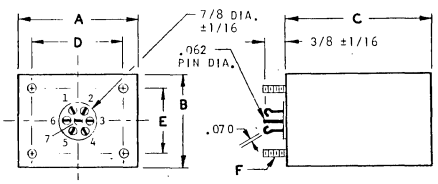


BASIC CIRCUIT SERIES CONNECTED PARALLEL CONNECTED

Output Volts (F.L.)	6C Series: Output Current (Amps) Parallel Connection	Series Connection	Size	Weight Lbs. Typ.	Model Number	4A Series: Output Current (Amps) Parallel Connection	Series Connection	Size	Weight Lbs. Typ.	Model Number
5V Parallel	1.00	0.50	EB	1.2	6C5-5	1.40	0.70	1	0.26	4A5-7
10V C.T.	3.00	1.50	FA	2.2	6C5-15	2.00	1.00	2	0.30	4A5-10
Series	6.00	3.00	GA	3.3	6C5-30	5.00	2.50	3	0.47	4A5-25
	12.00	6.00	HA	4.7	6C5-60	8.00	4.00	4	0.77	4A5-40
	20.00	10.00	JA	7.4	6C5-100	24.0	12.0	5	1.6	4A5-120
						30.0	15.0	6	2.0	4A5-150
6.3V Parallel	0.80	0.40	EB	1.2	6C6-5	1.11	0.55	1	0.26	4A6-7
12.6V C.T.	2.38	1.19	FA	2.2	6C6-15	1.58	0.79	2	0.30	4A6-10
Series	4.76	2.38	GA	3.3	6C6-30	4.00	2.00	3	0.47	4A6-25
	9.52	4.76	HA	4.7	6C6-60	8.00	4.00	4	0.77	4A6-50
	20.00	10.00	JA	7.4	6C6-126	19.0	9.50	5	1.6	4A6-120
						23.8	11.9	6	2.0	4A6-150
8V Parallel	0.62	0.31	EB	1.2	6C8-5	0.874	0.437	1	0.26	4A8-7
16V C.T.	1.86	0.93	FA	2.2	6C8 15	1.25	0.625	2	0.30	4A8-10
Series	3.72	1.86	GA	3.3	6C8-30	3.12	1.56	3	0.47	4A8-25
	7.44	3.72	HA	4.7	6C8-60	6.24	3.12	4	0.77	4A8-50
	17.50	8.75	JA	7.4	6C8-140	15.0	7.50	5	1.6	4A8-120
	20.00	10.00	KA	9.8	6C8-160	18.7	9.35	6	2.0	4A8-150
10V Parallel	0.50	0.25	EB	1.2	6C10-5	0.70	0.35	1	0.26	4A10-7
20V C.T.	1.50	0.75	FA	2.2	6C10-15	1.00	0.50	2	0.30	4A10-10
Series	3.00	1.50	GA	3.3	6C10-30	2.50	1.25	3	0.47	4A10-25
	6.00	3.00	HA	4.7	6C10-60	5.00	2.50	4	0.77	4A10-50
	14.00	7.00	JA	7.4	6C10-140	12.0	6.00	5	1.6	4A10-120
	17.00	8.50	KA	9.8	6C10-170	15.0	7.50	6	2.0	4A10-150
12V Parallel	0.40	0.20	EB	1.2	6C12-5	0.58	0.29	1	0.26	4A12-7
24V C.T.	1.20	0.60	FA	2.2	6C12-15	0.84	0.42	2	0.30	4A12-10
Series	2.40	1.20	GA	3.3	6C12-30	2.08	1.04	3	0.47	4A12-25
	4.80	2.40	HA	4.7	6C12-60	4.16	2.08	4	0.77	4A12-50
	11.60	5.80	JA	7.4	6C12-140	10.0	5.00	5	1.6	4A12-120
	14.16	7.08	KA	9.8	6C12-170	12.5	6.25	6	2.0	4A12-150
17V Parallel	0.30	0.15	EB	1.2	6C17-5	0.411	0.205	1	0.26	4A17-7
34V C.T.	0.88	0.44	FA	2.2	6C17-15	0.588	0.294	2	0.30	4A17-10
Series	1.76	0.88	GA	3.3	6C17-30	1.47	0.735	3	0.47	4A17-25
	3.52	1.76	HA	4.7	6C17-60	2.94	1.47	4	0.77	4A17-50
	8.20	4.10	JA	7.4	6C17-140	7.06	3.53	5	1.6	4A17-120
	10.00	5.00	KA	9.8	6C17-170	8.82	4.41	6	2.0	4A17-150
20V Parallel	0.24	0.12	EB	1.2	6C20-5	0.35	0.175	1	0.26	4A20-7
40V C.T.	0.72	0.36	FA	2.2	6C20-15	0.50	0.250	2	0.30	4A20-10
Series	1.44	0.72	GA	3.3	6C20-30	1.25	0.625	3	0.47	4A20-25
	2.88	1.44	HA	4.7	6C20-60	2.50	1.25	4	0.77	4A20-50
	7.00	3.50	JA	7.4	6C20-140	6.00	3.00	5	1.6	4A20-120
	8.50	4.25	KA	9.8	6C20-170	7.50	3.75	6	2.0	4A20-150
28V Parallel	0.18	0.09	EB	1.2	6C28-5	0.250	0.125	1	0.26	4A28-7
56V C.T.	0.54	0.27	FA	2.2	6C28-15	0.356	0.178	2	0.30	4A28-10
Series	1.08	0.54	GA	3.3	6C28-30	0.892	0.446	3	0.47	4A28-25
	2.16	1.08	HA	4.7	6C28-60	1.78	0.89	4	0.77	4A28-50
	5.00	2.50	JA	7.4	6C28-140	4.28	2.14	5	1.6	4A28-120
	6.06	3.03	KA	9.8	6C28-170	5.36	2.68	6	2.0	4A28-150
44V Parallel	0.10	0.05	EB	1.2	6C44-5	0.158	0.079	1	0.26	4A44-7
88V C.T.	0.30	0.15	FA	2.2	6C44-15	0.226	0.113	2	0.30	4A44-10
Series	0.60	0.30	GA	3.3	6C44-30	0.568	0.284	3	0.47	4A44-25
	1.20	0.60	HA	4.7	6C44-60	1.12	0.56	4	0.77	4A44-50
	3.16	1.58	JA	7.4	6C44-140	2.72	1.36	5	1.6	4A44-120
	3.86	1.93	KA	9.8	6C44-170	3.40	1.70	6	2.0	4A44-150
60V Parallel	0.08	0.04	EB	1.2	6C60-5	0.116	0.058	1	0.26	4A60-7
120V C.T.	0.24	0.12	FA	2.2	6C60-15	0.166	0.083	2	0.30	4A60-10
Series	0.48	0.24	GA	3.3	6C60-30	0.416	0.208	3	0.47	4A60-25
	0.96	0.48	HA	4.7	6C60-60	0.82	0.41	4	0.77	4A60-50
	2.32	1.16	JA	7.4	6C60-140	2.00	1.00	5	1.6	4A60-120
	2.82	1.41	KA	9.8	6C60-170	2.50	1.25	6	2.0	4A60-150

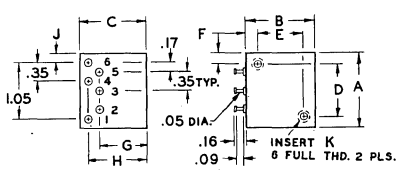
Size	A	B	C	D	E	F
EB	1.938	1.812	2.438	1.375	1.250	6-32 x 3/8
FA	2.312	2.062	3.125	1.688	1.438	6-32 x 3/8
GA	2.750	2.375	3.812	2.125	1.750	6-32 x 3/8
HA	3.062	2.625	4.250	2.297	1.859	8-32 x 3/8
JA	3.562	3.062	4.875	2.625	2.125	8-32 x 3/8
KA	3.938	3.375	5.250	3.000	2.438	10-32 x 1/2

Dimension A, B = +0.000 −0.125.
Dimension C = +0.000 −0.188
Dimension D, E = ±0.016 except size KA = 0.031
Dimension F = ±0.062

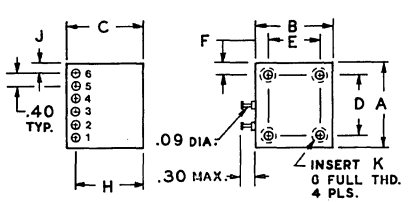


SIZES EB, FA, GA, HA, JA, KA

Size	A	B	C	D	E	F	G	H	J	K
1	1.37	1.25	1.31	1.00	.87	.19	1.00	1.19	.16	4-40
2	1.50	1.37	1.37	1.12	1.00	.19	1.06	1.25	.22	4-40
3	1.75	1.50	1.56	1.25	1.00	.25	1.25	1.44	.35	6-32
4	2.00	1.62	1.81	1.50	1.12	.25	1.50	1.69	.47	6-32
5	2.43	2.00	2.10	1.93	1.50	.25	—	1.90	.21	6-32
6	2.81	2.12	2.43	2.21	1.52	.30	—	2.23	.40	8-32



SIZES 1, 2, 3, 4



SIZES 5, 6

ABBOTT TRANSISTOR LABORATORIES, INC.
Transformer Div. Western Offices: 639 S. Glenwood Pl., Burbank, CA 91506 (213) 841-3630. Telex: 69-6282
Eastern: 520 Main St., Ft. Lee, NJ 07024 (201) 461-4411. Telex: 13-5332 • New England: (617) 272-5676 • Southwest: 710 Kindred Lane, Richardson, TX 75080 (214) 437-0697

abbott TRANSFORMERS

60 Hz Transformers

MODEL **P**

SPECIFICATIONS

INPUT PRIMARY: 115 VAC, 60 Hz ±5 Hz, 1 phase.

REGULATION: 10% no load to full load.

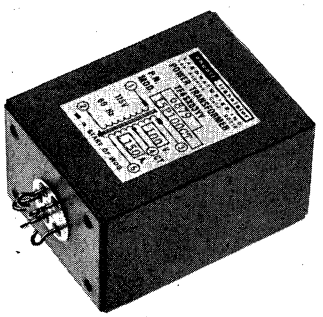
SECONDARY VOLTAGE TOLERANCE: Within 3% of listed output voltage when measured at full load and 115 VAC input.

CONSTRUCTION: To MIL-T-27D, grade: 4 class: "S", Case: steel.

ENVIRONMENT: To operate in 95°C maximum ambient temperature. Encapsulated to meet MIL-STD-810C for vibration, shock, acceleration, sand, dust, humidity, saltspray, fungus, sunshine, rain, explosion, and altitude (to a vacuum). NOTE: For high altitude operation, encapsulate terminals.

INSULATION TEST: 1750 VAC.

SECONDARY: See output voltage and current of specific models listed. For 50 Hz operation, reduce secondary current by 10% of ratings listed. These units are capable of 400 Hz operation; however, see Abbott's distinct line of miniature 400 Hz transformers.



Output Volts (F.L.)	Output Current (Amp)	Size	Secondary DCR ohms (typical)	Model Number
5.0	1.00	A1	0.335	5P5CT
	2.00	A2	0.12	10P5CT
	3.00	A3	0.07	15P5CT
	4.00	A4	0.066	20P5CT
	6.00	A5	0.04	30P5CT
	8.00	A6	0.03	40P5CT
	16.00	A7	0.014	80P5CT
6.3	0.79	A1	0.53	5P6.3CT
	1.58	A2	0.18	10.6:3CT
	2.38	A3	0.094	15P6.3CT
	3.16	A4	0.1	20P6.3CT
	4.76	A5	0.06	30P6.3CT
	6.35	A6	0.059	40P6.3CT
	12.70	A7	0.02	80P6.3CT
	19.00	A8	0.0014	120P6.3CT
8.0	0.67	A1	0.87	5P8CT
	1.25	A2	0.27	10P8CT
	1.88	A3	0.16	15P8CT
	2.50	A4	0.15	20P8CT
	3.76	A5	0.08	30P8CT
	5.00	A6	0.079	40P8CT
	10.00	A7	0.04	80P8CT
	15.00	A8	0.022	120P8CT
	20.00	A9	0.0072	160P8CT
10	0.50	A1	1.34	5P10CT
	1.00	A2	0.42	10P10CT
	1.50	A3	0.23	15P10CT
	2.00	A4	0.23	20P10CT
	3.00	A5	0.14	30P10CT
	4.00	A6	0.11	40P10CT
	8.00	A7	0.05	80P10CT
	12.00	A8	0.031	120P10CT
	16.00	A9	0.008	160P10CT
	20.00	A10	0.02	200P10CT
12.6	0.39	A1	2.06	5P12.6CT
	0.79	A2	0.65	10P12.6CT
	1.19	A3	0.4	15P12.6CT
	1.59	A4	0.34	20P12.6CT
12.6	2.38	A5	0.2	30P12.6CT
	3.18	A6	0.18	40P12.6CT
	6.35	A7	0.07	80P12.6CT
	9.53	A8	0.041	120P12.6CT
	12.70	A9	0.035	160P12.6CT
	15.90	A10	0.027	200P12.6CT
14	0.36	A1	2.95	5P14CT
	0.72	A2	0.74	10P14CT
	1.07	A3	0.6	15P14CT
	1.43	A4	0.4	20P14CT
	2.15	A5	0.23	30P14CT
	2.86	A6	0.19	40P14CT
	5.72	A7	0.1	80P14CT
	8.59	A8	0.055	120P14CT
	11.40	A9	0.042	160P14CT
	14.30	A10	0.029	200P14CT
16	0.34	A1	3.35	5P16CT
	0.68	A2	1.08	10P16CT
	0.94	A3	0.67	15P16CT
	1.25	A4	0.52	20P16CT
	1.87	A5	0.28	30P16CT
	2.50	A6	0.28	40P16CT
	5.00	A7	0.12	80P16CT
	7.50	A8	0.072	120P16CT
	10.00	A9	0.046	160P16CT
	12.50	A10	0.034	200P16CT
	18.70	A11	0.02	300P16CT
18	0.28	A1	4.65	5P18CT
	0.55	A2	1.42	10P18CT
	0.83	A3	0.78	15P18CT
	1.11	A4	0.62	20P18CT
	1.67	A5	0.38	30P18CT
	2.21	A6	0.36	40P18CT
	4.44	A7	0.16	80P18CT
	6.68	A8	0.08	120P18CT
	8.89	A9	0.060	160P18CT
	11.10	A10	0.04	200P18CT
	16.70	A11	0.022	300P18CT
20	0.25	A1	5.25	5P20CT
	0.50	A2	1.54	10P20CT
	0.75	A3	0.9	15P20CT
	1.00	A4	0.85	20P20CT
	1.50	A5	0.4	30P20CT
	2.00	A6	0.43	40P20CT
	4.00	A7	0.19	80P20CT
	6.00	A8	0.120	120P20CT
	8.00	A9	0.070	160P20CT
	10.00	A10	0.066	200P20CT
	15.00	A11	0.026	300P20CT
22	0.22	A1	7.3	5P22CT
	0.45	A2	1.9	10P22CT
	0.68	A3	1.2	15P22CT
	0.91	A4	0.95	20P22CT
	1.36	A5	0.55	30P22CT
	1.82	A6	0.57	40P22CT
	3.64	A7	0.25	80P22CT
	5.45	A8	0.125	120P22CT
	7.27	A9	0.092	160P22CT
	9.10	A10	0.073	200P22CT
	13.60	A11	0.031	300P22CT
25	0.20	A1	8.23	5P25CT
	0.40	A2	2.55	10P25CT
	0.60	A3	1.4	15P25CT
	0.80	A4	1.37	20P25CT
	1.20	A5	0.7	30P25CT
	1.60	A6	0.67	40P25CT
	3.20	A7	0.3	80P25CT
	4.80	A8	0.182	120P25CT
	6.40	A9	0.11	160P25CT
	8.00	A10	0.079	200P25CT
	12.00	A11	0.042	300P25CT
28	0.18	A1	11.4	5P28CT
	0.36	A2	3.0	10P28CT
	0.54	A3	1.9	15P28CT
	0.71	A4	1.6	20P28CT
	1.07	A5	0.94	30P28CT
	1.43	A6	0.90	40P28CT
28	2.86	A7	0.4	80P28CT
	4.29	A8	0.205	120P28CT
	5.72	A9	0.150	160P28CT
	7.10	A10	0.11	200P28CT
	10.70	A11	0.046	300P28CT
31	0.16	A1	13.8	5P31CT
	0.32	A2	3.8	10P31CT
	0.48	A3	2.2	15P31CT
	0.64	A4	2.2	20P31CT
	0.97	A5	0.96	30P31CT
	1.29	A6	0.95	40P31CT
	2.58	A7	0.45	80P31CT
	3.87	A8	0.31	120P31CT
	5.17	A9	0.166	160P31CT
	6.40	A10	0.12	200P31CT
	9.67	A11	0.054	300P31CT
35	0.14	A1	17.6	5P35CT
	0.29	A2	4.5	10P35CT
	0.43	A3	3.0	15P35CT
	0.57	A4	2.4	20P35CT
	0.86	A5	1.4	30P35CT
	1.14	A6	1.32	40P35CT
	2.28	A7	0.5	80P35CT
	3.43	A8	0.35	120P35CT
	4.57	A9	0.240	160P35CT
	5.71	A10	0.17	200P35CT
	8.59	A11	0.072	300P35CT
39	0.13	A1	19.7	5P39CT
	0.26	A2	6.3	10P39CT
	0.38	A3	3.5	15P39CT
	0.51	A4	3.6	20P39CT
	0.77	A5	1.62	30P39CT
	1.03	A6	1.5	40P39CT
	2.05	A7	0.7	80P39CT
	3.07	A8	0.342	120P39CT
	4.10	A9	0.270	160P39CT
	5.12	A10	0.18	200P39CT
	7.69	A11	0.08	300P39CT

Other standard models to 486V

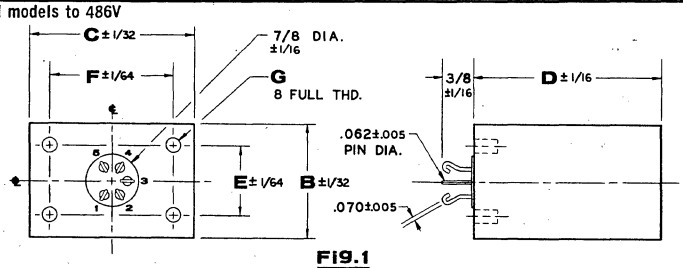


FIG. 1

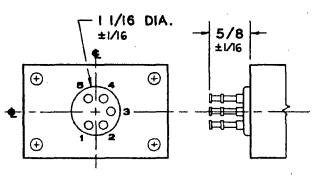


FIG. 2

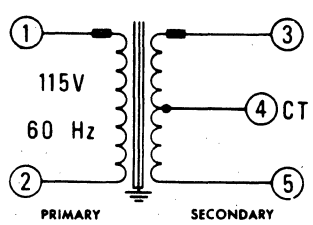
Size	B	C	D	E	F	G
A1	1½	1¾	2⅜	1⅛	1¼	6-32
A2	1¾	2 1/16	2¾	1¼	1½	6-32
A3	1⅞	2⅜	3⅛	1¼	1¾	8-32
A4	2	2⅜	3⅛	1½	1¾	8-32
A5	2⅛	2 1/16	3½	1½	2	8-32
A6	2¼	2 1/16	3½	1⅝	2	8-32
A7*	2⅝	3⅛	4⅛	2	2¼	8-32
A8*	2⅞	3 1/16	4½	2¼	2½	10-32
A9*	3⅛	3¾	4⅞	2 1/16	2¾	10-32
A10*	3⅜	4 1/16	5¼	2⅝	3	¼-20
A11*	3⅞	4 1/16	6	2¾	3½	¼-20

Model Type	Weight Lbs. (Max.)	Primary DCR (ohms typical)
5P	1.0	86
10P	1.5	36
15P	2.0	24
20P	2.5	15
30P	3.0	8.5
40P	3.3	6.7
80P	5.0	3.7
120P	6.5	1.9
160P	8.2	1.6
200P	10.5	1.1
300P	17.0	0.5

* See Fig. 2 for header configuration used on any unit with output current greater than 10 amps.

TYPICAL CIRCUIT DIAGRAM

"■" refers to the start of winding



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abbott TRANSFORMERS — 400 Hz Transformers — MODEL E

SPECIFICATIONS

Input Primary
115V, 400 Hz ±20 Hz, 1 phase

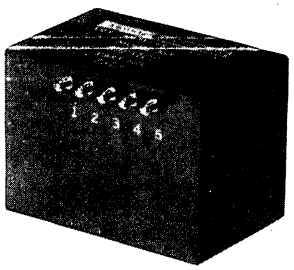
Regulation
10% no load to full load

Secondary Voltage Tolerance
Within 5% when measured at full load and 115 VAC input

Construction
To MIL-T-27D, grade 5, class: "S" Molded Diallyl Phthalate

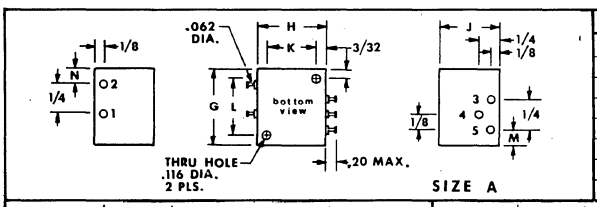
Environment
Encapsulated to meet MIL-STD-810C, including vibration, ambient temperature ot 85°C, shock, sand, dust, humidity, saltspray, fungus, sunshine, rain, explosion, and altitude (to a vacuum).

Output Secondary
See voltage and current of specific models listed.



Other models are available. Contact our nearest office for complete information.

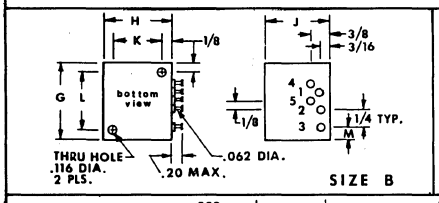
Output Volts	Output Current (Amps)	Size	Sec. DCR (ohms)	Model Number
5.0	0.400	A	0.60	2E5CT
	1.200	B	0.144	6E5CT
	3.000	C	0.046	15E5CT
	4.800	D	0.040	24E5CT
	16.000	E2	0.009	80E5CT
	35.000	F2	0.012	175E5CT
6.3	0.317	A	1.06	2E6.3CT
	0.950	B	0.24	6E6.3CT
	2.380	C	0.088	15E6.3CT
	3.800	D	0.107	24E6.3CT
	12.800	E2	0.016	80E6.3CT
	27.800	F2	0.019	175E6.3CT
8.0	0.250	A	1.63	2E8CT
	0.750	B	0.396	6E8CT
	1.880	C	0.135	15E8CT
	3.000	D	0.140	24E8CT
	10.000	E2	0.017	80E8CT
	22.000	F2	0.010	175E8CT
10.0	0.200	A	2.50	2E10CT
	0.600	B	0.587	6E10CT
	1.500	C	0.27	15E10CT
	2.400	D	0.180	24E10CT
	8.000	E	7.2	80E10CT
	17.500	F2	0.020	175E10CT
12.6	0.158	A	4.10	2E12.6CT
	0.475	B	0.99	6E12.6CT
	1.180	C	0.32	15E12.6CT
	1.900	D	0.225	24E12.6CT
	6.350	E	0.030	80E12.6CT
	13.900	F2	0.021	175E12.6CT
14.0	0.142	A	5.59	2E14CT
	0.428	B	1.11	6E14CT
	1.070	C	0.35	15E14CT
	1.720	D	0.32	24E14CT
	5.600	E	0.04	80E14CT
	12.500	F2	0.022	175E14CT
16	0.125	A	6.63	2E16CT
	0.375	B	1.58	6E16CT
	0.940	C	0.54	15E16CT
	1.500	D	0.35	24E16CT
	5.000	E	0.05	80E16CT
	10.900	F2	0.025	175E16CT
18	0.111	A	9.00	2E18CT
	0.333	B	2.21	6E18CT
	0.832	C	0.74	15E18CT
	1.330	D	0.40	24E18CT
	4.450	E	0.08	80E18CT
	9.700	F	0.027	175E18CT
20	0.100	A	10.9	2E20CT
	0.300	B	2.78	6E20CT
	0.750	C	1.4	15E20CT
	1.200	D	0.48	24E20CT
	4.000	E	0.09	80E20CT
	8.750	F	0.020	175E20CT
22	0.091	A	14.6	2E22CT
	0.273	B	2.80	6E22CT
	0.680	C	0.92	15E22CT
	1.090	D	0.63	24E22CT
	3.630	E	0.12	80E22CT
	7.900	F	0.020	175E22CT
25	0.080	A	20.4	2E25CT
	0.240	B	3.60	6E25CT
	0.600	C	1.3	15E25CT
	0.900	D	0.68	24E25CT
	3.200	E	0.13	80E25CT
	7.000	F	0.042	175E25CT
28	0.071	A	30.0	2E28CT
	0.214	B	4.20	6E28CT
	0.535	C	1.83	15E28CT
	0.855	D	0.98	24E28CT
	2.850	E	0.14	80E28CT
	6.250	F	0.043	175E28CT
31	0.064	A	25.6	2E31CT
	0.192	B	5.71	6E31CT
	0.485	C	1.62	15E31CT
	0.717	D	1.27	24E31CT
	2.470	E	0.18	80E31CT
	5.650	F	0.061	175E31CT
35	0.057	A	29.5	2E35CT
	0.171	B	6.89	6E35CT
	0.428	C	2.28	15E35CT
	0.685	D	1.70	24E35CT
	2.280	E	0.28	80E35CT
	5.000	F	0.098	175E35CT
39	0.051	A	38.6	2E39CT
	0.154	B	9.39	6E39CT
	0.384	C	2.54	15E39CT
	0.615	D	2.20	24E39CT
	2.050	E	0.32	80E39CT
	4.480	F	0.110	175E39CT
43	0.046	A	44.3	2E43CT
	0.139	B	10.25	6E43CT
	0.348	C	2.85	15E43CT
	0.556	D	2.42	24E43CT
	1.860	E	0.35	80E43CT
	4.060	F	0.114	175E43CT
48	0.041	A	57.0	2E48CT
	0.125	B	15.30	6E48CT
	0.312	C	4.05	15E48CT
	0.500	D	3.27	24E48CT
	1.660	E	0.40	80E48CT
	3.650	F	0.160	175E48CT
55	0.036	A	89.0	2E55CT
	0.109	B	17.30	6E55CT
	0.262	C	7.2	15E55CT
	0.435	D	3.83	24E55CT
	1.450	E	0.67	80E55CT
	3.170	F	0.196	175E55CT
63	0.031	A	100.0	2E63CT
	0.095	B	24.9	6E63CT
	0.238	C	6.51	15E63CT
	0.380	D	5.35	24E63CT
	1.270	E	0.71	80E63CT
	2.770	F	0.20	175E63CT
70	0.028	A	139.0	2E70CT
	0.085	B	27.1	6E70CT
	0.214	C	9.4	15E70CT
	0.342	D	8.10	24E70CT
	1.140	E	0.80	80E70CT
	2.500	F	0.25	175E70CT
80	0.025	A	163.0	2E80CT
	0.075	B	39.0	6E80CT
	0.198	C	13.4	15E80CT
	0.300	D	9.0	24E80CT
	1.000	E	0.92	80E80CT
	2.180	F	0.34	175E80CT
90	0.022	A	218.0	2E90CT
	0.067	B	41.0	6E90CT
	0.166	C	15.9	15E90CT
	0.267	D	12.5	24E90CT
	0.890	E	1.08	80E90CT
	1.940	F	0.38	175E90CT
100	0.020	A	283.0	2E100CT
	0.060	B	59.5	6E100CT
	0.150	C	16.8	15E100CT
	0.240	D	14.4	24E100CT
	0.800	E	1.64	80E100CT
	1.750	F	0.52	175E100CT
110	0.018	A	392.0	2E110CT
	0.054	B	62.3	6E110CT
	0.136	C	22.1	15E110CT
	0.218	D	19.5	24E110CT
	0.728	E	2.03	80E110CT
	1.590	F	0.72	175E110CT

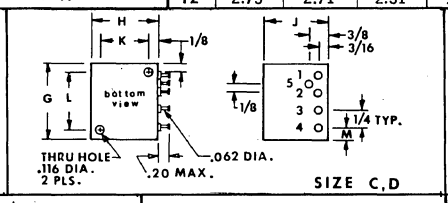


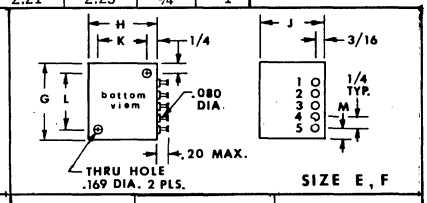
SIZE	G	H	J	K	L	M	N
A	.87	.74	.78	.55	.68	3/16	3/16
B	1.25	1.19	.88	.94	1.00	1/4	—
C	1.43	1.24	1.27	.99	1.18	1/4	—
D	1.47	1.28	1.40	1.03	1.22	1/4	—
E	2.31	1.52	1.75	1.02	1.81	1/2	—
E2	2.31	1.52	1.75	1.02	1.81	1/2	3/4
F	2.75	2.71	2.31	2.21	2.25	3/4	—
F2	2.75	2.71	2.31	2.21	2.25	3/4	1

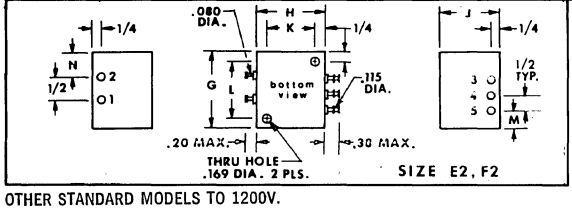
Dim. Tol. =
Fraction ±1/32,
xx = ±0.015,
xxx = ±0.005

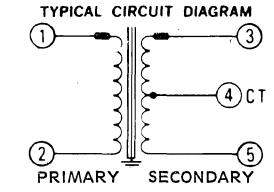
NOTE:
DIMENSIONS G & H MEASURED AT TOP OF TRANSFORMER











MODEL TYPE	WEIGHT lbs. (max)	PRIMARY DCR ohms (typical)
2E	0.06	201
6E	0.15	61
15E	0.28	14
24E	0.32	12
80E	0.80	2.0
175E	2.2	0.7

OTHER STANDARD MODELS TO 1200V.

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abbott TRANSFORMERS

400 Hz Power Toroid Transformers

MODELS TM TF

SPECIFICATIONS

INPUT PRIMARY: 115V, 400 Hz ±20 Hz, 1 phase for 230V operation add the suffix "A"

REGULATION: 5% or less, no load to full load

SECONDARY VOLTAGE TOLERANCE: Within 5% when measured at full load and 115 VAC input

INSULATION TEST: 1000 VAC

OPERATING TEMPERATURE: MODEL TM 90°C Maximum ambient/MODEL TF 80°C Maximum ambient

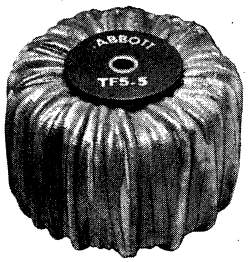
APPROXIMATE EFFICIENCY: 90% to 95%

OUTPUT SECONDARY: See voltage and current of specific models listed

CONSTRUCTION: MODEL TF — Open frame, Industrial Grade with Teflon leads 6" long MODEL TM — to meet MIL-T-27D, Grade 5, Class S, MIL-type Designation TF5S03ZZ

OPTIONS: "A" option is for 230V input primary. Add suffix "A" to model number (i.e. TF10-1A). "C" option is for center tapped output. Add suffix "C" to model number (i.e. TF10-1C)

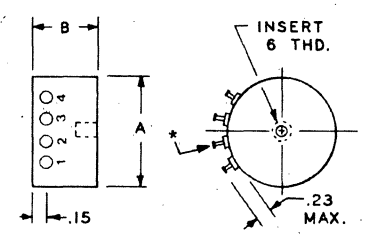
MODEL TM



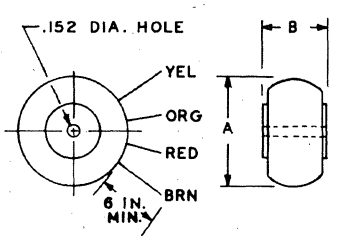
MODEL TF

Output Volts (F.L.)	Model No. TM	Model No. TF	Output Current (Amps)	Size	VA
5V	TM1-1	TF1-1	3.00	1	15
	TM1-2	TF1-2	5.00	2	25
	TM1-3	TF1-3	10.00	3	50
7V	TM2-1	TF2-1	2.14	1	15
	TM2-2	TF2-2	3.57	2	25
	TM2-3	TF2-3	7.14	3	50
	TM2-4	TF2-4	10.00	4	70
10V	TM3-1	TF3-1	1.50	1	15
	TM3-2	TF3-2	2.50	2	25
	TM3-3	TF3-3	5.00	3	50
	TM3-4	TF3-4	7.50	4	75
	TM3-5	TF3-5	10.00	5	100
12V	TM4-1	TF4-1	1.25	1	15
	TM4-2	TF4-2	2.08	2	25
	TM4-3	TF4-3	4.17	3	50
	TM4-4	TF4-4	6.25	4	75
	TM4-5	TF4-5	8.33	5	100
14V	TM5-1	TF5-1	1.07	1	15
	TM5-2	TF5-2	1.79	2	25
	TM5-3	TF5-3	3.57	3	50
	TM5-4	TF5-4	5.36	4	75
	TM5-5	TF5-5	7.14	5	100

Output Volts (F.L.)	Model No. TM	Model No. TF	Output Current (Amps)	Size	VA
17V	TM6-1	TF6-1	0.88	1	15
	TM6-2	TF6-2	1.47	2	25
	TM6-3	TF6-3	2.94	3	50
	TM6-4	TF6-4	4.41	4	75
	TM6-5	TF6-5	5.88	5	100
24V	TM7-1	TF7-1	0.63	1	15
	TM7-2	TF7-2	1.04	2	25
	TM7-3	TF7-3	2.08	3	50
	TM7-4	TF7-4	3.13	4	75
	TM7-5	TF7-5	4.17	5	100
28V	TM8-1	TF8-1	0.54	1	15
	TM8-2	TF8-2	0.89	2	25
	TM8-3	TF8-3	1.79	3	50
	TM8-4	TF8-4	2.68	4	75
	TM8-5	TF8-5	3.57	5	100
34V	TM9-1	TF9-1	0.44	1	15
	TM9-2	TF9-2	0.75	2	25
	TM9-3	TF9-3	1.47	3	50
	TM9-4	TF9-4	2.21	4	75
	TM9-5	TF9-5	2.94	5	100
115V	TM10-1	TF10-1	0.13	1	15
	TM10-2	TF10-2	0.21	2	25
	TM10-3	TF10-3	0.43	3	50
	TM10-4	TF10-4	0.65	4	75
	TM10-5	TF10-5	0.87	5	100



MODEL TM

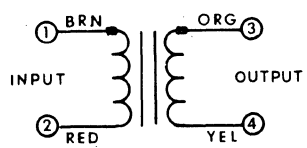


MODEL TF

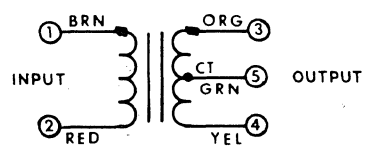
SIZE	1		2		3		4		5	
MODEL	TM	TF	TM	TF	TM	TF	TM	TF	TM	TF
DIM A	1.62	1.50	1.75	1.63	2.13	2.00	2.13	2.00	2.38	2.25
DIM B	0.95	0.95	1.00	1.00	1.10	1.10	1.30	1.30	1.60	1.60
WT. (LB. MAX.)	0.26	0.17	0.33	0.25	0.52	0.38	0.66	0.52	1.1	0.79
INSERT	6-32	—	8-32	—	8-32	—	10-32	—	10-32	—

DIMENSIONAL TOLERANCE: Model TM ±.03; Model TF Dim A, B Max.
*Terminal Spacing is 0.35.

STANDARD & OPTION A



OPTION C



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abbott TRANSFORMERS

400 Hz 3 Ø Power Transformers

MODEL **4D**

SPECIFICATIONS

INPUT PRIMARY:
WYE: (4 wire) Line to Common 115 VAC
WYE: (3 wire) Line to Line 200 VAC
DELTA: (3 wire) Line to Line 115 VAC (see option "A")
DELTA: (3 wire) Line to Line 200 VAC (see option "B")

INPUT FREQUENCY: 400 Hz ±20 Hz.

OUTPUT: See specific models listed.

OUTPUT VOLTAGE TOLERANCE: Within 5% when measured at full load and nominal VAC input.

REGULATION: 10% no load to full load.

INSULATION TEST: 1500 VRMS.

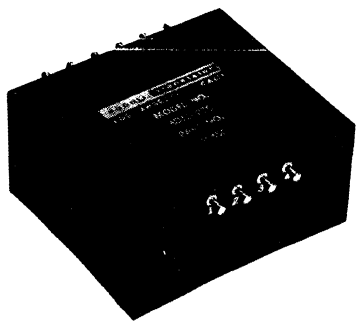
EFFICIENCY: Ranges from 90% to 95%.

OPERATING AMBIENT TEMPERATURE: 80°C Maximum

TEMPERATURE RISE: Less than 50°C.

CONSTRUCTION: To MIL-T-27D, Grade 5, class "S".

ENVIRONMENT: Encapsulated to meet MIL-STD-810C, including vibration, temperature to 80°C, shock, sand, dust, humidity, saltspray, fungus, sunshine, rain, explosion. Note: For high altitude operation encapsulate terminals.



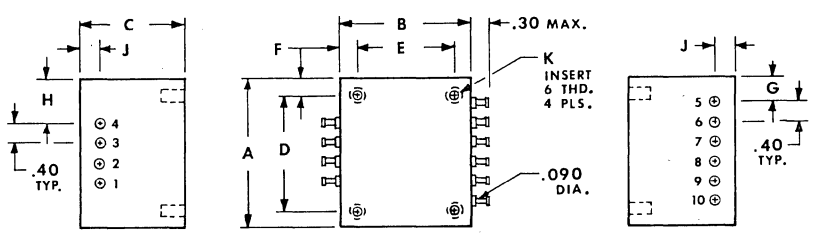
	OUTPUT PER PHASE					
	DELTA: L to L (3 wire) — WYE: L to COM. (4 wire)		WYE: L to L (3 wire)			
Model Number	Volts RMS	Current (Amps)	Volts RMS	Current (Amps)	Size	Weight Lbs. Max.
4D5-90	5	6.00	8.66	3.47	1	1.3
4D5-120	5	8.00	8.66	4.62	2	1.6
4D5-150	5	10.00	8.66	5.78	3	2.3
4D5-200	5	13.34	8.66	7.70	4	2.4
4D12-90	12	2.50	20.8	1.45	1	1.3
4D12-120	12	3.34	20.8	1.93	2	1.6
4D12-150	12	4.17	20.8	2.41	3	2.3
4D12-200	12	5.56	20.8	3.21	4	2.4
4D12-270	12	7.50	20.8	4.33	5	2.8
4D12-375	12	10.42	20.8	6.02	6	3.8
4D15-90	15	2.00	26.0	1.16	1	1.3
4D15-120	15	2.67	26.0	1.54	2	1.6
4D15-150	15	3.34	26.0	1.93	3	2.3
4D15-200	15	4.45	26.0	2.57	4	2.4
4D15-270	15	6.00	26.0	3.47	5	2.8
4D15-375	15	8.34	26.0	4.82	6	3.8
4D20-90	20	1.50	34.6	0.87	1	1.3
4D20-120	20	2.00	34.6	1.16	2	1.6
4D20-150	20	2.50	34.6	1.45	3	2.3
4D20-200	20	3.34	34.6	1.93	4	2.4
4D20-270	20	4.50	34.6	2.60	5	2.8
4D20-375	20	6.25	34.6	3.61	6	3.8
4D28-90	28	1.08	48.5	0.62	1	1.3
4D28-120	28	1.43	48.5	0.83	2	1.6
4D28-150	28	1.79	48.5	1.03	3	2.3
4D28-200	28	2.38	48.5	1.38	4	2.4
4D28-270	28	3.22	48.5	1.86	5	2.8
4D28-375	28	4.47	48.5	2.58	6	3.8
4D48-90	48	0.63	83.1	0.36	1	1.3
4D48-120	48	0.84	83.1	0.49	2	1.6
4D48-150	48	1.05	83.1	0.61	3	2.3
4D48-200	48	1.39	83.1	0.81	4	2.4
4D48-270	48	1.88	83.1	1.09	5	2.8
4D48-375	48	2.61	83.1	1.51	6	3.8
4D115-90	115	0.26	200	0.15	1	1.3
4D115-120	115	0.35	200	0.20	2	1.6
4D115-150	115	0.44	200	0.25	3	2.3
4D115-200	115	0.58	200	0.34	4	2.4
4D115-270	115	0.79	200	0.45	5	2.8
4D115-375	115	1.09	200	0.63	6	3.8

Option "A" — To order DELTA input 115 VAC L-L. Add suffix "A" to Model No. e.g. 4D5-90A
Option "B" — To order DELTA input 200 VAC L-L. Add suffix "B" to Model No. e.g. 4D5-90B

Size	A	B	C	D	E
1	2.90	2.40	1.45	2.50	2.00
2	2.90	2.70	1.55	2.50	2.30
3	3.65	2.80	1.70	3.15	2.30
4	3.65	3.00	1.70	3.15	2.50
5	3.65	3.00	1.95	3.15	2.50
6	4.95	3.20	1.90	4.45	2.70

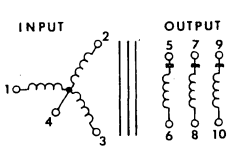
Size	F	G	H	J	K
1	.20	.45	.85	.20	6-32
2	.20	.45	.85	.20	6-32
3	.25	.82	1.22	.20	8-32
4	.25	.82	1.22	.20	8-32
5	.25	.82	1.22	.20	8-32
6	.25	1.47	1.87	.20	8-32

DIMENSIONAL TOL.: D, E ±0.02; all others ±0.04

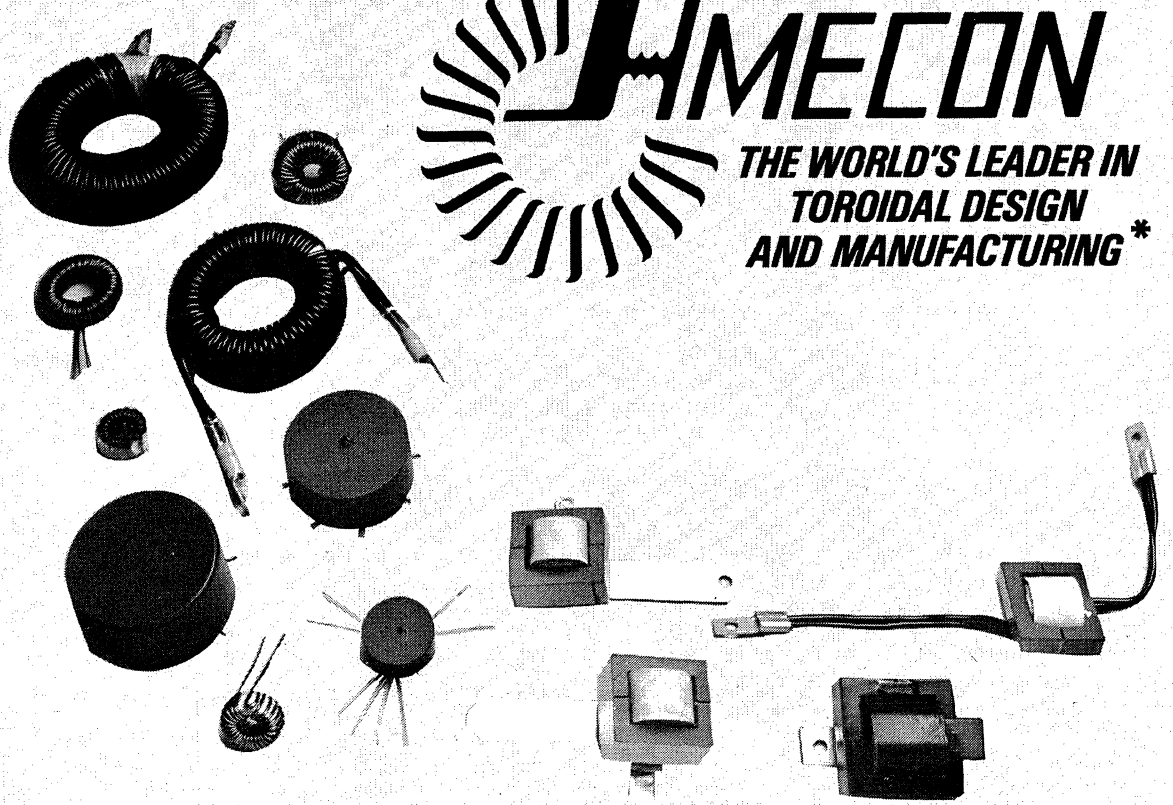


INPUT CONNECTION:
WYE, 115V to Com 1, 2, 3 Line 4 Com
WYE, 200V L-L 1, 2, 3
DELTA 115V or 200V L-L 1, 2, 3

OUTPUT CONNECTION:
WYE, L-Com Connect 6-8-10 Load 5-6, 7-6, 9-6
DELTA L-L Connect 6-7, 8-9, 5-10 Load 5, 7, 9
WYE, L-L Connect 6-10, 8-10 Load 5, 7, 9



ABBOTT TRANSISTOR LABORATORIES, INC.
Transformer Div. Western Offices: 639 S. Glenwood Pl., Burbank, CA 91506 (213) 841-3630. Telex: 69-6282
Eastern: 520 Main St., Ft. Lee, NJ 07024 (201) 461-4411. Telex: 13-5332 • New England: (617) 272-5676 • Southwest: 710 Kindred Lane, Richardson, TX 75080 (214) 437-0697



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* From 0.1" to 55.5" Diameter & 0.1 oz. to 1,800 lbs.

AMECON

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1900 Chris Lane, Anaheim, CA 92805 714/634-2220

MINIATURE SPLIT-BOBBIN PLUG-IN POWER TRANSFORMER

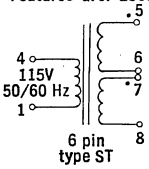
For printed circuit applications

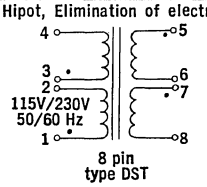
Transformers wound on a split bobbin permit the primaries and secondaries to be wound side by side rather than one over the other. Transformers can be supplied with single 115V or 115/230V, 50/60 Hz, dual primary, secondaries can be series or parallel connected. Units meet UL & V.D.E. standards.

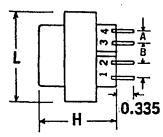
Part Number		Secondary Rms Rating		Part Number		Secondary Rms Rating	
Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel	Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel
ST-35-K10	DST-35-K10	10V C.T. @ 0.25A	5V @ 0.5A	ST-41-K10	DST-41-K10	10V C.T. @ 0.6A	5V @ 1.2A
ST-35-K12	DST-35-K12	12.6V C.T. @ 0.2A	6.3V @ 0.4A	ST-41-K12	DST-41-K12	12.6V C.T. @ 0.5A	6.3V @ 1A
ST-35-K16	DST-35-K16	16V C.T. @ 0.15A	8V @ 0.3A	ST-41-K16	DST-41-K16	16V C.T. @ 0.4A	8V @ 0.8A
ST-35-K20	DST-35-K20	20V C.T. @ 0.12A	10V @ 0.24A	ST-41-K20	DST-41-K20	20V C.T. @ 0.3A	10V @ 0.6A
ST-35-K24	DST-35-K24	24V C.T. @ 0.1A	12V @ 0.2A	ST-41-K24	DST-41-K24	24V C.T. @ 0.25A	12V @ 0.5A
ST-35-K28	DST-35-K28	28V C.T. @ 0.085A	14V @ 0.17A	ST-41-K28	DST-41-K28	28V C.T. @ 0.2A	14V @ 0.4A
ST-35-K36	DST-35-K36	36V C.T. @ 0.065A	18V @ 0.13A	ST-41-K36	DST-41-K36	36V C.T. @ 0.17A	18V @ 0.34A
ST-35-K48	DST-35-K48	48V C.T. @ 0.05A	24V @ 0.1A	ST-41-K48	DST-41-K48	48V C.T. @ 0.125A	24V @ 0.25A
ST-35-K56	DST-35-K56	56V C.T. @ 0.045A	28V @ 0.09A	ST-41-K56	DST-41-K56	56V C.T. @ 0.11A	28V @ 0.22A
ST-35-K120	DST-35-K120	120V C.T. @ 0.02A	60V @ 0.04A	ST-41-K120	DST-41-K120	120V C.T. @ 0.05A	60V @ 0.1A
ST-48-K10	DST-48-K10	10V C.T. @ 1.2A	5V @ 2.4A	ST-57-K10	DST-57-K10	10V C.T. @ 2A	5V @ 4A
ST-48-K12	DST-48-K12	12.6V C.T. @ 1.0A	6.3V @ 2.0A	ST-57-K12	DST-57-K12	12.6V C.T. @ 1.6A	6.3V @ 3.2A
ST-48-K16	DST-48-K16	16V C.T. @ 0.8A	8V @ 1.6A	ST-57-K16	DST-57-K16	16V C.T. @ 1.25A	8V @ 2.5A
ST-48-K20	DST-48-K20	20V C.T. @ 0.6A	10V @ 1.2A	ST-57-K20	DST-57-K20	20V C.T. @ 1A	10V @ 2A
ST-48-K24	DST-48-K24	24V C.T. @ 0.5A	12V @ 1.0A	ST-57-K24	DST-57-K24	24V C.T. @ 0.8A	12V @ 1.6A
ST-48-K28	DST-48-K28	28V C.T. @ 0.42A	14V @ 0.84A	ST-57-K28	DST-57-K28	28V C.T. @ 0.7A	14V @ 1.4A
ST-48-K36	DST-48-K36	36V C.T. @ 0.35A	18V @ 0.7A	ST-57-K36	DST-57-K36	36V C.T. @ 0.55A	18V @ 1.1A
ST-48-K48	DST-48-K48	48V C.T. @ 0.25A	24V @ 0.5A	ST-57-K48	DST-57-K48	48V C.T. @ 0.4A	24V @ 0.8A
ST-48-K56	DST-48-K56	56V C.T. @ 0.22A	28V @ 0.44A	ST-57-K56	DST-57-K56	56V C.T. @ 0.35A	28V @ 0.7A
ST-48-K120	DST-48-K120	120V C.T. @ 0.16A	60V @ 0.32A	ST-57-K120	DST-57-K120	120V C.T. @ 0.16A	60V @ 0.32A

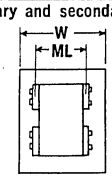
Size	VA	L	W	H	ML	A	B	C
35	2.4	1⅜ inch	1⅛ inch	1⅜ inch	1⅜ inch	0.250 inch	0.250 inch	1.200 inch
41	6	1⅝ inch	1⅝ inch	1⅝ inch	1⅛ inch	0.250 inch	0.350 inch	1.280 inch
48	12	1⅞ inch	1⅝ inch	1⅞ inch	1¼ inch	0.300 inch	0.400 inch	1.410 inch
57	20	2¼ inch	1⅞ inch	1⅞ inch	1½ inch	0.300 inch	0.400 inch	1.600 inch

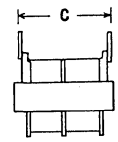
Features are: 2500V RMS Hipot, Elimination of electro-static shield, no cross-over of primary and secondary lead class S insulation. −130°C.

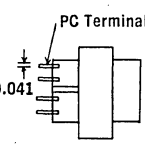












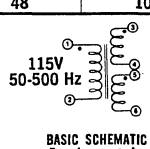
Note: Pin 2 and 3 omitted on single primary versions. The specification in the table may be changed without advance notice for improvement of the products.

MINIATURE PLUG-IN POWER TRANSFORMER

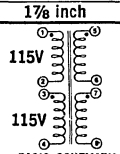
Economy line of split-bobbin miniature power transformers for printed circuit plug-in applications. Unit: inch

Part Number			Secondary Rms Rating		Part Number			Secondary Rms Rating	
Single 115V 6 Pin	Single 230V 6 Pin	Dual 115/230V 8 Pin	Series V.C.T. A	Parallel V A	Single 115V 6 Pin	Single 230V 6 Pin	Dual 115/230V 8 Pin	Series V.C.T. A	Parallel V A
PC-35-K10	CPC-35-K10	DPC-35-K10	10 @ 0.12	5 @ 0.24	PC-35-K28	CPC-35-K28	DPC-35-K28	28 @ 0.04	14 @ 0.08
PC-35-K12	CPC-35-K12	DPC-35-K12	12.6 @ 0.1	6.3 @ 0.2	PC-35-K34	CPC-35-K34	DPC-35-K34	34 @ 0.035	17 @ 0.07
PC-35-K16	CPC-35-K16	DPC-35-K16	16 @ 0.075	8 @ 0.15	PC-35-K40	CPC-35-K40	DPC-35-K40	40 @ 0.03	20 @ 0.06
PC-35-K20	CPC-35-K20	DPC-35-K20	20 @ 0.06	10 @ 0.12	PC-35-K56	CPC-35-K56	DPC-35-K56	56 @ 0.02	28 @ 0.04
PC-35-K24	CPC-35-K24	DPC-35-K24	24 @ 0.05	12 @ 0.10	PC-35-K120	CPC-35-K120	DPC-35-K120	120 @ 0.01	60 @ 0.02
PC-41-K10	CPC-41-K10	DPC-41-K10	10 @ 0.44	5 @ 0.88	PC-41-K28	CPC-41-K28	DPC-41-K28	28 @ 0.16	14 @ 0.32
PC-41-K12	CPC-41-K12	DPC-41-K12	12.6 @ 0.35	6.3 @ 0.70	PC-41-K34	CPC-41-K34	DPC-41-K34	34 @ 0.125	17 @ 0.25
PC-41-K16	CPC-41-K16	DPC-41-K16	16 @ 0.26	8 @ 0.52	PC-41-K40	CPC-41-K40	DPC-41-K40	40 @ 0.11	20 @ 0.22
PC-41-K20	CPC-41-K20	DPC-41-K20	20 @ 0.22	10 @ 0.44	PC-41-K56	CPC-41-K56	DPC-41-K56	56 @ 0.08	28 @ 0.16
PC-41-K24	CPC-41-K24	DPC-41-K24	24 @ 0.18	12 @ 0.36	PC-41-K120	CPC-41-K120	DPC-41-K120	120 @ 0.035	60 @ 0.07
PC-48-K10	CPC-48-K10	DPC-48-K10	10 @ 1.0	5 @ 2.0	PC-48-K28	CPC-48-K28	DPC-48-K28	28 @ 0.36	14 @ 0.72
PC-48-K12	CPC-48-K12	DPC-48-K12	12.6 @ 0.8	6.3 @ 1.6	PC-48-K34	CPC-48-K34	DPC-48-K34	34 @ 0.30	17 @ 0.60
PC-48-K16	CPC-48-K16	DPC-48-K16	16 @ 0.64	8 @ 1.28	PC-48-K40	CPC-48-K40	DPC-48-K40	40 @ 0.25	20 @ 0.50
PC-48-K20	CPC-48-K20	DPC-48-K20	20 @ 0.50	10 @ 1.0	PC-48-K56	CPC-48-K56	DPC-48-K56	56 @ 0.18	28 @ 0.36
PC-48-K24	CPC-48-K24	DPC-48-K24	24 @ 0.45	12 @ 0.9	PC-48-K120	CPC-48-K120	DPC-48-K120	120 @ 0.085	60 @ 0.17

Size	VA	L	W	H	6 Pin X	8 Pin A	B
*35	1.2	1⅜ inch	1⅛ inch	1⅜ inch	0.312	0.200	1.000
41	4.4	1⅝ inch	1¼ inch	1⅜ inch	0.400	0.250	1.100
48	10	1⅞ inch	1⅞ inch	1⅝ inch	0.400	0.250	1.300



BASIC SCHEMATIC
Transformer can be connected in series or parallel.



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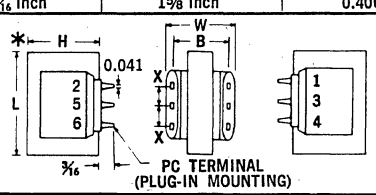

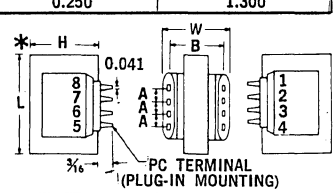

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- Impedance Matching
- Audio Transformers (All types)
- Sub & Ultra Miniature • Pulse Transformers
- Miniature Power Transformers
- Telephone Matching Transformers
- Isolation • Microphone Coupling

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PRODUCTS SUMMARY

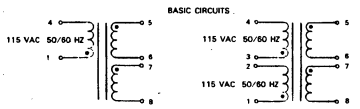
Pulse Transformers
Trigger Transformers
Flyback Transformers
Power Transformers
Low Power Step-up Transformer
DC-DC Converters
Switching Magnetics
Audio Transformers
Potted Transformer Assemblies

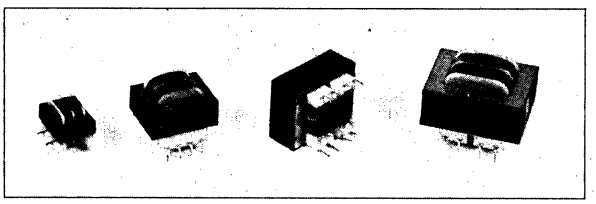
APPLICATION

Data Transmission, High Frequency Coupling
SCR Trigger, Motor Speed Controls
High Voltage CRT, Spark Gap Ignition, High Voltage Power Supplies
Instrumentation, DC Power Supplies, Control Circuits.
Neuro Stimulators, Infant Monitors, Implantable Medical Electronics
I.C. Bias Circuits, Miniature Power Supplies, Aerospace Instruments
State of the Art DC Supplies, High Frequency Inverters & Converters
Telephone Industry, Communications, Impedence Matching
Medical Devices, Hazardous Environments, High Reliability Military

SPLIT BOBBIN POWER TRANSFORMERS

BASIC CIRCUITS





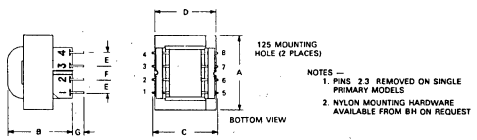
FEATURES

- High Dielectric Breakdown Strength
- Less Need For Electrostatic Shielding
- Compact Construction
- Single Or Dual Primary
- Custom Outputs Available On Request
- Designed To Meet U.L. Specs

SPECIFICATIONS

- 2500 VRMS Hipot
- Temperature Class B, 130°C
- Temperature Rise, 35°C Maximum At Rated Power
- Primary 115 VAC Or 115/230 VAC
- Sizes — 1.1, 2.4, 6, 12 VA

MECHANICAL



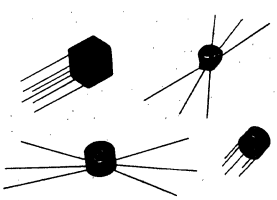
SIZE	A	B	C	D	E	F	G	Mounting Hardware
1.1 VA	1.375	.937	1.125	1.200	.250	.250	.250	None
2.4 VA	1.375	1.187	1.125	1.200	.250	.250	.250	None
6 VA	1.625	1.312	1.312	1.280	.250	.350	.250	4-40X1 3/8
12 VA	1.875	1.437	1.562	1.410	.300	.400	.250	4-40X1 3/8

SIZE	SINGLE PRIMARY	DUAL PRIMARY	SERIES OUTPUT Volts AC AMPS RMS	PARALLEL OUTPUT Volts AC AMPS RMS
1.1 VA	507-3200	507-3200D	6 VCT .180	3V .360
	507-3201	507-3201D	10 VCT .110	5V .220
	507-3202	507-3202D	12.6 VCT .090	6.3V .180
	507-3203	507-3203D	16 VCT .070	8V .140
	507-3204	507-3204D	20 VCT .055	10V .110
	507-3205	507-3205D	24 VCT .045	12V .090
	507-3206	507-3206D	28 VCT .040	14V .080
	507-3207	507-3207D	36 VCT .030	18V .060
	507-3208	507-3208D	48 VCT .023	24V .046
	507-3209	507-3209D	56 VCT .020	28V .040
2.4 VA	507-3300	507-3300D	6 VCT .400	3V .800
	507-3301	507-3301D	10 VCT .250	5V .500
	507-3302	507-3302D	12.6 VCT .200	6.3V .400
	507-3303	507-3303D	16 VCT .150	8V .300
	507-3304	507-3304D	20 VCT .120	10V .240
	507-3305	507-3305D	24 VCT .100	12V .200
	507-3306	507-3306D	28 VCT .085	14V .170
	507-3307	507-3307D	36 VCT .065	18V .130
	507-3308	507-3308D	48 VCT .050	24V .100
	507-3309	507-3309D	56 VCT .045	28V .090
6 VA	507-3400	507-3400D	6 VCT 1.00	3V 2.00
	507-3401	507-3401D	10 VCT .600	5V 1.20
	507-3402	507-3402D	12.6 VCT .500	6.3V 1.30
	507-3403	507-3403D	16 VCT .400	8V .800
	507-3404	507-3404D	20 VCT .300	10V .600
	507-3405	507-3405D	24 VCT .250	12V .500
	507-3406	507-3406D	28 VCT .200	14V .400
	507-3407	507-3407D	36 VCT .170	18V .340
	507-3408	507-3408D	48 VCT .125	24V .250
	507-3409	507-3409D	56 VCT .110	28V .220
12 VA	507-3500	507-3500D	6 VCT 2.00	3V 4.00
	507-3501	507-3501D	10 VCT 1.20	5V 2.40
	507-3502	507-3502D	12.6 VCT 1.00	6.3V 2.00
	507-3503	507-3503D	16 VCT .800	8V 1.60
	507-3504	507-3504D	20 VCT .600	10V 1.20
	507-3505	507-3505D	24 VCT .500	12V 1.00
	507-3506	507-3506D	28 VCT .420	14V .840
	507-3507	507-3507D	36 VCT .350	18V .700
	507-3508	507-3508D	48 VCT .250	24V .500
	507-3509	507-3509D	56 VCT .220	28V .440

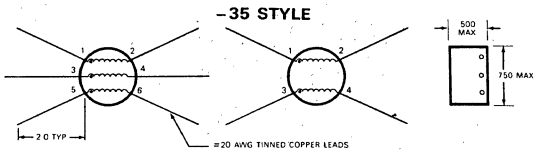
Custom Outputs Available Within VA Limits

SERIES 505 - SCR TRIGGER TRANSFORMERS

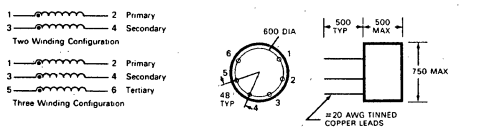
- FOUR CASE STYLES
- 1600 OR 2500 VRMS ISOLATION
- TINNED COPPER LEADS
- LOW Ciw TO PREVENT FALSE TRIGGERING
- AVAILABLE FROM STOCK
- ORDER BY PART NUMBER 505-XX YY
  - ★ SPECIFY CASE STYLE
  - ★★ SPECIFY ELECTRICAL PARAMETERS



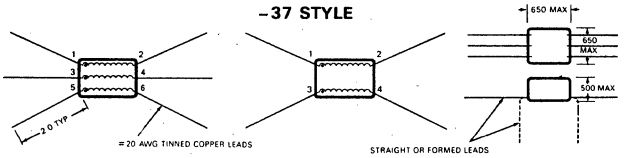
-35 STYLE



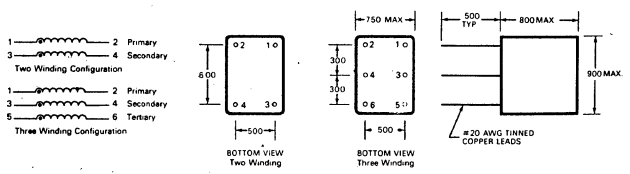
-36 STYLE



-37 STYLE



-55 STYLE



★ STANDARD CASE STYLES

CASE NO.	PCB MOUNTING	ISOLATION VOLTAGE	TEMPERATURE RANGE	ENCAPSULATED	LEAD SIZE
35	YES	1600 VRMS 60HZ	−10°C TO +70°C	YES	20 AWG
36	YES	1600 VRMS 60HZ	0°C TO 60°C	YES	20 AWG
37	YES	1600 VRMS 60HZ	0°C TO 60°C	NO	20 AWG
55	YES	2500 VRMS 60HZ	0°C TO 60°C	YES	20 AWG

★★ STANDARD ELECTRICAL SPECIFICATIONS

ELECTRICAL PARAMETER NUMBER	TURNS RATIO	PRIMARY INDUCTANCE (mh −MIN.)	PRIMARY ET CONSTANT (V−μsec MIN.)	INTERWINDING CAPACITANCE (PF −MAX.)	LEAKAGE INDUCTANCE (μh −MAX.)
00	1:1	.25	45	20	5
01	1:1	1.0	90	30	20
02	1:1	5.0	180	30	45
03	1:1	20.0	360	50	200
04	1:1:1	.25	45	20	5
05	1:1:1	1.0	90	30	20
06	1:1:1	5.0	180	30	45
07	1:1:1	20.0	360	50	200
08	2:1	1.0	90	30	40
09	2:1	5.0	180	30	60
10	2:1:1	1.0	90	30	40
11	2:1:1	5.0	180	30	60
12	5:1	20.0	360	50	200
13	5:1:1	20.0	360	50	200

CUSTOM VERSIONS AVAILABLE

SEND FOR FULL CATALOG

331 BREMER BLDG.
ST. PAUL, MN 55101

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TELEX. 29-7022

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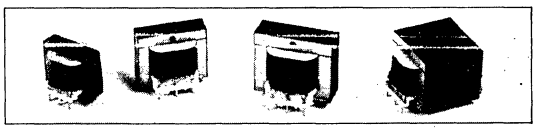
MINIATURE POWER TRANSFORMERS

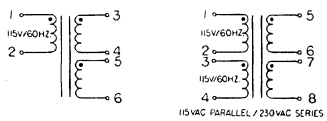


FEATURES

- PC Mount
- Designed To U.L. Specs
- Mounting Frame Optional
- Single or Dual Primary
- Wide Range of Outputs
- Thermal Cutout Available on Request

SPECIFICATIONS

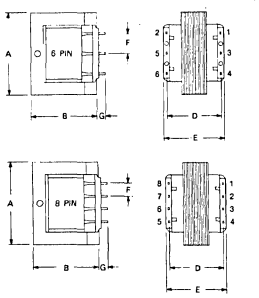
- Sizes — 1.5, 4.5, 10, 24 VA Rating
- Temperature class B (35°C Max. Rise At Rated Power)
- Dielectric Strength 1250 VRMs
- Inputs 115V Or 115/230V



SIZE	BH PART NUMBER Single 115V	BH PART NUMBER Dual 115/230	SERIES Volts AC AMPS RMS	PARALLEL Volts AC AMPS RMS
1.5 VA	507-2001	507-2001D	6 VCT At .250	3V At .500
	507-2002	507-2007D	10 VCT At .150	5V At .300
	507-2003	507-2003D	12.6 VCT At .120	6.3V At .240
	507-2004	507-2004D	15 VCT At .100	7.5V At .200
	507-2005	507-2005D	20 VCT At .075	10V At .150
	507-2006	507-2006D	24 VCT At .060	12V At .120
	507-2007	507-2007D	34 VCT At .040	17V At .080
	507-2008	507-2008D	48 VCT At .030	24V At .060
	507-2009	507-2009D	56 VCT At .020	28 VCT At .040
4.5 VA	507-2101	507-2101D	6 VCT At .75	3V At 1.5
	507-2102	507-2102D	10 VCT At .450	5V At .900
	507-2103	507-2103D	12.6 VCT At .350	6.3V At .700
	507-2104	507-2104D	15 VCT At .300	7.5V At .600
	507-2105	507-2105D	20 VCT At .220	10V At .440
	507-2106	507-2106D	24 VCT At .180	12V At .360
	507-2107	507-2107D	34 VCT At .125	17V At .250
	507-2108	507-2108D	48 VCT At .090	24V At .180
	507-2109	507-2109D	56 VCT At .080	28V At .160
10 VA	507-2201	507-2201D	6 VCT At 1.6	3V At 3.3
	507-2202	507-2202D	10 VCT At 1	5V At 2
	507-2203	507-2203D	12.6 VCT At .800	6.3V At 1.6
	507-2204	507-2204D	15 VCT At .650	7.5V At 1.3
	507-2205	507-2205D	20 VCT At .500	10V At 1.0
	507-2206	507-2206D	24 VCT At .400	12V At .800
	507-2207	507-2207D	34 VCT At .300	17V At .600
	507-2208	507-2208D	48 VCT At .200	24V At .400
	507-2209	507-2209D	56 VCT At .180	28V At .360
24 VA	507-2301	507-2301D	6 VCT At 4.0	3V At 8.0
	507-2302	507-2302D	10 VCT At 2.4	5V At 4.8
	507-2303	507-2303D	12.6 VCT At 1.9	6.3V At 3.8
	507-2304	507-2304D	15 VCT At 1.6	7.5V At 3.2
	507-2305	507-2305D	20 VCT At 1.2	10V At 2.4
	507-2306	507-2306D	24 VCT At 1.0	12V At 2.0
	507-2307	507-2307D	34 VCT At .700	17V At 1.4
	507-2308	507-2308D	48 VCT At .500	24V At 1.0
	507-2309	507-2309D	56 VCT At .420	28V At .840

Additional Outputs Available Within VA Limits

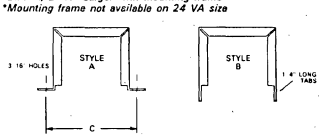
MECHANICAL

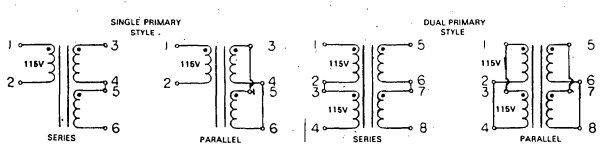


DIMENSIONS

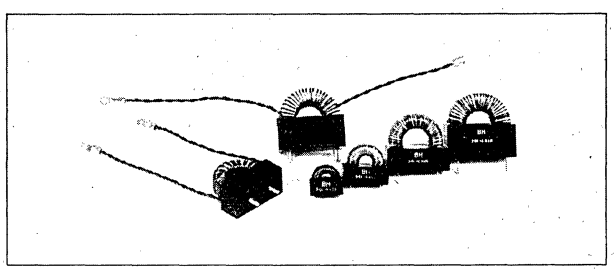
SIZE	PIN	A	B	C	D	E	F	G
1.5	6	1.375	1.22	1.750	1.00	1.125	.312	.188
1.5	8	1.375	1.22	1.750	1.00	1.125	.200	.188
4.5	6	1.625	1.4	2.0	1.10	1.25	.400	.188
4.5	8	1.625	1.4	2.0	1.10	1.25	.250	.188
10	6	1.875	1.625	2.375	1.30	1.312	.400	.188
10	8	1.875	1.625	2.375	1.30	1.312	.250	.188
24	6	1.625	1.375	—	2.1	2.25	.400	.188
24	8	1.625	1.375	—	2.1	2.25	.250	.188

**Dim. A, B ¼" Larger with mounting frame*
**Mounting frame not available on 24 VA size*





TOROID INDUCTORS FOR SWITCHING POWER SUPPLIES

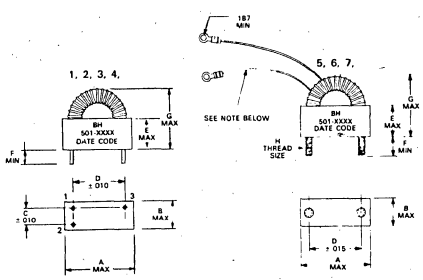


- Current Range, 1 AMP To 50 AMPS
- Cost Effective Design
- Wide Range Of Inductance
- Maximum Temperature Rise, 40°C Above Ambient
- PC Mount

ELECTRICAL CHARACTERISTICS AT 25°C

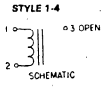
BH PART NUMBER	RATED DC CURRENT (AMPS)	MINIMUM INDUCTANCE AT RATED DC μh	MINIMUM INDUCTANCE AT ZERO DC μh	DC RESISTANCE MAXIMUM Ω	MIN. ENERGY STORAGE ½ LI²	PACKAGE STYLE	LEAD DIA INCHES ±.004
501-1001	1.0	725	1400	.75	366	1	.025
501-1002	2.5	115	230	.12	366	1	.025
501-1003	2.5	370	740	.23	1166	2	.025
501-1004	4.1	40	80	.045	361	1	.032
501-1005	4.1	140	280	.086	1185	2	.032
501-1006	4.1	360	720	.177	3034	3	.032
501-1007	6.5	15	30	.018	359	1	.040
501-1008	6.5	50	100	.035	1162	2	.040
501-1009	6.5	140	280	.070	3000	3	.040
501-1010	6.5	290	580	.098	6190	4	.040
501-1011	10.0	7	14	.0075	350	1	.051
501-1012	10.0	20	40	.014	1150	2	.051
501-1013	10.0	60	120	.028	3000	3	.051
501-1014	10.0	120	240	.040	6200	4	.051
501-1015	20.0	6	12	.004	1200	5	NA
501-1016	20.0	15	30	.0072	3200	6	NA
501-1017	20.0	30	60	.010	6400	7	NA
501-1018	40.0	3.5	7.0	.0017	2800	6	NA
501-1019	40.0	7	14	.0024	5920	7	NA
501-1020	50.0	4.5	9	.0016	5875	7	NA

—CUSTOM VERSIONS AVAILABLE ON REQUEST—



STYLE	A	B	C	D	E	F	G	H
1	1.05 / 26,67	.55 / 13,97	.400 / 10,16	.800 / 20,32	.55 / 13,97	.20 / 5,08	1.10 / 27,94	N/A
2	1.45 / 36,83	.80 / 20,32	.600 / 15,24	.900 / 22,86	.58 / 14,73	.20 / 5,08	1.40 / 35,56	N/A
3	2.00 / 50,80	.95 / 24,13	.700 / 17,78	1.20 / 30,48	.75 / 19,05	.20 / 5,08	1.90 / 48,26	N/A
4	2.15 / 54,86	1.12 / 28,45	.900 / 22,86	1.50 / 38,10	1.05 / 26,67	.20 / 5,08	2.20 / 55,88	N/A
5	1.45 / 36,83	.80 / 20,32	N/A	.900 / 22,86	.58 / 14,73	.25 / 6,35	1.40 / 15,56	6-32
6	2.00 / 50,80	.95 / 24,13	N/A	1.20 / 30,48	.75 / 19,05	.25 / 6,35	1.90 / 48,26	8-32
7	2.16 / 54,86	1.12 / 28,45	N/A	1.50 / 38,10	1.05 / 26,67	.25 / 6,35	2.20 / 55,88	10-32

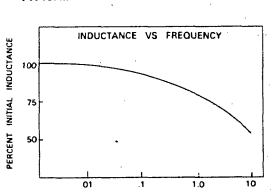
STYLE 1-4



STYLE 5-7

NOTE: Style 5, 6, 7 Leads Cut to 6" Length/Custom Lengths Available Upon Request

TYPICAL INDUCTANCE CHARACTERISTICS



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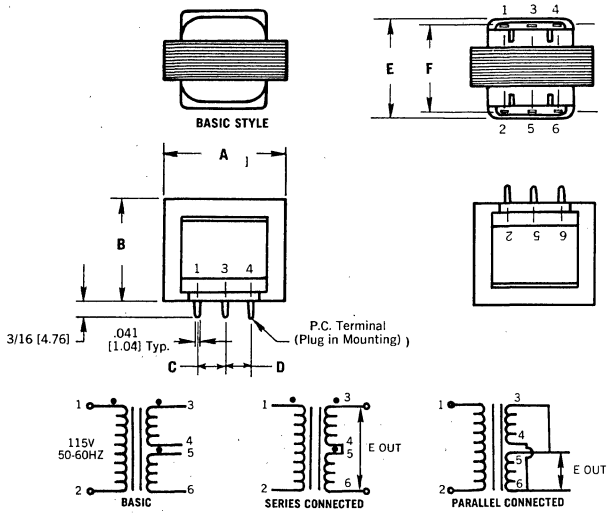
LOW POWER TRANSFORMERS

PL-11, PL-12, PL-13, PL-14

Low Power Dual Secondary Transformers*



BASIC SCHEMATICS

	A	B	C	D	E	F
PL-11	1.01 [25.65]	.84 [21.34]	.25 [6.35]	.25 [6.35]	.875 [22.22]	.720 [18.29]
PL-12	1-3/8 [34.92]	1-3/16 [30.16]	.312 [7.92]	.312 [7.92]	1-1/8 [28.58]	1.00 [25.4]
PL-13	1-5/8 [41.28]	1-3/8 [34.92]	.400 [10.16]	.400 [10.16]	1-1/4 [31.75]	1.100 [27.94]
PL-14	1-7/8 [47.62]	1.60 [40.64]	.400 [10.16]	.400 [10.16]	1-7/16 [36.51]	1.30 [33.02]

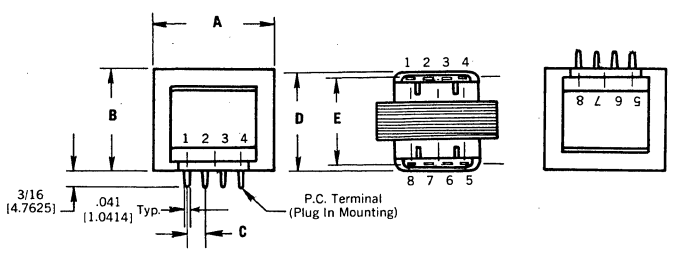
ELECTRICAL CHARACTERISTICS

INPUT VOLTAGE 115V @ 60HZ

OUTPUT VOLTAGE Series	OUTPUT VOLTAGE Parallel	OUTPUT CURRENT (MA) Series	OUTPUT CURRENT (MA) Parallel	MODEL NO.
8 V CT	4 V	94	188	PL-11-01
		188	376	PL-12-01
		562	1124	PL-13-01
		940	1880	PL-14-01
10 V CT	5 V	75	150	PL-11-02
		120	240	PL-12-02
		440	880	PL-13-02
		1000	2000	PL-14-02
12.6 V CT	6.3 V	60	120	PL-11-03
		100	200	PL-12-03
		350	700	PL-13-03
		800	1600	PL-14-03
15 V CT	7.5 V	50	100	PL-11-04
		100	200	PL-12-04
		300	600	PL-13-04
		500	1000	PL-14-04
16 V CT	8 V	47	94	PL-11-05
		75	150	PL-12-05
		260	520	PL-13-05
		640	1280	PL-14-05
20 V CT	10 V	38	76	PL-11-06
		60	120	PL-12-06
		220	440	PL-13-06
		500	1000	PL-14-06
24 V CT	12 V	31	62	PL-11-07
		50	100	PL-12-07
		180	360	PL-13-07
		450	900	PL-14-07
30 V CT	15 V	25	50	PL-11-08
		50	100	PL-12-08
		150	300	PL-13-08
		250	500	PL-14-08
34 V CT	17 V	22	44	PL-11-09
		35	70	PL-12-09
		125	250	PL-13-09
		300	600	PL-14-09
40 V CT	20 V	19	38	PL-11-10
		30	60	PL-12-10
		110	220	PL-13-10
		250	500	PL-14-10
54 V CT	27 V	28	56	PL-12-11
		84	168	PL-13-11
		140	280	PL-14-11
56 V CT	28 V	20	40	PL-12-12
		80	160	PL-13-12
		180	360	PL-14-12
76 V CT	38 V	20	40	PL-12-13
		60	120	PL-13-13
		100	200	PL-14-13
88 V CT	44 V	15	30	PL-12-14
		50	100	PL-13-14
		120	240	PL-14-14
120 V CT	60 V	10	20	PL-12-15
		35	70	PL-13-15
		85	170	PL-14-15
180 V CT	90 V	6	12	PL-12-16
		24	48	PL-13-16
		55	110	PL-14-16
230 V CT	115 V	5	10	PL-12-17
		20	40	PL-13-17
		40	80	PL-14-17

PL-22, PL-23, PL-24

Low Power Transformers*
Dual Primary—Dual Secondary



	A	B	C	D	E
PL-22	1-3/8 [34.92]	1-3/16 [30.16]	.20 [5.08]	1-1/8 [28.58]	1.00 [25.40]
PL-23	1-5/8 [41.28]	1-3/8 [34.92]	.25 [6.35]	1-1/4 [31.75]	1.10 [27.94]
PL-24	1-7/8 [47.62]	1.60 [40.64]	.25 [6.35]	1-7/16 [36.51]	1.30 [33.02]

ELECTRICAL CHARACTERISTICS

INPUT VOLTAGE = 115V 60HZ OR 230V 50HZ-60HZ

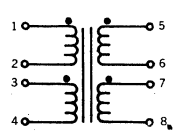
Same characteristics as PL-12, 13, 14 except dual primary for 115 or 230 volt operation.

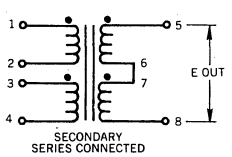
*Recognized under the Component Program of Underwriters Laboratories, Inc. Listed under File E71961.

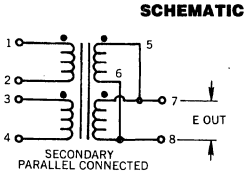
CUSTOMER APPLICATION

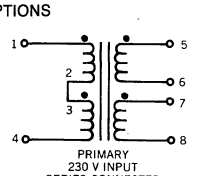
SCHEMATIC OPTIONS

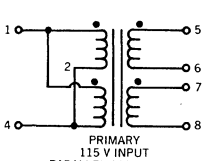
SCHEMATIC BASIC STYLE









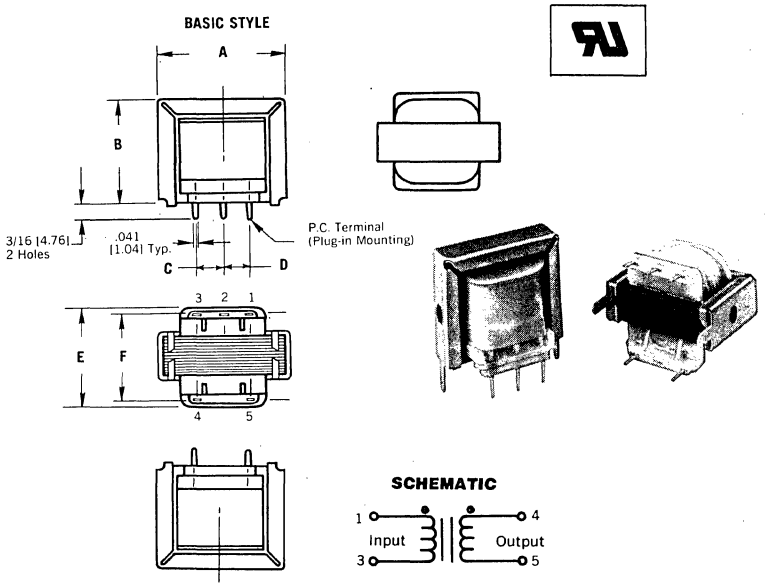


For complete information, write or phone

DALE ELECTRONICS, INC., East Highway 50, Yankton, South Dakota 57078. Phone 605-665-9301

LOW POWER TRANSFORMERS
PL Series, Dual and Single Secondary

PL-32, PL-33, PL-34
Low-Cost Single Secondary Power Transformer,* 115 Volt Primary Input



ELECTRICAL CHARACTERISTICS

OUTPUT VOLTAGE	OUTPUT CURRENT (MA)	MODEL NO.
6.4V	200	PL-32-01
	700	PL-33-01
	1300	PL-34-01
10V	120	PL-32-02
	450	PL-33-02
	800	PL-34-02
12.6V	100	PL-32-03
	350	PL-33-03
	650	PL-34-03
15 V	80	PL-32-04
	300	PL-33-04
	550	PL-34-04
20 V	60	PL-32-05
	225	PL-33-05
	400	PL-34-05
24 V	50	PL-32-06
	185	PL-33-06
	330	PL-34-06
30 V	40	PL-32-07
	150	PL-33-07
	270	PL-34-07
54 V	22	PL-32-08
	80	PL-33-08
	150	PL-34-08
76 V	16	PL-32-09
	60	PL-33-09
	110	PL-34-09
88 V	14	PL-32-10
	50	PL-33-10
	90	PL-34-10
115 V	10	PL-32-11
	40	PL-33-11
	70	PL-34-11
180 V	7	PL-32-12
	25	PL-33-12
	45	PL-34-12
230 V	5	PL-32-13
	20	PL-33-13
	35	PL-34-13

BASIC SCHEMATICS [Numbers in brackets indicate millimeters]

	A	B	C	D	E	F
PL-32	1.45 [36.91]	1.16 [29.37]	.31 [7.92]	.31 [7.92]	1.13 [28.58]	1.00 [25.40]
PL-33	1.70 [43.26]	1.38 [34.93]	.40 [10.16]	.40 [10.16]	1.25 [31.75]	1.10 [27.94]
PL-34	1.95 [49.61]	1.63 [41.28]	.40 [10.16]	.40 [10.16]	1.44 [36.51]	1.30 [33.02]

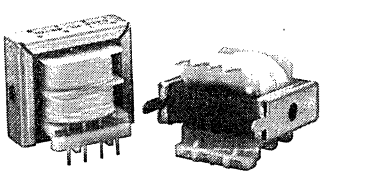
*Recognized under the Component Program of Underwriters Laboratories, Inc. Listed under File E71961.

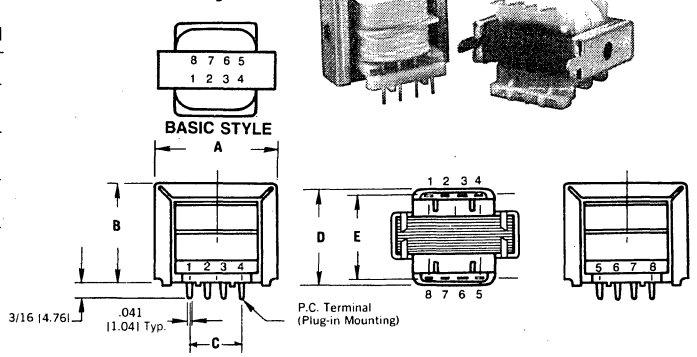
PL-42, PL-43, PL-44
Low Power Transformers—Dual Primary—Dual Secondary

BASIC SCHEMATICS [Numbers in brackets indicate millimeters]

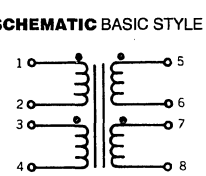
	A	B	C	D	E
PL-42	1-29/64 [36.91]	1-13/16 [30.16]	.20 [5.08]	1-1/8 [28.58]	1.00 [25.40]
PL-43	1-45/64 [43.26]	1-3/8 [34.92]	.25 [6.35]	1-1/4 [31.75]	1.10 [27.94]
PL-44	1-61/64 [49.61]	1.60 [40.64]	.25 [6.35]	1-7/16 [35.51]	1.30 [33.02]

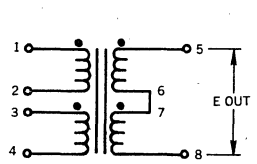
ELECTRICAL CHARACTERISTICS
INPUT VOLTAGE = 115V 60HZ OR 230V 50HZ-60HZ
Same characteristics as PL-12, 13, 14 except dual primary for 115 or 230 volt operation.



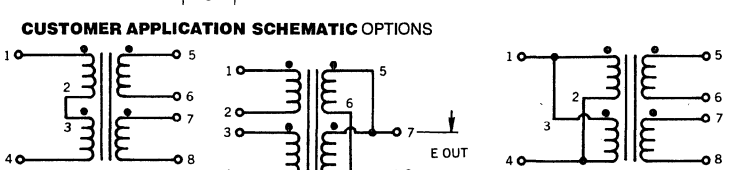


SCHEMATIC BASIC STYLE





CUSTOMER APPLICATION SCHEMATIC OPTIONS



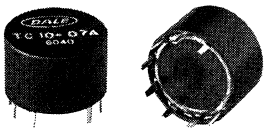
OPTIONAL MOUNTING FRAMES AVAILABLE ON ALL STYLES (CONSULT FACTORY)

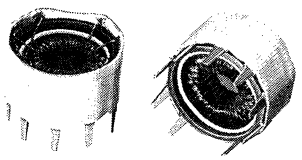
For complete information, write or phone

DALE ELECTRONICS, INC., East Highway 50, Yankton, South Dakota 57078. Phone 605-665-9301

DALE®

TC CONVERTER TRANSFORMERS





FEATURES

• High conversion efficiency from DC input to filtered DC output • Designed especially for low-power solid state circuits • Designed for mounting on printed circuit boards • Miniature size for minimum space • Choice of encapsulated or open (impregnated) styles

SPECIFICATIONS

ELECTRICAL

Transformer Power Rating: 3 watts

Isolation, Primary-Secondary: 500 volts 60 Hz, operating characteristics may be varied to suit specific applications by appropriate selection of circuit components

ENVIRONMENTAL

Operating Temp. Range: −20°C to +80°C, intended for use in enclosed commercial and industrial applications

MECHANICAL

Coating: Varnish dip coat or epoxy encapsulated

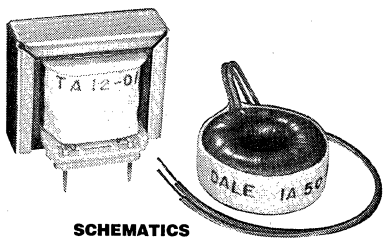
Terminals: .015″ thick, solder plated, varnish-free. Intended for P.C. board mounting

TYPICAL APPLICATIONS

Power supply for gas discharge display, battery-operated portable instruments, operational amplifier power supplies.

TA and IA SERIES

Telephone Coupling Transformers and Holding Coils



FEATURES

• Designed and built to meet telephone company requirements for data and voice access on leased private telephone lines or through the dial-up switched telephone network. • Provides line isolation, impedance matching, line balance, hybrid and holding coil applications.

SPECIFICATIONS

ELECTRICAL

Frequency Response: ±.5 DB from 300 to 3500 Hz

Power Level: −45 DBM to +7 DBM

Impedance Matching: ±10% from 300 to 3500 Hz

Return Loss:
22 DB min. = TA 10-03
13 DB min. = TA 13-01
14 DB min. = TA 14-01
26 DM min. = TA 10-01, TA 10-02, TA 10-04, TA 10-05, TA 10-06, TA 10-07, TA 11-01

Longitudinal Balance: Per FCC 68.310

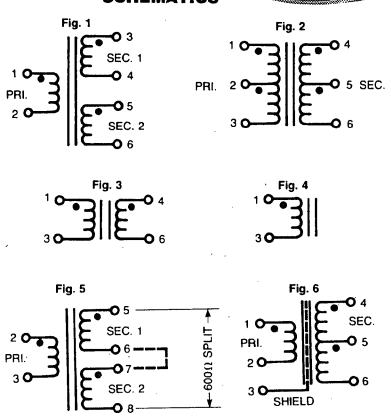
Distortion: .5% max.

MECHANICAL

Coating: TA = Vacuum impregnated with polyester varnish.
IA = Tough vinyl coating.

Terminals: TA = Precision spaced PC type plug-in terminals.
IA = #28 AWG teflon coated insulated terminals.

SCHEMATICS



ELECTRICAL CHARACTERISTICS

MODEL NO.	APPLICATION	PRIMARY IMPEDANCE	SECONDARY IMPEDANCE	FIGURE LETTER	SCHEMATIC FIGURE NO.	NO. OF UNITS REQ'D	TERMINAL NUMBERS USED
TA 10-01	HYBRID	600Ω	600Ω/600Ω	C	1	2	1, 2, 3, 4, 5, 6
TA 10-02	COUPLING	600Ω	900Ω	C	3	1	1, 3, 4, 6
TA 10-03	BRIDGING	4KΩ	600Ω	C	3	1	1, 3, 4, 6
TA 10-04	COUPLING	600Ω CT	600Ω CT	C	2	1	1, 2, 3, 4, 5, 6
TA 10-05	COUPLING	600Ω	600Ω	C	3	1	1, 3, 4, 6
TA 10-06	COUPLING	900Ω	900Ω	C	3	1	1, 3, 4, 6
TA 10-07	COUPLING	600Ω	600Ω	A	3	1	1, 3, 4, 6
TA 11-01	HYBRID	600Ω	600Ω/600Ω	C	1	2	1, 2, 3, 4, 5, 6
TA 13-01	COUPLING	600Ω	600Ω SPLIT 75 MA DC	B	5	1	2, 3, 5, 6, 7, 8
TA 14-01	COUPLING	600Ω	900Ω/600Ω 100/120 MA DC	D	6	1	1, 2, 3, 4, 5, 6
TA 12-01	HOLDING COIL	2.0 H @ 60 MA, 1.3 H @ 100 MA DC DCR = 180Ω		C	4	1	1, 3
IA 40-01	HOLDING COIL	1.0 H @ 0 MA, .8 H @ 25 MA DC DCR = 225Ω		—	4	1	—
IA 50-01	HOLDING COIL	1.0 H @ 0 MA, .8 H @ 40 MA DC DCR = 113Ω		—	4	1	—

For complete information write or phone
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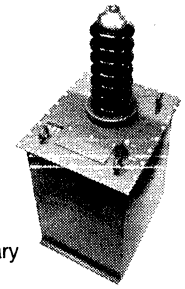
High Voltage Line Isolation Transformers In Oil Insulating Tanks



Model 3–TR–150–11

FEATURES:

- ▼ Complete varnish impregnation under vacuum
- ▼ Epoxy anchoring
- ▼ Immersed in high grade insulating oil*
- ▼ Electrostatic shield between primary and secondary windings
- ▼ "AN" type connector provided for input connections
- ▼ Good regulation

*Note: Shipped without oil to minimize transportation charges, except when otherwise specified in order.

SPECIFICATIONS:

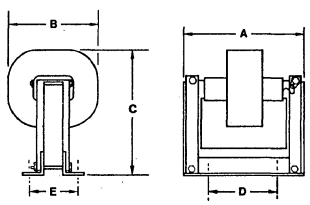
- ▼ Each model available with porcelain output insulator
- ▼ Models also available with two shielded polyethylene output cables in place of porcelain insulator
- ▼ Standard types available for 120V and 240V input lines in 1:1, 1:2, and 2:1 voltage ratios with other input and output voltages available upon request
- ▼ Recommended for industrial, research, and developmental applications

Standard 60Hz Types				
Model No.*	Max. kVA	kV dc Insulation	Tank Size (in.) (W X D X H)**	Insulator Height (in.)***
1-TR-30-XX	1	30	10 X 12 X 11	6
1.5-TR-30-XX	1.5	30	13 X 13⅞ X 16½	6
1-TR-50-XX	1	50	13 X 13⅞ X 16⅜	8½
3-TR-50-XX	3	50	13 X 13⅞ X 16⅜	8½
1-TR-60-XX	1	60	9¾ X 12⅜ X 13⅜	11
2-TR-60-XX	2	60	16½ X 16½ X 21⅜	11
3-TR-60-XX	3	60	16½ x 16½ X 21⅜	11
5-TR-60-XX	5	60	16½ X 16½ X 21⅜	11
3-TR-75-XX	3	75	16½ X 16½ X 22	11
1-TR-100-XX	1	100	20¾ X 17½ X 17 13/16	14
3-TR-100-XX	3	100	20¾ X 17½ X 17 13/16	14
3-TR-150-XX	3	150	15½ X 18¾ X 24	19½
5-TR-150-XX	5	150	15½ X 18¾ X 24	19½
0.5-TR-250-XX	0.5	250	25 X 33 X 37 5/16	28¾
2-TR-250-XX	2	250	25 X 33 X 37 5/16	28¾
3-TR-250-XX	3	250	29¾ X 29¾ X 36⅜	28¾
5-TR-250-XX	5	250	25 X 33 X 37¼	28¾
4-TR-300-XX	4	300	39½ X 47½ X 50½	35
Models With Shielded Cables Instead Of Porcelain Insulator:				
0.5-CTR-250-XX	0.5	250	25 X 33 X 37 5/16	
2-CTR-250-XX	2	250	25 X 33 X 37 5/16	
3-CTR-250-XX	3	250	29¾ X 29¾ X 36⅜	
4-CTR-300-XX	4	300	25 X 33 X 37¼	
5-CTR-250-XX	5	250	39½ X 47½ X 50½	

*Note: Add the following suffix in place of XX:

For	Suffix	For	Suffix
120/120	11	240/120	21
120/240	12	240/240	22

**Note: Dimensions are nominal and outline drawings are available upon request.
***Note: If shielded polyethylene output cables are desired in place of porcelain insulator, designate part number with a "C" prefix, e.g., 1-CTR-30-XX.



Transformer, High Voltage—Filament Isolation Open Type Construction—Epoxy Coated

High Voltage Filament Isolation Transformers				
Type	Secondary Volts	Secondary Amps	Isolation kV dc (Working)	Size (A X B X C)
AD 3227	5	1	10	2⅝ X 2⅜ X 3⅛
AD 3231	5	3	10	3 X 2⅝ X 3½
AD 3234	5	5	10	3¼ X 2⅝ X 3⅞
AD 3226	6.3	1	10	2⅝ X 2⅜ X 3⅛
AD 3230	6.3	3	10	3 X 2⅞ X 3½
AD 3233	6.3	5	10	3¼ X 2⅞ X 3⅞
AD 3238	5	1	20	4½ X 3 X 4
AD 3239	5	3	20	4⅜ X 3½ X 4⅜
AD 3240	5	5	20	4⅞ X 3½ X 5⅛
AD 3241	6.3	1	20	4½ X 3 X 4
AD 3242	6.3	3	20	4⅜ X 3½ X 4⅜
AD 3243	6.3	5	20	4⅞ X 3½ X 5⅛
AD 3247	5	1	30	4⅞ X 3½ X 5
AD 3248	5	3	30	5¼ X 3¾ X 5¼
AD 3249	5	5	30	6¼ X 3¾ X 6½
AD 3250	6.3	1	30	4⅞ X 3½ X 5
AD 3251	6.3	3	30	5¾ X 3¾ X 5¼
AD 3252	6.3	5	30	6¼ X 3¾ X 6½

All primaries: 115 volts, 60Hz.

Transformer, High Voltage—Line Isolation Open Type Construction—Epoxy Coated

FEATURES:

- ▼ Designed for continuous operation at rated voltage and power
- ▼ Epoxy coated, air insulated up to 30kV dc, oil insulated over 30kV dc
- ▼ Well suited to applications requiring reliable isolated line voltage at power ratings up to 1kVA
- ▼ Other higher voltage and power units available upon request

SPECIFICATIONS:
Primaries: 115V or 230V, 60Hz
Secondaries: 115V

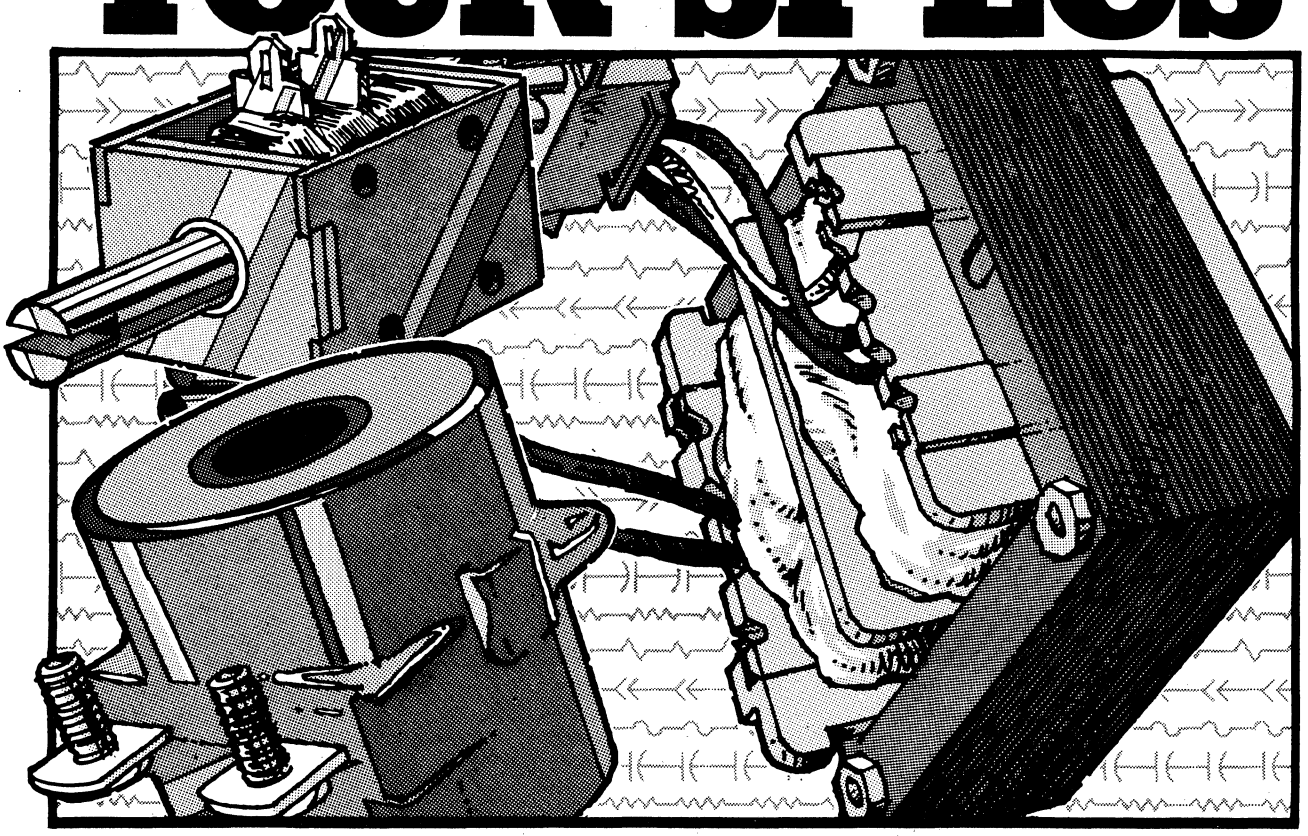
Type	Rating kVA	Size (A X B X C)	Mounting Dimensions (D X E)	Insulation kV dc Working
AD 1640	0.200	6⅛ X 4 X 5⅛	4½ X 3	10
AD 1641	0.500	7⅝ X 5⅞ X 7¾	5⅜ X 4¼	10
AD 1642	0.750	9½ X 6 5/16 X 8¼	7¼ X 4 13/16	10
AD 1643	1.000	8½ X 8 X 9¾	6 X 5	10
AD 1644	0.200	8½ X 4 X 5⅝	6⅞ X 3⅛	20
AD 1645	0.500	10¼ X 5⅝ X 7½	8 X 4¼	20
AD 1646	0.750	9¾ X 6¾ X 8	7½ X 4 13/16	20
AD 1647	1.000	11¼ X 6⅝ X 8¾	8¾ X 4⅝	20
AD 3060	0.250	8½ X 7¼ X 6½	7 5/16 X 3⅜	30
AD 3061	0.500	9¾ X 7 X 8¾	7 13/16 X 3½	30
AD 3062	0.750	10½ X 7½ X 9½	8½ X 3⅝	30
AD 3063	1.000	11 X 9 X 9½	8¾ X 3¾	30
AD 3064	0.250	10 X 7 X 6½	8 13/16 X 3⅜	40
AD 3065	0.500	11¼ X 7¼ X 8¾	9⅛ X 3½	40
AD 3066	0.750	12½ X 7½ X 9½	10¼ X 3⅝	40
AD 3067	1.000	12¾ X 9 X 9½	10 7/16 X 3¾	40
AD 3068	0.250	13¼ X 7¼ X 6½	12 X 3⅜	50
AD 3069	0.500	13¼ X 7¼ X 8¾	11⅛ X 3½	50
AD 3070	0.750	14½ X 7½ X 9½	12¼ X 3⅝	50
AD 3071	1.000	14¾ X 9 X 9½	12 7/16 X 3¾	50

DEL

DEL ELECTRONICS CORPORATION

250 East Sandford Boulevard, Mount Vernon, New York 10550
Phone: 914/699-2000 TWX 710-562-0130

WE WANT YOUR SPECS



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You turned it on and it worked. No wonder you trust Stancor.®

Your radio kit. Back then it was your most important project. When it worked the very first time you turned it on, you were filled with pride. You trusted Stancor transformers then. And you can still trust them now.

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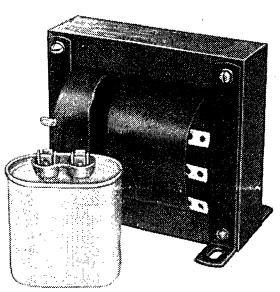
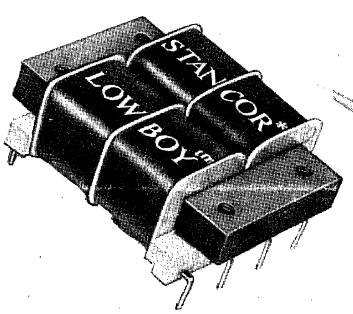
TRANSFORMERS

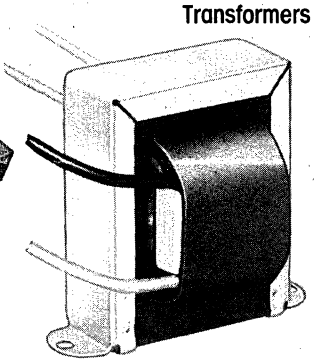


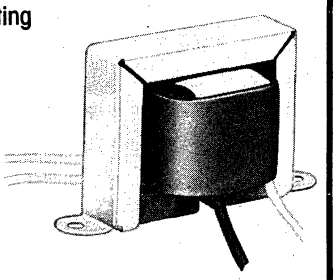
Type CV Constant Voltage Transformer 60VA thru 480 VA



Low Boy™ Low Profile

Class 2 Energy-Limiting Transformers



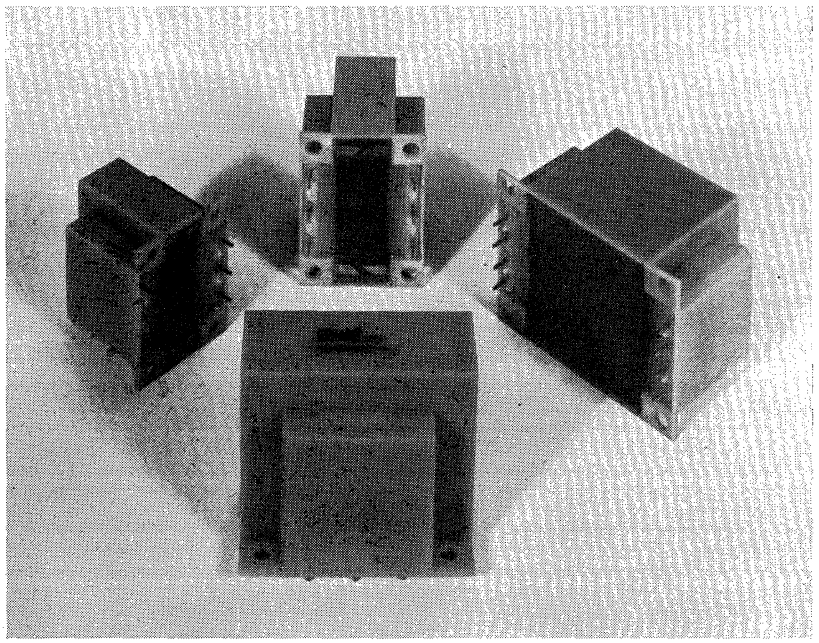


UNITED TECHNOLOGIES
HAMILTON STANDARD
CONTROLS

3-73

FORM-TRAN™

For military style packaging of printed circuit board plug-in transformers — at commercial prices



FEATURES

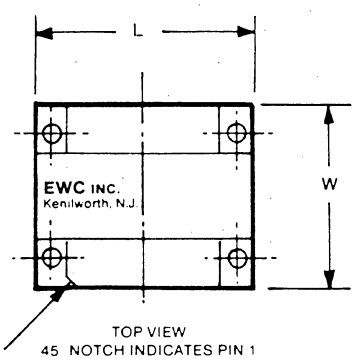
- Assures greater reliability.
- Encapsulated in form fitting shells to protect against possible damage due to use of water soluble and other fluxes as well as electrolytic corrosion experienced on open type construction.
- Enhances physical appearance of your printed circuit board.
- In addition to UL recognition modified "Form-Tran" packaging can be provided that will meet safety requirements valid in all member countries of the European Community and Canada.

FORM-TRAN PACKAGING CAN BE PROVIDED FOR OUR STANDARD LINES OF

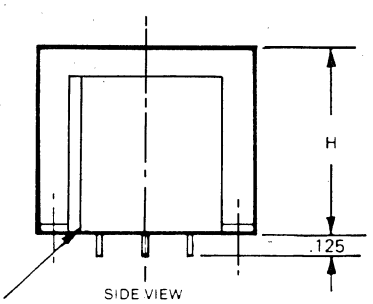
PC/DPC*
EL/DEL*
MPC/DMPC*

Simplify by inserting the letter "P" for mechanical configuration.

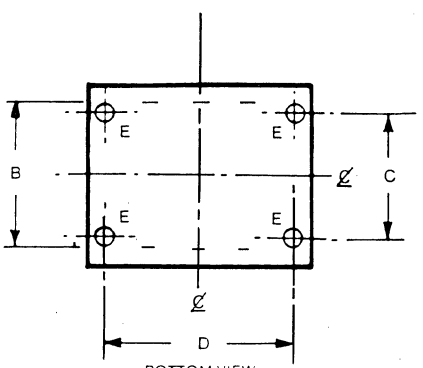
* See following pages for part numbers and details.



TOP VIEW
45 NOTCH INDICATES PIN 1



SIDE VIEW
45 NOTCH INDICATES PIN 1



BOTTOM VIEW

Size	L ±.03	W ±.03	H ±.03	B ±.010	C ±.010	D ±.010	E DIA.
37	1.52	1.22	1.26	1.000	.840	1.270	.125 .132
50	1.77	1.30	1.44	1.100	1.000	1.463	.159 .169
62	2.02	1.50	1.70	1.300	1.125	1.625	.159 .169
24	1.70	2.32	1.42	2.100	2.00	1.463	.159 .169

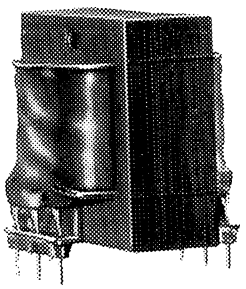
RECOGNIZED COMPONENT UNDERWRITERS LABS INC.

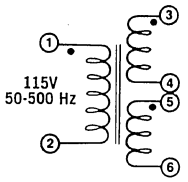
EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

Power Transformers—P.C.

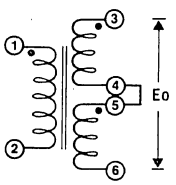
Recognized Component
Underwriters Labs, Inc.

Single 115V Primary
Type PC-6 Pins

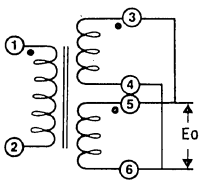




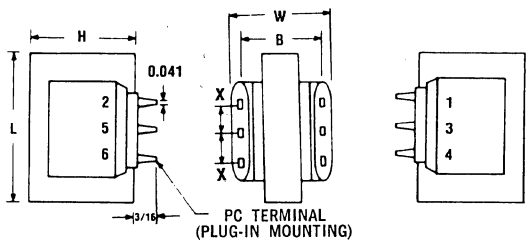
BASIC SCHEMATIC
Transformer can be connected in series or parallel.



SERIES CONNECTED

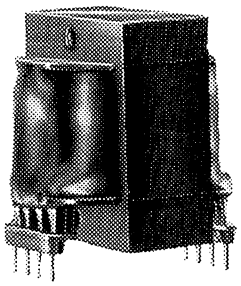


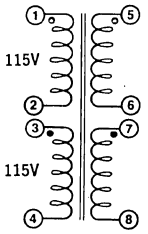
PARALLEL CONNECTED



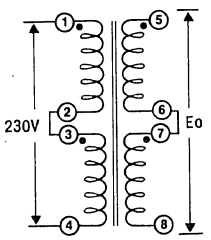
BRACKET AND CHANNEL FRAME MOUNTING AVAILABLE

Dual 115/230V Primary
Type DPC-8 Pins

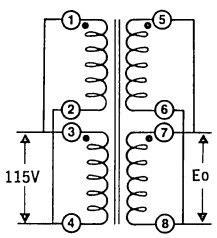




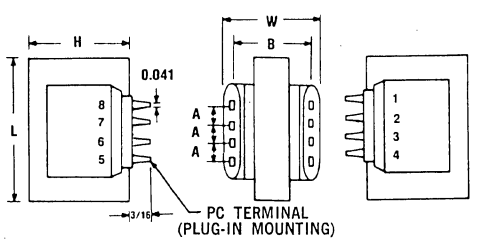
BASIC SCHEMATIC
Transformer can be connected in series or parallel.



SERIES CONNECTED

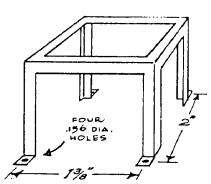


PARALLEL CONNECTED



BRACKET AND CHANNEL FRAME MOUNTING AVAILABLE

"SLIDE ON" BRACKET
FOR SIZE 24 P/N B24



Size	VA	L	W	H	6 PIN X	8 PIN A	B	Wt. Oz.
25	1.0	1	1 3/8	0.83	0.250	0.200	1.200	2.5
37	1.2	1 3/8	1 1/8	1 3/16	0.312	0.200	1.000	3
50	4.4	1 5/8	1 1/4	1 3/8	0.400	0.250	1.100	5
62	10	1 7/8	1 7/16	1 5/8	0.400	0.250	1.300	9
24	24	1 5/8	2 1/4	1 3/8	0.400	0.250	2.100	12

HOW TO ORDER

D PC - 10 - 2400 B 4

- 4 — Individual Spec
- B — Mechanical Configuration — Mounting
- 2400 — Secondary Current (ma RMS) rating
- 10 — Secondary Voltage (V RMS) rating
- PC — Transformer Series
- D — Primary Rating

Primary Rating

No Letter	115V	50/60 Hz	6 pin
C	230V	50/60 Hz	6 pin
D	115/230V	50/60 Hz	8 pin
E	277V	50/60 Hz	6 pin
F	332V	50/60 Hz	6 pin

Transformer Series
PC — Single Section Bobbin PC Transformers
EL — "2 Section" Split Bobbin PC Transformer

Secondary Voltage Rating — in volts RMS

Secondary Current Rating — in ma RMS

Mechanical Configuration
A = Channel Frame Mounting — Style A — Screw Mount
B = No Frame
C = Channel Frame Mounting — Style C — PC to b Mount
E = Channel Frame — No Mounting
P = Potted — FORM-TRAN™ Construction available on sizes 37, 50, 62 and 24 only

EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

Power Transformers—P.C.

Recognized Component
Underwriters Labs, Inc.

SECONDARY RMS RATING			PRIMARY 50/500 Hz				
Series	Parallel @ 2x Current		*	*	*		
V.C.T. MA	V MA	Size	Single 115V 6 Pin	Single 230V 6 Pin	Dual 115/230V 8 Pin	Single 277V 6 Pin	Single 332V 6 Pin
10 @ 90	5 @ 180	25	PC-10-90B53	CPC-10-90B53	DPC-10-90B53	EPC-10-90B53	FPC-10-90B53
10 @ 120	5 @ 240	37	PC-10-120B1	CPC-10-120B1	DPC-10-120B1	EPC-10-120B1	FPC-10-120B1
10 @ 440	5 @ 880	50	PC-10-440B2	CPC-10-440B2	DPC-10-440B2	EPC-10-440B2	FPC-10-440B2
10 @ 1000	5 @ 2000	62	PC-10-1000B3	CPC-10-1000B3	DPC-10-1000B3	EPC-10-1000B3	FPC-10-1000B3
10 @ 2400	5 @ 4800	24	PC-10-2400B4	CPC-10-2400B4	DPC-10-2400B4	EPC-10-2400B4	FPC-10-2400B4
12.6 @ 70	6 @ 140	25	PC-12-70B54	CPC-12-70B54	DPC-12-70B54	EPC-12-70B54	FPC-12-70B54
12.6 @ 100	6.3 @ 200	37	PC-12-100B5	CPC-12-100B5	DPC-12-100B5	EPC-12-100B5	FPC-12-100B5
12.6 @ 350	6.3 @ 700	50	PC-12-350B6	CPC-12-350B6	DPC-12-350B6	EPC-12-350B6	FPC-12-350B6
12.6 @ 800	6.3 @ 1600	62	PC-12-800B7	CPC-12-800B7	DPC-12-800B7	EPC-12-800B7	FPC-12-800B7
12.6 @ 2000	6.3 @ 4000	24	PC-12-2000B8	CPC-12-2000B8	DPC-12-2000B8	EPC-12-2000B8	FPC-12-2000B8
16 @ 55	8 @ 110	25	PC-16-55B55	CPC-16-55B55	DPC-16-55B55	EPC-16-55B55	FPC-16-55B55
16 @ 75	8 @ 150	37	PC-16-75B9	CPC-16-75B9	DPC-16-75B9	EPC-16-75B9	FPC-16-75B9
16 @ 260	8 @ 520	50	PC-16-260B10	CPC-16-260B10	DPC-16-260B10	EPC-16-260B10	FPC-16-260B10
16 @ 640	8 @ 1280	62	PC-16-640B11	CPC-16-640B11	DPC-16-640B11	EPC-16-640B11	FPC-16-640B11
16 @ 1500	8 @ 3000	24	PC-16-1500B12	CPC-16-1500B12	DPC-16-1500B12	EPC-16-1500B12	FPC-16-1500B12
20 @ 45	10 @ 90	25	PC-20-45B56	CPC-20-45B56	CPC-20-45B56	EPC-20-45B56	FPC-20-45B56
20 @ 60	10 @ 120	37	PC-20-60B13	CPC-20-60B13	DPC-20-60B13	EPC-20-60B13	FPC-20-60B13
20 @ 220	10 @ 440	50	PC-20-220B14	CPC-20-220B14	DPC-20-220B14	EPC-20-220B14	FPC-20-220B14
20 @ 500	10 @ 1000	62	PC-20-500B15	CPC-20-500B15	DPC-20-500B15	EPC-20-500B15	FPC-20-500B15
20 @ 1200	10 @ 2400	24	PC-20-1200B16	CPC-20-1200B16	DPC-20-1200B16	EPC-20-1200B16	FPC-20-1200B16
24 @ 35	12 @ 70	25	PC-24-35B57	CPC-24-35B57	DPC-24-35B57	EPC-24-35B57	FPC-24-35B57
24 @ 50	12 @ 100	37	PC-24-50B17	CPC-24-50B17	DPC-24-50B17	EPC-24-50B17	FPC-24-50B17
24 @ 180	12 @ 360	50	PC-24-180B18	CPC-24-180B18	DPC-24-180B18	EPC-24-180B18	FPC-24-180B18
24 @ 450	12 @ 900	62	PC-24-450B19	CPC-24-450B19	DPC-24-450B19	EPC-24-450B19	FPC-24-450B19
24 @ 1000	12 @ 2000	24	PC-24-1000B20	CPC-24-1000B20	DPC-24-1000B20	EPC-24-1000B20	FPC-24-1000B20
28 @ 30	14 @ 60	25	PC-28-30B58	CPC-28-30B58	DPC-28-30B58	EPC-28-30B58	FPC-28-30B58
28 @ 40	14 @ 80	37	PC-28-40B49	CPC-28-40B49	DPC-28-40B49	EPC-28-40B49	FPC-28-40B49
28 @ 160	14 @ 320	50	PC-28-160B50	CPC-28-160B50	DPC-28-160B50	EPC-28-160B50	FPC-28-160B50
28 @ 360	14 @ 720	62	PC-28-360B51	CPC-28-360B51	DPC-28-360B51	EPC-28-360B51	FPC-28-360B51
28 @ 800	14 @ 1.6A	24	PC-28-800B52	CPC-28-800B52	DPC-28-800B52	EPC-28-800B52	FPC-28-800B52
34 @ 25	17 @ 50	25	PC-34-25B59	CPC-34-25B59	DPC-34-25B59	EPC-34-25B59	FPC-34-25B59
34 @ 35	17 @ 70	37	PC-34-35B21	CPC-34-35B21	DPC-34-35B21	EPC-34-35B21	FPC-34-35B21
34 @ 125	17 @ 250	50	PC-34-125B22	CPC-34-125B22	DPC-34-125B22	EPC-34-125B22	FPC-34-125B22
34 @ 300	17 @ 600	62	PC-34-300B23	CPC-34-300B23	DPC-34-300B23	EPC-34-300B23	FPC-34-300B23
34 @ 700	17 @ 1400	24	PC-34-700B24	CPC-34-700B24	DPC-34-700B24	EPC-34-700B24	FPC-34-700B24
40 @ 20	20 @ 40	25	PC-40-20B60	CPC-40-20B60	DPC-40-20B60	EPC-40-20B60	FPC-40-20B60
40 @ 30	20 @ 60	37	PC-40-30B25	CPC-40-30B25	DPC-40-30B25	EPC-40-30B25	FPC-40-30B25
40 @ 110	20 @ 220	50	PC-40-110B26	CPC-40-110B26	DPC-40-110B26	EPC-40-110B26	FPC-40-110B26
40 @ 250	20 @ 500	62	PC-40-250B27	CPC-40-250B27	DPC-40-250B27	EPC-40-250B27	FPC-40-250B27
40 @ 600	20 @ 1200	24	PC-40-600B28	CPC-40-600B28	DPC-40-600B28	EPC-40-600B28	FPC-40-600B28
56 @ 15	28 @ 30	25	PC-56-15B61	CPC-56-15B61	DPC-56-15B61	EPC-56-15B61	FPC-56-15B61
56 @ 20	28 @ 40	37	PC-56-20B29	CPC-56-20B29	DPC-56-20B29	EPC-56-20B29	FPC-56-20B29
56 @ 80	28 @ 160	50	PC-56-80B30	CPC-56-80B30	DPC-56-80B30	EPC-56-80B30	FPC-56-80B30
56 @ 180	28 @ 360	62	PC-56-180B31	CPC-56-180B31	DPC-56-180B31	EPC-56-180B31	FPC-56-180B31
56 @ 420	28 @ 840	24	PC-56-420B32	CPC-56-420B32	DPC-56-420B32	EPC-56-420B32	FPC-56-420B32
88 @ 10	44 @ 20	25	PC-88-10B62	CPC-88-10B62	DPC-88-10B62	EPC-88-10B62	FPC-88-10B62
88 @ 15	44 @ 30	37	PC-88-15B33	CPC-88-15B33	DPC-88-15B33	EPC-88-15B33	FPC-88-15B33
88 @ 50	44 @ 100	50	PC-88-50B34	CPC-88-50B34	DPC-88-50B34	EPC-88-50B34	FPC-88-50B34
88 @ 120	44 @ 240	62	PC-88-120B35	CPC-88-120B35	DPC-88-120B35	EPC-88-120B35	FPC-88-120B35
88 @ 270	44 @ 540	24	PC-88-270B36	CPC-88-270B36	DPC-88-270B36	EPC-88-270B36	FPC-88-270B36
120 @ 8	60 @ 16	25	PC-120-8B63	CPC-120-8B63	DPC-120-8B63	EPC-120-8B63	FPC-120-8B63
120 @ 10	60 @ 20	37	PC-120-10B37	CPC-120-10B37	DPC-120-10B37	EPC-120-10B37	FPC-120-10B37
120 @ 35	60 @ 70	50	PC-120-35B38	CPC-120-35B38	DPC-120-35B38	EPC-120-35B38	FPC-120-35B38
120 @ 85	60 @ 170	62	PC-120-85B39	CPC-120-85B39	DPC-120-85B39	EPC-120-85B39	FPC-120-85B39
120 @ 200	60 @ 400	24	PC-120-200B40	CPC-120-200B40	DPC-120-200B40	EPC-120-200B40	FPC-120-200B40
180 @ 5	90 @ 10	25	PC-180-5B64	CPC-180-5B64	DPC-180-5B64	EPC-180-5B64	FPC-180-5B64
180 @ 6	90 @ 12	37	PC-180-6B41	CPC-180-6B41	DPC-180-6B41	EPC-180-6B41	FPC-180-6B41
180 @ 24	90 @ 48	50	PC-180-25B42	CPC-180-24B42	DPC-180-24B42	EPC-180-24B42	FPC-180-24B42
180 @ 55	90 @ 110	62	PC-180-55B43	CPC-180-55B43	DPC-180-55B43	EPC-180-55B43	FPC-180-55B43
180 @ 130	90 @ 260	24	PC-180-130B44	CPC-180-130B44	DPC-180-130B44	EPC-180-130B44	FPC-180-130B44
230 @ 4	115 @ 8	25	PC-230-4B65	CPC-230-4B65	DPC-230-4B65	EPC-230-4B65	FPC-230-4865
230 @ 5	115 @ 10	37	PC-230-5B45	CPC-230-5B45	DPC-230-5B45	EPC-230-5B45	FPC-230-5B45
230 @ 20	115 @ 40	50	PC-230-20B46	CPC-230-20B46	DPC-230-20B46	EPC-230-20B46	FPC-230-20B46
230 @ 40	115 @ 80	62	PC-230-40B47	CPC-230-40B47	DPC-230-40B47	EPC-230-40B47	FPC-230-40B47
230 @ 100	115 @ 200	24	PC-230-100B48	CPC-230-100B48	DPC-230-100B48	EPC-230-100B48	FPC-230-100B48

RATINGS BASED ON 20% REGULATION.

METHOD OF DETERMINING SECONDARY RMS CURRENT:

Rectifier Type	Filter Type	RMS Secondary Current
Full Wave Center Tap	Choke Input	.7 x DC Amps
Full Wave Center Tap	Capacitor Input	1.2 x DC Amps
Full Wave Bridge	Choke Input	1.0 x DC Amps
Full Wave Bridge	Capacitor Input	1.8 x DC Amps

EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

Economy Line of Split-Bobbin Miniature Power Transformers

For printed circuit plug-in applications

Recognized Component
Underwriters Labs, Inc.

ATTRACTIVE PRICE SAVINGS IN QUANTITIES OF 500 AND OVER!

Available only in three types of channel frames as shown and in three different VA ratings these units are priced lower than our standard PC/DPC series and will afford substantial savings in larger quantity ranges. Additional savings can be realized if single secondary can be used in lieu of dual secondaries as shown.

Electrical characteristics differ from our standard PC/DPC series.

Style "C" channel frames supplied hot tin dipped to assure proper solderability. Other styles supplied electro tin plated.

SECONDARY RMS RATING			PRIMARY 50/60 Hz	
Series	Parallel @ 2x Current		Single 115V 6 Pin	Dual 115/230V 8 Pin
V.C.T. MA	V MA	Size		
10 @ 120	5 @ 240	37	EL-10-120*1	DEL-10-120*1
10 @ 440	5 @ 880	50	EL-10-440*2	DEL-10-440*2
10 @ 1000	5 @ 2000	62	EL-10-1000*3	DEL-10-1000*3
12.6 @ 100	6.3 @ 200	37	EL-12-100*5	DEL-12-100*5
12.6 @ 350	6.3 @ 700	50	EL-12-350*6	DEL-12-350*6
12.6 @ 800	6.3 @ 1600	62	EL-12-800*7	DEL-12-800*7
16 @ 75	8 @ 150	37	EL-16-75*9	DEL-16-75*9
16 @ 260	8 @ 520	50	EL-16-260*10	DEL-16-260*10
16 @ 640	8 @ 1280	62	EL-16-640*11	DEL-16-640*11
20 @ 60	10 @ 120	37	EL-20-60*13	DEL-20-60*13
20 @ 220	10 @ 440	50	EL-20-220*14	DEL-20-220*14
20 @ 500	10 @ 1000	62	EL-20-500*15	DEL-20-500*15
24 @ 50	12 @ 100	37	EL-24-50*17	DEL-24-50*17
24 @ 180	12 @ 360	50	EL-24-180*18	DEL-24-180*18
24 @ 450	12 @ 900	62	EL-24-450*19	DEL-24-450*19
28 @ 40	14 @ 80	37	EL-28-40*49	DEL-28-40*49
28 @ 160	14 @ 320	50	EL-28-160*50	DEL-28-160*50
28 @ 360	14 @ 720	62	EL-28-360*51	DEL-28-360*51
34 @ 35	17 @ 70	37	EL-34-35*21	DEL-34-35*21
34 @ 125	17 @ 250	50	EL-34-125*22	DEL-34-125*22
34 @ 300	17 @ 600	62	EL-34-300*23	DEL-34-300*23
40 @ 30	20 @ 60	37	EL-40-30*25	DEL-40-30*25
40 @ 110	20 @ 220	50	EL-40-110*26	DEL-40-110*26
40 @ 250	20 @ 500	62	EL-40-250*27	DEL-40-250*27
56 @ 20	28 @ 40	37	EL-56-20*29	DEL-56-20*29
56 @ 80	28 @ 160	50	EL-56-80*30	DEL-56-80*30
56 @ 180	28 @ 360	62	EL-56-180*31	DEL-56-180*31
88 @ 15	44 @ 30	37	EL-88-15*33	DEL-88-15*33
88 @ 50	44 @ 100	50	EL-88-50*34	DEL-88-50*34
88 @ 120	44 @ 240	62	EL-88-120*35	DEL-88-120*35
120 @ 10	60 @ 20	37	EL-120-10*37	DEL-120-10*37
120 @ 35	60 @ 70	50	EL-120-35*38	DEL-120-35*38
120 @ 85	60 @ 170	62	EL-120-85*39	DEL-120-85*39
180 @ 6	90 @ 12	37	EL-180-6*41	DEL-180-6*41
180 @ 24	90 @ 48	50	EL-180-24*42	DEL-180-24*42
180 @ 55	90 @ 110	62	EL-180-55*43	DEL-180-55*43
230 @ 5	115 @ 10	37	EL-230-5*45	DEL-230-5*45
230 @ 20	115 @ 40	50	EL-230-20*46	DEL-230-20*46
230 @ 40	115 @ 80	62	EL-230-40*47	DEL-230-40*47

(*) Specify letter "E", "A" or "C" for mounting style of channel frame required.

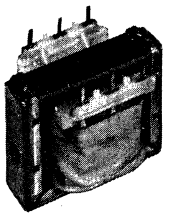
For FORM-TRAN® construction use letter "P". See eem page 1•2534 for ordering information.

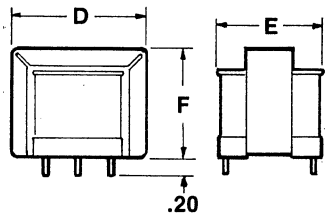
EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

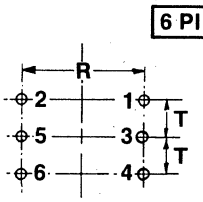
P.C. BOARD LAYOUT
(CIRCUIT SIDE)

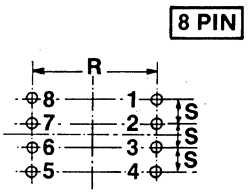
Recommended PC Hole Dia. = 0.052

Style E
Channel Frame

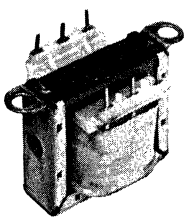


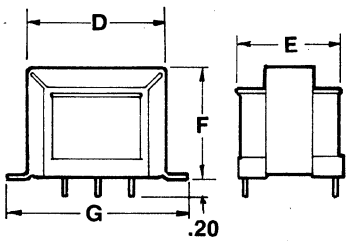


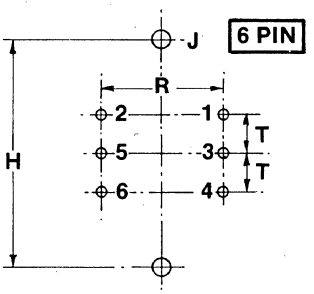


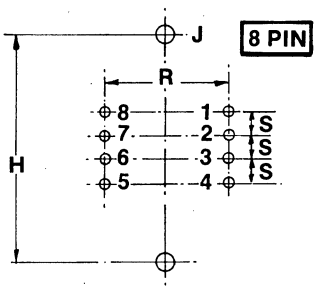


Style A
Channel Frame



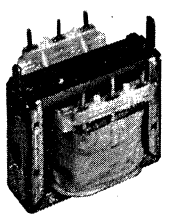


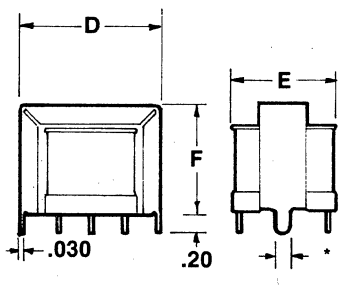


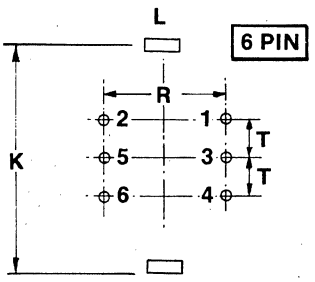


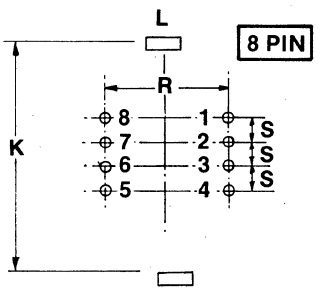
J = 0.190 DIA.

Style C
Channel Frame









* for size 37 & 50 = .13
for size 62 = .19

SIZE	D	E	F	G	H	K	R	S	T	WGT. OZ.
37	1-1/2	1-1/8	1-7/32	2-1/16	1.75	1.422	1.000	.200	0.312	3
50	1-23/32	1-1/4	1-13/32	2-3/8	2.00	1.672	1.100	.250	0.400	5
62	1-31/32	1-7/16	1-21/32	2-13/16	2.38	1.922	1.300	.250	0.400	9

EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

Miniature Plug-In Power Transformers

For triple-output regulated supplies

This line was designed around our standard PC and LP Series and is specified in terms of DC output.

Size "V" available with single primary only.
Sizes "X" and "Y" available with single or dual primary.
Sizes "6" and "12" available with dual primary only.
1000V hipot is standard on Sizes "V", "X" and "Y"
1500V hipot is standard on Sizes "6" and "12".

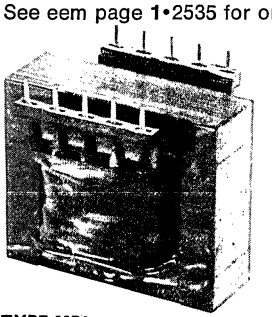
Recognized Component
Underwriters Labs, Inc.

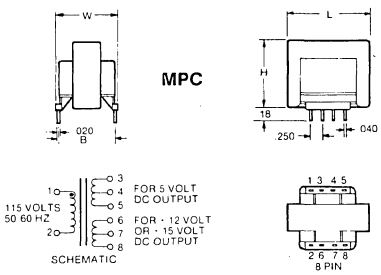
IDEAL FOR MICROPROCESSOR APPLICATIONS

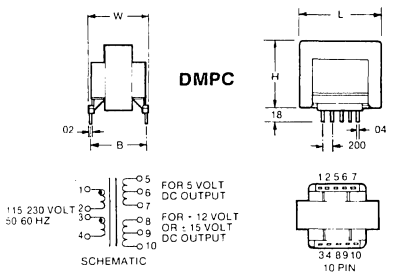
TYPE MPC AND DMPC

Size	L	W	H	8-Pin	10-Pin	B	Lbs.
V	1-5/8	1-1/4	1-3/8	0.250	0.200	1.100	0.31
X	1-7/8	1-7/16	1-5/8	0.250	0.200	1.300	0.56
Y	1-5/8	2-1/4	1-3/8	0.250	0.200	2.100	0.75

MPC and DMPC's also available with channel frames see eem page **1**•2838 or FORM-TRAN® Construction
See eem page **1**•2535 for ordering information.

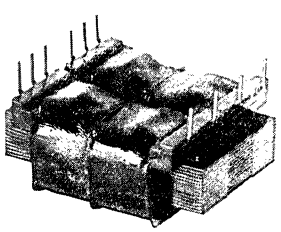


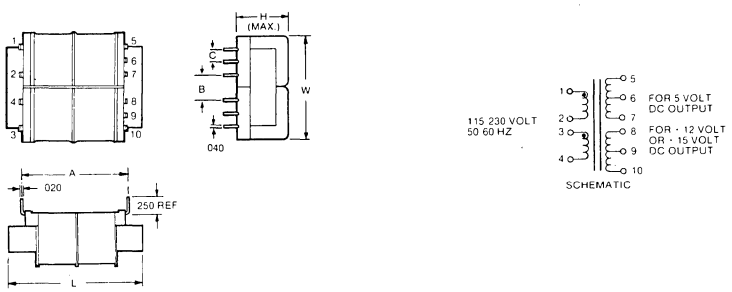




TYPE MPL

Size	L	W	H	A	B	C	Lbs.
6	1-7/8	1-9/16	0.850	1.600	0.375	0.187	0.43
12	2-1/2	2.000	1.065	2.000	0.500	0.250	0.68





Part Number Primary 50/60 Hz		DC OUTPUT		
115 V (8 Pin)	115/230 V (10 Pin)	Output #1	Output #2	Size
MPC-V-12B1	N/A	5VDC 180ma	±12VDC 35ma	V
MPC-V-15B2	N/A	5VDC 180ma	±15VDC 30ma	V
MPC-X-12B11	DMPC-X-12B31	5VDC 360ma	±12VDC 60ma	X
MPC-X-15B12	DMPC-X-15B32	5VDC 360ma	±15VDC 50ma	X
MPC-Y-12B21	DMPC-Y-12B41	5VDC 835ma	±12VDC 150ma	Y
MPC-Y-15B22	DMPC-Y-15B42	5VDC 835ma	±15VDC 130ma	Y
N/A	MPL-6-12B51	5VDC 135ma	±12VDC 40ma	6
N/A	MPL-6-15B52	5VDC 135ma	±15VDC 35ma	6
N/A	MPL-12-12B61	5VDC 270ma	±12VDC 85ma	12
N/A	MPL-12-15B62	5VDC 270ma	±15VDC 70ma	12

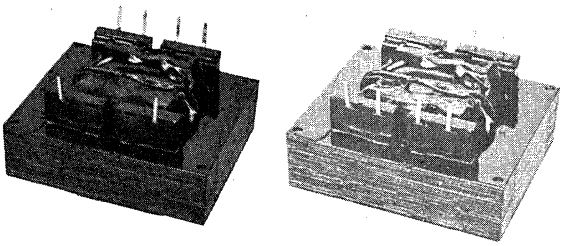
EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

Miniature Split-Bobbin Plug-in Power Transformers

For printed circuit applications

Part Number		SECONDARY RMS RATING	
Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel
ST 2-10B41	DST 2-10B41	10V C.T. @ 0.11A	5V @ 0.22A
ST 3-10B1	DST 3-10B1	10V C.T. @ 0.25A	5V @ 0.5A
ST 4-10B2	DST 4-10B2	10V C.T. @ 0.6A	5V @ 1.2A
ST 5-10B3	DST 5-10B3	10V C.T. @ 1.2A	5V @ 2.4A
ST 6-10B4	DST 6-10B4	10V C.T. @ 2A	5V @ 4A
ST 7-10B51	DST 7-10B51	10V C.T. @ 3.6A	5V @ 7.2A
ST 2-12B42	DST 2-12B42	12.6V C.T. @ 0.09A	6.3V @ 0.18A
ST 3-12B5	DST 3-12B5	12.6V C.T. @ 0.2A	6.3V @ 0.4A
ST 4-12B6	DST 4-12B6	12.6V C.T. @ 0.5A	6.3V @ 1.0A
ST 5-12B7	DST 5-12B7	12.6V C.T. @ 1.0A	6.3V @ 2.0A
ST 6-12B8	DST 6-12B8	12.6V C.T. @ 1.6A	6.3V @ 3.2A
ST 7-12B52	DST 7-12B52	12.6V C.T. @ 2.85A	6.3V @ 5.7A
ST 2-16B43	DST 2-16B43	16V C.T. @ 0.07A	8V @ 0.14A
ST 3-16B9	DST 3-16B9	16V C.T. @ 0.15A	8V @ 0.3A
ST 4-16B10	DST 4-16B10	16V C.T. @ 0.4A	8V @ 0.8A
ST 5-16B11	DST 5-16B11	16V C.T. @ 0.8A	8V @ 1.6A
ST 6-16B12	DST 6-16B12	16V C.T. @ 1.25A	8V @ 2.5A
ST 7-16B53	DST 7-16B53	16V C.T. @ 2.25A	8V @ 4.5A
ST 2-20B44	DST 2-20B44	20V C.T. @ 0.055A	10V @ 0.11A
ST 3-20B13	DST 3-20B13	20V C.T. @ 0.12A	10V @ 0.24A
ST 4-20B14	DST 4-20B14	20V C.T. @ 0.3A	10V @ 0.6A
ST 5-20B15	DST 5-20B15	20V C.T. @ 0.6A	10V @ 1.2A
ST 6-20B16	DST 6-20B16	20V C.T. @ 1A	10V @ 2A
ST 7-20B54	DST 7-20B54	20V C.T. @ 1.8A	10V @ 3.6A
ST 2-24B45	DST 2-24B45	24V C.T. @ 0.045A	12V @ 0.09A
ST 3-24B17	DST 3-24B17	24V C.T. @ 0.1A	12V @ 0.2A
ST 4-24B18	DST 4-24B18	24V C.T. @ 0.25A	12V @ 0.5A
ST 5-24B19	DST 5-24B19	24V C.T. @ 0.5A	12V @ 1.0A
ST 6-24B20	DST 6-24B20	24V C.T. @ 0.8A	12V @ 1.6A
ST 7-24B55	DST 7-24B55	24V C.T. @ 1.5A	12V @ 3.0A
ST 2-28B46	DST 2-28B46	28V C.T. @ 0.04A	14V @ 0.08A
ST 3-28B21	DST 3-28B21	28V C.T. @ 0.085A	14V @ 0.17A
ST 4-28B22	DST 4-28B22	28V C.T. @ 0.2A	14V @ 0.4A
ST 5-28B23	DST 5-28B23	28V C.T. @ 0.42A	14V @ 0.84A
ST 6-28B24	DST 6-28B24	28V C.T. @ 0.7A	14V @ 1.4A
ST 7-28B56	DST 7-28B56	28V C.T. @ 1.3A	14V @ 2.6A
ST 2-36B47	DST 2-36B47	36V C.T. @ 0.03A	18V @ 0.06A
ST 3-36B25	DST 3-36B25	36V C.T. @ 0.065A	18V @ 0.13A
ST 4-36B26	DST 4-36B26	36V C.T. @ 0.17A	18V @ 0.34A
ST 5-36B27	DST 5-36B27	36V C.T. @ 0.35A	18V @ 0.7A
ST 6-36B28	DST 6-36B28	36V C.T. @ 0.55A	18V @ 1.1A
ST 7-36B57	DST 7-36B57	36V C.T. @ 1A	18V @ 2A
ST 2-48B48	DST 2-48B48	48V C.T. @ 0.023A	24V @ 0.046A
ST 3-48B29	DST 3-48B29	48V C.T. @ 0.05A	24V @ 0.1A
ST 4-48B30	DST 4-48B30	48V C.T. @ 0.125A	24V @ 0.25A
ST 5-48B31	DST 5-48B31	48V C.T. @ 0.25A	24V @ 0.5A
ST 6-48B32	DST 6-48B32	48V C.T. @ 0.4A	24V @ 0.8A
ST 7-48B58	DST 7-48B58	48V C.T. @ 0.75A	24V @ 1.5A
ST 2-56B49	DST 2-56B49	56V C.T. @ 0.02A	28V @ 0.04A
ST 3-56B33	DST 3-56B33	56V C.T. @ 0.045A	28V @ 0.09A
ST 4-56B34	DST 4-56B34	56V C.T. @ 0.11A	28V @ 0.22A
ST 5-56B35	DST 5-56B35	56V C.T. @ 0.22A	28V @ 0.44A
ST 6-56B36	DST 6-56B36	56V C.T. @ 0.35A	28V @ 0.7A
ST 7-56B59	DST 7-56B59	56V C.T. @ 0.65A	28V @ 1.3A
ST 2-120B50	DST 2-120B50	120V C.T. @ 0.01A	60V @ 0.02A
ST 3-120B37	DST 3-120B37	120V C.T. @ 0.02A	60V @ 0.04A
ST 4-120B38	DST 4-120B38	120V C.T. @ 0.05A	60V @ 0.1A
ST 5-120B39	DST 5-120B39	120V C.T. @ 0.1A	60V @ 0.2A
ST 6-120B40	DST 6-120B40	120V C.T. @ 0.16A	60V @ 0.32A
ST 7-120B60	DST 7-120B60	120V C.T. @ 0.3A	60V @ 0.6A

SPLIT BOBBIN — HIGHLY ISOLATED

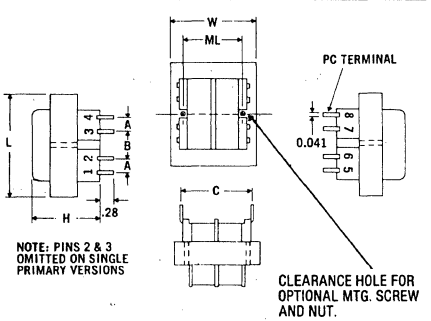


6 PIN TYPE ST — 8 PIN TYPE DST

TRANSFORMERS WOUND ON A SPLIT BOBBIN PERMIT THE PRIMARIES AND SECONDARIES TO BE WOUND SIDE BY SIDE RATHER THAN ONE OVER THE OTHER.

FEATURES ARE:
2500 V RMS Hipot
Elimination of electro-static shield
No cross-overs of primary and secondary leads
Class S insulation - 130°C

Transformers can be supplied with single 115V or 115/230V, 50/60 HZ dual primaries. Secondaries can be series or parallel connected.



Size	VA	L	W	H	ML	A	B	C	Lbs.
2	1.1	1 3/8	1 1/8	15/16	—	.250	.250	1.200	0.17
3	2.4	1 3/8	1 1/8	1 3/16	—	.250	.250	1.200	0.25
4	6	1 5/8	1 5/16	1 5/16	1 1/16	.250	.350	1.280	0.44
5	12	1 7/8	1 9/16	1 7/16	1 1/4	.300	.400	1.410	0.70
6	20	2 1/4	1 7/8	1 7/16	1 1/2	.300	.400	1.600	0.80
7	36	2 5/8	2 3/16	1 9/16	†	.400	.400	1.850	1.10

†Size 7 has 4 mtg. holes on 2 3/16 x 1 3/4 centers for a #6 screw. Need not be nylon.

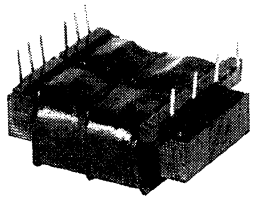
RECOGNIZED COMPONENT UNDERWRITERS LABS INC.

EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

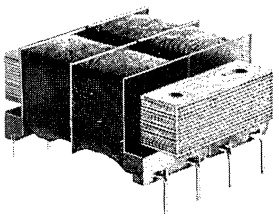
Miniature LO-PROFILE Plug-in Power Transformers

For printed circuit applications

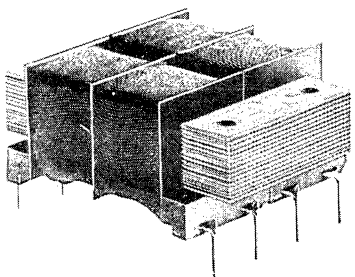
Three sizes: 2.5VA - 0.650 inches high/6VA - 0.850 inches high/12VA - 1.065 inches high



2.5VA - 0.650" HIGH



6VA - 0.850" HIGH



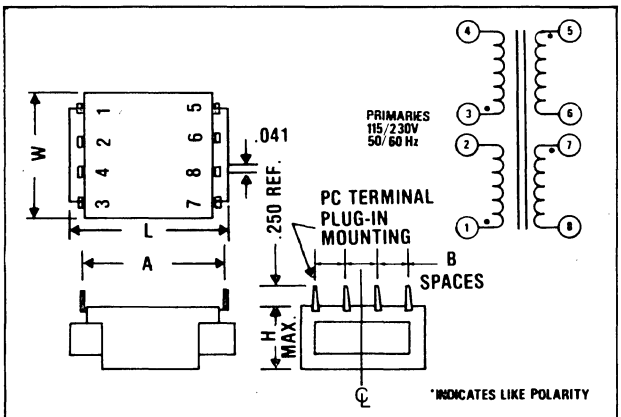
12VA - 1.065" HIGH

EWC's lo-profile, plug-in power transformers are designed for low height, critical pc board applications in semiconductor control and instrumentation. Interchangeable with those of other manufacturers, the units are for use in single, dual or reference dc supplies, or isolated control circuits.

EWC TRANSFORMERS FEATURE:

- **Non-concentric winding, achieved by secondary being wound alongside primary rather than directly over it, to lower inter-winding capacitance, thus eliminating the use of an electro-static shield.**
- **Hum-bucking (semi-toroidal) construction to diminish radiated magnetic field and balanced winding.**
- **Lo-profile design permitting close card spacing: 3/4" for 2.5VA units, 1" for 6VA units and 1 1/4" for 12VA units.**
- **Dual Primaries: 115/230V, 50/60 Hz**
- **1500V RMS HIPOT**

Part No.	Size	SECONDARY* Series	SECONDARY* Parallel
LP 10-250-B23	2	10V C.T. @ 250MA	5V @ 500MA
LP 10-600-B1	6	10V C.T. @ 600MA	5V @ 1.2A
LP 10-1200-B2	12	10V C.T. @ 1200MA	5V @ 2.4A
LP 12-200-B24	2	12.6V C.T. @ 200MA	6.3V @ 400MA
LP 12-450-B3	6	12.6V C.T. @ 450MA	6.3V @ 900MA
LP 12-900-B4	12	12.6V C.T. @ 900MA	6.3V @ 1.8A
LP 16-150-B25	2	16V C.T. @ 150MA	8V @ 300MA
LP 16-350-B5	6	16V C.T. @ 350MA	8V @ 700MA
LP 16-700-B6	12	16V C.T. @ 700MA	8V @ 1.4A
LP 20-125-B26	2	20V C.T. @ 125MA	10V @ 250MA
LP 20-300-B7	6	20V C.T. @ 300MA	10V @ 600MA
LP 20-600-B8	12	20V C.T. @ 600MA	10V @ 1.2A
LP 24-100-B27	2	24V C.T. @ 100MA	12V @ 200MA
LP 24-250-B9	6	24V C.T. @ 250MA	12V @ 500MA
LP 24-500-B10	12	24V C.T. @ 500MA	12V @ 1A
LP 34-75-B28	2	34V C.T. @ 75MA	17V @ 150MA
LP 34-170-B11	6	34V C.T. @ 170MA	17V @ 340MA
LP 34-340-B12	12	34V C.T. @ 340MA	17V @ 680MA
LP 40-60-B29	2	40V C.T. @ 60MA	20V @ 120MA
LP 40-150-B13	6	40V C.T. @ 150MA	20V @ 300MA
LP 40-300-B14	12	40V C.T. @ 300MA	20V @ 600MA
LP 56-45-B30	2	56V C.T. @ 45MA	28V @ 90MA
LP 56-100-B15	6	56V C.T. @ 100MA	28V @ 200MA
LP 56-200-B16	12	56V C.T. @ 200MA	28V @ 400MA
LP 88-28-B31	2	88V C.T. @ 28MA	44V @ 56MA
LP 88-65-B17	6	88V C.T. @ 65MA	44V @ 130MA
LP 88-130-B18	12	88V C.T. @ 130MA	44V @ 260MA
LP 120-20-B32	2	120V C.T. @ 20MA	60V @ 40MA
LP 120-50-B19	6	120V C.T. @ 50MA	60V @ 100MA
LP 120-100-B20	12	120V C.T. @ 100MA	60V @ 200MA
LP 230-10-B33	2	230V C.T. @ 10MA	115V @ 20MA
LP 230-25-B21	6	230V C.T. @ 25MA	115V @ 50MA
LP 230-50-B22	12	230V C.T. @ 50MA	115V @ 100MA



Size	L	W	H	A	B	Oz.
2	1 7/8	1 5/16	0.650	1.600	0.375	5
6	1 7/8	1 5/16	0.850	1.600	0.375	7
12	2 1/2	2	1.065	2.000	0.500	11

*Regulation of Size 2 and 6 units is 30%, i.e., no load-secondary voltage is 30% higher than full load. Regulation of Size 12 units is 20%.

RECOGNIZED COMPONENT
UNDERWRITERS LABS INC.

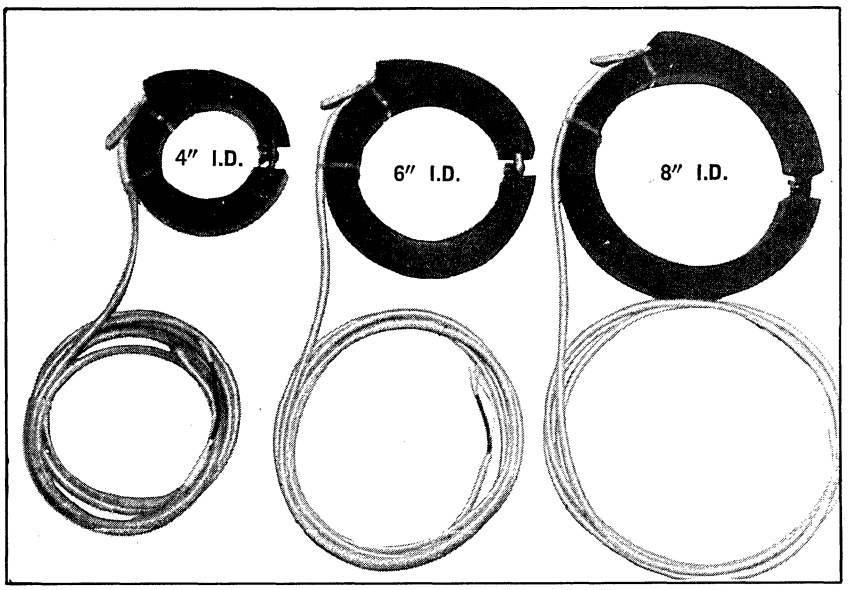
EWC® INC.
725 FEDERAL AVENUE, KENILWORTH, NEW JERSEY 07033 • (201) 245-3200 TWX 710-996-5993 800-526-4048

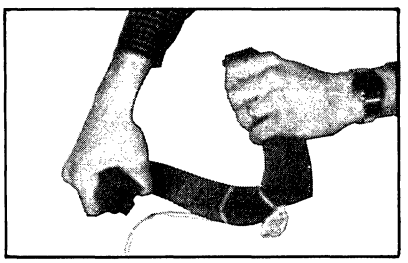
EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.

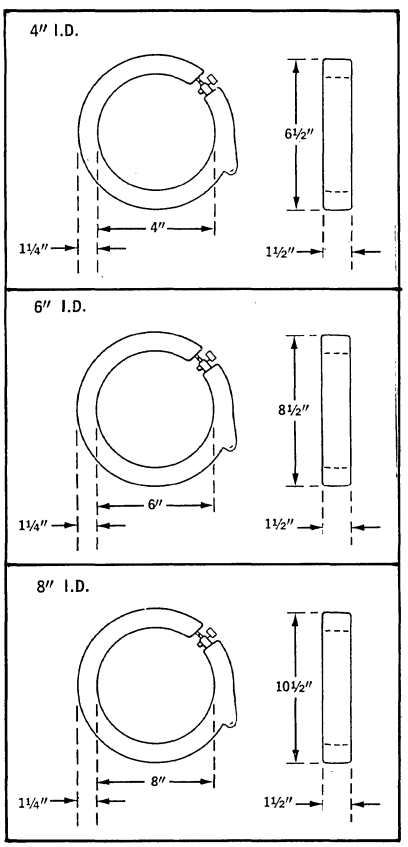
FLEX-CORE DIV.
MORLAN & ASSOCIATES, INC.
6625 McVEY BLVD. — WORTHINGTON, OHIO 43085
PHONE
(614) 889-6152

SPLIT-CORE CURRENT TRANSFORMERS





NOTE: Open split-core with a twisting motion only.



DESCRIPTION: This split-core current transformer was designed for easy installation on large bus or wire conductors in order to make electrical load surveys or for continuous monitoring of current.

APPLICATION: To be used with any 5 amp indicating or recording ammeter or amp or watt transducer. Also useable with indicating or recording clamp-on ammeter.

CONSTRUCTION: Directional silicon steel is used for the flexible core. Secondary windings are of copper. Unit is encapsulated in silicon rubber which protects against moisture, dirt, oil and corona. Remains flexible from −45° to +200°C.

INSULATION LEVEL: 600VAC — can be used over insulated conductors on higher voltage circuits.

SAFETY FACTOR: Secondary voltage limited to less than 50VAC when secondary leads are open circuited.

SECONDARY LEADS: 12 feet long with spade connectors.

COLOR: Transformer (red) — leads (yellow).

CURRENT RATIO	INSIDE DIAMETER 4"	6"	8"	BURDEN CAPACITY	ACCURACY	THERMAL FACTOR	NOTES
300/5	X	X	—	2VA	4%	1.25	
400/5	X	X	—	2VA	4%	1.25	
500/5	X	X	—	3VA	3%	1.25	
600/5	X	X	—	3VA	3%	1.25	
800/5	X	X	—	5VA	2%	1.5	Other ratios available
1000/5	X	X	—	10VA	2%	2.0	3 amp secondary available
1200/5	X	X	—	10VA	2%	2.0	Loop coil multiplier available
1500/5	X	X	X	10VA	2%	2.0	Special lead lengths available
2000/5	—	X	X	10VA	2%	2.0	
2500/5	—	X	X	10VA	2%	2.0	
3000/5	—	X	X	10VA	2%	1.5	
3500/5	—	X	X	10VA	2%	1.5	
4000/5	—	X	X	10VA	2%	1.25	
5000/5	—	X	X	10VA	2%	1.25	
6000/5	—	—	X	10VA	2%	1.25	

FREED TRANSFORMER CO., INC.

MIL-T-27 COMPONENTS

TRANSISTOR SUPPLY TRANSFORMERS
TST SERIES

Manufactured and Guaranteed to Specifications MIL-T-27

TST-6 — Frequency 57 Hz to 63 Hz — Primary 115 volts units with * primary 115 and/or 230 volts

TST-4 — Frequency 380 Hz to 1000 Hz — Primary 115 volts

TST units can be supplied in commercial type construction (channel or shell type with leads).

**When ordering specify (6) for 57 to 63 Hz and (4) for 380 to 1000 Hz

D.C. to RMS Conversion Chart

Resistive or Inductive Loads		Capacitive Loads	
Full Wave Center Tapped	Full Wave Bridge	Full Wave Center Tapped	Full Wave Bridge
E_{RMS} = 2.22 Edc	E_{RMS} = 1.11 Edc	E_{RMS} = 1.6 Edc	E_{RMS} = .8 Edc
I_{RMS} = .75 Idc	I_{RMS} = 1.05 Idc	I_{RMS} = 1.1 Idc	I_{RMS} = 1.55 Idc

Edc – should include voltage drop across reactor and voltage drop across one diode for F.W.C.T. and voltage drop across two diodes for F.W. Bridge.

	R.M.S. Output		Case	
Part No.	Volt	Amp	—4	—6
TST(**)-1	6.3 CT	.30	AH	AH
TST(**)-2	6.3 CT	.60	AH	AJ
TST(**)-3	12.6 Split	.80	AJ	EB
TST(**)-4	12.6 Split	1.5	AJ	FA
TST(**)-5	12.6 Split	2.0	AJ	GB*
TST(**)-6	25.2 Split	1.5	EB	GA*
TST(**)-7	25.2 Split	4.0	GB	JA*
TST(**)-8	30 Split	.50	AJ	FA
TST(**)-9	30 Split	1.0	AJ	GB*
TST(**)-10	30 Split	1.5	EB	GA*
TST(**)-11	30 Split	2.0	FA	HA*
TST(**)-12	40 Split	.50	AJ	FA
TST(**)-13	40 Split	1.0	EB	GA*
TST(**)-14	40 Split	1.5	FA	HA*
TST(**)-15	40 Split	2.0	FA	JB*
TST(**)-16	50 Split	.50	AJ	GB*
TST(**)-17	50 Split	1.0	FA	GA*
TST(**)-18	50 Split	1.5	FA	JB*
TST(**)-19	50 Split	2.0	GB	JA*
TST(**)-20	60 Split	.50	AJ	GB*
TST(**)-21	60 Split	1.0	FA	HA*
TST(**)-22	60 Split	1.5	FA	JA*
TST(**)-23	70 Split	.50	EB	GA*
TST(**)-24	70 Split	1.0	FA	JB*
TST(**)-25	70 Split	1.5	GB	JA*
TST(**)-26	80 Split	.25	AJ	FA
TST(**)-27	80 Split	.50	EB	GA*
TST(**)-28	80 Split	1.0	FA	JB*
TST(**)-29	90 Split	.25	AJ	GB*
TST(**)-30	90 Split	.50	EB	GA*
TST(**)-31	90 Split	1.0	FA	JA*
TST(**)-32	100 Split	.25	AJ	GB*
TST(**)-33	100 Split	.50	FA	GA*
TST(**)-34	100 Split	1.20	GA	KB*

STANDARD MILITARY AUDIO TRANSFORMERS
Frequency Response 300-10,000 Hz ±2 DB

Catalog No.	Application	Type Designation	Impedance Level in Ohms Primary	Secondary	Ratio	Max. Power Level DBM	Pri. D.C. Per Side in Ma	Max. D.C. unbalance	Case
MGA 1	Transformer; interstage, single or P.P. plates to single or P.P. grid	TF4RX15AJ	10,000 C.T.	90,000 split and C.T.	1:3 overall	+15	10	10	AJ
MGA 2	Transformer; matching 600 ohm line to voice coil.	TF4RX16AJ	600 split	4, 8, 16	6.12:1 overall	+33	0	0	AJ
MGA 3	Transformer; input, 600 ohm line to single or P.P. grids.	TF4RX10AJ	600 split	135,000 C.T.	1:15	+15	0	0	AJ
MGA 4	Transformer; matching, 600 ohm line to 600 ohm line.	TF4RX16AJ	600 split	600 split	1:1	+15	0	0	AJ
MGA 5	Transformer; output, single plate 7,600 ohm, 4,800 ohm to 600 ohm line.	TF4RX13AJ	7,600 tap @ 4,800	600 split	3.56:1	+33	40	40	AJ
MGA 6	Transformer; output, single plate 7,600 ohm, 4,800 ohm to voice coil.	TF4RX13AJ	7,600 tap @ 4,800	4, 8, 16	21.8:1	+33	40	40	AJ
MGA 7	Transformer; output, single or P.P. plates to 600 ohm line.	TF4RX13AJ	15,000 C.T.	600 split	5:1	+33	10	10	AJ
MGA 8	Transformer; output, P.P. plates to 600 ohm line.	TF4RX13AJ	24,000 C.T.	600 split	6.32:1	+30	10	1	AJ
MGA 9	Transformer; output, P.P. plates to 600 ohm line.	TF4RX13AJ	60,000 C.T.	600 split	10:1	+27	10	1	AJ

STANDARD MILITARY POWER AND FILAMENT TRANSFORMERS
Primary 105/115/125V 60~

SINGLE PHASE 400 Hz, AND THREE PHASE 60 AND 400 Hz TRANSFORMERS CAN BE SUPPLIED ON SPECIAL ORDER.

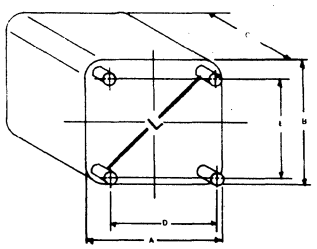
Catalog No.	MIL-T-27 Type Designation	Hi Volt	D.C. Volts	D.C. Amps	Fil. No. 1	Fil. No. 2	Case
MGP 1	TF4RX03HA001	200/100/0/100/200	185	.070	5 6. 3V @ 2A	6. 3V @ 3A	HA
MGP 2	TF4RX03JB002	690 C.T.	260	.070	5/6. 3V @ 2A	6. 3V @ 4A	JB
MGP 3	TF4RX03KB006	650 C.T.	245	.150	6. 3V @ 5A	5V @ 3A	KB
MGP 4	TF4RX03LB003	800 C.T.	318	.175	5V @ 3A	6. 3V @ 8A	LB
MGP 5	TF4RX03MB004	900 C.T.	345	.250	5V @ 3A	6. 3V @ 8A	MB
MGP 6	TF4RX02KB001	700 C.T.	255	.250			KB
MGP 7	TF4RX02LB002	1100 C.T.	419	.250			LB
MGP 8	TF4RX02NB003	1600 C.T.	640	.250			NB

Catalog No.	MIL-T-27 Type Designation	Secondary Volts	Secondary Current Amps	Secondary Test Volts RMS	Case
MGF 1	TF4RX01EB002	2.5	3.0	2,500	EB
MGF 2	TF4RX01GB003	2.5	10.0	2,500	GB
MGF 3	TF4RX01FB004	5.0	3.0	2,500	FB
MGF 4	TF4RX01HB005	5.0	10.0	2,500	HB
MGF 5	TF4RX01FB006	6.3	2.0	2,500	FB
MGF 6	TF4RX01GB007	6.3	5.0	2,500	GB
MGF 7	TF4RX01JB008	6.3	10.0	2,500	JB
MGF 8	TF4RX01KB009	6.3	20.0	2,500	KB
MGF 9	TF4RX01JB012	2.5	10.0	10,000	JB
MGF 10	TF4RX01KB013	5.0	10.0	10,000	KB

PULSE TRANSFORMERS

Catalog No.	MIL Type	Blocking Osc.	Inter-stage Coupling	Low Power Output	Pulse Voltage Kilovolts	Pulse Duration Micro-seconds	Duty Rate	No. of Windings	Test Voltage KV., RMS	Character-istic Impedance Ohms	Case No.
MPT-1	TF4RX35YY	√	√		0.25/0.25/0.25	0.2-1.0	.004	3	0.7	250	DM-20
MPT-2	TFR4X35YY	√	√		0.25/0.25	0.2-1.0	.004	2	0.7	250	DM-20
MPT-3	TF4RX35YY	√	√		0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250	DM-18
MPT-4	TF4RX35YY	√	√		0.5/0.5	0.2-1.5	.002	2	1.0	250	DM-18
MPT-5	TF4RX35YY	√	√		0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500	DM-20
MPT-6	TF4RX35YY	√	√		0.5/0.5	0.5-2.0	.002	2	1.0	500	DM-20
MPT-7	TF4RX35YY	√	√	√	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200	DM-18
MPT-8	TF4RX35YY	√	√	√	0.7/0.7	0.5-1.5	.002	2	1.5	200	DM-18
MPT-9	TF4RX35YY	√	√	√	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200	DM-18
MPT-10	TF4RX35YY	√	√	√	1.0/1.0	0.7-3.5	.002	2	2.0	200	DM-18
MPT-11	TF4RX35YY	√	√	√	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500	DM-01
MPT-12	TF4RX35YY	√	√	√	0.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	700	DM-8

MIL CASES, NOMINAL DIMENSIONS, INCHES



Mil Case	A	B	C	D	L	E	Mtg. Studs	Wt. Lbs.
AH	1 5/16	1 5/16	1 3/4		1 1/4		6-32 x 3/8	3/8
AJ	1 5/8	1 5/8	2 3/8	1 3/16		1 3/16	6-32 x 3/8	2/3
EA	1 15/16	1 13/16	2 3/4	1 3/8		1 1/4	6-32 x 3/8	1
EB	1 15/16	1 13/16	2 7/16	1 1/8		1 1/4	6-32 x 3/8	7/8
FA	2 5/16	2 1/16	3 1/8	1 11/16		1 7/16	6-32 x 3/8	1 3/4
FB	2 5/16	2 1/16	2 1/2	1 11/16		1 7/16	6-32 x 3/8	1 1/2
GA	2 3/4	2 3/8	3 13/16	2 1/8		1 3/4	6-23 x 3/8	3 1/2
GB	2 3/4	2 3/8	2 13/16	2 1/8		1 3/4	6-32 x 3/8	2 1/2
HA	3 1/16	2 5/8	4 1/4	2 19/64		1 55/64	8-32 x 3/8	4 1/2
HB	3 1/16	2 5/8	3 3/16	2 19/64		1 55/64	8-32 x 3/8	3 1/2
JA	3 5/16	3 1/16	4 7/8	2 5/8		2 1/8	8-32 x 3/8	6
JB	3 5/16	3 1/16	3 7/8	2 5/8		2 1/8	8-32 x 3/8	5
KA	3 15/16	3 3/8	5 1/4	3		2 7/16	10-32 x 1/2	8 1/2
KB	3 15/16	3 3/8	4 5/16	3		2 7/16	10-32 x 1/2	7

FREED TRANSFORMER CO., INC.

HERMETICALLY SEALED MINIATURE AND SUB-MINIATURE FILTERS TO MIL-F-18327

Freed Standard Filters are **Hermetically Sealed Miniature and Sub-Miniature** high performance components designed for both production and laboratory applications in the Communications and Electronic industry. In order to achieve attenuation requirements not obtainable with one single filter, one can combine several standard filters of different transmission characteristics. Wide Band Pass characteristics are obtainable by combining low and high Pass Units. The astatic construction of inductive components together with special shielding reduces the hum pick-up of the standard filters.

Low Pass Filters: The attenuation characteristics of Low Pass Filters are 6db or less at cut-off frequency • **ILP-ILM Interstage Low Pass Filter.** Characteristic impedance 10,000 ohms, in and out • **LLP-LLM Line Low Pass Filter.** Characteristic Impedance 500 to 600 ohms, in and out • **High Pass Filters:** The attenuation characteristics of High Pass Filters are 6db or less at cut-off frequency • **IHP-IHM Interstage High Pass Filter.** Characteristic Impedance 10,000 ohms, in and out. • **LHP-LHM Line High Pass Filter.** Characteristic Impedance 500 to 600 ohms, in and out • **Band Pass Filters:** The attenuation characteristics of Band Pass Filters are 2db or less at plus or minus 3% of center frequency • **IBP-IBM Interstage Band Pass Filter.** Normal input impedance — 10,000 ohms. Output impedance .5 megohms. Effective voltage step-up 2:1. (Output voltage to source voltage.) • **LBP-LBM Line Band Pass Filter.** Nominal input impedance 500 to 600 ohms. Output impedance .5 megohms. Effective voltage step-up 5:1. (Output voltage to source voltage.)

Special filters in all six types are available upon request.

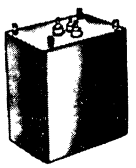
MINIATURE

Catalog No.	Cut-off Frequency Hz	
ILP- 100	100	Low Pass Filters attenuation ≧35 Db at 1.5 x Fc ≦ 40 Db at 2 x Fc
ILP- 200	200	
ILP- 300	300	
ILP- 500	500	
ILP- 750	750	
ILP- 1,000	1,000	
ILP- 1,500	1,500	
ILP- 2,000	2,000	
ILP- 2,500	2,500	
ILP- 3,000	3,000	
ILP- 5,000	5,000	
ILP- 7,000	7,000	
ILP- 10,000	10,000	
ILP- 15,000	15,000	
ILP- 20,000	20,000	
ILP- 23,000	23,000	
ILP- 25,000	25,000	
ILP- 32,000	32,000	
ILP-130,000	130,000	
ILP-150,000	150,000	
LLP- 500	500	
LLP- 1,000	1,000	
LLP- 1,500	1,500	
LLP- 1,600	1,600	
LLP- 2,000	2,000	
LLP- 2,500	2,500	
LLP- 3,000	3,000	
LLP-16,000	16,000	
LLP-20,000	20,000	
LLP-70,000	70,000	
LLP-80,000	80,000	
IHP- 200	200	High Pass Filters attenuation ≧35 Db at .67 x Fc ≧40 Db at .5 Fc
IHP- 250	250	
IHP- 300	300	
IHP- 400	400	
IHP- 500	500	
IHP- 1,000	1,000	
IHP- 2,000	2,000	
IHP- 3,000	3,000	
IHP-10,000	10,000	
IHP-15,000	15,000	
LHP- 200	200	
LHP- 300	300	
LHP- 400	400	
LHP- 500	500	
LHP- 800	800	
LHP- 1,000	1,000	
LHP- 2,000	2,000	
LHP- 6,000	6,000	
LHP-10,000	10,000	
IBP- 100	100	Band Pass Filters attenuation ≧40 Db at 0.5 x Fc and 2 x Fc
IBP- 200	200	
IBP- 250	250	
IBP- 400	400	
IBP- 500	500	
IBP- 700	700	
IBP- 800	800	
IBP- 900	900	
IBP- 1,000	1,000	
IBP- 1,500	1,500	
IBP- 2,000	2,000	
IBP- 3,000	3,000	
IBP- 5,000	5,000	
IBP- 7,200	7,200	
IBP-10,000	10,000	
IBP-12,000	12,000	
IBP-15,000	15,000	
IBP-30,000	30,000	
IBP-57,600	57,600	
LBP- 100	100	
LBP- 300	300	
LBP- 400	400	
LBP- 600	600	
LBP- 800	800	
LBP- 1,000	1,000	
LBP- 1,500	1,500	
LBP- 2,000	2,000	
LBP- 3,000	3,000	
LBP- 7,200	7,200	
LBP-10,000	10,000	
LBP-14,400	14,400	
LBP-20,000	20,000	
LBP-28,800	28,800	

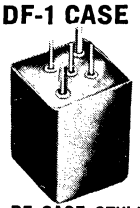
SUB-MINIATURE

Catalog No.	Cut-off Freq. Hz	Case No.	
ILM- 300	300	DF-01	Low Pass Filters attenuation ≧30 Db at 1.5 x Fc ≧40 Db at 2 x Fc
ILM- 500	500	DF-01	
ILM- 750	750	DF-01	
ILM- 1,000	1,000	DF-01	
ILM- 1,500	1,500	DF-01	
ILM- 2,000	2,000	DF-01	
ILM- 2,500	2,500	DF-01	
ILM- 3,000	3,000	DF-01	
ILM- 5,000	5,000	DF-01	
ILM- 7,000	7,000	DF-01	
ILM- 10,000	10,000	DF-01	
ILM- 15,000	15,000	DF-01	
ILM- 20,000	20,000	DF-01	
ILM- 23,000	23,000	DF-01	
ILM- 25,000	25,000	DF-01	
ILM- 32,000	32,000	DF-01	
ILM-130,000	130,000	DF-01	
ILM-150,000	150,000	DF-01	
LLM- 500	500	DF-03	
LLM- 1,000	1,000	DF-03	
LLM- 1,500	1,500	DF-02	
LLM- 1,600	1,600	DF-02	
LLM- 2,000	2,000	DF-02	
LLM- 2,500	2,500	DF-02	
LLM- 3,000	3,000	DF-02	
LLM-16,000	16,000	DF-02	
LLM-20,000	20,000	DF-02	
LLM-70,000	70,000	DF-02	
LLM-80,000	80,000	DF-02	
IHM- 300	300	DF-01	High Pass Filters attenuation ≧30 Db at .67 x Fc ≧40 Db at .5 Fc
IHM- 400	400	DF-01	
IHM- 500	500	DF-01	
IHM- 1,000	1,000	DF-01	
IHM- 2,000	2,000	DF-01	
IHM- 3,000	3,000	DF-01	
IHM-10,000	10,000	DF-01	
IHM-15,000	15,000	DF-01	
LHM- 300	300	DF-03	
LHM- 400	400	DF-03	
LHM- 500	500	DF-03	
LHM- 800	800	DF-03	
LHM- 1,000	1,000	DF-02	
LHM- 2,000	2,000	DF-02	
LHM- 6,000	6,000	DF-02	
LHM-10,000	10,000	DF-02	
IBM- 400	400	DF-02	Band Pass Filters attenuation ≧35 Db at 0.5 x Fc and 2 x Fc
IBM- 500	500	DF-02	
IBM- 700	700	DF-02	
IBM- 800	800	DF-02	
IBM- 900	900	DF-02	
IBM- 1,000	1,000	DF-02	
IBM- 1,500	1,500	DF-02	
IBM- 2,000	2,000	DF-01	
IBM- 3,000	3,000	DF-01	
IBM- 5,000	5,000	DF-01	
IBM- 7,200	7,200	DF-01	
IBM-10,000	10,000	DF-01	
IBM-12,000	12,000	DF-01	
IBM-15,000	15,000	DF-01	
IBM-30,000	30,000	DF-01	
IBM-57,600	57,600	DF-01	
LBM- 300	300	DF-02	
LBM- 400	400	DF-02	
LBM- 600	600	DF-02	
LBM- 800	800	DF-02	
LBM- 1,000	1,000	DF-01	
LBM- 1,500	1,500	DF-01	
LBM- 2,000	2,000	DF-01	
LBM- 3,000	3,000	DF-01	
LBM- 7,200	7,200	DF-01	
LBM-10,000	10,000	DF-01	
LBM-14,400	14,400	DF-01	
LBM-20,000	20,000	DF-01	
LBM-28,800	28,800	DF-01	

ALL MINIATURE FILTERS ARE SUPPLIED IN DF-1 CASE



DF-1 CASE
Height: 2½"
Width: 1 1/16"
Depth: 1 3/16"
Mtg. Cen.: 1¼"x¾"
Studs: 4 6-32x3/8"
Knockout: ⅞" dia.



DF CASE STYLE DF-01
Height: 1⅜"
Width: ¾"
Depth.: ¾"
Mtg. Cen.: 9/16" Diag.
Studs: 2 ÷ 4-40

DF-02
Height: 1⅜"
Width: 1"
Depth.: 1"
Mtg. Cen.: ¾" Diag.
Studs: 2 ÷ 4-40

DF-03
Height: 1¾"
Width: 1"
Depth.: 1"
Mtg. Cen.: ¾"
Studs: 2 ÷ 4-40

SUBMINIATURE TELEMETERING BAND PASS FILTERS

Type No.	Center Frequency Fo - in Hz	Band Width <3DB	Stop Band Attenuation
MTN-.4	.4	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-.56	.56	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-.73	.73	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-.96	.96	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-1.3	1.3	±7½%	≧38 DB @ 1.75 & .58 Fo
MTN-1.7	1.7	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-2.3	2.3	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-3.0	3.0	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-3.9	3.9	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-5.4	5.4	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-7.35	7.35	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTH-10.5	10.5	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-14.5	14.5	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-22	22	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-30	30	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-40	40	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-52.5	52.5	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-70	70	±7½%	≧ 38 DB @ 1.75 & .58 Fo
MTN-22	22	±15%	≧ 40 DB @ 2.5 & .4 Fo
MTW-30	30	±15%	≧ 40 DB @ 2.5 & .4 Fo
MTW-40	40	±15%	≧ 40 DB @ 2.5 & .4 Fo
MTW-52.5	52.5	±15%	≧ 40 DB @ 2.5 & .4 Fo
MTW-70	70	±15%	≧ 40 DB @ 2.5 & .4 Fo

CASE SIZES
DF-01: ¾ x ¾ x 1¾ — MTN-2.3 Thru MTW-70
DF-02: 1 x 1 x 1¾ — MTN-4 Thru MTN 1.7

NULL "T" FILTERS SERIES 1950

Standard models are available for 30, 60 and 120 cycles in a wide range of impedances. Each network will give a minimum of 50 db attenuation at the null frequency.

The null frequency is adjusted to a tolerance of ±2%.

All Null T Filters are hermetically sealed.

Prices on request.

Catalog No.	Frequency
NTF- 30	30 Hz
NTF- 60	60 Hz
NTF-120	120 Hz

FREED TRANSFORMER COMPANY. INC. 1795 WEIRFIELD ST., RIDGEWOOD, QUEENS, N.Y. 11385

FREED TRANSFORMER CO., INC.

TOROIDAL INDUCTORS

Using the latest developments in the field of magnetic materials and new impregnation and molding techniques the Freed Transformer Co. makes available to the industry the most extensive line of toroidal inductors.

Freed toroids are available in three types of constructions. Open units coated with a special high temperature extremely low loss compound, hermetically sealed in metal cases or molded in special **Freed Epoxy Resin.** Both hermetically sealed and molded units meet the latest military specification MIL-T-27A(graded 1 or 4 and 2 or 5 respectively.)Freed toroidal inductors are supplied with either molypermalloy or carbonyl iron powder cores

1. Temperature Stabilization:

The molypermalloy and carbonyl iron powder cores have a temperature coefficient of inductance. Depending on the degree of temperature stabilization the cores have different temperature coefficients. The degree of stabilization is denoted by a two-letter code.

SF Non-stabilized cores, ±2½% inductance variations from —55°C to +85°C.
SN Non-stabilized cores, +2% inductance variations from —55°C to +85°C.
SE Temperature stabilized cores, +0.1% to —0.4% inductance variations from —1.5°C to +54°C.
SB Temperature stabilized cores, ±0.1% inductance variations from +13°C to +35°C.
SD Temperature stabilized cores, ±0.1% inductance variations from —1.5°C to +54°C.
SW Temperature stabilized cores, ±0.25% inductance variations from —54°C to +85°C.
SM Temperature stabilized cores, ±.25% —65°C to +125°C.
SP Temperature stable carbonyl iron cores, ±0.3% inductance variations from —55°C to +85°C.

The temperature (stabilization) coefficient of an inductor will depend upon the nominal inductance value, operating frequency and A.C. voltage across the coil. Under some unfavorable working conditions the temperature coefficient of inductance corresponding to a given stability characteristic may be exceeded.

Toroids with special requirements such as tapped toroids, toroidal transformers, molded and cased units with dimensions other than standard sizes and high temperature toroids can be supplied on request. Our engineering and laboratory facilities are available for consultation, research and development.

TOROIDAL INDUCTORS

Type	Ω/H	Max. Norm. Idc	Max. Norm. Iac	Max. Norm. Vac	Uncased	Mold	Case	Frequency
TI- 1	70	55	73.5	0.46	OS-8	MR-6	DT-3, DT-5	1–15 KHz
TI- 1A	68	75	90.5	0.57	OS-9	MR-7	DT-4	1–15 KHz
TI- 2	160	90	135	0.85	OS-6	MR-5	DT-3, DT-5	10–50 KHz
TI- 3	600	100	67	0.42	OS-6	MR-5	DT-3, DT-5	50–200 KHz
TI- 3A	310	150	240	1.5	OS-10	MR-8	DT-4	50–200 KHz
TI- 4	110	55	67	0.42	OS-5	MR-4	DT-2, DM-11	1–15 KHz
TI- 5	260	28	35	0.22	OS-3	MR-3	DT-1, DM-2	1–15 KHz
TI- 6	230	75	125	0.80	OS-10	MR-8	DT-4	10–50 KHz
TI- 7	480	40	53	0.33	OS-3	MR-3	DT-1, DM-2	10–50 KHz
TI- 8	1,500	50	80	0.5	OS-3	MR-3	DT-1, DM-2	30–75 KHz
TI- 9	150	200	240	1.5	OS-10	MR-3	DT-4	30–75 KHz
TI-10	430	125	270	1.7	OS-7	MR-5	DT-3, DT-5	30–75 KHz
TI-11	30	120	190	1.2	OS-11	MR-10	DT-4	1–15 KHz
TI-12	45	100	160	1	OS-9	MR-8	DT-4	1–15 KHz
TI-13	55	140	175	1.1	OS-9	MR-8	DT-4	10–50 KHz
TI-14	580	150	—	—	OS-5	MR-4	DT-2, DM-11	10–100 KHz
TI-15	900	100	—	—	OS-3	MR-3	DT-1, DM-2	10–100 KHz
TI-16	600	16	21	0.13	OS-1	MR-1, MS-1	DST-1	1–15 KHz
TI-17	1,200	20	29	0.18	OS-1	MR-1, MS-1	DST-1	10–50 KHz
TI-18	2,600	30	40	0.25	OS-1	MR-1, MS-1	DST-1	30–75 KHz
TI-19	4,500	25	29	0.18	OS-1	MR-1, MS-1	DST-1	50–200 KHz
TI-20	2,750	100	*	*	OS-4	MR-3A	DT-2	20KHz–2MHz
TI-21	1,200	350	*	*	OS-1	MR-1, MS-1	DT-1	100KH –10MHz
TI-22	5,600	210	*	*	OS-2	MR-2	DT-1	50KHz–5MHz
TI-23	7,000	250	*	*	OS-2	MR-2	DT-1	50KHz–5MHz
TI-24	330	15	18	0.11	OS-1	MR-1, MS-1	DST-1	200Hz–12KHz
TI-25	200	20	24	0.15	OS-12	MR-2	DT-1	200Hz–12KHz
TI-26	150	25	32	0.20	OS-3	MR-3	DT-1, DM-3	200Hz–12KHz
TI-27	76.5	50	62	0.39	OS-5	MR-4	DT-2, DM-11	200Hz–12KHz
TI-28	48.5	50	64	0.40	OS-8	MR-6	DT-3, DT-5	200Hz–12KHz
TI-29	33.5	70	88	0.55	OS-9	MR-7	DT-4	200Hz–12KHz
TI-30	28	100	135	0.84	OS-9	MR-8	DT-4	200Hz–12KHz
TI-31	19.5	100	136	0.85	OS-11	MR-10	DT-4	200Hz–12KHz
TI-32	48.5	6	14.5	0.09	OS-3	MR-3	DT-1, DM-2	100Hz–10KHz
TI-33	2,150	8	13	0.08	OS-13	MR-11	DT-6	1–15 KHz
TI-34	1,700	8	9.5	0.06	OS-14	MR-11	DT-6	1–15 KHz
TI-35	4,100	10	18	0.11	OS-13	MR-11	DT-6	10–50 KHz
TI-36	3,950	10	11	0.07	OS-14	MR-11	DT-6	10–50 KHz
TI-37	23.5	10	32	0.20	OS-5	MR-14	DT-2, DM-11	100Hz–10KHz
TI-38	100	4	9.5	0.06	OS-1	MR-1, MS-1	DST-1	100Hz–10KHz

*TI-20 through TI-23 have a very low voltage coefficient and inductance will change very little with voltage. Because of high frequency application, the maximum voltage is limited rather by breakdown than by saturation.

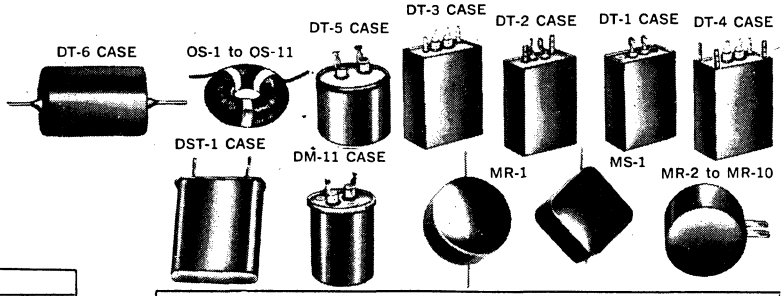
Normalized $V_{AC} = \frac{V}{F} \frac{1}{\sqrt{L_H}}$

Normalized $I_{AC} = I_{AC} \sqrt{L_H}$

Normalized $I_{DC} = I_{DC} \sqrt{L_H}$

where F —operating frequency in Hz
L_H —inductance in henries
Iac—A.C. current in MA
Idc—D.C. current in MA
V —A.C. voltage across the core

CASED, UNCASED AND MOLDED UNITS



UNCASED

Type	O.D.	Hi.
OS-1	5/8"	5/16"
OS-2	7/8"	3/8"
OS-3	1"	3/8"
OS-4	1"	9/16"
OS-5	1 3/16"	5/8"
OS-6	1 5/8"	7/8"
OS-7	1 11/16"	5/8"
OS-8	1 7/8"	11/16"
OS-9	2 1/4"	1 1/8"
OS-10	2 3/8"	1 1/4"
OS-11	2 5/8"	1 1/8"
OS-12	13/16"	3/8"
OS-13	3/8"	1/4"
OS-14	7/16"	7/32"

MOLDED

Type	O.D.	Hi.	Clearance Hole Mounting
MR-1	7/8"	13/32"	Pig Tails
MR-2	1 1/16"	1/2"	No. 4
MR-3	1 3/16"	1/2"	No. 6
MR-3A	1 3/16"	11/16"	No. 6
MR-4	1 1/2"	3/4"	No. 8
MR-5	1 7/8"	1"	No. 8
MR-6	2 1/8"	7/8"	No. 8
MR-7	2 3/8"	1 5/16"	No. 10
MR-8	2 1/2"	1 3/8"	No. 10
MR-9	2 5/8"	1 7/16"	No. 10
MR-10	2 7/8"	1 3/4"	No. 10
MR-11	7/16"	1/4"	Pig Tails
MS-1	25/32"x25/32"	13/32"	Pig Tails

CASED

Type	Hi.	Dia.	Length	Width	Mtg.	Mtg. Cen.	Cutout
DT-1	1 3/32"		1 1/16"	1/2"	2 4-40 inserts	3/4"	5/16" x 1/2".
DT-2	1 3/4"		1 1/16"	13/16"	2 6-32 studs	7/8" x 9/32"	3/8" x 11/16"
DT-3	2"		1 25/32"	7/8"	2 6-32 studs	1 1/4" x 3/8"	3/8" x 3/4"
DT-4	3 1/8"		2 3/4"	1 5/16"	4 8-32 studs	2 1/16" x 11/16"	3/4" x 3/8"
DT-5	1 3/16"	1 13/16"			2 6-32 inserts	1 1/8"	3/8" x 1"
DT-6	5/8"	1/2"			Pig Tails		
DM-2	1"	1 1/16"			2 4-40 inserts	5/8"	3/8" x 7/8"
DM-11	1 1/2"	1 3/8"			2 6-32 inserts	7/8"	3/8" x 7/8"
DST-1	25/32"		3/4"	11/32"	1/4" long pins	To fit 1/2" crystal socket	

FREED TRANSFORMER COMPANY. INC. 1795 WEIRFIELD ST., RIDGEWOOD, QUEENS, N.Y. 11385

FREED TRANSFORMER CO., INC.

COMMERCIAL GRADE COMPONENTS

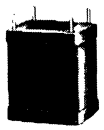
These components are designed to meet the demand for low-cost replacement parts for commercial electronic equipment.

The best commercially available materials have been utilized in the design of these units, to insure reliability and excellent performance characteristics. Vacuum impregnation with a non-hygroscopic varnish to prevent penetration of humidity are employed to give these units long life and trouble-free performance.

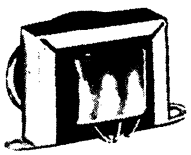
230-115 V, 50-60 C.P.S. Stepdown Transformers rated from 25 V A up to 5,000 V A Rating and line booster transformers are included in this series.

All units, with only a few exceptions, are uncased or of shell-type construction.

Isolation transformers and Stepdown transformers are equipped with line cord and receptacle.



DC



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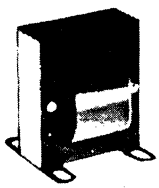


FV

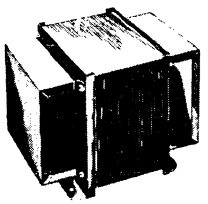
Case No.	Height	Width	Depth	Mtg. Centers	Mtg. Studs
DC2B	3½	2⅝	2¼	2x1¾	(4)8-32
DC4A	3¾	3⅛	3	2½x2½	(4)8-32
DC5C	4⅞	4⅛	3½	3⅛x2⅝	(4)10-32
DC6A	4⅞	5	4⅛	3¾x3	(4)10-32
CH60	2	3¼	1¾	2 13/16	(2)3/16
CH62	2	3¼	2⅛	2 13/16	(2)3/16
CH70	2⅝	3 11/16	2¼	3⅛	(2)3/16
CH80	2⅝	4	2⅝	3 9/16	(2)3/16
FV10	3 1/16	2½	2 9/16	2x2	(4) 13/64 x 21/64
FV12	3 1/16	2½	2 11/16	2x2⅛	(4) 13/64 x 21/64
FV22	3 7/16	2 13/16	2⅞	2¼x2¼	(4)3/16 x 3/8
FV30	4 1/32	3⅛	3	2½x2¼	(4) 13/64 x 21/64
HB718	6¼	6½	8½	4¾x4½	(4)9/32 x 21/32
HB728	6¼	6½	9¾	4¾x5¾	(4)9/32 x 21/32
VS401	3 5/16	2 15/16	3¼	2¼x1 15/16	(4)3/16 x 3/8
VS501	3 29/32	3¼	3⅜	2½x2 1/16	(4)3/16 x 3/8
VS503	3 29/32	3¼	3⅝	2½x2 5/16	(4)3/16 x 3/8
VS601	4 21/32	3⅞	3⅝	3x2 7/16	(4)3/16 x 3/8
VS603	4 21/32	3⅞	3⅞	3x2 11/16	(4)3/16 x 3/8
VS604	4 21/32	3⅞	4	3x2 7/8	(4)3/16 x 3/8
VS611	4 21/32	3⅞	4⅞	3x3 1/16	(4)3/16 x 3/8
VS612	4 21/32	3⅞	5	3x3 13/16	(4)3/16 x 3/8
VS706	5 7/16	4 9/16	5½	3½x3¾	(4)3/16 x 3/8
VS714	5 7/16	4 9/16	6½	3½x4¾	(4)3/16 x 3/8
VS718	5 7/16	4 9/16	7	3½x5¼	(4)9/32 x 21/32
VS728	5 7/16	4 9/16	8¼	3½x6½	(4)3/16 x 3/8

FILAMENT TRANSFORMERS

All primaries are for 115V, 50/60 c.p.s.

Catalog No.	Secondary Voltage	Secondary Current Amps	Secondary Test Voltage RMS	Case Size
TF 1	2.5 (C.T.)	7.5	1500	CH60
TF 2	2.5 (C.T.)	10	1500	CH70
TF 3	2.5 (C.T.)	5	7500	DC2B
TF 4	2.5 (C.T.)	10	7500	DC4A
TF 5	5.0 (C.T.)	4	1500	CH60
TF 6	5.0 (C.T.)	6	1500	CH70
TF 7	5.0 (C.T.)	10	1500	CH80
TF 8	5.0 (C.T.)	10	1500	FV10
TF 9	5.0 (C.T.)	20	2500	FV30
TF 10	5.0 (C.T.)	20	10,000	DC6A
TF 11	6.3 (C.T.)	1.35	1500	CH50
TF 12	6.3 (C.T.)	3	1500	CH60
TF 13	6.3 (C.T.)	5	1500	CH70
TF 14	6.3 (C.T.)	7	1500	FV12
TF 15	6.3 (C.T.)	10	1500	FV22
TF 16	10 (C.T.)	5	2500	CH80
TF 17	10 (C.T.)	5	2500	FV10
TF 18	10 (C.T.) *or* 11 (C.T.) (tapped primary)	12 *or* 11	7500	DC-5C
TF 19	12.6 (C.T.)	2	1500	CH62

TF 3, 4, 10 & 18 supplied with terminals. All others with leads.



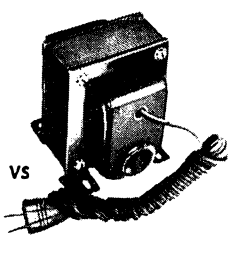
HB

AUTO TRANSFORMERS

To be used as step-down transformer. Equipped with standard receptacle and line cord.

Catalog No.	Transformation	VA Rating	Weight (lbs.)	Case Size
SDT 1*	230/115 V. 50/60 c.p.s.	25	1	CH-60
SDT 2*	230/115 V. 50/60 c.p.s.	50	1¼	CH-62
SDT 3	230/115 V. 50/60 c.p.s.	50	2½	VS-300
SDT 4	230/115 V. 50/60 c.p.s.	100	3	VS-401
SDT 5	230/115 V. 50/60 c.p.s.	200	5	VS-501
SDT 6	230/115 V. 50/60 c.p.s.	300	6½	VS-601
SDT 7	230/115 V. 50/60 c.p.s.	400	8	VS-604
SDT 8	230/115 V. 50/60 c.p.s.	500	11	VS-611
SDT 9	230/115 V. 50/60 c.p.s.	750	15	VS-706
SDT 10	230/115 V. 50/60 c.p.s.	1000	23	VS-718
SDT 11	230/115 V. 50/60 c.p.s.	1500	29½	VS-728
SDT 12*	230/115 V. 50/60 c.p.s.	2000	37	HB-718

*Supplied with leads without line cord and receptacle.



VS

ISOLATION TRANSFORMERS

Electrostatic shield between primary and secondary. Equipped with standard receptacle and line cord.

Catalog Number	Primary Voltage 50/60 c.p.s.	Secondary Voltage	VA Rating	Case Size
IT 1	115	115	50	VS-401
IT 2	115	115	100	VS-503
IT 3	115	115	300	VS-700
IT 4	115	115	500	VS-714
IT 5*	220/440	110/220	250	VS-612
IT 6*	220/440	110/220	500	VS-714

*Supplied with leads without line cords and receptacle.

MCV – CONSTANT VOLTAGE TRANSFORMERS – MCV

(FERRO-RESONANT TRANSFORMERS)

The MCV line of constant voltage transformers provides accurate regulation against line and/or load variations, without the use of tubes or moving parts.

Input Voltage Range
95 to 130

Rated output within ± 2% of nominal value. Regulation automatically maintained within ± 1%. Regulation from 25% to full load ± 2%.

- MILITARY SPECIFICATIONS
- NO TUBES
- COMMERCIAL
- NO MOVING PARTS
- ACCURATE REGULATIONS
- FAST RESPONSE
- FULLY AUTOMATIC
- SUPPLIED WITH CONDENSERS

Reg. Output in R.M.S. Volts	Output in V.A. P.F-1	CATALOG NUMBERS			
		60 Cycles		400 Cycles	
		Comm.	Military*	Comm.*	Military*
115	5	MCV65LC	MCV65LM	MCV45LC	MCV45LM
115	25	MCV625LC	MCV625LM	MCV425LC	MCV425LM
115	75	MCV675LC	MCV675LM	MCV475LC	MCV475LM
115	125	MCV6125LC	MCV6125LM	MCV4125LC	MCV4125LM
115	175	MCV6175LC	MCV6175LM	MCV4175LC	MCV4175LM
115	250	MCV6250LC	MCV6250LM	MCV4250LC	MCV4250LM
115	375	MCV6375LC	MCV6375LM	MCV4375LC	MCV4375LM
115	500	MCV6500LC	MCV6500LM	MCV4500LC	MCV4500LM
115	750	MCV6750LC	MCV6750LM	MCV4750LC	MCV4750LM
115	1000	MCV61000LC	MCV61000LM	MCV41000LC	MCV41000LM
26	5	MCV654FC	MCV654FM	MCV454FC	MCV454FM
26	25	MCV6254FC	MCV6254FM	MCV4254FC	MCV4254FM
26	75	MCV6754FC	MCV6754FM	MCV4754FC	MCV4754FM
26	125	MCV61254FC	MCV61254FM	MCV41254FC	MCV41254FM
6.4	5	MCV65FC	MCV65FM	MCV45FC	MCV45FM
6.4	25	MCV625FC	MCV625FM	MCV425FC	MCV425FM
6.4	75	MCV675FC	MCV675FM	MCV475FC	MCV475FM
6.4	125	MCV6125FC	MCV6125FM	MCV4125FC	MCV4125FM

*Condensers are not provided with units. Where condensers are provided they are external to units.

AVAILABLE UPON REQUEST
MAGNETIC AMPLIFIERS AND SATURABLE TRANSFORMERS

FREED TRANSFORMER COMPANY. INC. 1795 WEIRFIELD ST., RIDGEWOOD, QUEENS, N.Y. 11385

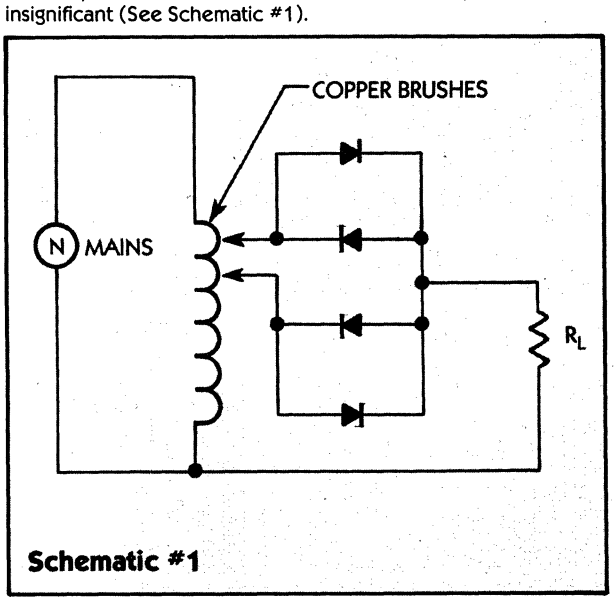
THE PROBLEM:

Conventional variable transformers have been built for years by dozens of companies all over the world, all along the same lines. A core of transformer steel (typically toroidal) is wound with a layer of copper wire which has a bare surface track ground down to provide a contact area for a traversing carbon brush. The inherent design flaw is that to provide continuous contact while traversing, the brush shorts two turns of the coil. This creates a turn-to-turn short circuit in the transformer which, if not for the relatively high impedance winding, the resistance of the wire, and the voltage drop in the carbon brush, would cause overheating and ultimate failure in the coil and brush. This weakness precludes the manufacture of a large KVA unit. More KVA requires lower impedance, heavier wire (less resistance in the shorted turn loop) and larger mass of brush (less voltage drop). Each of these changes increases the shorted-turn circulating current to the point that elaborate cooling systems are required to prevent the device from self destructing. Therefore, manufacturers of conventional adjustable transformers have been limited to the relatively small sizes of 7.5KVA or 21KVA three phase, or the system must be oil cooled to remove the destructive heat. At power levels above 7.5 and 21KVA multiple units must be stacked, with all the resulting size, cost and manpower penalties.

PESCHEL VARIABLE TRANSFORMER™

THE SOLUTION:

The PESCHEL VARIABLE TRANSFORMER (PVT) has the same basic transformer steel core surrounded by a copper wire winding. However, the winding is done so that all odd turns compose one track and all even turns the other. Each nickel plated track is traversed by its own copper (not carbon) brush a few thousandths of an inch narrower than winding wire dimension. The two brushes are connected together through one or more sets of back-to-back diodes with a standard .6 volt forward voltage drop. Thus as long as the turn-to-turn voltage is less than 1.2 volts, no current can circulate. The .6 volt drop is insignificant (See Schematic #1).



Schematic #1

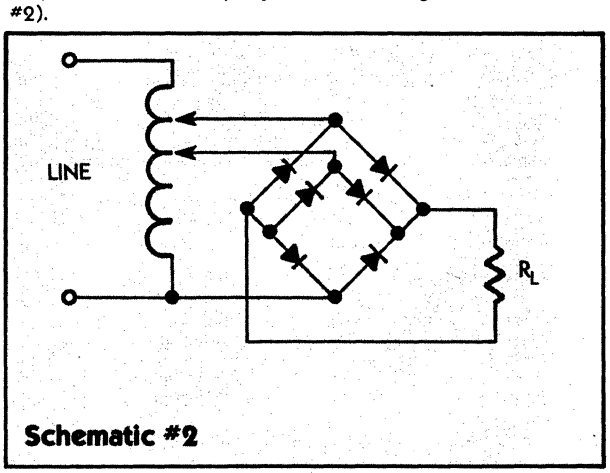
The diodes are extremely inexpensive because there is no PIV requirement, the copper brushes are not only less expensive than carbon brushes, but provide much better conductivity, consequently, electrical losses which occur in carbon brushes are avoided.

The PVT also incorporates ampere balancing coils under the tapped winding. These balancing coils eliminate higher centerpoint or non-linear impedance characteristics found in single layer variable transformers.

Heat from diode drop/load current is minimal compared to the rating of the unit and is not dissipated on the core, but on the track hardware. Less heat generation allows considerably lengthened overload time ratings. Furthermore, the brush mechanism of the PVT has significantly less mass than the brush mechanism of conventional ganged units, allowing smaller drive motors and/or much faster traverse speeds.

If line isolation or step-up or step-down voltages are required a primary is inserted under the tapped winding. This eliminates the need for an extra transformer and simultaneously reduces wasted power.

DC OUTPUT: If the same blocking diodes (with appropriate higher PIV) on the AC machine are connected in a bridge circuit, output is a continuously adjustable DC voltage. (See Schematic #2).



Schematic #2

Analysis of the schematic shows turn-to-turn current is precluded from circulating by the drop of the two diodes and the load resistance. Two extra diodes are required in a single phase bridge, six in three phase, but the cost of the diodes are insignificant when compared to SCR's and associated firing circuits. The advantages of the PVT over an SCR controller are many. The cost per horsepower within a certain range (like 5 to 100HP) should be less. Maintenance is greatly simplified. Since the PVT is an electro-mechanical device, plant maintenance people can see the problem whereas modern electronic controllers are "Black Boxes" beyond the technical capabilities of most plant electricians. Electro-magnetic interference caused by high frequencies generated by SCR turn-on is eliminated and output voltages, other than rectified line voltage, are easily obtained without an additional transformer.

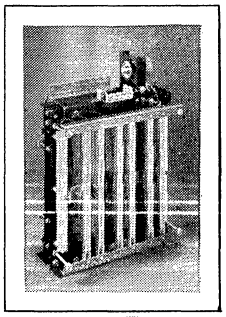
CONCLUSION:

In brief, the PVT is a significant break-through in variable transformer technology. Inventors have long recognized the inherent flaw of the conventional variable transformer and struggled to eliminate or reduce the turn-to-turn short circuit losses, however, it wasn't until appropriate diodes became available, that the problem could be solved. As with so many other significant inventions, the solution was elegantly simple, once it was conceived.

The invention of the PVT eliminates the one inherent flaw in existing variable transformer design and permits manufacture of **any size** for **any voltage.**

Hipotronics
P.O. Drawer A, Route 22, Brewster, New York 10509
Phone (914) 279-8091
Twx: 710-574-2420 HIPO BRWS NY Tlx: 178915-HIPBNY

PESCHEL VARIABLE TRANSFORMER™



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AC VARIABLE TRANSFORMERS

240V INPUT

25% STEP-UP 0-300V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
1	300	100	30
1	300	140	42
1	300	28C	84
3	300	100Y	52
3	300	140Y	73
3	300	140D	126

100% STEP-UP 0-480V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
1	480T	100	48
1	480T	140	67
1	480T	280	134
3	480T	60Y	50
3	480T	100Y	83
3	480T	140Y	116
3	480T	140D	202

480V INPUT

25% STEP-UP 0-600V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
1	600	100	60
1	600	140	84
1	600	280	168
3	600	100Y	104
3	600	140Y	145
3	600	140D	252

100% STEP-UP 0-960V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
1	960	100	96
1	960	140	135
1	960	200	192
1	960	280	269
3	960	100Y	166
3	960	140Y	232
3	960	140D	403

2400V INPUT

1 PHASE 0-2400V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
1	2400	60	144
1	2400	100	240
1	2400	140	336
1	2400	280	672

4160V INPUT

3 PHASE 0-4160V OUTPUT

MODEL φ	VOLTS	AMPS	KVA
3	4160	70Y	500
3	4160	140Y	1000

13,600V INPUT

3 PHASE* 13,600V

MODEL φ	VOLTS	AMPS	MVA
3	13.6	43Y	1
3	13.6	64Y	1.5
3	13.6	130Y	3.0

*OIL INSULATED

- No Distortion
- No Unbalance
- 1-2% Impedance any position
- No shorted turns
- No carbon brushes, copper contacts
- Single coil/core
- Air insulated
- 1/2 size and weight of any comparable unit
- 15 times overload capability

DC VARIABLE TRANSFORMERS

208/240 3φ INPUT

MODEL φ	VOLTS	AMPS	KW
3A	300	75	23
3A	300	125	38
3A	300	175	53
3A	375	75	28
3A	375	125	47
3A	375	175	66
3A	450	75	34
3A	450	125	56
3A	450	175	79
3A	500	75	38
3A	500	125	63
3A	500	175	88
3A	600	75	45
3A	600	125	75
3A	600	175	105

380V 3φ INPUT

MODEL φ	VOLTS	AMPS	KW
3B	475	75	36
3B	475	125	60
3B	475	175	83
3B	600	75	45
3B	600	125	75
3B	600	175	105
3B	700	75	53
3B	700	125	88
3B	700	175	123
3B	925	75	70
3B	925	125	116
3B	925	175	162

440/480 3φ INPUT

MODEL φ	VOLTS	AMPS	KW
3C	600	75	45
3C	600	125	75
3C	600	175	105
3C	750	75	56
3C	750	125	94
3C	750	175	131
3C	900	75	66
3C	900	125	113
3C	900	175	158
3C	1200	75	90
3C	1200	125	150
3C	1200	175	210

ADVANTAGES:
- No Electronics
- No Waveshape Chopping
- No Effect on Power Factor
- No EMI
- Same Ripple, Any Voltage

USES:
- DC Motor Speed Controller
- Chemical Processes
- Electro-Magnets
- Electropainting

OPTIONS:
- 1% regulator package
- Cabinet
- Fully Instrumented with meters, input breakers, overloads, cabinet, etc.

DC VARIABLE TRANSFORMERS WITH LINE ISOLATION

50 AMPERE, 4% RIPPLE, CONTINUOUSLY ADJUSTABLE FROM 0 TO MAXIMUM 3 φ INPUT

MODEL DC	VOLTS	AMPS	Input Note	KW
DC	300	50A	▼	15
DC	500	50A		25
DC	600	50A		30
DC	750	50A		38
DC	1000	50A		50
DC	1250	50A		63
DC	1500	50A		75
DC	2000	50A		100
DC	2500	50A		125
DC	3000	50A		150
DC	5000	50A		250
DC	10KV	50A		500
DC	15KV	50A		750
DC	20KV	50A		1MW
DC	25KV	50A	▲	1.25MW
DC	30KV	50A		1.5MW

Hyphen desired input voltage after current when ordering

100 AMPERE, 4% RIPPLE, CONTINUOUSLY ADJUSTABLE FROM 0 TO MAXIMUM 3 φ INPUT

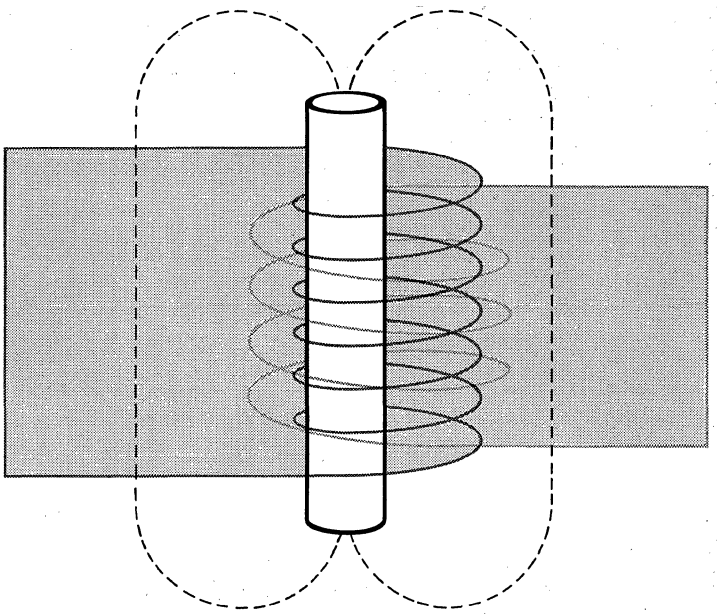
MODEL DC	VOLTS	AMPS	Input Note	KW
DC	300	100A	▼	30
DC	500	100A		50
DC	600	100A		60
DC	750	100A		75
DC	1000	100A		100
DC	1250	100A		125
DC	1500	100A		150
DC	2000	100A		200
DC	2500	100A		250
DC	3000	100A		300
DC	5000	100A		500
DC	10KV	100A		1MW
DC	15KV	100A		1.5MW
DC	20KV	100A		2MW
DC	25KV	100A	▲	2.5MW
DC	30KV	100A		3MW

Hyphen desired input voltage to current when ordering

FEATURES:
- Continuously Adjustable Output From 0 to Max
- No SCR Spikes, Waveform Chopping or Power Factor Change
- 4% Ripple at any Voltage Setting
- Extremely Efficient, i.e. 96% on the Lowest kW Unit to 98.4% on the 3 Megawatt
- Primary Voltages from 208V to 13.0 kV Available
- 1/4-1/2 Weight and Size Of Equivalent Power Units
- Rectifiers Have 2x PIV and 2-4x Current Safety Factor, RC Compensated
- Voltage Resolution From 0.6% on Low Voltage Units to 12% on High Voltage Models
- 50/60 HZ Standard
- Servo Motor Drive
- Polarity — Reversible or Floating
- Regulation — Less Than 5% No Load to Full Load

NOTES:
Model Nos prefix DC to volts — current & hyphen the desired AC input, i.e.
1st model DC 300-50 — 208V
last model DC 30kV-50 — 13.2kV or DC 30kV-50 — 4161V
Order with any input voltage desired

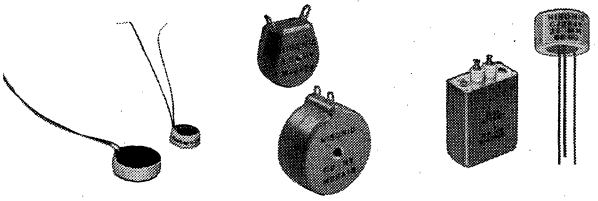
Hisonic... specialists in custom and standard inductor and transformer components



The control of electric current is only as good as the components that carry it.

INDUCTORS: Our manufacturing capabilities are the result of experience dating back to 1950 and now include virtually every known construction your special applications may require . . . and at reasonable prices.

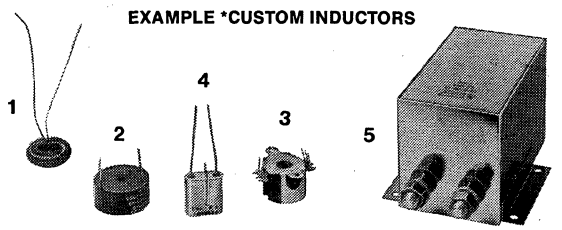
UNCASED STANDARD MOLDED METAL CASED



*Toroidal Series	Ind. Range	Max. Q	Freq. Range	DC R Ohms/MH	Uncased Size
J2	5.6MH to 3.3HY	90	Up to 30 KHZ	.50	.620D x .30H
J3	2.7 to 470MH	110	20 to 150KHZ	1.1	.620D x .30H
J4	.56 to 33MH	110	100 to 400KHZ	5.1	.620D x .30H
J5	.10 to 10MH	150	250KHZ to 1.5MHZ	8.9	.620D x .30H
R2	6.8MH to 6.8HY	135	Up to 20KHZ	.18	.960D x .40H
R3	3.3 to 470MH	180	10 to 60KHZ	.39	.960D x .40H
R4	1.2 to 68MH	170	40 to 160KHZ	.90	.960D x .40H
S2	6.8MH to 15HY	160	Up to 15KHZ	.10	1.250D x .62H
S3	3.3 to 560MH	225	10 to 60KHZ	.21	1.250D x .62H
T2	22MH to 39HY	210	Up to 15KHZ	.045	1.850D x .85H
V2	68MH to 68HY	245	Up to 8KHZ	.028	2.400D x .92H
W2	100MH to 100HY	260	Up to 6KHZ	.021	2.700D x 1.05H

*Write for Series Bulletins on electrical and case style details

EXAMPLE *CUSTOM INDUCTORS

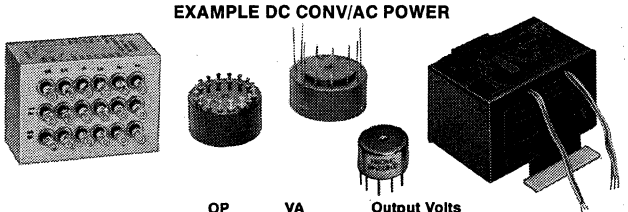


P/N	Fig.	Description	Characteristics	Type	Size
26-5103 Series	2	Encaps. PC Mtg.	See R Series Std.	Tor.	1.06x.5H
06-4000-27	1	DC Filter Choke	250uH@1.5ACD	Tor.	970Dx.4H
06-4000-39	3	Var. Ind. PC Mtg.	90-110MH Q250	Pot	.80Dx.5H
26-5034 Series	4	Xtal Case Mtg.	See J Series Std.	Tor.	.34x.75x.8H
26-5135-00	5	Shielded Choke	50uH@100ADC	Lam.	2.65x5x3H

*Advise requirements for recommended solution and quotation

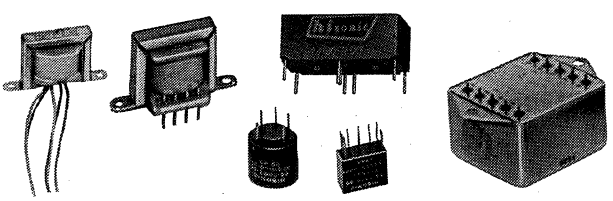
TRANSFORMERS: Hisonic's special power/converter and signal/matching transformers for both audio and wide video ranges are used in airborne comm/nav and ground communications systems. Included are toroidal, pot core, and laminated core types manufactured to commercial and MIL specifications. Our 30 year experience is at your disposal to help solve your transformer and inductor problems.

EXAMPLE DC CONV/AC POWER



P/N	Input	OP Freq.	VA Rating	Output Volts Peak (or RMS)	Size
24-0170-10	10V DC	24KHZ	0.8	20CT	.28x .6x 48H
24-0193-10	14/28V DC	6KHZ	18	4.7.11.5CT.22.5CT.550	1.8 ODx .94H
06-2124-10	200 V L-L	400HZ-3Ø	840	200L-L	4.3x3.9x2.1H
24-0107-10	14/28V DC	2KHZ	27	90/45CT.180/25.180/25	2.1 ODx .88H
24-0512-10	260V PK	100PPS	20KVA PK	4.6 KV PK PULSE	2.5x2.3x1.1H
24-0114-10	14/28V DC	400HZ	75	26.60	2.9 ODx1.5H
24-0271-10	14/28V DC	5KHZ	80	6.5CT.22.5CT.100.100	2.0x2.0x1.OH
24-0277-10	42V DC	10KHZ	200	100	2.0x2.5x1.2H
24-0177-10	10V AC	400HZ	2	1.4.1.4.10(RMS)	1.9 ODx .86H
24-0169-10	26V AC	400HZ	17	21/13CT(RMS)	1.0x1.4x1.3H
24-0215-10	115V AC	400HZ	180	20.27.27.42(RMS)	3.2x3.8x4.1H

EXAMPLE SIGNAL/PULSE/MATCH



P/N	Description	Impedance	Response	Level	Size
24-0239-11	Video Range Match	150:150.25	100KHZ-2.5MHZ	60mw	.63x.63x.44H
24-0275-10	Wide Band Match	135CT:1000	1KHZ-2MHZ	4mw	1.1 ODx.75H
24-0659-10	Syncro/Resolver	800 OHMS	400HZ	270mw	1.5x.75x.56H
24-0240-10	Wide Bank Hybrid	600.600+600	50HZ-50KHZ	1mw	1.8x2.0x1.0H
24-0171-10	Radio Freq. Hybrid	50.100+100	700KHZ-4MHZ	10mw	75 ODx85H
24-0153-10	Pulse Match	10K.40K	tp1.2ms.tr60us	25mw	.53x.53x.7H
24-0180-10	Pulse Output	5.600w/tap	tp.4us.tr.2us	6KW	1.5 ODx.8H

OTHER PRODUCTS: :(Mil Spec & Commercial) Filters — Transformers — Tuned Circuits — Amp/phase Equalizers — Lumped Constant Delay Lines

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Key source for reliable magnetic components, power supplies and control systems for over 40 years.

300 VA TO 3000 KVA STANDARD & SPECIALTY MAGNETIC COMPONENTS

STANDARD TRANSFORMERS

DIT SERIES — Drive Isolation Transformers. (12-550KVA, U.L. Listed)

Designed to provide electrical isolation and voltage transformation for SCR adjustable-speed motor drives. Dry type. 600V class. Single phase and three phase. 50Hz and 60Hz. 5% FCAN and FCBN primary taps. Open frame or NEMA I enclosed, 150°C rise/220°C insulation class standard, 155°C or 80°C or 55°C rise/220°C insulation class optional.

Size Range (KVA)

Single Phase

• 1, 1½, 3, 5, 8, 12, 15, 20, 27, 30, 34

Three Phase

• 8, 12, 15, 20, 27, 34, 40, 51, 63, 75, 93, 120, 150, 180, 220, 280, 330, 440, 550, 660, 760, 870, 980, 1100.

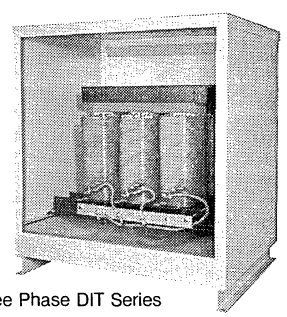
Standard Voltages Available

Single Phase

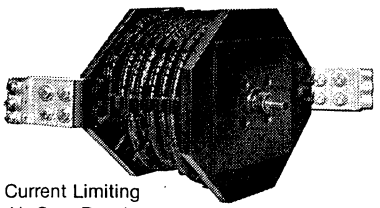
• Primary or Secondary 208, 230, 380, 460, 575, 230/460, 415

Three Phase

• Primary (△) 208, 230, 380, 460, 575, 230/460, 415
• Secondary 208Y/120, 230Y/133, 380Y/220, 460Y/266, 575Y/332, 230x460Y/133x266, 415Y/240



Three Phase DIT Series



Current Limiting Air Core Reactor

GPT SERIES — General Purpose Transformers

Designed to provide electrical isolation and voltage transformation for lighting, electric heating and industrial motor loads. Dry type, 600V class, single phase and three phase, 50Hz and 60Hz. FCAN and FCBN primary tap arrangements are standard. 150°C rise/220°C insulation class standard, 115°C or 80°C or 55°C rise/220°C insulation class optional.

Size Range (KVA)

Single Phase

• 3, 5, 7½, 10, 15, 25, 37½, 50, 75, 100, 167

Three Phase

• 3, 6, 9, 15, 30, 45, 60, 75, 112½, 150, 225, 300, 400, 500, 750, 1000

Standard Voltages Available

Single Phase

• Primary (3KVA-15KVA) 240/480, 208, 277, 480, 600
(25KVA-167KVA) 240x480, 480, 600
• Secondary (All KVA sizes) 120/240

Three Phase

• Primary (△) 240, 480, 600
• Secondary 208Y/120, 240△, 480Y/277

HVDT SERIES—High Voltage Distribution Transformers

Designed for in-plant distribution and voltage step-down. Conventional dry type or resin cast coil. 5KV through 15KV class. Single phase and three phase. 50Hz and 60Hz. FCAN and FCBN primary tap arrangements are standard. 150°C rise/220°C insulation class standard, 115°C or 80°C or 55°C rise/220°C insulation class optional.

Size Range (KVA)

Single Phase

• 3, 5, 10, 15, 25, 37½, 50, 75, 100, 167, 200, 250, 333, 500

Three Phase

• 15, 30, 45, 75, 112½, 150, 225, 300, 400, 500, 750, 1000

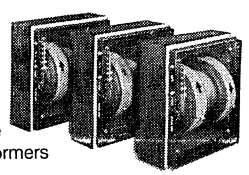
Standard Voltages Available

Single Phase

• Primary
5KV Class: 2400/4160Y
8.66KV Class: 4160/7200Y
15KV Class: 7200/12470Y
7620/13200Y, 7960/13800Y
• Secondary (All KVA Sizes)
120/240

Three Phase

• Primary (△)
5KV Class: 2400, 4160, 4800
8.66KV Class: 7200
15 KV Class: 12000, 12470, 13200, 13800
• Secondary
208Y/120, 240△, 480Y/277



High Voltage X-ray Transformers

SPECIALTY MAGNETIC COMPONENTS

Also see our catalog pages under AC POWER SOURCES and DC POWER SOURCES.

Transformers

• Convection, forced air or water cooled.
• Dry type, liquid filled, cast-resin.
• Low voltage, high voltage to 300KV.
• High current to 20,000 Amperes.
• High frequency to 10KHz.
• Low temperature rise, high efficiency.
• Ferroresonant transformers - conventional constant voltage and harmonic-neutralized.
• Ultra isolation transformers to 0.005 picofarads.
• Low capacitance transformers, electrostatic shielded.
• High reactance transformers - short circuit current limited.
• Modulation (Output) transformers to 50KW.
• Rectifier and filament transformers.

Inductors

LC Series - Link Chokes (DC)

Designed for use as a smoothing inductor in the DC link between rectifier and inverter in variable-speed AC motor drives from 15 to 1000 HP. Dry type, 600V class.

LR Series - Line Reactors (AC)

Designed for use as a line reactor in the three phase input lines supplying variable-speed AC motor drives from 15 to 1000 HP. Dry type, 600V class; three phase; 50Hz and 60Hz.
Other specialty inductors include:
• AC, DC.
• Iron-core, air-core.
• Linear, swinging.
• AC current limiting reactors.
• AC power factor correction reactors.
• DC filter chokes.
• AM modulation reactors.

Saturable Reactors:

Low voltage, High voltage to 15 KV. Sizes to 1000 KVA.

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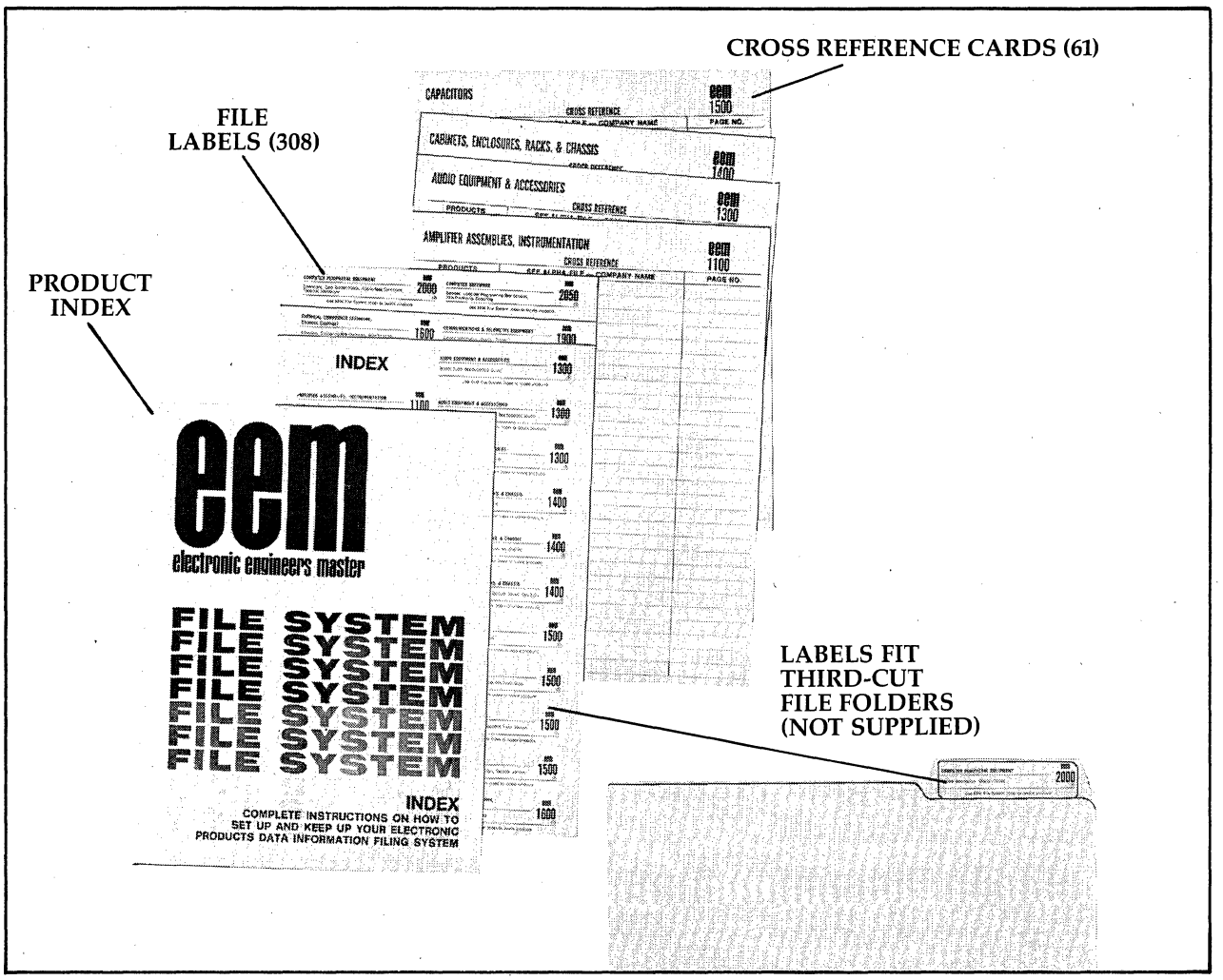

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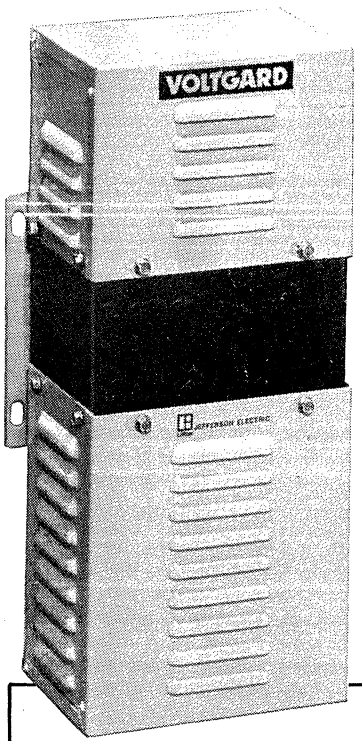

VOLTGARD™ by Jefferson

Even with all the advances made in the transmission of electric power, the single most source of trouble is the voltage variation at the final distribution point. These variations can be caused by switching equipment, lightning and heavy current drawing machinery. These changes can cause trouble in equipment unless some control is used to stabilize the voltage. This is where the Voltgard line voltage regulator is used.

The Voltgard gives ±½% regulation for a input range of ±15% of nominal. The Voltgard has a sinewave output and contains less than 3% total harmonics under full load. It is most applicable to AC applications where harmonics can affect operation. With a given change in line voltage, the output voltage will fall in the regulation band within 25 milliseconds (1½ cycles). As the input frequency changes, the output voltage changes in the same direction. For a 1% change in frequency, there is a 1½% change in output voltage.

The Voltgard has a full-load efficiency of 90 percent for nominal output levels. Another advantage of Voltgard, it is also current limiting. As the load current is increased beyond the rating, the output voltage will fall to zero. This is very important in a short circuit situation because the unit can be at short circuit indefinitely and not damage the unit. Voltgard will operate in an ambient range of -20°C to +50°C.

With all the features of Voltgard, it makes this unit most suitable for any type of electronic equipment, process control equipment, photography and most other applications where the AC voltage must be stable for operation.

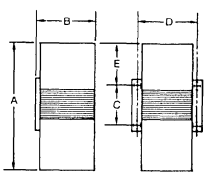

Figure 1

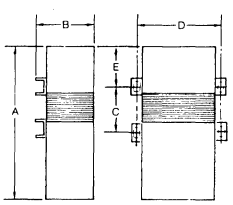

Figure 2

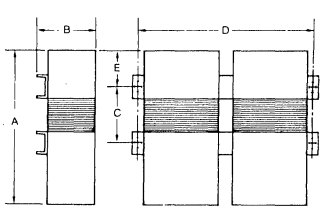

Figure 3

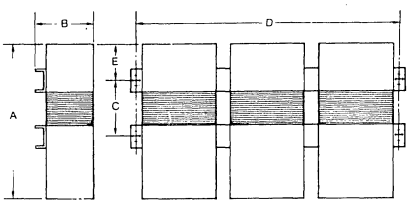

Figure 4

60 Hertz, Single Phase

Output VA Rating	Catalog Number	Input Voltage Range	Nominal Output Voltage	Shipping Weight (Pounds)	Figure Code	Dimensions A (Length)	B (Depth)	C	D (Width)	E Mounting Slots
300	**350-0810**	95-130, 190-260	120	33	1	13¾	8⅜	5⅝	8⅛	5 ⅜ x 13/16
300	**350-0822**	190-260, 380-520	120 x 240	33	1	13¾	8⅜	5⅝	8⅛	5 ⅜ x 13/16
500	**350-0910**	95-130, 190-260	120	40	1	14½	8⅜	5⅝	8⅛	5 ⅜ x 13/16
500	**350-0922**	190-260, 380-520	120 x 240	40	1	14½	8⅜	5⅝	8⅛	5 ⅜ x 13/16
750	**350-1032**	95-130, 175-235, 190-260	120 x 240	52	1	15¼	8⅜	5⅝	8⅛	5 ⅜ x 13/16
1000	**350-1122**	190-260, 380-520	120 x 240	63	1	16¼	8⅜	5⅝	8⅛	5 ⅜ x 13/16
1000	**350-1132**	95-130, 175-235, 190-260	120 x 240	63	1	16¼	8⅜	5⅝	8⅛	5 ⅜ x 13/16
1500	**350-1232**	95-130, 175-235, 190-260	120 x 240	87	2	18¼	8⅜	6⅝	8⅝	5 7/16 x ⅝
2000	**350-1322**	190-260, 380-520	120 x 240	130	2	19¼	9¼	3⅞	11¾	5 7/16 x 11/16
2000	**350-1332**	95-130, 190-260, 175-235	120 x 240	130	2	19¼	9¼	3⅞	11¾	5 7/16 x 11/16
2500	**350-1422**	190-260, 380-520	120 x 240	145	2	19⅞	9¼	4⅝	11¾	5 7/16 x 11/16
2500	**350-1432**	95-130, 175-235, 190-260	120 x 240	145	2	19⅞	9¼	4⅝	11¾	5 7/16 x 11/16
3000	**350-1522**	190-260, 380-520	120 x 240	177	2	20⅞	9¼	5 7/16	11¾	5 7/16 x 11/16
3000	**350-1532**	95-130, 175-235, 190-260	120 x 240	177	2	20⅞	9¼	5 7/16	11¾	5 7/16 x 11/16
3750	**350-1622**	190-260, 380-520	120 x 240	200	2	21⅞	9¼	6 7/16	11¾	5 7/16 x 11/16
3750	**350-1632**	95-130, 175-235, 190-260	120 x 240	200	2	21⅞	9¼	6 7/16	11¾	5 7/16 x 11/16
5000	**350-1722**	190-260, 380-520	120 x 240	300	3	19⅞	9¼	4⅝	24¾	5 7/16 x 11/16
5000	**350-1732**	95-130, 175-235, 190-260	120 x 240	300	3	19⅞	9¼	4⅝	24¾	5 7/16 x 11/16
7500	**350-1822**	190-260, 380-520	120 x 240	410	3	21⅞	9¼	6 7/16	24¾	5 7/16 x 11/16
9000	**350-1922**	190-260, 380-520	120 x 240	520	4	20⅞	9¼	5 7/16	37	5 7/16 x 11/16
11000	**350-2022**	190-260, 380-520	120 x 240	625	4	21⅞	9¼	6 7/16	37	5 7/16 x 11/16

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- Single, Dual, and Tapped Primaries
- Single and Multiple Outputs
- Terminals and Flexible Leads Available
- Available with End Bells

- Non-Concentric Winding — Lower Capacitance — Better Insulation — 2500-4000 VRMS Hipot — No Need for Electro-static Shield

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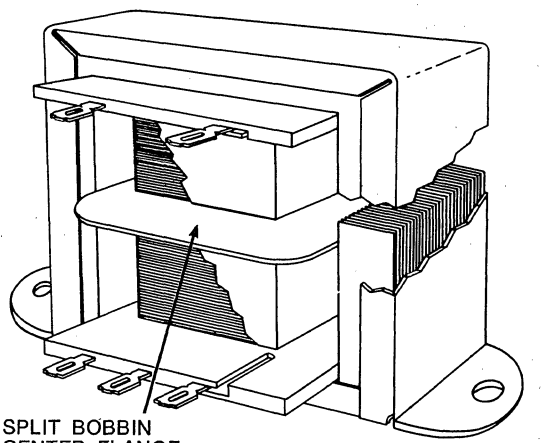

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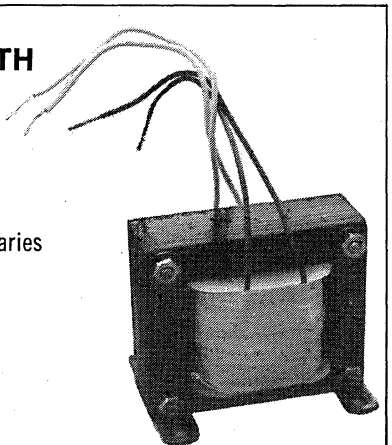

- 50/500 Hz
- Power Ratings up to 750 VA
- Wide Range of Voltages
- Single, Dual, and Tapped Primaries
- Single and Multiple Outputs
- Available with End Bells
- Terminals also available

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- 50/60 Hz
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- 100-1200 VA
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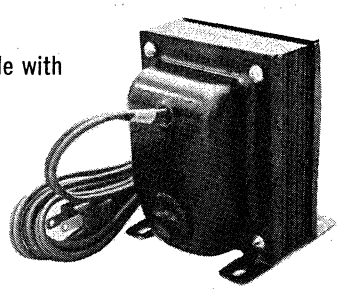

POWER ISOLATION TRANSFORMERS

- Split Bobbin Construction for High Isolation at Low Cost . . . (2500-4000 VRMS hipot)
- Power Ratings from 10 VA-2400 VA for 50/60 Hz Operation
- 115V/230V:115V, 115V:115V, 115V/230V:115V/230V, Many OtherVoltage Ratings Available
- Terminals or Flexible Leads Available. Open Frame or Enclosed Construction

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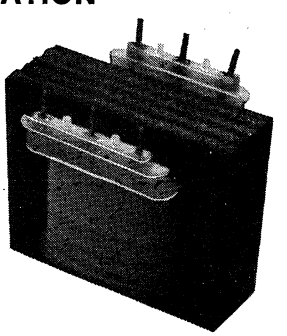

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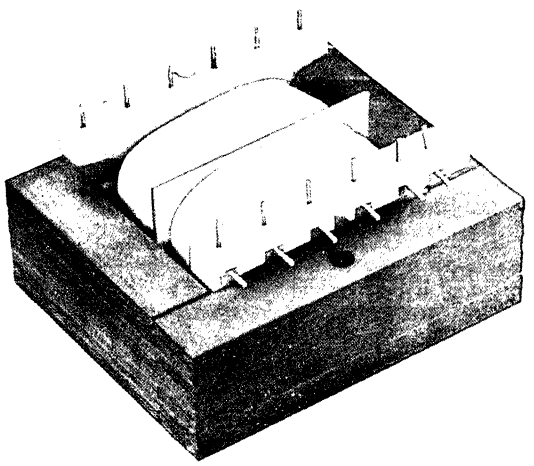
LOW PROFILE SPLIT BOBBIN — PC BOARD TRANSFORMERS — SERIES L 20VA



L Series Transformers offer a particularly low profile for 20VA (only 1.34″ high). Although they are relatively light (¾ lb.) optional mounting holes for #4 screws are available for additional mounting strength.

The use of a Split Bobbin allows winding to be non-concentric (side-by-side), consequently high isolation is achieved at low cost.

- Better insulation — 2500 VRMS hipot is standard.
- Lower capacitance — no need for electro-static shield.

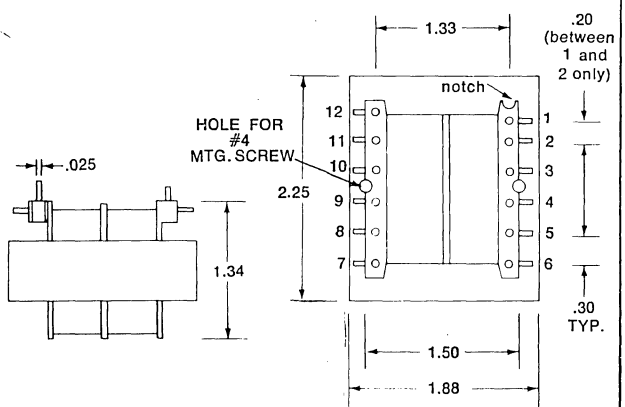
Please note that the standard items listed below utilize 6 or 8 pins, while 12 pins are available. We would like to quote your more complex requirements . . . you may save cost and space by combining two less complex Transformers into one.

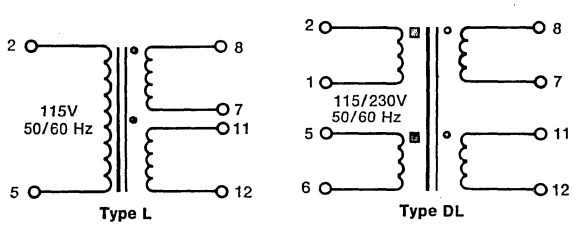
We would also be glad to quote your less complex requirements. For example, if only a Single Primary and Single Secondary are needed, you can save considerable cost by utilizing only 4 Pins.

STANDARD TRANSFORMERS

Part #		Secondary RMS Ratings	
Single 115V Pri.	Dual 115/ 230V Pri.	Series	Parallel
L-10	DL-10	10 VCT @ 2A	5V @ 4A
L-12	DL-12	12.6 VCT @ 1.6A	6.3V @ 3.2A
L-16	DL-16	16 VCT @ 1.25A	8V @ 2.5A
L-20	DL-20	20 VCT @ 1A	10V @ 2A
L-24	DL-24	24 VCT @ .8A	12V @ 1.6A
L-32	DL-32	32 VCT @ .625A	16V @ 1.25A
L-40	DL-40	40 VCT @ .5A	20V @ 1A
L-48	DL-48	48 VCT @ .4A	24V @ .8A
L-80	DL-80	80 VCT @ .25A	40V @ .5A
L-120	DL-120	120 VCT @ .16A	60V @ .32A

Smaller, lower profile units as well as larger, more powerful units are available.



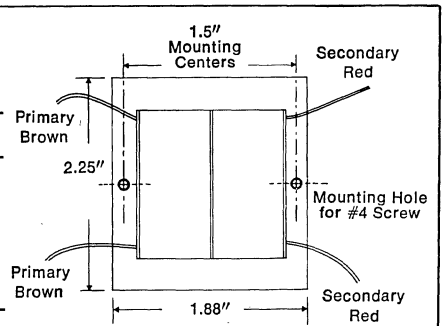


LOW PROFILE SPLIT BOBBIN POWER TRANSFORMERS with 4″ Flexible Leads

- Only 1.1 inches high — Wt. ½ lb.
- Ideal for PC Board and Chassis Mounting where low height is required
- 2500 VRMS hipot

Standard Transformers:
115 V 50/60 Hz Primary — 10 VA

Part Number	Secondary RMS Full Load Rating
LPS 10-8	8 V @ 1.25 A
LPS 10-10	10 V @ 1 A
LPS 10-12	12.6 V @ .8 A
LPS 10-16	16 V @ .63 A
LPS 10-20	20 V @ .5 A
LPS 10-24	24 V @ .42 A
LPS 10-32	32 V @ .31 A



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power to 1000 VA

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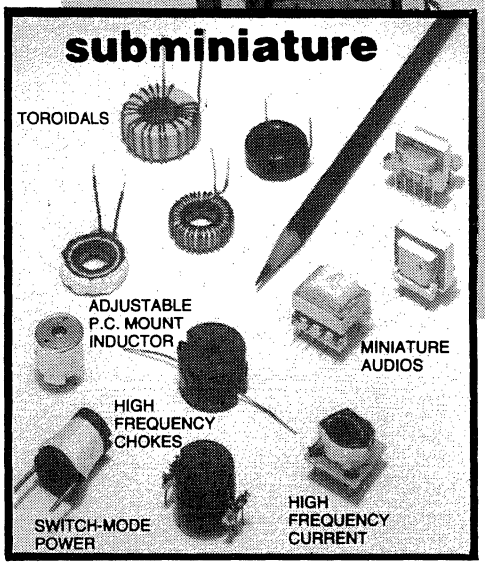

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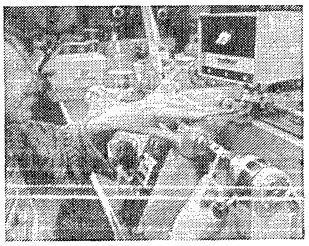
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Experienced personnel with specially developed electronic skills for an exacting technology to meet the most critical requirements. Manufactured to conform to UL, CSA, VDE, FCC-Part 68, etc.

Our specialty is your special application and we invite you to send or call for your custom requirements. For no obligation quotes, engineering, design consultation and manufacture, contact Lenco, the performance people.

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AUDIO Impedance matching — Isolation —Broad frequency response — Low insertion loss — FCC Part 68.

CONSTANT VOLTAGE Regulating transformers built to your specifications for DC power supplies or low distortion AC.

CONTROL Custom designed to UL, VDE, CSA, etc. specifications.

CONVERTER High Conversion efficiency from DC input to filtered DC out. Toroidal, Laminated, Ferrite, (Switch-Mode) etc.

CURRENT Toroidal, Laminated, Core, Impregnated, or Encapsulated.

FILAMENT Dry type, Laminated core.

HIGH TEMPERATURE Vacuum impregnation with temperature material to 200 °C. Epoxy encapsulated.

INDUCTORS Filter, A.C. Noise filtering, Switch-mode.

INPUT AND OUTPUT Designed to your specifications.

ISOLATION Audio, Step-down, Step-up, Foil electrostatic shielded, Electromagnetic shielded.

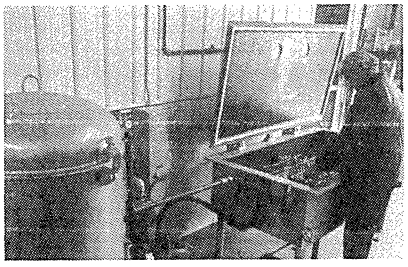
LOW PROFILE PC mount, Split bobbin, Vacuum varnish or epoxy impregnated.

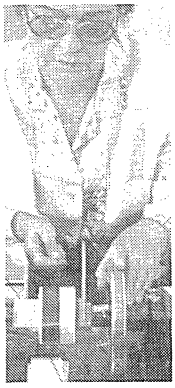
MEDICAL UL 544 Patient connected, or non-patient connected. Power.

POT CORES PC mount, Frame mount, Encapsulated or Impregnated.

SWITCH-MODE POWER Dry type, Air cooled, Laminated or Ferrite.

THREE PHASE 50-60-400 Hertz up to 1 KVA.


VACUUM IMPREGNATION SYSTEM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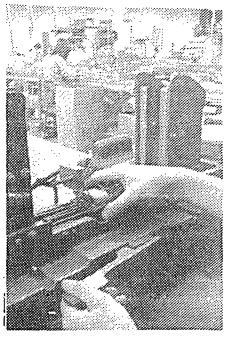
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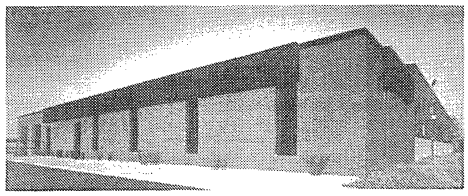

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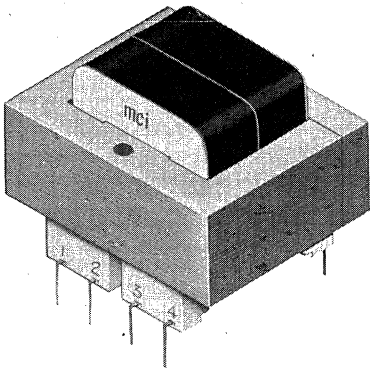
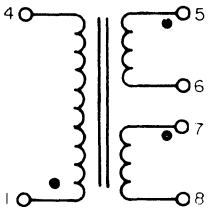
HORIZONTAL P.C. TRANSFORMERS

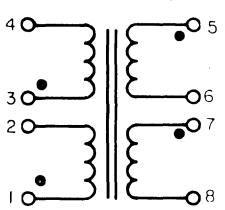
SERIES 4-01- & 4-02-



4-01
115V
50/60 Hz



4-02
115/230V
50/60 Hz



2,500-volt RMS Hipot, available in a variety of sizes. Maximum operating temperature 130°C. Available with either single 115V, or dual 115/230V primary. MCI's pin configuration is designed for ease of connection in printed circuit boards. Heavier transformers are provided with mounting holes for additional mounting security. Adaptations of standard transformers are also available. Dots on schematics shown below indicate like polarity.

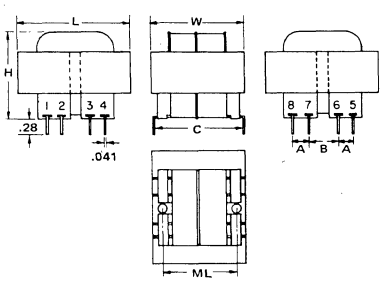
CURRENT RATING

Secondary Voltage	Series Parallel	-010 10V C.T. 5V	-012 12.6V C.T. 6.3V	-016 16V C.T. 8V	-020 20V C.T. 10V	-024 24V C.T. 12V	-028 28V C.T. 14V	-036 36V C.T. 18V	-048 48V C.T. 24V	-056 56V C.T. 28V	-120 120V C.T. 60V
Series											
Size 2		.11A	.09A	.07A	.055A	.045A	.04A	.03A	.023A	.02A	.01A
Size 3		.25A	.2A	.15A	.12A	.1A	.085A	.065A	.05A	.045A	.02A
Size 4		.6A	.5A	.4A	.3A	.25A	.2A	.17A	.125A	.11A	.05A
Size 5		1.2A	1.0A	.8A	.6A	.5A	.42A	.35A	.25A	.22A	.1A
Size 6		2.0A	1.6A	1.25A	1.0A	.8A	.7A	.55A	.4A	.35A	.16A
Size 7		3.6A	2.85A	2.25A	1.8A	1.5A	1.3A	1.0A	.75A	.65A	.3A
Parallel											
Size 2		.22A	.18A	.14A	.11A	.09A	.08A	.06A	.046A	.04A	.02A
Size 3		.5A	.4A	.3A	.24A	.2A	.17 A	.13A	.1A	.09A	.04A
Size 4		1.2A	1.0A	.8A	.6A	.5A	.4A	.34A	.25A	.22A	.1A
Size 5		2.4A	2.0A	1.6A	1.2A	1.0A	.84A	.7A	.5A	.44A	.2A
Size 6		4.0A	3.2A	2.5A	2.0A	1.6A	1.4A	1.1A	.8A	.7A	.32A
Size 7		7.2A	5.7A	4.5A	3.6A	3.0A	2.6A	2.0A	1.5A	1.3A	.6A

DIMENSIONS

Size	VA	L	W	H	ML	A	B	C	Optional Mtg. Screw & Nut	Lbs.
2	1.1	1-3/8	1-1/8	15/16	—	.250	.250	1.200	None	0.17
3	2.4	1-3/8	1-1/8	1-3/16	—	.250	.250	1.200	None	0.25
4	6.0	1-5/8	1-5/16	1-5/16	1-1/16	.250	.350	1.280	4-40 × 1-3/8 Nylon	0.44
5	12.0	1-7/8	1-9/16	1-7/16	1-1/4	.300	.400	1.410	4-40 × 1-3/8 Nylon	0.70
6	20.0	2-1/4	1-7/8	1-7/16	1-1/2	.300	.400	1.600	4-40 × 1-3/8 Nylon	0.80
7	36.0	2-5/8	2-3/16	1-9/16	†	.400	.400	1.850	†	1.1

† 4 mounting holes 2 3/16 × 1 3/4 for #6 screw



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Digit Number	Example	Indicates	Example
First Digit	4	Transformer	Always 4
Second & Third Digits	01	Type	Horizontal P.C., single primary
Fourth Digit	3	Size in either series or parallel configuration	Size 3
Last three digits	010	Secondary voltage	10V C.T.

The part number for the example used is 4-01-3-010, which is the part number for a Single Primary, Horizontal P.C. Transformer, Size 3, with a 10V C.T. Secondary Voltage or 5V.

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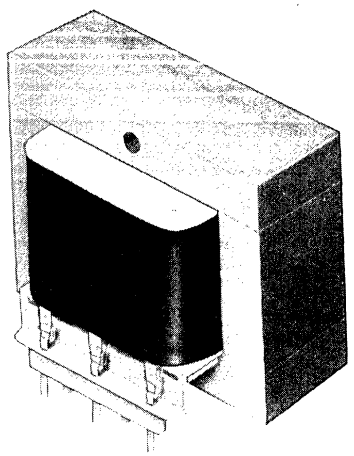
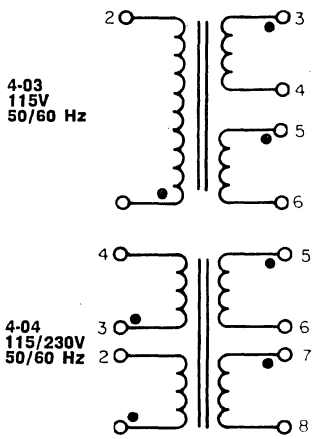
VERTICAL P.C. TRANSFORMERS

SERIES 4-03- & 4-04-





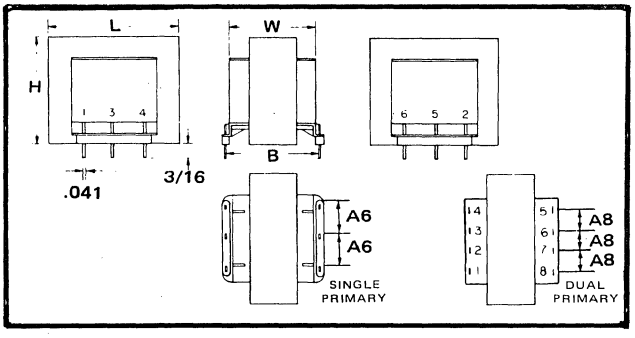
1,000-volt RMS Hipot, available in a variety of sizes. Maximum operating temperature 130°C . Available with either single 115V, or dual 115/230V primary. MCI's pin configuration is designed for ease of connection in printed circuit boards. Adaptations of standard transformers are also available. Dots on schematics shown below indicate like polarity.

CURRENT RATING

Secondary Voltage	Series / Parallel	-010 10V C.T. 5V	-012 12.6V C.T. 6.3V	-016 16V C.T. 8V	-020 20V C.T. 10V	-024 24V C.T. 12V	-028 28V C.T. 14V	-034 34V C.T. 17V	-040 40V C.T. 20V	-056 56V C.T. 28V	-088 88V C.T. 44V	-120 120V C.T. 60V	-180 180V C.T. 90V	-230 230V C.T. 115V
Series														
Size 1		.090A	.070A	.055A	.045A	.035A	.030A	.025A	.020A	.015A	.010A	.008A		
Size 2		.120A	.100A	.075A	.060A	.050A	.040A	.035A	.030A	.020A	.015A	.010A	.006A	.005A
Size 3		.440A	.350A	.260A	.220A	.180A	.160A	.125A	.110A	.080A	.050A	.035A	.024A	.020A
Size 4		1.0A	.800A	.640A	.500A	.450A	.360A	.300A	.250A	.180A	.120A	.085A	.055A	.040A
Size 5		2.4A	2.0A	1.5A	1.2A	1.0A	.800A	.700A	.600A	.420A	.270A	.200A	.130A	.100A
Parallel														
Size 1		.180A	.140A	.110A	.090A	.070A	.060A	.050A	.040A	.030A	.020A	.016A		
Size 2		.240A	.200A	.150A	.120A	.100A	.080A	.070A	.060A	.040A	.030A	.020A	.012A	.010A
Size 3		.880A	.700A	.520A	.440A	.360A	.320A	.250A	.220A	.160A	.100A	.070A	.048A	.040A
Size 4		2.0A	1.6A	1.28A	1.0A	.900A	.720A	.600A	.500A	.360A	.240A	.170A	.110A	.080A
Size 5		4.8A	4.0A	3.0A	2.4A	2.0A	1.6A	1.4A	1.2A	.840A	.540A	.400A	.260A	.200A

DIMENSIONS

Size	VA	L	W	H	A-6 (6 Pin)	A-8 (8 Pin)	B	WT. (oz.)
1	1.0	1	1-3/8	0.83	0.250	0.200	1.200	2.5
2	1.2	1-3/8	1-1/8	1-3/16	0.312	0.200	1.000	3.0
3	4.4	1-5/8	1-1/4	1-3/8	0.400	0.250	1.100	5.0
4	10.0	1-7/8	1-7/16	1-5/8	0.400	0.250	1.300	9.0
5	24.0	1-5/8	2-1/4	1-3/8	0.400	0.250	2.100	12.0



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Second & Third Digits	01	Type	Horizontal P.C., single primary
Fourth Digit	3	Size in either series or parallel configuration	Size 3
Last three digits	010	Secondary voltage	10V C.T.

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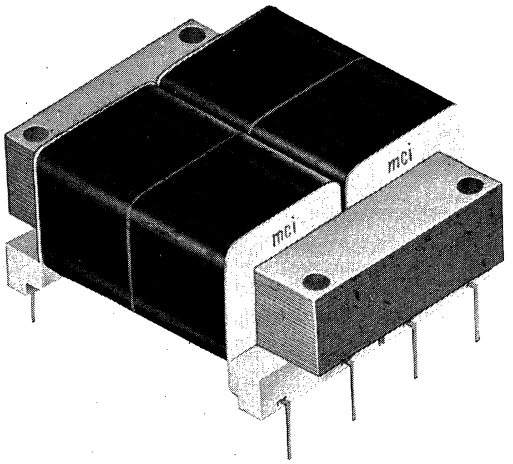
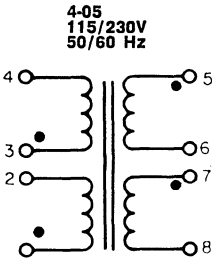
LOW PROFILE P.C. TRANSFORMERS

SERIES 4-05-





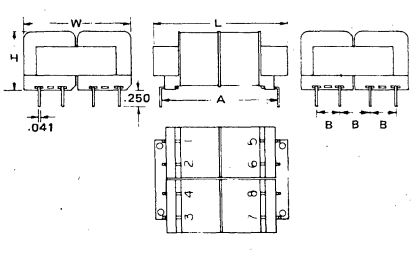
1,500-volt RMS Hipot, available in a variety of sizes. Maximum operating temperature 130°C. Available with dual 115/230V primary. MCI's pin configuration is designed for ease of connection in printed circuit boards. Adaptations of standard transformers are also available. Dots on schematics shown below indicate like polarity.

CURRENT RATING

Secondary Voltage	Series Parallel	-010 10V C.T. 5V	-012 12.6V C.T. 6.3V	-016 16V C.T. 8V	-020 20V C.T. 10V	-024 24V C.T. 12V	-034 34V C.T. 17V	-040 40V C.T. 20V	-056 56V C.T. 28V	-088 88V C.T. 44V	-120 120V C.T. 60V	-230 230V C.T. 115V
Series												
Size 1		.250A	.200A	.156A	.125A	.104A	.073A	.062A	.044A	.028A	.020A	.010A
Size 2		.600A	.450A	.350A	.300A	.250A	.170A	.150A	.100A	.065A	.050A	.025A
Size 3		1.200A	.900A	.700A	.600A	.500A	.340A	.300A	.200A	.130A	.100A	.050A
Parallel												
Size 1		.500A	.400A	.312A	.250A	.208A	.146A	.124A	.088A	.056A	.040A	.020A
Size 2		1.2A	.900A	.700A	.600A	.500A	.340A	.300A	.200A	.130A	.100A	.050A
Size 3		2.4A	1.8A	1.4A	1.2A	1.0A	.680A	.600A	.400A	.260A	.200A	.100A

DIMENSIONS

Size	VA	L	W	H	A	B	Oz.
1	2.5	1-7/8	1-9/16	0.650	1.600	0.375	5
2	6.0	1-7/8	1-9/16	0.850	1.600	0.375	7
3	12.0	2-1/2	2	1.065	2.000	0.500	11



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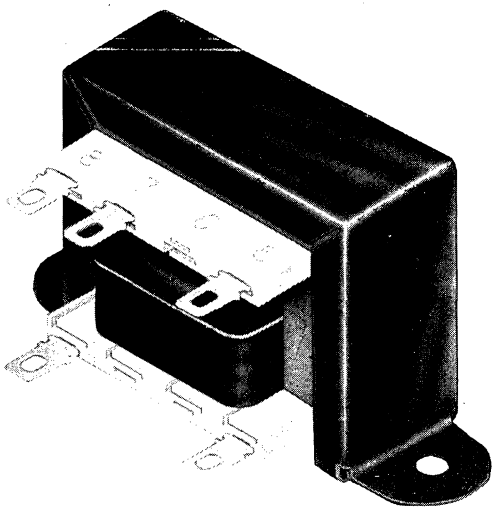
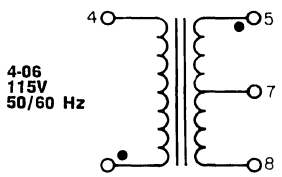
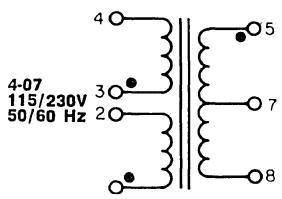
QUICK CONNECT POWER TRANSFORMERS

SERIES 4-06- & 4-07-







2500 Volt RMS Hipot in a variety of practical sizes. Maximum operating temperature 130°C available with either single 115 or dual 115/230V primary (for all but 2.4 VA size).

MCI's split bobbin and non-concentric winding provide better insulation and high signal isolation, thus eliminating the need for electrostatic shielding.

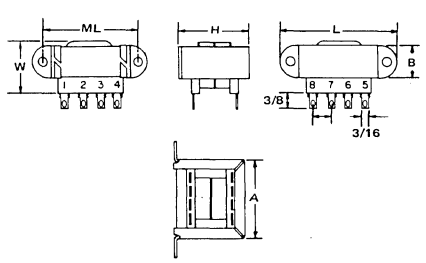
Adaptations of standard transformers are also available. Dots on schematics shown below indicate like polarity.

CURRENT RATING

Secondary Voltage	−010 10V C.T.	−012 12.6V C.T.	−016 16V C.T.	−020 20V C.T.	−024 24V C.T.	−028 28V C.T.	−036 36V C.T.	−048 48V C.T.	−056 56V C.T.	−120 120V C.T.
Transformer Size										
3	.25A	.2A	.15A	.12A	.1A	.085A	.065A	.05A	.045A	.02A
4	.6A	.5A	.4A	.3A	.25A	.2A	.17A	.125A	.11A	.05A
5	1.2A	1.0A	.8A	.6A	.5A	.42A	.35A	.25A	.22A	.1A
6	3.0A	2.5A	2.0A	1.5A	1.25A	1.1A	.85A	.63A	.54A	.25A
7	5.0A	4.0A	3.5A	2.8A	2.4A	2.0A	1.5A	1.2A	1.0A	.5A
8	10.0A	8.0A	6.25A	5.0A	4.0A	3.6A	2.8A	2.0A	1.8A	.85A

DIMENSIONS

Size	VA	L	W	H	A	B	ML	Lbs.
3	2.4	2-1/16	1-1/16	1-3/16	1-5/8	9/16	1-3/4	0.25
4	6	2-3/8	1-1/4	1-3/8	1-11/16	11/16	2	0.44
5	12	2-13/16	1-3/8	1-5/8	1-15/16	13/16	2-3/8	0.7
6	30	3-1/4	1-11/16	1-15/16	2-5/16	1-1/16	2-13/16	1.1
7	56	3-11/16	1-13/16	2-1/4	2-11/16	1-1/16	3-1/8	1.7
8	100	4-1/32	2-1/4	2-9/16	3-1/16	1-5/16	3-9/16	2.75



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TELEPHONE COUPLING TRANSFORMERS

FOR INTERCONNECT OF VOICE/DATA MODEM TERMINALS TO TELEPHONE LINES

DESIGNED TO MEET FCC PART 68

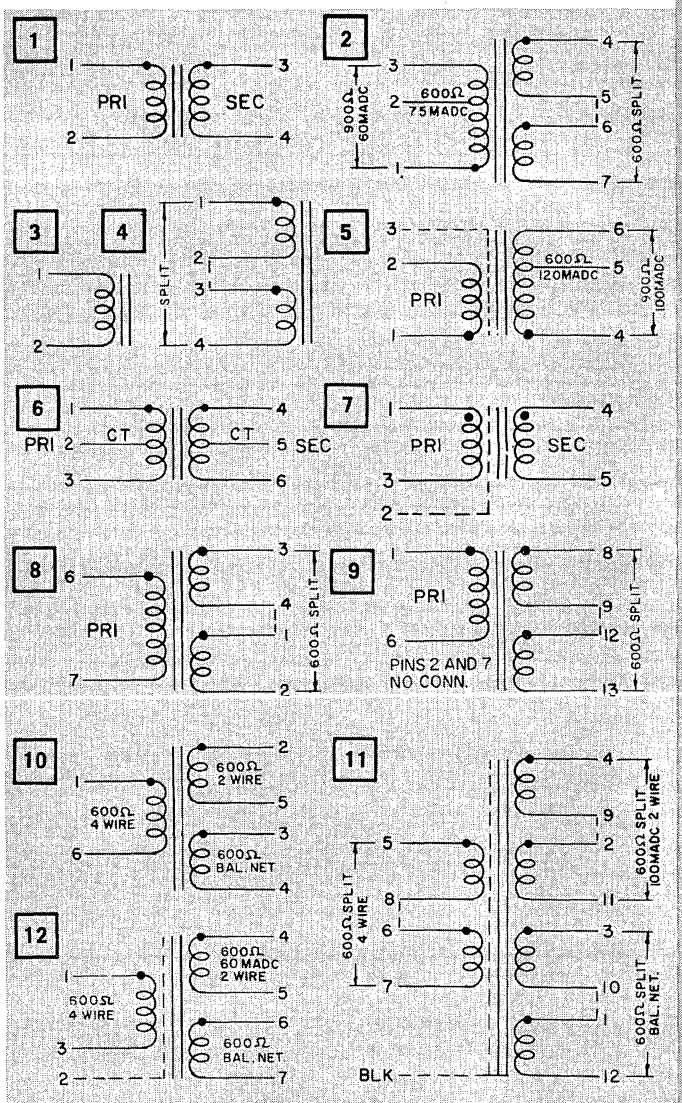
Provides line isolation and matching — Prevents line imbalance — Wide dynamic signal level capability — Low distortion — Permits Optimum use of Voice-Grade Telephone Lines for Broadband Data Signals

- Frequency Response: 300-3500 Hz ±0.5 dB
- Level: −45 dBm to +7 dBm
- Longitudinal Balance: Per FCC 68.310
- Distortion: 0.5% Max.
- Impedance Matching: ±10% over entire frequency range
- Return Loss: 26 dB Min.

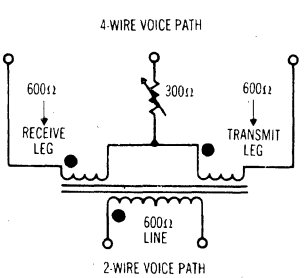
Part No.	Primary Impedance	Secondary Impedance	Schematic No.	Fig.
COUPLING				
T1104	600	600	1	A
T2104	600	600	1	B
T2106	600 CT	600 CT	6	E
T2108	600	900	1	B
T2110§	900	900	7	C
T2316¶	4000	600	1	B
T4113■	900/600 60/75 mA DC	600 Split	2	J
T5114	600	600 Split @ 75 mA	8	K
T5115	600	600 Split @ 120 mA	9	L
T6112§	600	900/600 100/120 mA DC	5	G
HOLDING COILS				
T4415	2.0 hy @ 60 mA, 1.3 hy @ 100 mA DC, 180Ω		3	H
T5415	1.4 hy ±20% @ 120 mA DC, 180Ω Split Winding		4	K
T7410	1.0 hy @ 0 mA, 0.8 hy @ 25 mA DC, 225Ω		3	D
T8410	1.0 hy @ 0 mA, 0.8 hy @ 40 mA DC, 113Ω		3	D
HYBRID				
T2220‡	600 (4W)	600/600	10	E
T3220‡	600 (4W)	600/600	10	F
T4220‡§	600 (4W)	600/600 60 mA DC (2W)	12	J
T5220†§*	600 (4W)	600/600 100 mA DC (2W)	11	M

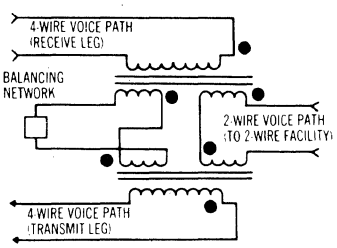
‡ 2 required for Hybrid operation. Trans-Hybrid loss 45 db typical
■ Level −15 to +7 dBm § Electrostatic Shield * All windings split
† T5220: 300-4000 Hz ±0.3 dB Trans-Hybrid loss and Long. Bal. >60 dB. Level −40 to +20 dBm, Static Shielded, 2 required for Hybrid operation ¶ Bridging

Available on Special Order with Other Ratings and Construction



TYPICAL HYBRID APPLICATIONS





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FOR INTERCONNECT OF VOICE/DATA MODEM TERMINALS TO TELEPHONE LINES

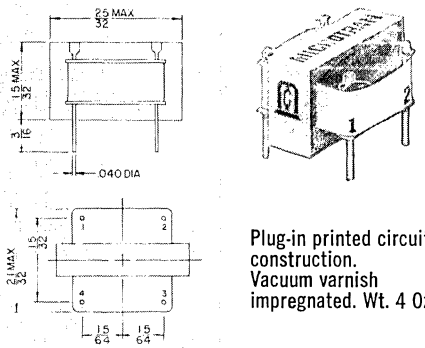


FIG. A

Plug-in printed circuit construction.
Vacuum varnish impregnated. Wt. 4 Oz.

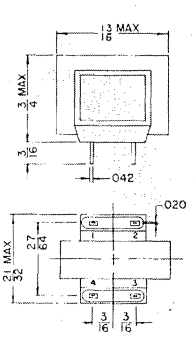
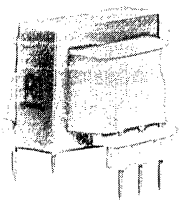


FIG. B



Plug-in printed circuit construction.
Vacuum varnish impregnated. Wt. .5 oz.

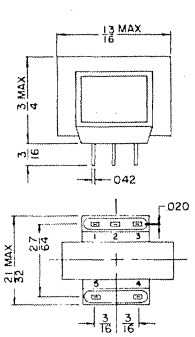
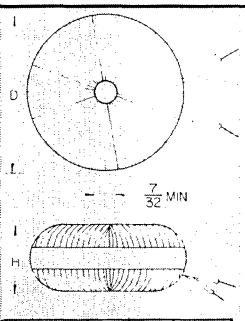
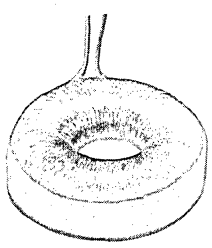


FIG. C

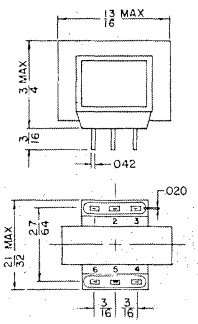


Size Series	D	H	Wt. Oz
T7400	1	13/32	3/4
T8400	1 1/4	5/8	2

FIG. D

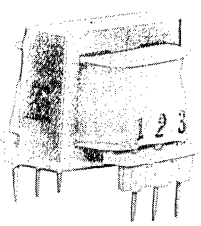


High-Q Toroid.
Microcrystalline wax impregnated.
Supplied with 4" #28 leads.

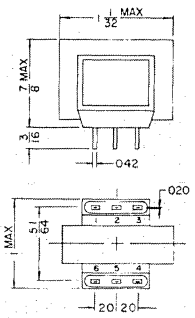


Wt. 0.5 oz.

FIG. E



Plug-in printed circuit construction.
Vacuum varnish impregnated.



Wt. 1.2 oz.

FIG. F

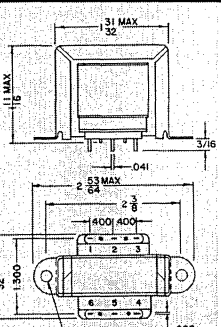
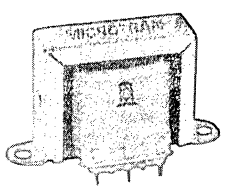


FIG. G



Plug-in printed circuit construction with mounting channel.
Vacuum varnish impregnated. Wt. 9.5 Oz.

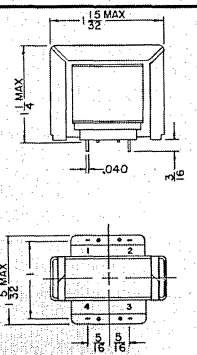
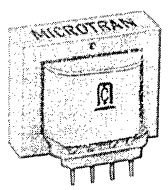


FIG. H



Plug-in printed circuit construction.
Vacuum varnish impregnated. Wt. 3.5 Oz.

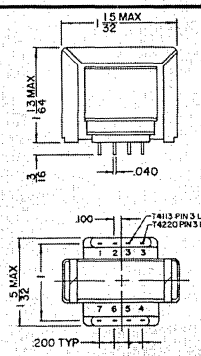


FIG. J

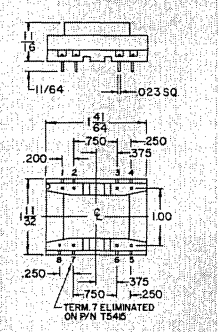
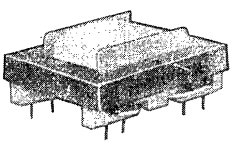


FIG. K



Flat Profile.
Plug-in printed circuit construction.
Vacuum varnish impregnated. Wt. 2.5 Oz.

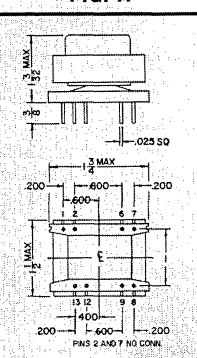
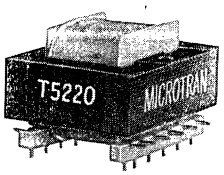


FIG. L



Flat Profile.
Plug-in printed circuit construction.
Vacuum varnish impregnated. Wt. 5.5 Oz.

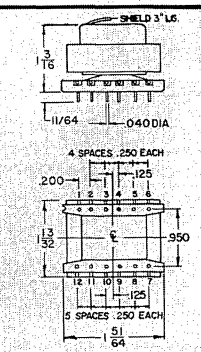


FIG. M

IMMEDIATE DELIVERY FROM DISTRIBUTORS

Dept. EM / 145 E. Mineola Avenue, Valley Stream, NY / (516) 561-6050 / TWX: 510-225-8412

MICROTRAN — MINIATURIZED AUDIO TRANSFORMERS

MICROPHONE/TRANSDUCER INPUT TRANSFORMERS

FOR: PROFESSIONAL SOUND STUDIOS — BROADCAST MIXING CONSOLES — CONTROL AND INSTRUMENT AMPLIFIERS

EQUIVALENT TO IMPORTED EUROPEAN STUDIO GRADE TRANSFORMERS

- WIDE BANDWIDTH — BROAD FREQUENCY RESPONSE
- EXTREMELY LOW DISTORTION
- NEGLIGIBLE HUM PICK UP
- SUBMINIATURE SIZE
- EASE OF MOUNTING AND ORIENTATION
- POLARIZING VOLTAGE CONNECTION FOR CONDENSER MICROPHONES
- LOW MICROPHONICS
- ELECTROSTATIC SHIELDING

Part No.	Nom. Turns Ratio Pri:Sec	Nom. Impedance Ratio Primary	Nom. Impedance Ratio Secondary	Typical Open Circuit Primary Impedance @ 50 Hz†	Frequency Response‡	Fig.	Replaces Beyer Part No.
S101-S	1:20	12.5	5,000	100	30-15,000 Hz ±1 dB	-S	TR-BV35704
S101-SP	1.20	12.5	5,000	100	30-15,000 Hz ±1 dB	-SP	STR-BV37704
S105-S	1:15	200	45,000	2,000	30-15,000 Hz ±1 dB	-S	351.015.006
S105-SP	1:15	200	45,000	2,000	30-15,000 Hz ±1 dB	-SP	370.015.006
S107-S	1:15	200/50 split	45,000	2,000	30-15,000 Hz ±1 dB	-S	351.215.006
S107-SP	1:15	200/50 split	45,000	2,000	30-15,000 Hz ±1 dB	-SP	370.215.006
S108-S	1:10	200	20,000	2,000	30-15,000 Hz ±1 dB	-S	351.010.005
S108-SP	1:10	200	20,000	2,000	30-15,000 Hz ±1 dB	-SP	370.010.005
S111-S	1:7.1	200	10,000	2,000	30-15,000 Hz ±1 dB	-S	351.007.004
S111-SP	1:7.1	200	10,000	2,000	30-15,000 Hz ±1 dB	-SP	370.007.004
S116-S	1:5	200	5,000	2,000	30-15,000 Hz ±1 dB	-S	351.005.003
S116-SP	1:5	200	5,000	2,000	30-15,000 Hz ±1 dB	-SP	370.005.003
S118-S	1:5	200/50 split	5,000	2,000	30-15,000 Hz ±1 dB	-S	351.205.003
S118-SP	1:5	200/50 split	5,000	2,000	30-15,000 Hz ±1 dB	-SP	370.205.003
S126-S	1:1	600 CT	600	3,750	30-20,000 Hz ±.5 dB	-S	TR-145/BV35508
S126-SP	1:1	600 CT	600	3,750	30-20,000 Hz ±.5 dB	-SP	STR-145/BV37508
S130-S	1:1	10,000	10,000	100,000	30-15,000 Hz ±1 dB	-S	TR-145/BV35590
S130-SP	1:1	10,000	10,000	100,000	30-15,000 Hz ±1 dB	-SP	STR-145/BV37590
S100-FB	Right angle mounting bracket for S100 -S series.					-FB	

† Designed for optional bridging termination use to provide additional 6 dB output voltage gain.
‡ Frequency response measured with source equal to nominal primary impedance and with unloaded secondary except 100K load on S105 and S107 series.

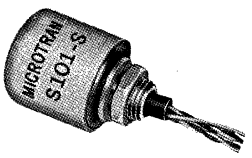


Fig. -S
SINGLE THREADED STUD MOUNTING
Double Mu-metal shielding. 3″ color coded leads. 5/16″D. stud provided with nut. 5/8″D x 13/16″H.

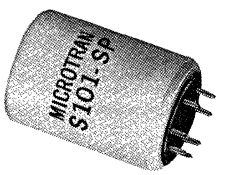


Fig. -SP
PRINTED CIRCUIT MOUNTED
Double Mu-metal shielded. 3/4″D x 1 1/16″H. 7-.040 pins 1/8″ H.

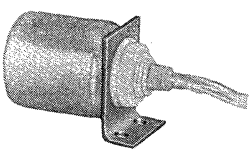
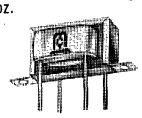


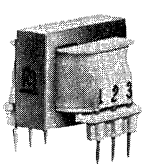
Fig. -FB
RIGHT ANGLE MOUNTING BRACKET
For mounting of -S series transformers. M.C. 3/8″.

MINIATURE AUDIO TRANSFORMERS — M & MT SERIES

MOLDED M-M
To order add -M to Part No. For plug-in printed circuit applications. Epoxy resin provides resistance to extremes of ambient. Weight 1¾ oz.

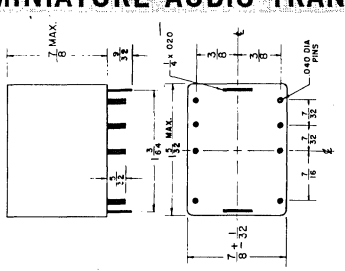


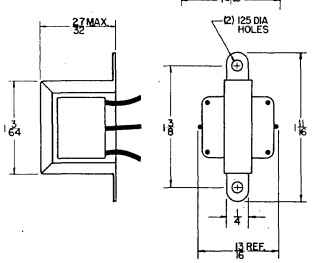
OPEN FRAME WITH CHANNEL M-FB
To order add -FB to Part No. Leads 4″ long. #28 PVC Weight 1.13 Oz.

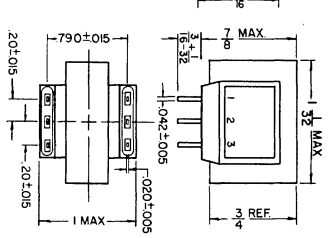


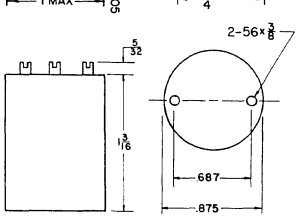
OPEN FRAME PRINTED CIRCUIT M-PC
To order add -PC to Part No. Units with more than 6 pins have 7 or 8 — .025 x .015 pins on .150 centers. Weight 1.2 Oz.

ALUMINUM CASED M-A
To order add -A to Part No. Supplied with 2-56 screws. Weight 1.25 Oz.









All items shown in charts below are available in any of the mechanical packages shown. These units can be used as input, interstage, output, isolation and other impedance matching applications. Primary and secondary windings may be interchanged to obtain required impedance matching. Also available in hermetic construction.

Part No.*	Primary Impedance	Secondary Impedance	Pri. DC Unbalance mA	Operating Level dBm	Frequency Response ±2 dB
M3-(*)•	7.5/30	50,000	0	5	20-20,000
M12-(*)	50/250 CT	50/250/600 CT	0	8	20-20,000
M1-(*)•	50/250/600 CT	50,000	0	5	20-20,000
M1-S	Same as M1 above — with dual nickel alloy shield				
M2-(*)•	50/250/600 CT	50,000 CT	0	5	20-20,000
M14-(*)	200	½ Megohm	0	9	80,3,000
M15-(*)	10,000	1 Megohm	0	11	100-2,500
M8-(*)	15,000	50/250/600 CT	0	8	20-20,000
M9-(*)	15,000	50/250/600 CT	4	21	150-20,000
M4-(*)	15,000	60,000	0	6	20-15,000
M5-(*)	15,000	60,000	4	14	200-20,000
M6-(*)	15,000	95,000 CT	0	5	20-15,000
M7-(*)	15,000	95,000 CT	4	11	200,20,000
M10-(*)•	30,000 CT	50/250/600 CT	0	8	30-50,000
M11-(*)•	50,000	50/250/600 CT	0	5	20-20,000
M13-(*)	Reactor 300 hy. 0 DC		50 hy. @ 3 mA		6000Ω D.C.R.
M90	Magnetic Shield Mu-Metal slip on can for M-A Series 25 db shielding				
MT2-(*)	100	10 CT/40 CT	100	27	200-20,000
MT30-(*)	250 CT	500	10	30	200-15,000
MT23-(*)	250 CT	1000	10	30	200-15,000
MT14-(*)	400	10	50	25	200-20,000
MT15-(*)	500 CT	210	30	27	300-20,000
MT1-(*)	600	600	10	23	200-15,000
MT35-(*)‡	600	600 CT & 600 CT	0	5	40-20,000
MT36-(*)†	600 CT	600 CT	0	15	50-15,000
MT26-(*)	600 CT	600 CT	20	23	200-15,000
MT9-(*)	600 CT	1,200 CT	4	23	200-15,000
MT33-(*)	600/150 Split	600/150 Split	20	23	200-20,000
MT22-(*)	600/150 Split	1,200 CT	4	23	200-15,000
MT29-(*)	1600 CT	450	15	30	200-15,000
MT12-(*)	2,000	3.4	10	32	200-15,000
MT24-(*)	2,500	600 CT	10	32	200-15,000
MT13-(*)	4,000 CT	3.4	3	32	200-15,000
MT11-(*)	4,000 CT	600 CT	3	32	200-15,000
MT21-(*)	4,000 CT	600/150 Split	3	32	200-15,000
MT25-(*)	7,500 CT	600 CT	8	32	200-15,000
MT34-(*)	10,000/2500 Split	2000/500 Split	4	20	200-20,000
MT10-(*)•	25,000	600	3	22	200-15,000
MT7-(*)•	25,000	1,200 CT	3	22	200-15,000
MT18-(*)•	25,000 CT	1,200 CT	6	22	200-15,000
MT5-(*)•	50,000	6	3	20	300-15,000
MT3-(*)	50,000	600	3	20	300-15,000
MT8-(*)•	50,000 CT	1,200 CT	3	20	300-15,000
MT20-(*)•	50,000 CT	1200/300 Split	3	20	300-15,000
MT6-(*)•	100,000	1,200 CT	1.4	17	200-15,000

* Add -M, -PC, -A, or -FB to Part Number to designate construction.
• These items not available in -PC construction.
‡ For telephone line coupling or hybrid telephone line.
† Broadcast fidelity line matching transformer. Frequency response ±0.5 dB.

IMMEDIATE DELIVERY FROM DISTRIBUTORS

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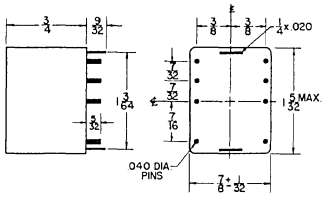
MICROTRAN

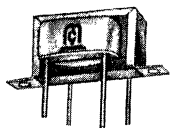
MINIATURIZED AUDIO TRANSFORMERS

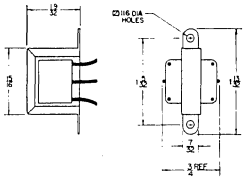
SUB-MINIATURE TRANSFORMERS — SM & SMT SERIES



MOLDED SM-M

To order add -M to Part Number. For plug-in printed circuit applications. Epoxy resin provides resistance to extremes of ambient. Weight 1½ Oz.





OPEN FRAME WITH CHANNEL SM-FB

To order add -FB to Part Number. Weight ¾ Oz. Leads #28 PVC 4″ long.

Primary and secondary windings may be interchanged to obtain required impedance matching. These units can be used as input, interstage, output, isolation and other impedance matching requirements. Also available in hermetic construction.

Part No.	Primary Impedance	Secondary Impedance	Pri. DC Unbalance mA	Oper. Level DBM	Frequency Response ±2 dB
SM1-(*)	200/50	250,000/62,500	0	6	80-10,000
SM3-(*)	10,000	200	3	21	150-10,000
SM2-(*)	10,000	90,000	0	8	100-10,000
SM4-(*)	30,000	50	1	21	150-10,000
SM6-(*)	100,000	60	0.5	21	150-10,000
SM5-(*)	Reactor 50 hy at 1 mA DC		3,000Ω DC Res.		
SMT1-(*)	600	600	9	23	200-15,000
SMT26-(*)	600 CT	600 CT	18	23	200-15,000
SMT9-(*)	600 CT	1,200 CT	18	23	200-15,000
SMT12-(*)	2,000	3.4	5	30	200-15,000
SMT19-(*)	2,500	2,500 CT	5	26	200-15,000
SMT36-(*)	2,500 CT	2,500/625 Split	10	26	200-15,000
SMT13-(*)	4,000 CT	3.4	5	30	200-15,000
SMT17-(*)	10,000 CT	200 CT	6	20	200-15,000
SMT16-(*)	10,000	1,500 CT	1	23	200-15,000
SMT10-(*)	25,000	600	2	20	200-15,000
SMT7-(*)	25,000	1,200 CT	1.5	20	200-15,000
SMT18-(*)	25,000 CT	1,200 CT	3	20	200-15,000
SMT5-(*)	50,000	6	1	20	300-15,000
SMT3-(*)	50,000	600	1	20	300-15,000
SMT4-(*)	50,000 CT	600 CT	2	20	200-15,000
SMT8-(*)	50,000 CT	1,200 CT	2	20	200-15,000

* Add either -M or -FB to Part Number to designate construction.

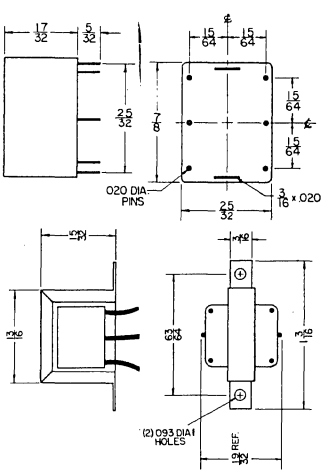
MICRO-MINIATURE TRANSFORMERS — MM & MMT SERIES

Part No.	Primary Impedance	Secondary Impedance	Pri. DC Unbalance mA	Oper. Level DBM	Frequency Response ±2 dB
MM1-(*)	200/50	250,000/62,500	0	4	200-10,000
MM3-(*)	10,000	200	3	20	150-10,000
MM2-(*)	10,000	90,000	0	4	150-10,000
MM4-(*)	30,000	50	1	20	150-10,000
MM7-(*)	30,000	1,200	0.5	20	200-10,000
MM6-(*)	100,000	60	0.5	20	250-10,000
MM5-(*)	Reactor 50 hy. @ 1 mA DC		4,700 Ω DC Res.		
MMT1-(*)	600	600	8	22	200-15,000
MMT26-(*)	600 CT	600 CT	16	22	200-15,000
MMT33-(*)	600 CT	600/150 Split	16	22	200-15,000
MMT9-(*)	600 CT	1,200 CT	16	22	200-15,000
MMT32-(*)	600 CT	1200/300 Split	16	22	200-15,000
MMT12-(*)	2,000	3.4	5	28	200-15,000
MMT31-(*)	2,000 CT	500 CT	10	28	200-15,000
MMT19-(*)	2,500	2,500 CT	2	23	200-15,000
MMT13-(*)	4,000 CT	3.4	5	28	200-15,000
MMT11-(*)	4,000 CT	600 CT	5	28	200-15,000
MMT21-(*)	4,000 CT	600/150 split	5	28	200-15,000
MMT25-(*)	7,500 CT	600 CT	4	22	200-15,000
MMT30-(*)	7,500 CT	1,200 CT	4	22	200-15,000
MMT35-(*)	10,000 CT	150/37.5 split	2	20	200-15,000
MMT17-(*)	10,000 CT	200 CT	6	20	200-15,000
MMT16-(*)	10,000	1,500 CT	1	20	200-15,000
MMT28-(*)	10,000 CT	1,500 CT	2	20	200-15,000
MMT29-(*)	10,000 CT	10,000 CT	2	20	200-15,000
MMT10-(*)	25,000	600	1	20	200-15,000
MMT27-(*)	25,000 CT	600 CT	2	20	200-15,000
MMT7-(*)	25,000	1,200 CT	1	20	200-15,000
MMT18-(*)	25,000 CT	1,200 CT	2	20	200-15,000
MMT5-(*)	50,000	6	1	20	200-15,000
MMT3-(*)	50,000	600	0.7	20	200-15,000
MMT4-(*)	50,000 CT	600 CT	1.4	20	200-15,000
MMT8-(*)	50,000 CT	1,200 CT	1.4	20	200-15,000

* Add either -M or -FB to Part Number to designate construction.

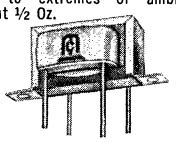
Primary and secondary windings may be interchanged to obtain required impedance matching. These units can be used as input, interstage, output, isolation and other impedance matching requirements. Also available in hermetic construction.

The low profile design of this series makes them ideal for use on plug-in printed circuit boards.



MOLDED MM-M

To order add -M to Part Number For plug-in printed circuit applications. Epoxy resin provides resistance to extremes of ambient. Weight ½ Oz.



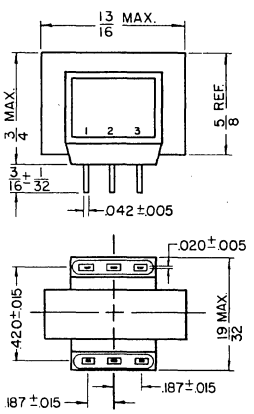
OPEN FRAME WITH CHANNEL MM-FB

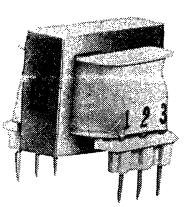
To order add -FB to Part Number. Leads #28 PVC 4″ long. Weight .36 Oz.

DECI-MINIATURE TRANSFORMERS — DCM SERIES

FREQUENCY RESPONSE 200-15,000 Hz ±2 dB

Part No.	Primary Impedance	Secondary Impedance	Pri. DC Unbalance mA	Operating Level DBM
DCM1-PC	25,000 CT	1,200 CT	2	18
DCM2-PC	15,000 CT	15,000 CT	3	19
DCM3-PC	15,000 CT	600 CT	3	19
DCM4-PC	10,000 CT	5000 CT	4	20
DCM5-PC	10,000	2,500/625 Split	2	20
DCM6-PC	10,000 CT	1,500 CT	4	20
DCM7-PC	5,000 CT	80,000 CT	6	15
DCM8-PC	4,000 CT	1,200 CT	6	20
DCM9-PC	4,000 CT	600 CT	6	20
DCM10-PC	4,000	600/150 Split	3	20
DCM11-PC	2,500 CT	2,500 CT	8	20
DCM12-PC	2,500	2,500/625 Split	4	20
DCM13-PC	2,500 CT	625 CT	8	20
DCM14-PC	2,500 CT	200 CT	8	20
DCM18-PC	600 CT	50,000 CT	16	20
DCM19-PC	600	8000/2000 Split	8	20
DCM20-PC	600 CT	200 CT	16	20
DCM21-PC	600 CT	600 CT	16	20
DCM22-PC	250 CT	600 CT	25	20
DCM51-PC	Choke	10 hy. @ 0 mA DC	5 hy. @ 3 mA DC	300Ω DCR
DCM52-PC	Choke	5 hy. @ 0 mA DC	2 hy. @ 5 mA DC	155Ω DCR
DCM53-PC	Choke	2.5 hy. @ 0 mA DC	1 hy. @ 7 mA DC	75Ω DCR





PRINTED CIRCUIT — DCM SERIES

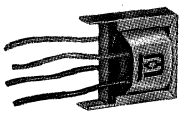
New Industrial/Commercial grade miniature printed circuit transformers. Rigid terminals provide fixed mounting centers usually found in expensive molded transformers. Weight .5 Oz.

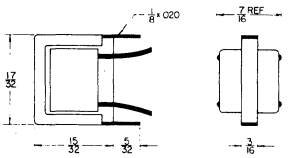
IMMEDIATE DELIVERY FROM DISTRIBUTORS

Dept. EM / 145 E. Mineola Avenue, Valley Stream, NY / (516) 561-6050 / TWX: 510-225-8412

MICROTRAN — MINIATURIZED AUDIO TRANSFORMERS

VERI-MINIATURE TRANSFORMERS — VM SERIES





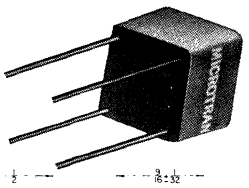
PLUG-IN TAB MOUNTED CHANNEL .VM-FPB

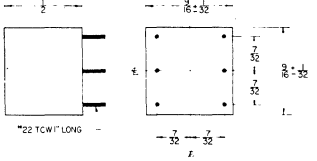
To order add -FPB to Part Number, i.e. VM2-FPB. 4″ color coded leads. Weight .2 Oz.

FREQUENCY RESPONSE ±2 dB 200 TO 10,000 Hz

Part No.	Primary Impedance	Secondary Impedance	Unbal. Pri. DC mA	Pri. DCR	Sec. DCR	Level mW
VM1-(*)	50	600	5.5	7	90	15
VM7-(*)	500	3.4	3.5	50	.5	15
VM16-(*)	500 CT	250 CT	7.5	50	25	15
VM14-(*)	600 CT	600 CT	7.0	50	65	15
VM8-(*)	1,250	3.4	2.0	135	.5	15
VM9-(*)	1,250	50	2.0	135	6.5	15
VM10-(*)	2,500	2,500 CT	1.5	225	215	3
VM17-(*)	10,000 CT	5,000 CT	0	400	300	5
VM12-(*)	20,000	1,000	0.16	625	85	5
VM13-(*)	20,000	1,000 CT	0.16	625	85	5
VM3-(*)	25,000	600	0.15	720	45	5
VM5-(*)	50,000	600	0.1	830	55	5
VM15-(*)	50,000 CT	50,000 CT	0	2000	2600	5
VM6-(*)	100,000	1,200 CT	0.07	2000	150	5
VM2-(*)	200,000	600	0.05	3000	110	2.5
VM4-(*)	200,000	1,200	0.035	3100	165	5
VM11-(*)	Choke	20 hy. (0 mA)	12 hy. (.5 mA)		1000	
VM90	Magnetic Shield Mu-Metal slip-on can for VM-M Series. 20 dB shielding.					

* Add either -FPB, or -M to Part Number to designate construction. See Photos.





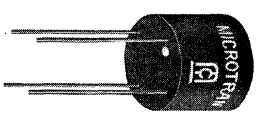
MOLDED VM-M

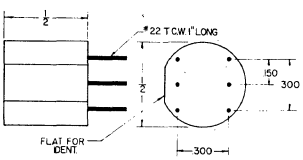
To order add -M to Part Number, i.e. VM2-M, VM9-M. Epoxy molded. Weight .25 Oz.

ULTRA-MINIATURE TRANSFORMERS — UM SERIES

The miniaturized design of this series offers a relatively high power level for condensed module and printed circuit packaging.

Frequency Response ±2 dB 300 to 10,000 Hz
Measured at Level Stated for 300 Hz



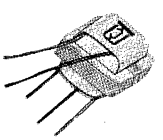


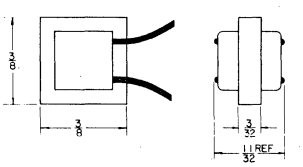
MOLDED UM-M

To order add -M to Part Number, i.e. UM22-M. Weight .14 Oz.

Part No.	Primary Impedance	Secondary Impedance	Unbal. Pri. DC mA	Pri. DCR	Sec. DCR	Level mW @ 300 Hz	Level mW @ 1 kHz
UM26-(*)	400	11	3	35	1.5	15	500
UM27-(*)	400 CT	11	6	35	1.5	15	500
UM25-(*)	400	50	3	35	5	15	500
UM29-(*)	600 CT	600 CT	7	45	60	5	400
UM24-(*)	1,000	50	3	65	10	5	500
UM33-(*)	1,000 CT	600	6	80	65	5	500
UM32-(*)	1,500 CT	600	5	135	65	5	500
UM39-(*)	2,500 CT	600 CT	2	250	50	5	500
UM34-(*)	10,000 CT	600 CT	2	850	40	5	500
UM31-(*)	10,000 CT	1,200 CT	2	850	120	5	500
UM37-(*)	10,000	2,000 CT	1	850	200	5	500
UM35-(*)	15,000 CT	15,000 CT	1	930	1210	5	300
UM36-(*)	20,000 CT	800 CT	0.5	1100	80	5	500
UM22-(*)	20,000	1,000	0.5	1100	100	5	300
UM23-(*)	20,000	1,200 CT	0.5	1100	110	5	300
UM21-(*)	100,000	1,000	0	1900	135	5	70
UM30-(*)	Choke	1.5 hy. (0 mA)	0.7 hy. (2 mA)		100		
UM28-(*)	Choke	10 hy. (0 mA)	8 hy. (0.5 mA)		650		
UM90	Magnetic Shield Mu-Metal slip-on can for UM-M Series. 20 dB shielding.						

* Add either -F, or -M to Part Number to designate construction. See Photos. Power levels shown are for 7½% maximum distortion.



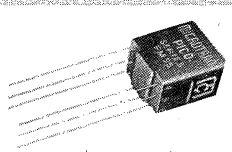


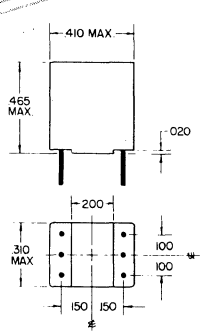
OPEN FRAME UM-F

To order add -F to Part Number, i.e. UM22-F. 4″ color coded leads. Weight .08 Oz.

PICO MINIATURE TRANSFORMERS — PM SERIES

Designed to provide maximum utilization of space in miniaturized printed circuit board applications. .10 grid dimensions conform to P.C. design standards. **Frequency Response ±2 dB 300 Hz to 100 kHz†**



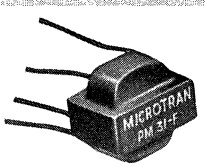


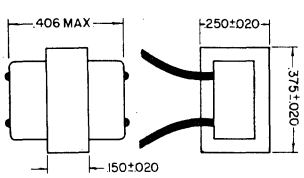
MOLDED PM-M

To order add -M to Part Number. Epoxy molded. For printed circuit applications. Gold plated nickel alloy leads .020 x ¾″. Weight .1 Oz.

Part No.	Primary Impedance	Secondary Impedance	Unbal. Pri. DC mA	Pri. DCR	Sec. DCR	Level mW
PM37-(*)	120 CT	3.2	10	16	0.75	50
PM38-(*)	300 CT	600	7	41	98	50
PM35-(*)	500	50	3	60	8	50
PM36-(*)	500	500/125 Split	3	72	85	50
PM34-(*)	600 CT	600 CT	3	75	105	50
PM33-(*)	1,500 CT	600	3	170	95	50
PM31-(*)	2,500	2,500 CT	1	250	325	50
PM29-(*)•	10,000 CT	500 CT	1	1050	80	50
PM27-(*)	10,000	1,200	0.5	1050	280	50
PM23-(*)•	10,000 CT	1,200 CT	1	1050	280	50
PM25-(*)•	10,000	1200/300 Split	0.5	1050	280	50
PM19-(*)•	10,000 CT	2,000 CT	1	1000	300	50
PM21-(*)•	10,000	2000/500 Split	0.5	1000	300	50
PM17-(*)•	10,000 CT	10,000 CT	1	1000	1300	50
PM15-(*)	25,000	1,000	0.25	1700	110	40
PM11-(*)•	25,000 CT	1,000 CT	0.5	1700	110	40
PM13-(*)•	25,000	1000/250 Split	0.25	1700	110	40
PM7-(*)•	50,000 CT	1,000 CT	0	3300	75	10
PM9-(*)•	50,000	1000/250 Split	0	3300	75	10
PM5-(*)•	200,000	1,000	0	5300	110	10
PM3-(*)•	200,000 CT	1,000 CT	0	5300	110	10
PM41-(*)	Audio Choke	.3 hy.	4	43		
PM40-(*)	Audio Choke	3.5 hy.	2	700		
PM30-(*)	Audio Choke	6 hy.	2	1800		
PM90	Magnetic Shield Mu-Metal slip-on can for PM-M series, 20 dB shielding					

• These items not available in open frame construction.
* Add either -F, -M to Part Number. See photos figures PM-M & PM-F. Power levels shown are for 15% max. distortion, PM35-20%, PM37-25%. Frequency response measured as stated power level above.
† PM3 & PM5 — 45 kHz.





OPEN FRAME PM-F

To order add -F to Part Number. 4 inch #30 Plastic leads color coded. Weight .05 Oz.

IMMEDIATE DELIVERY FROM DISTRIBUTORS

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MICROTRAN

TOROIDAL INDUCTORS

QE SERIES

Ultra miniaturized with low height design. Exceptionally high "Q" and wide frequency range. Frequency range of QEL Series 1 to 300 kHz; QEM, 3 to 500 kHz. Accuracy, ±2%. Molded in epoxy resin with .020" x 2" gold-plated nickel alloy leads. Size, .450" dia. x .285".

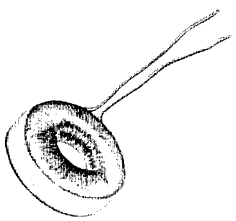
QEL-M SERIES				QEM-M SERIES			
Part No.	Inductance	Typ. DCR Ohms	Typ. Dist. Cap., pF	Part No.	Inductance	Typ. DCR Ohms	Typ. Dist. Cap., pF
QEL1-M	1 mH	2.1	25	QEM05-M	0.5 mH	2.1	20
QEL2-M	2 mH	3.6	30	QEM1-M	1 mH	3.8	30
QEL5-M	5 mH	7.3	35	QEM2-M	2 mH	6.2	35
QEL10-M	10 mH	15.8	45	QEM5-M	5 mH	15.9	45
QEL15-M	15 mH	20	45	QEM10-M	10 mH	19	50
QEL25-M	25 mH	32	50	QEM15-M	15 mH	42	55
QEL50-M	50 mH	69	50	QEM25-M	25 mH	88	60
QEL100-M	100 mH	185	70	QEM50-M	50 mH	193	70

QE-M Molded

QG SERIES

Frequency range of QGL Series, to 20 kHz; QGM Series, 2 to 100 kHz. Accuracy, ±2%. **QG-F:** Open frame, microcrystalline wax dipped with 4" #28 plastic leads. Size, 5/8" dia. x 3/32". **QG-M:** Molded in high temperature epoxy resin with .020" x 2" gold plated nickel alloy leads. Leads may be bent downward for plug-in printed circuit use. Size, 7/8" dia. x 3/8".

QGL SERIES				QGM SERIES			
QGL5-	5 mH	2.5	30	QGM1-	1 mH	1.4	22
QGL10-	10 mH	5	33	QGM2-	2 mH	2.5	25
QGL15-	15 mH	8	34	QGM5-	5 mH	6	28
QGL30-	30 mH	17	37	QGM10-	10 mH	12	31
QGL50-	50 mH	28	40	QGM15-	15 mH	18	32
QGL100-	100 mH	50	42	QGM25-	25 mH	30	35
QGL250-	250 mH	130	46	QGM50-	50 mH	52	37
QGL500-	500 mH	290	48	QGM100-	100 mH	115	39
QGL1000-	1.0 H	530	51				
QGL1500-	1.5 H	825	53				

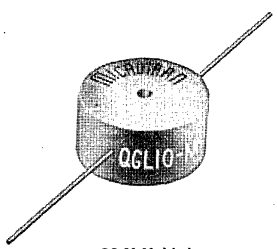


QG-F, QI-F, QK-F, QPL-F, QTL-F Open Frame

QI SERIES

Frequency range to 20 kHz; accuracy, ±2%. **QIL-M:** Molded in high temperature epoxy with silver plated turret lugs. Size, 1 3/16" dia. x 1/2". **QIL-H:** Hermetically sealed in metal case with Teflon terminals. Size, 1 1/16" x 1/2" x 1 7/32". **QIL-F:** Open frame. Microcrystalline wax dipped with 4" #28 plastic leads. Size, 1" dia. x 13/32".

QIL SERIES							
QIL3-	3 mH	.73	36	QIL150-	150 mH	34	50
QIL5-	5 mH	1.1	38	QIL250-	250 mH	55	53
QIL10-	10 mH	2.1	40	QIL500-	500 mH	95	55
QIL15-	15 mH	3.3	42	QIL1000-	1.0 H	210	57
QIL25-	25 mH	5.3	45	QIL1500-	1.5 H	335	59
QIL50-	50 mH	11	47	QIL2500-	2.5 H	550	61
QIL100-	100 mH	22	49				



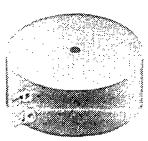
QG-M Molded

QK SERIES

Frequency range of QKL Series, to 10 kHz; QKM Series, 5 to 50 kHz. Accuracy, ±2%. **QK-F:** Open frame, microcrystalline wax dipped; 4" #28 plastic leads. Size, 1 1/4" dia. x 5/8". **QK-H:** Hermetic with Teflon terminals. Size, 1 15/32" x 25/32" x 1 47/64". **QK-M:** Molded in high temperature epoxy resin; silver plated turret lugs. Size, 1 3/8" dia. x 3/4"; #8 clearance hole.

QKL SERIES							
QKL5-	5 mH	.62	60	QKL250-	250 mH	28	87
QKL10-	10 mH	1.1	66	QKL500-	500 mH	63	91
QKL15-	15 mH	1.7	68	QKL1000-	1.0 H	110	96
QKL25-	25 mH	2.8	72	QKL1500-	1.5 H	175	98
QKL50-	50 mH	6	76	QKL2500-	2.5 H	275	103
QKL100-	100 mH	11	81	QKL5000-	5 H	645	106
QKL150-	150 mH	17	83	QKL10,000-	10 H	1175	112

QKM SERIES							
QKM2-	2 mH	.45	52	QKM100-	100 mH	25	79
QKM5-	5 mH	1.1	58	QKM250-	250 mH	65	87
QKM10-	10 mH	2.5	62	QKM500-	500 mH	115	92
QKM25-	25 mH	6.5	70	QKM1000-	1.0 H	250	97
QKM50-	50 mH	11	74				



QI-M, QK-M, QPL-M, QTL-M Molded

QP SERIES

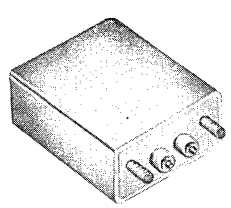
Frequency range to 10 kHz; accuracy, ±2%. **QPL-F:** Open frame, microcrystalline wax dipped; 4" #24 leads. Size, 1 5/16" x 7/8". **QPL-H:** Hermetically sealed with Teflon terminals. Size, 1 5/16" x 1 1/16" x 2 3/32". **QPL-M:** Molded in high temperature epoxy resin; silver plated turret lugs. Size, 2" dia. x 1".

QPL SERIES							
QPL25-	25 mH	1.5	100	QPL2500-	2.5 H	150	133
QPL50-	50 mH	2.5	105	QPL5000-	5.0 H	350	138
QPL100-	100 mH	6	110	QPL7500-	7.5 H	525	140
QPL250-	250 mH	15	115	QPL10,000-	10 H	600	142
QPL500-	500 mH	25	120	QPL15,000-	15 H	900	146
QPL1000-	1.0 H	60	125	QPL25,000-	25 H	1500	150
QPL1500-	1.5 H	90	130				

QT SERIES

Frequency range to 15kHz; accuracy, ±2%. **QTL-F:** Open frame, microcrystalline wax dipped; 4" #24 leads. Size, 2 7/16" dia. x 1". **QTL-H:** Hermetic, Teflon terminals. Size, 2 5/16" x 1 5/16" x 2 13/16". **QTL-M:** Molded in epoxy resin. Size, 2 7/8" x 1 3/8".

QTL SERIES							
QTL25-	25 mH	0.85	127	QTL1500-	1.5 H	40	177
QTL50-	50 mH	1.5	136	QTL2500-	2.5 H	70	184
QTL100-	100 mH	2.8	144	QTL5000-	5 H	140	192
QTL150-	150 mH	3.9	149	QTL10,000-	10 H	270	200
QTL250-	250 mH	7	156	QTL15,000-	15 H	430	205
QTL500-	500 mH	15	164	QTL25,000-	25 H	850	212
QTL1000-	1.0 H	27	173	QTL50,000-	50 H	1500	221



QI-H, QK-H 2 studs, QPL-H, QTL-H 4 studs Hermetic

IMMEDIATE DELIVERY FROM DISTRIBUTORS

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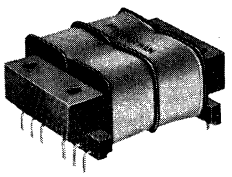
MICROTRAN — P.C. 50/60 Hz POWER TRANSFORMERS

FLATSTACK® LOW PROFILE PLUG-IN PRINTED CIRCUIT POWER TRANSFORMERS

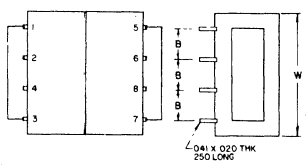
For Low Height P.C. Board Solid-State Power, Control, and Instrumentation Applications

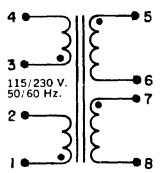
- **2 SIZES:** 6 VA Types 0.85″ High for 1″ Card Spacing
  12 VA Types 1.065″ High for 1¼″ Card Spacing
- **SPLIT BOBBIN — Primaries and Secondaries Wound Side by Side**
  1500 V Hipot
  High Isolation for Low Leakage Applications
  Low Capacity Coupling Minimizes Line Noise and False Triggering
- **HUM-BUCKING SEMI-TOROIDAL CONSTRUCTION**
  Balanced Windings Reduce Magnetic Field Radiation
- **PRECISION SPACED MOLDED-IN TERMINALS**
- **DUAL PRIMARIES:** 115/230V, 50/60 Hz

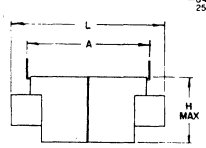


NEW LOW PROFILE CONSTRUCTION

PF SERIES FOR POWER SUPPLIES, INSTRUMENTS, CONTROL EQUIPMENT



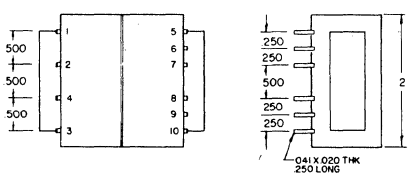


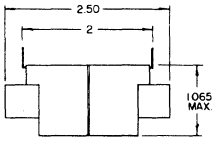


Series	L	W	H	A	B	Wt. Oz.
PF6-	1⅞	1⅜₁₆	0.850	1.600	0.375	7
PF12-	2½	2	1.065	2.000	0.500	11

Part No.	SECONDARY — Parallel Connected AC Volts	Parallel Connected RMS Amps	Series Connected AC Volts	Series Connected RMS Amps
PF6 Series • 115/230V Primary • 6 VA				
PF6-10	5.0	1.200	10.0 CT	.600
PF6-12	6.3	.900	12.6 CT	.450
PF6-16	8.0	.700	16.0 CT	.350
PF6-24	12.0	.500	24.0 CT	.250
PF6-34	17.0	.340	34.0 CT	.170
PF6-56	28.0	.200	56.0 CT	.100
PF12 Series • 115/230V Primary • 12 VA				
PF12-10	5.0	2.400	10.0 CT	1.200
PF12-12	6.3	1.800	12.6 CT	.900
PF12-16	8.0	1.400	16.0 CT	.700
PF12-24	12.0	1.000	24.0 CT	.500
PF12-34	17.0	.680	34.0 CT	.340
PF12-56	28.0	.400	56.0 CT	.200

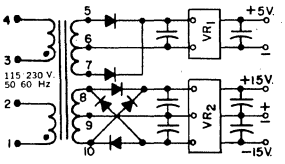
PFT SERIES FOR TRIPLE OUTPUT REGULATED POWER SUPPLIES





PFT12 SERIES
WEIGHT: 11 OZ.

PFT SERIES



PFT12 Series • 115/230V Primary • 12 VA

Part No.	Secondary #1 AC Volts	Secondary #1 RMS Amps	Secondary #2 AC Volts	Secondary #2 RMS Amps	DC Output #1 C.T.F.W. DC Volts	DC Output #1 Cur. mA DC	DC Output #2 C.T.F.W. DC Volts	DC Output #2 Cur. mA DC
PFT12-35	16.0 CT	.360	35.0 CT	.150	+8.75†	300	±22†	85

† +8.75 and ±22 DC output volts are for inputs to +5V and ±12V or ±15V IC voltage regulators. See PFT schematic. Line input 115/230V, ±10%.

PLUG-IN PRINTED CIRCUIT POWER TRANSFORMERS

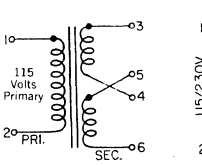
- COMPACT DESIGN FOR MINIATURIZED SOLID STATE CIRCUITRY
- FOR POWER SUPPLIES, INSTRUMENTS AND CONTROL APPLICATIONS
- DUAL SECONDARIES MAY BE PARALLEL OR SERIES CONNECTED

Top lugs on PC2000 series provide for 115/230V primary voltage options without changes in PC board. PC3000 series has 8 PC pins. 50/60 Hz.

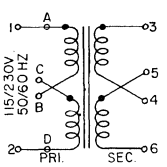
Primary 115V Part No.	Fig.	Primary 115/230V Part No.	Fig.	Part No.	Fig.	Secondary Parallel Connected AC Volts	Parallel Connected RMS Amps	Series Connected AC Volts	Series Connected RMS Amps
PC6506	A	PC2506	C	PC3506	A	6.3 CT	.250	(Single Secondary)	
PC6512	A	PC2512	C	PC3512	A	12.6	.120	25.2 CT	.060
PC6524	A	PC2524	C	PC3524	A	40.0	.040	80.0 CT	.020
PC6528	A	PC2528	C	PC3528	A	58.0	.026	116.0 CT	.013
PC6608	B	PC2608	D	PC3608	B	6.3	.700	12.6 CT	.350
PC6616	B	PC2616	D	PC3616	B	28.0	.156	56.0 CT	.078
PC6624	B	PC2624	D	PC3624	B	40.0	.110	80.0 CT	.055
PC6628	B	PC2628	D	PC3628	B	58.0	.066	116.0 CT	.033
PC6632	B	PC2632	D	PC3632	B	115.0V @ .020A & 12.6V @			.150A
PC6708	B	PC2708	D	PC3708	B	6.3	1.200	12.6 CT	.600
PC6712	B	PC2712	D	PC3712	B	12.6	.600	25.2 CT	.300
PC6715	B	PC2715	D	PC3715	B	20.0	.370	40.0 CT	.185
PC6716	B	PC2716	D	PC3716	B	28.0	.270	56.0 CT	.135
PC6724	B	PC2724	D	PC3724	B	40.0	.180	80.0 CT	.090
PC6728	B	PC2728	D	PC3728	B	58.0	.130	116.0 CT	.065
PC6732	B	PC2732	D	PC3732	B	115.0V @ .025A & 12.6V @			.250A

Series	Watts	W	D	H	Wt. Oz.
PC2500/PC3500/PC6500	1½	1²⁵⁄₆₄	1⁵⁄₃₂	1¹⁷⁄₆₄	3.2
PC2600/PC3600/PC6600†	4½	1⁴⁵⁄₆₄	1¼	1²⁵⁄₆₄	6.5
PC2700/PC3700/PC6700‡	7½	1⁶³⁄₆₄	1¹⁵⁄₃₂	1⁴¹⁄₆₄	9.5

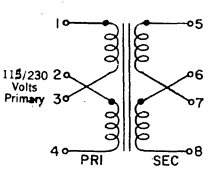
† Channel mounting 2″ M.C. ‡ 2⅜″ M.C.



PC6000 SERIES



PC3000 SERIES



PC2000 SERIES

FIG. A

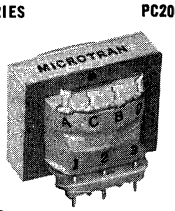


FIG. C

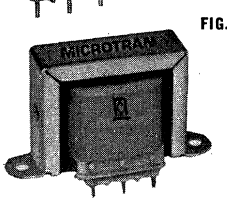


FIG. B

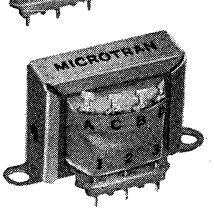


FIG. D

IMMEDIATE DELIVERY FROM DISTRIBUTORS

Dept. EM / 145 E. Mineola Avenue, Valley Stream, NY / (516) 561-6050 / TWX: 510-225-8412

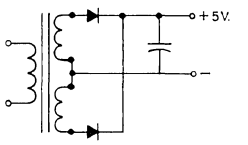
MICROTRAN

P.C. 50/60 Hz POWER SUPPLY TRANSFORMERS

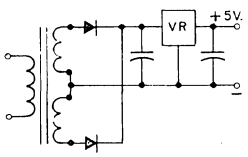
PLUG-IN PRINTED CIRCUIT POWER TRANSFORMERS FOR DC POWER SUPPLIES

For Microprocessor Logic and OP AMP Power Supplies. For construction of low cost, miniaturized, regulated and unregulated DC power supplies for latest solid-state digital and linear circuitry. Permits packaging flexibility unobtainable with prepackaged power supplies. Low-profile, miniaturized construction permits close stacking of P.C. boards. Precision spaced molded-in terminals. All primaries 115 V 50/60 Hz except PCL6600 Series. 115 230V 50/60 Hz. **Transformers supplied with engineering bulletin providing schematics and suggested components.**

TRANSFORMERS FOR +5V DC UNREGULATED AND REGULATED POWER SUPPLIES



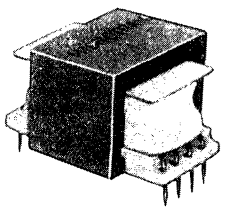
#1 — UNREGULATED



#2 — REGULATED

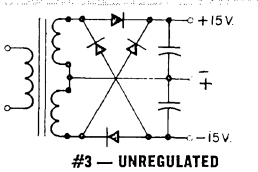
Part No.	SECONDARY Parallel Connected AC Volts	SECONDARY Parallel Connected RMS Amps	SECONDARY Series Connected AC Volts	SECONDARY Series Connected RMS Amps	DC OUTPUT C.T.F.W. DC Volts	DC OUTPUT Current mA DC	Schematic No.	Fig.
PC6205	4.50	0.18	9.0 CT	0.09	+5	75	1	A
PC6505	4.50	0.36	9.0 CT	0.18	+5	150	1	B
PC6605	4.50	1.10	9.0 CT	0.55	+5	450	1	D
PCL6605	4.50	1.10	9.0 CT	0.55	+5	450	1	C
PC6705	4.50	2.00	9.0 CT	1.00	+5	825	1	D
PC6905	4.50	5.00	9.0 CT	2.50	+5	2000	1	A
PC6210	7.75	0.12	15.5 CT	0.06	+8.5†	50	2	A
PC6510	7.75	0.22	15.5 CT	0.11	+8.5†	90	2	B
PC6610	7.75	0.64	15.5 CT	0.32	+8.5†	265	2	D
PCL6610	7.75	0.64	15.5 CT	0.32	+8.5†	265	2	C
PC6710	7.75	1.20	15.5 CT	0.60	+8.5†	500	2	D
PC6910	7.75	3.10	15.5 CT	1.55	+8.5†	1300	2	A

†+8.5 DC output volts for input to +5V IC Voltage Regulator, see Typical Schematic Regulated.



PC6200/PCT6200 SERIES
PC6900/PCT6900 SERIES
FIG. A

TRANSFORMERS FOR ±15V DC DUAL OUTPUT UNREGULATED AND REGULATED POWER SUPPLIES



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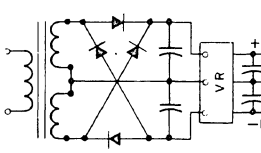
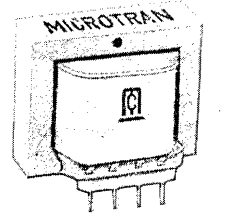


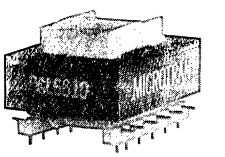
#4 — REGULATED

Part No.	SECONDARY Parallel Connected AC Volts	SECONDARY Parallel Connected RMS Amps	SECONDARY Series Connected AC Volts	SECONDARY Series Connected RMS Amps	DC OUTPUT C.T.F.W. DC Volts	DC OUTPUT Current mA DC	Schematic No.	Fig.
PC6211	12.0	0.07	24.0 CT	0.035	±15	22	3	A
PC6511	12.0	0.13	24.0 CT	0.065	±15	40	3	B
PC6611	12.0	0.40	24.0 CT	0.200	±15	120	3	D
PCL6611	12.0	0.40	24.0 CT	0.200	±15	120	3	C
PC6711	12.0	0.76	24.0 CT	0.380	±15	220	3	D
PC6911	12.0	1.90	24.0 CT	0.950	±15	550	3	A
PC6214	16.0	0.05	32.0 CT	0.025	±20†	15	4	A
PC6514	16.0	0.10	32.0 CT	0.050	±20†	30	4	B
PC6614	16.0	0.30	32.0 CT	0.150	±20†	90	4	D
PCL6614	16.0	0.30	32.0 CT	0.150	±20†	90	4	C
PC6714	16.0	0.56	32.0 CT	0.280	±20†	165	4	D
PC6914	16.0	1.40	32.0 CT	0.700	±20†	410	4	A

† ±20 DC output volts for input to ±15V IC Voltage Regulator, see Typical Schematic - Regulated.

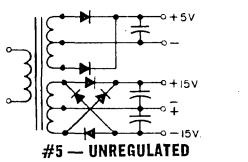


PC6500/PCT6500 SERIES
FIG. B



PCL6600 SERIES
FIG. C

TRANSFORMERS FOR +5V AND ±15V DC TRIPLE OUTPUT UNREGULATED AND REGULATED POWER SUPPLIES



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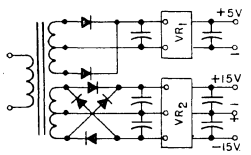
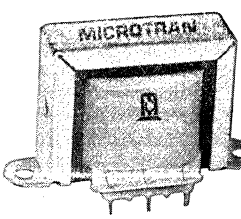


#6 — REGULATED

Part No.	SECONDARY #1 AC Volts	SECONDARY #1 RMS Amps	SECONDARY #2 AC Volts	SECONDARY #2 RMS Amps	DC OUTPUT #1 C.T.F.W. DC Volts	DC OUTPUT #1 Cur. mA DC	DC OUTPUT #2 C.T.F.W. DC Volts	DC OUTPUT #2 Cur. mA DC	Schematic No.	Fig.
PCT6230	9.0 CT	0.048	24.0 CT	0.020	+5	40	±15	12	5	A
PCT6530	9.0 CT	0.072	24.0 CT	0.032	+5	60	±15	20	5	B
PCT6630	9.0 CT	0.240	24.0 CT	0.080	+5	200	±15	50	5	D
PCL6630	9.0 CT	0.240	24.0 CT	0.080	+5	200	±15	50	5	C
PCT6730	9.0 CT	0.480	24.0 CT	0.160	+5	400	±15	100	5	D
PCT6930	9.0 CT	1.200	24.0 CT	0.440	+5	1000	±15	275	5	A
PCT6531	15.5 CT	0.048	32.0 CT	0.020	+8.5†	40	±20†	12	6	B
PCT6631	15.5 CT	0.140	32.0 CT	0.058	+8.5†	115	±20†	35	6	D
PCL6631	15.5 CT	0.140	32.0 CT	0.058	+8.5†	115	±20†	35	6	C
PCT6731	15.5 CT	0.300	32.0 CT	0.100	+8.5†	250	±20†	60	6	D
PCT6931	15.5 CT	0.690	32.0 CT	0.298	+8.5†	575	±20†	175	6	A

† +8.5 and ±20 DC output volts are for inputs to +5V and ±15V IC Voltage Regulator, see Typical Schematic - Regulated.

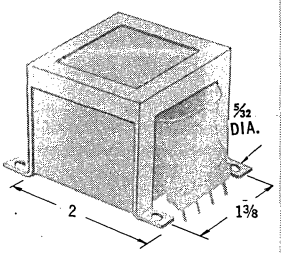


PC6600/PCT6600 SERIES
PC6700/PCT6700 SERIES
FIG. D

DIMENSIONAL CHART

Series	Watts	W (Inches)	D (Inches)	H (Inches)	Wt. Oz.
PC6200/PCT6200	1	1 1/64	1 3/8	27/32	2.3
PC6500/PCT6500	1 1/2	1 25/64	1 5/32	1 11/64	3.2
PC6600/PCT6600†	4 1/2	1 45/64	1 1/4	1 25/64	6.5
PCL6600	4 1/2	1 51/64	1 13/32	1 3/16	6.6
PC6700/PCT6700‡	7 1/2	1 61/64	1 15/32	1 41/64	9.5
PC6900/PCT6900	24	1 41/64	2 1/4	1 11/32	12.0

† Channel mounting 2″ M.C. ‡ 2 3/8″ M.C.



SLIP-ON BRACKET
For PC6900 Series
Order as Part Number PC6900-FB
Max. Height 1 7/16″

IMMEDIATE DELIVERY FROM DISTRIBUTORS

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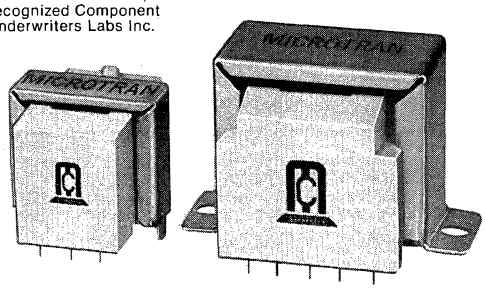
MICROTRAN

P.C. 50/60 Hz POWER TRANSFORMERS

INTERNATIONAL SERIES PLUG-IN PRINTED CIRCUIT POWER TRANSFORMERS

- For Solid-State Power, Control, and Instrumentation Applications
- UL Recognized — Meets IEC-65 Safety Requirements for Worldwide Usage
- Physical Barriers Between Primary and Secondary — Double Protection System — 4,000 Volt Hipot

Recognized Component
Underwriters Labs Inc.



PW SERIES — FOR CONTROL AND POWER SUPPLY APPLICATIONS

115/230V 50/60 Hz Primary

Part No.	Secondary: Parallel Connected AC Volts	Secondary: Parallel Connected RMS Amps	Secondary: Series Connected AC Volts	Secondary: Series Connected RMS Amps	Schematic	Fig.
PW28 SERIES • 0.5 VA						
PW28-10	10.0 C.T.	.050	(Single Secondary)		1†	A
PW28-16	16.0 C.T.	.031	(Single Secondary)		1†	A
PW28-24	24.0 C.T.	.021	(Single Secondary)		1†	A
PW35 SERIES • 1.1 VA						
PW35-10	10.0 C.T.	.110	(Single Secondary)		1	A
PW35-12	12.6 C.T.	.090	(Single Secondary)		1	A
PW35-16	16.0 C.T.	.070	(Single Secondary)		1	A
PW35-24	24.0 C.T.	.046	(Single Secondary)		1	A
PW35-36	36.0 C.T.	.031	(Single Secondary)		1	A
PW41 SERIES • 3.5 VA						
PW41-10	10.0 C.T.	.350	(Single Secondary)		1	B
PW41-12	12.6 C.T.	.280	(Single Secondary)		1	B
PW41-16	16.0 C.T.	.220	(Single Secondary)		1	B
PW41-24	24.0 C.T.	.150	(Single Secondary)		1	B
PW41-36	36.0 C.T.	.100	(Single Secondary)		1	B
PW48 SERIES • 9.5 VA						
PW48-10	5.0	1.900	10.0 C.T.	.950	2	B
PW48-12	6.3	1.500	12.6 C.T.	.750	2	B
PW48-16	8.0	1.200	16.0 C.T.	.600	2	B
PW48-24	12.0	.800	24.0 C.T.	.400	2	B
PW48-36	18.0	.520	36.0 C.T.	.260	2	B
PW48-56	28.0	.340	56.0 C.T.	.170	2	B
PW54 SERIES • 12.5 VA						
PW54-10	5.0	2.500	10.0 C.T.	1.250	2	C
PW54-12	6.3	2.000	12.6 C.T.	1.000	2	C
PW54-16	8.0	1.560	16.0 C.T.	.780	2	C
PW54-24	12.0	1.040	24.0 C.T.	.520	2	C
PW54-36	17.0	.700	36.0 C.T.	.350	2	C
PW54-56	28.0	.446	56.0 C.T.	.223	2	C

† PW28 Series has 115V primary only. 230V primary available on special order. Order as PW28-10-230, etc.

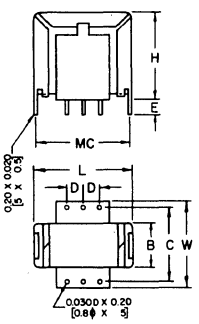
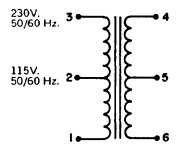
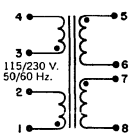


FIG. A



SCHEMATIC 1



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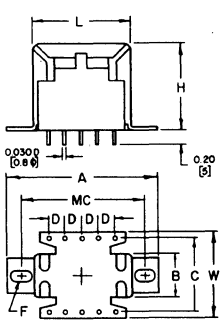
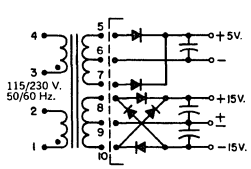


FIG. B



SCHEMATIC 3

PWT SERIES — FOR TRIPLE OUTPUT REGULATED AND UNREGULATED POWER SUPPLIES

115/230V 50/60 Hz Primary

Part No.	Secondary #1 AC Volts	Secondary #1 RMS Amps	Secondary #2 AC Volts	Secondary #2 RMS Amps	DC Output #1 C.T.F.W. DC Volts	DC Output #1 Cur. mA DC	DC Output #2 C.T.F.W. DC Volts	DC Output #2 Cur. mA DC	Schematic	Fig.
PWT54-1024	9.0 C.T.	.800	24.0 C.T.	.300	+5	670	±15	170	3	C
PWT54-1633	16.0 C.T.	.550	33.0 C.T.	.180	+9**	470	±21**	120	4	C

** +9 and ±21 DC output volts are for inputs to +5V and ±15V IC Voltage Regulators; see Schematic #4.

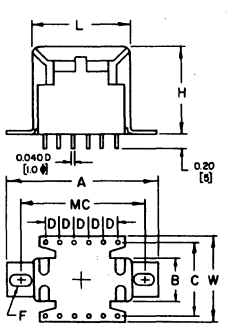
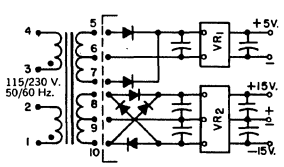


FIG. C



SCHEMATIC 4

DIMENSIONS Inches [mm]

Series	L	W	H	MC	A	B	C	D	E	F	Oz. [Gm.]
PW28	1.16 [29.5]	1.32 [33.5]	1.10 [28]	1.12 [28.5]	—	0.50 [12.5]	0.984 [25]	0.197 [5]	0.20 [5]	—	2.5 [70]
PW35	1.44 [36.5]	1.69 [43]	1.26 [32]	1.40 [35.5]	—	0.61 [15.5]	1.380 [35]	0.295 [7.5]	0.24 [6]	—	4.5 [130]
PW41	1.67 [42.5]	1.91 [48.5]	1.42 [36]	2.05 [52]	2.36 [60]	0.85 [21.5]	1.575 [40]	0.394 [10]	—	0.138x0.177 [3.5x4.5]	8.0 [230]
PW48	1.99 [50.5]	2.05 [52]	1.69 [43]	2.32 [59]	2.72 [69]	1.08 [27.5]	1.772 [45]	0.295 [7.5]	—	0.177x0.256 [4.5x6.5]	14.0 [400]
PW54	2.22 [56.5]	2.09 [53]	1.93 [49]	2.72 [69]	3.15 [80]	1.08 [27.5]	1.772 [45]	0.295 [7.5]	—	0.177x0.256 [4.5x6.5]	18.0 [510]

PWT54 and PW54 have same dimensions.

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SPLITFORM® PRINTED CIRCUIT POWER TRANSFORMERS

For Compact P.C. Board Solid-State Power, Control and Instrumentation Applications

- **SPLIT BOBBIN CONSTRUCTION — Center Flange Insulation Barrier 2500V RMS Hipot**
  High Isolation for Low Leakage Applications
  Low Capacitive Coupling Minimizes Line Noise and False Triggering
- **115V SINGLE OR 115/230V DUAL PRIMARY**
- **DUAL SECONDARIES MAY BE EITHER PARALLEL OR SERIES CONNECTED**
- **PRECISION SPACED MOLDED-IN TERMINALS**
  Terminal Numbers are Molded on Bobbin
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- **ATTRACTIVE PRICING**

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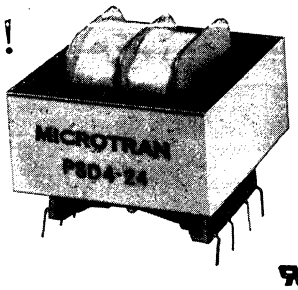
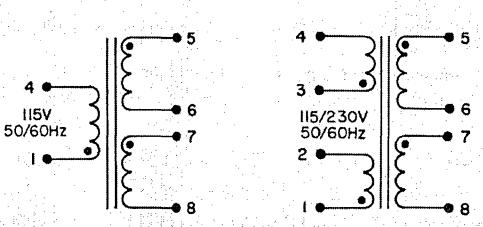


Recognized Component
Underwriters Labs Inc.

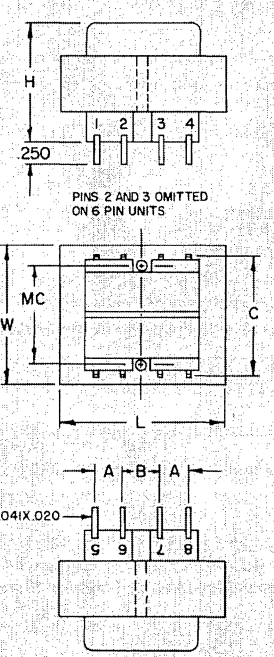
PART NUMBER		SECONDARY RMS RATING			
Single Pri. 115V 6 Pin	Dual Pri. 115/230V 8 Pin	Parallel Connected		Series Connected	
		AC Volts	RMS Amps	AC Volts	RMS Amps
PSS2-10	PSD2-10	5.0	0.22	10.0 C.T.	0.11
PSS3-10	PSD3-10	5.0	0.5	10.0 C.T.	0.25
PSS4-10	PSD4-10	5.0	1.2	10.0 C.T.	0.6
PSS5-10	PSD5-10	5.0	2.4	10.0 C.T.	1.2
PSS2-12	PSD2-12	6.3	0.18	12.6 C.T.	0.09
PSS3-12	PSD3-12	6.3	0.4	12.6 C.T.	0.2
PSS4-12	PSD4-12	6.3	1.0	12.6 C.T.	0.5
PSS5-12	PSD5-12	6.3	2.0	12.6 C.T.	1.0
PSS2-16	PSD2-16	8.0	0.14	16.0 C.T.	0.07
PSS3-16	PSD3-16	8.0	0.3	16.0 C.T.	0.15
PSS4-16	PSD4-16	8.0	0.8	16.0 C.T.	0.4
PSS5-16	PSD5-16	8.0	1.6	16.0 C.T.	0.8
PSS2-20	PSD2-20	10.0	0.11	20.0 C.T.	0.055
PSS3-20	PSD3-20	10.0	0.24	20.0 C.T.	0.12
PSS4-20	PSD4-20	10.0	0.6	20.0 C.T.	0.3
PSS5-20	PSD5-20	10.0	1.2	20.0 C.T.	0.6
PSS2-24	PSD2-24	12.0	0.09	24.0 C.T.	0.045
PSS3-24	PSD3-24	12.0	0.2	24.0 C.T.	0.1
PSS4-24	PSD4-24	12.0	0.5	24.0 C.T.	0.25
PSS5-24	PSD5-24	12.0	1.0	24.0 C.T.	0.5
PSS2-28	PSD2-28	14.0	0.08	28.0 C.T.	0.04
PSS3-28	PSD3-28	14.0	0.17	28.0 C.T.	0.085
PSS4-28	PSD4-28	14.0	0.4	28.0 C.T.	0.2
PSS5-28	PSD5-28	14.0	0.84	28.0 C.T.	0.42
PSS2-36	PSD2-36	18.0	0.06	36.0 C.T.	0.03
PSS3-36	PSD3-36	18.0	0.13	36.0 C.T.	0.065
PSS4-36	PSD4-36	18.0	0.34	36.0 C.T.	0.17
PSS5-36	PSD5-36	18.0	0.7	36.0 C.T.	0.35
PSS2-48	PSD2-48	24.0	0.046	48.0 C.T.	0.023
PSS3-48	PSD3-48	24.0	0.1	48.0 C.T.	0.05
PSS4-48	PSD4-48	24.0	0.25	48.0 C.T.	0.125
PSS5-48	PSD5-48	24.0	0.5	48.0 C.T.	0.25
PSS2-56	PSD2-56	28.0	0.04	56.0 C.T.	0.02
PSS3-56	PSD3-56	28.0	0.09	56.0 C.T.	0.045
PSS4-56	PSD4-56	28.0	0.22	56.0 C.T.	0.11
PSS5-56	PSD5-56	28.0	0.44	56.0 C.T.	0.22
PSS2-120	PSD2-120	60.0	0.02	120.0 C.T.	0.01
PSS3-120	PSD3-120	60.0	0.04	120.0 C.T.	0.02
PSS4-120	PSD4-120	60.0	0.1	120.0 C.T.	0.05
PSS5-120	PSD5-120	60.0	0.2	120.0 C.T.	0.1



6 Pin PSS Series **8 Pin PSD Series**

PSS, PSD Series	VA	DIMENSIONS Inches [mm]							Lb. [Gm.]
		L	W	H	MC	A	B	C	
2	1.1	1.375 [35.0]	1.125 [28.6]	.937 [23.8]	— —	.250 [6.35]	.250 [6.35]	1.200 [30.5]	0.17 [77.4]
3	2.4	1.375 [35.0]	1.125 [28.6]	1.187 [30.2]	— —	.250 [6.35]	.250 [6.35]	1.200 [30.5]	0.25 [114]
4	6	1.625 [41.3]	1.312 [33.3]	1.312 [33.3]	1.0625* [27.0]*	.250 [6.35]	.350 [8.9]	1.280 [32.5]	0.44 [200]
5	12	1.875 [47.6]	1.562 [39.7]	1.437 [36.5]	1.250* [31.8]*	.300 [7.62]	.400 [10.16]	1.410 [35.8]	0.70 [319]

* Clearance hole for 4-40 x 1⅜" nylon mtg. screw. Order screw as P/N PS-S and nut as P/N PS-N.



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400 Hz POWER TRANSFORMERS

DC-DC CONVERTER TRANSFORMERS

Permits conversion of low-voltage DC to higher voltages for operating mobile equipment or for DC isolation. Supplied with schematic and component values.

Select the Unit That Meets Your Power & Size Requirements	Part No.	Total VA Output‡	DC Input Volts	Volts	DC Output¶ Bridge mA	DC Output¶ CT Full Wave Volts	DC Output¶ CT Full Wave mA	Switching Freq. Hz (approx.)	Size, Inches D x W x H	Size, Inches Mtg. Cent. MD	Size, Inches Mtg. Cent. MW	Type of Construction	Fig.	Approx. Weight Oz.
High Voltage Low Power Miniature Design	M8149	25 mW	3	1,000*	25μA	—	—	400	1 1/64 x 61/64 x 27/32	—	—	Plug-in	E	1.2
	M8050	25 mW	1	1,000*	25μA	—	—	400	1 11/16 x 13/16 x 27/32	1 3/8	—	Open Frame with Leads	C	1.25
	M8051	25 mW	3	1,000*	25μA	—	—	400	1 x 1 x 1 3/8	1 1/8	—	MIL — AG	F	2.4
	M8073	25 mW	4	425-500*	50μA	—	—	50-3K†	3/8 x 3/8 x 3/8	—	—	Open Frame	B	.1
	M8074	50 mW	3	535*	90μA	—	—	400	1 11/16 x 13/16 x 27/32	1 3/8	—	Open Frame	C	1.25
	M8072	190 mW	2.7	480*	400μA	—	—	800	1 11/16 x 13/16 x 27/32	1 3/8	—	Open Frame	C	1.25
	M8120	190 mW	28	480*	400μA	—	—	3.5K	1 11/16 x 13/16 x 27/32	1 3/8	—	Open Frame	C	1.25
For Displays Nixie-Panaplex	M8121	3	5	190	15	—	—	20K	9/16D x 11/32H			Open Frame	G	.3
5 VA High Voltage Low Profile Encapsulated	M8115	5	13.8	±250 or 500§	10	250	20	6K	1 1/4D x 3/4H — .140 Cl. Hole			Toroidal	D	1.1
	M8117	5	28	±250 or 500§	10	250	20	6K	1 1/4D x 3/4H — .140 Cl. Hole			Toroidal	D	1.1
	M8122	5	5	±15 or 30	175	15	350	20K	7/8D x 17/32H — .140 Cl. Hole			Toroidal	H	1.1
High Frequency Encapsulated	M8132	30	13.8	±15 or 30§	1,000	15	2,000	20K	1 1/4D x 3/4H — .140 Cl. Hole			Toroidal	D	1.1
	M8133	30	28	±15 or 30§	1,000	15	2,000	20K	1 1/4D x 3/4H — .140 Cl. Hole			Toroidal	D	1.1
Medium Power Low Profile Encapsulated	M8113	50	13.8	±14 or 28§	1,750	14	3,500	2.5K	2 1/8D x 1 1/4H — .170 Cl. Hole			Toroidal	D	6
	M8114	50	28	±14 or 28§	1,750	14	3,500	2.5K	2 1/8D x 1 1/4H — .170 Cl. Hole			Toroidal	D	6
	M8116	50	13.8	±35 or 70§	700	35	1,400	2.5K	2 1/8D x 1 1/4H — .170 Cl. Hole			Toroidal	D	6
	M8118	50	28	±35 or 70§	700	35	1,400	2.5K	2 1/8D x 1 1/4H — .170 Cl. Hole			Toroidal	D	6

‡ Full-wave and CT loads may be simultaneously drawn, but for continuous duty, total VA output should not be exceeded. † Frequency depends on load and bias conditions.
¶ Based on approximately 1 volt drop per rectifier. § For positive and negative voltage supply as utilized in op-amp and similar circuitry.

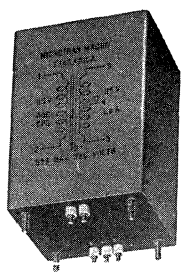

FIG. A

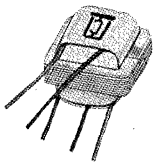

FIG. B

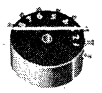

FIG. D

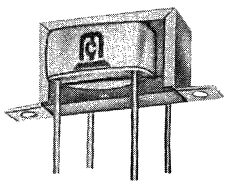

FIG. C

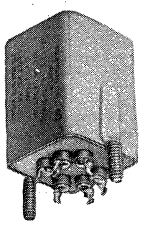

FIG. F

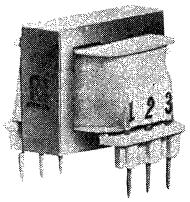

FIG. E

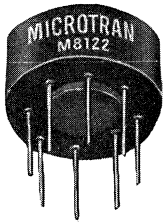

FIG. H

FIG. G

400 Hz PLUG-IN P.C. POWER

Compact design for miniature solid state circuitry. Precision spaced molded-in terminals. Dual secondaries may be connected in series or parallel. 115V Primary.

Part No.	Secondary - Parallel	Secondary - Series
PC4304	3.15V @ .1A	6.3V CT @ .05A
PC4312	12.6V @ .026A	25.2V CT @ .013A
PC4316	28V @ .012A	56V CT @ .006A
PC4320	35V @ .01A	70V CT @ .005A
PC4408	6.3V @ 0.60A	12.6V CT @ .30A
PC4412	12.6V @ 0.30A	25.2V CT @ .15A
PC4416	28V @ 0.14A	56V CT @ .07A
PC4424	40V @ 0.10A	80V CT @ .05A
PC4428	58V @ .066A	116V CT @ .033A
PC4432	115V @ .010A, 12.6V @ .150A	

DIMENSIONS

Series	W	D	H	Fig.	Wt. Oz.
PC4300	49/64	1 1/16	23/32	E	.5
PC4400	1 1/64	61/64	27/32	E	1.2

400 Hz TOROIDAL P.C. POWER

For Applications Requiring Minimum Size and Weight. Epoxy molded. Printed circuit pins can be bent for chassis mounting. .170 Clearance Hole for #8 Screw. Primary 115 Volts, MIL Designation TF5S03ZZ.

Part No.	Secondary Volts	Secondary Current mA	VA	Dimensions OD	Dimensions Height	Fig.	Wt. Oz.
M8106	28 CT	320	9	1 5/32	1 1/8	H	2
M8107	28 CT	710	20	1 1/2	1 1/4	H	4
M8108	56 CT	160	9	1 5/32	1 1/8	H	2
M8109	56 CT	356	20	1 1/2	1 1/4	H	4
M8110	115 CT	78	9	1 5/32	1 1/8	H	2
M8111	115 CT	170	20	1 1/2	1 1/4	H	4

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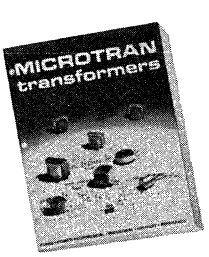

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Hermetically sealed and open frame power / control / isolation transformers, 50/60 and 400 Hz, available from stock. Send for complete catalog.

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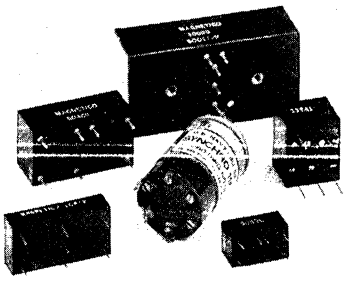
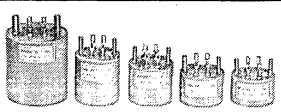
SCOTT T TRANSFORMERS



FEATURES:
- PRECISION/INTERCHANGEABILITY
- REPEATABILITY
- STABILITY/NO AGING
- NO SYSTEM TRIMMING REQUIRED



HOW TO ORDER:
Order Magnetico Standard Units directly by using the Magnetico Part Number.

VA RATING	SECONDARY VOLTAGE
Catalog Number	6.0 thru 300 (VRMS)

SCHEMATIC	SHIELD
X — No Tap	N — No Shield
T — Center Tap	S — Electrostatic Shield

EXAMPLE:
To order a 115 V 400 Hz to 26 V center tapped, 6 VA power transformer with no shield. Order Magnetico Number: **9602-26-T-N.**
VA RATING: 9602 **SCHEMATIC:** T
SECONDARY VOLTAGE: 26 **SHIELD:** N

SYNCHRO TO RESOLVER CONVERTER TRANSFORMERS

Part No.	Input Voltage (L-L)	Output RMS Sine & Cosine	Frequency Hz	Input Z kΩ	Typical Load kΩ	Accuracy Arc Seconds	Size Inches	Weight Oz.
52975	11.8	1	400	20	100	4 min.	⅞ x ½ x 7/16	.5
10472	11.8	6	400	10	10	5 min.	¾ x 1½ x ⅜	.6
11870	90	6 CT	60	500	100	60	1.1 x 2.1 x 1.1	4
12094	90	6 CT	60 & 400	500	100	2 min.	1.1 x 2.1 x 1.1	4
50460	90	6	400	60	10	60	⅞ x 1⅝ x 11/16	2
50642	11.8	6	400	30	10	60	⅞ x 1⅝ x 11/16	2
50726	90	6 CT	400	500	100	60	13/16 x 1½ x ⅝	1.5
9652	11.8	5	400	100	10	30	1⅜ x 2¾ x ⅞	5
9514	90	4.25	400	1000	10	30	1⅜ x 2¾ x ⅞	5
52910	11.8	1	400	10	100	4 min.	½ x ⅞ x .31	.5
52450	90	6	400	100	100	5 min.	⅝ x 1¼ x ½	3¾
52290	11.8	3.2	400	20	10	3 min.	⅞ x ½ x 7/16	⅓
52569	90	2 CT	400	80	100	5 min.	⅝ x ⅞ x 5/16	⅓
13084	11.8	6 CT	400	100	100	1 min.	¾ x 1½ x ⅜	½
13530	11.8	1	400	10	50	1 min.	⅝ x 1¼ x .3	.5

RESOLVER TO SYNCHRO CONVERTER TRANSFORMERS

Part No.	Input Voltage 4 Wire	Output 3 Wire (L-L)	Frequency Hz	Load Ohms (L-L)	Input Z Ohms	Accuracy Arc Minutes	Size Inches	VA Rating
10084	11.8	11.8	400	150	1.5K	2	1 x 2 x .65 H	.5
10086	6.0	11.8	400	150	1K	2	1 x 2 x .65 H	1
10088	9.0	11.8	400	150	2K	1.5	1⅜ x 2¾ x .65 H	1
10090	9.0	90	400	2500	1K	1	1⅜ x 2¾ x ⅞ H	1
11999	7.0	11.8	400	30	500	1	2 x 4 x 1 H	3
50749	7.2	90	60	8000	700	2	1½ x 3⅜ x 1¼ H	3
12186	7.0	90	60	4000	250	1	2 x 4 x1½ H	3.2
52020	9	11.8	400	14	100	3.5	1½ x 2½ x 1¼	4.5
52021	9	90	400	800	100	3.5	2 x 4 x 1¼	1
52449	6	90	400	2500	150	3	1 x 1⅝ x 11/16	2
52164	6	90	400	2500	100	2	1½ x 3 x 1⅛	10
12945	6	11.8	400	300	1K	5	¾ x 1½ x 7/16	½

STANDARD MINIATURE 400 Hz POWER TRANSFORMERS

CONDENSED PERFORMANCE DATA — PRIMARY VOLTAGE 115 VRMS. All Units Designed to Meet MIL-T-27D. IMMEDIATE DELIVERY FOR PROTOTYPE QUANTITIES.

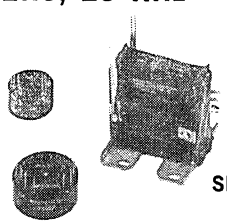
Catalog Number	VA Rating	Secondary Voltage (RMS)	O.D. ±1/32	Height ±1/32	Nominal Weight	Nom. Reg.	Nom.* Temp. Rise
9600	2	6-300 V	1″	13/32″	1 oz/ 30 gm	18%	10°C
9601	4	6-300 V	1″	11/16″	1.2 oz/ 35 gm	15%	12°C
9602	6	6-300 V	1″	⅞″	1.6 oz/ 45 gm	10%	18°C
9603	9	6-300 V	1″	1 1/16″	2.1 oz/ 60 gm	8%	20°C
9604	30	6-300 V	1⅜″	1½″	5.3 oz/150 gm	7%	23°C
10648	75	10-300 V	2″	1 5/16″	10 oz	±3%	30°C
10649	150	10-300 V	2¼″	1 9/16″	18 oz	±3%	40°C

Example: To order a 115 V 400 Hz to 26 V center tapped, 6 VA transformer with no shield — order Magnetico 9602-26-T-N
VA Rating: 9602 Secondary Voltage: 26 Schematic T: Shield: N.

SWITCHING TRANSFORMERS, 20 KHz

13962 — Input 160 VDC — Output (2) 5V @ 4A, (2) 15V @ ½A — Rated 55VA — 1.5 D x .8 Hi
13963 — Input 160 VDC — Output (4) 5V @ 4A, (2) 15V @ .66A — Rated 140 Watts — 1.75 D x .8 Hi
53248 — Input 160 VDC — Output (2) 12V @ 65A — Rated 650 Watts — 3″ x 2¾″ x 3″ Hi

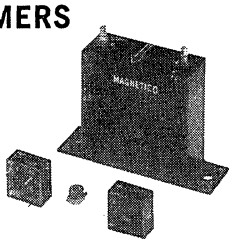
CUSTOM DESIGNS — Multiple Outputs — QUICK RESPONSE



CURRENT TRANSFORMERS

1V/Amp for Switching Applications
PC mount 13960 Series
1V/Amp for 400 Hz Power,
001V/Amp for 3000 Amp
Transmitter Monitor

Custom/Standard — QUICK RESPONSE

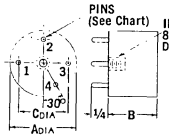


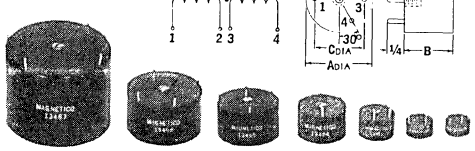
SPECIALS ARE STANDARD WITH US

MAGNETICO

SWITCHING INDUCTORS

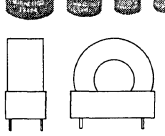
PARALLEL: Connect 1 to 3 & 2 to 4
SERIES: Connect 2 to 3, use 1 & 4





MIL-T-27 GRADE 5

Toroidal design on Molypermalloy Cores provides lowest leakage inductance and low pick up, PC mount, Hi-Q, low loss, stable inductance values.



Part No.	Induct. ±8% @ .1V 1kHz Par./Ser.		Res. Ohms Par./Ser.		DC Amps @ 90% Induct. Par./Ser.		Safe Operating Current Par./Ser.		A	B	C
13461-010	10 μH	40 μH	.015	.060	2.50	1.25	2.5†	1.25†	⅝	5/16	.500
-040	40 μH	160 μH	.050	1.00	1.25	.625	1.5†	.60†	⅝	5/16	.500
-100	100 μH	400 μH	.075	.30	.83	.415	1.0*	.5*	⅝	5/16	.500
13463-010	10 μH	40 μH	.005	.020	4.65	2.32	17.0*	8.5*	1	⅝	.875
-040	40 μH	160 μH	.012	.045	2.40	1.20	8.2*	4.1*	1	⅝	.875
-100	100 μH	400 μH	.030	.12	1.50	.75	5.0*	2.5*	1	⅝	.875
13464-090	40 μH	160 μH	.010	.040	5.4	2.7	20.0*	10.0*	1⅜	⅞	1.250
-100	100 μH	400 μH	.010	.040	3.4	1.7	10.0*	5.0*	1⅜	⅞	1.250
13465-200	200 μH	800 μH	.020	.080	2.75	1.37	10.0*	5.0*	1¾	1	1.625
13466-040	40 μH	160 μH	.003	.012	8.40	4.20	30.0*	15.0*	2	1⅛	1.875
-100	100 μH	400 μH	—	—	5.60	2.80	20.0*	10.0*	2	1⅛	1.875
13467-100	100 μH	400 μH	.004	.016	8.00	4.00	30.0*	15.0*	2½	1¼	2.375
-200	200 μH	800 μH	.009	.036	4.10	2.05	20.0*	10.0*	2½	1¼	2.375
-500	500 μH	2 MH	.015	.060	1.10	.55	4.0*	2.0*	2½	1¼	2.375

* 50% Inductance † 90% Inductance

OPEN TYPES OR VERTICAL MOUNTING (OPTIONAL)

CALL FOR PART BEST SUITED FOR YOUR SPEC

Laminated • Telephone Matching • Precision Inductors High Voltage

MAGNETICO INC.

182 MORRIS AVENUE, HOLTSVILLE, N.Y. 11742 TELEPHONE: (516) 654-1166

Toroidal Winding Scott-T • Inverter Current • Wideband Pulse

LET MAGNETICO QUOTE "ALL" YOUR REQUIREMENTS • THE BEST IN TRANSFORMERS • FILTERS • AUDIO HYBRIDS • POWER SUPPLIES

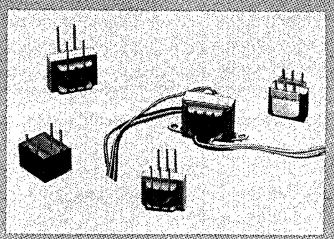
MULTI PRODUCTS INTERNATIONAL

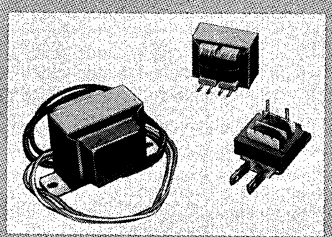
218 LITTLE FALLS RD., P.O. BOX 238, CEDAR GROVE, N.J. 07009

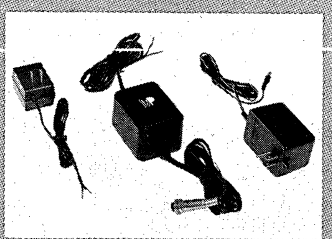
MPI is one of the most reliable suppliers, on a large scale, of transformer and magnetic components to the computer, data processing, communications & medical and recreational electronics OEMS. All units meet MPI's stringent QC standards and are UL CSA & VDE listed as required.

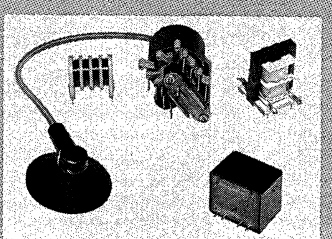
The product categories below provide general specification information for our basic product lines. However, our ability to design and manufacture custom components, to your specs, makes us the industry's true "super source".

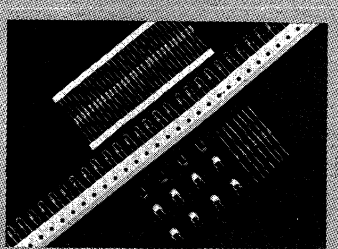
Call today! – **(201) 239-8183 • Telex 130430**











AUDIO/MATCHING TRANSFORMERS

Test Voltage	1500, 2100 & 3500 VDE	Return Loss	26db typical
Frequency Response	300Hz-3500Hz special to 50,000 Hz	Insertion Loss	.1 to 3.5db
Power Level	−50dbm +30dbm	D.C. Current	0 to 100 MA DC
Long Balance	45db to 75db	Distortion	50db typical
Impedence	input to 40,000 OHMS output 100,000 OHMS	Size	Metric size EI-14, EI-16, EI-19, EI-24, EI-28, & EI-35

POWER TRANSFORMERS

Typical Input For All Transformers
100 ~ 120V
220 ~ 240V
50 ~ 60Hz

METRIC SIZE	OUTPUT	METRIC SIZE	OUTPUT
EI-24	0.5VA	EI-66	50VA
EI-28	1 VA	EI-76	80VA
EI-35	1.8VA	EI-86	150VA
EI-41	5.0VA	EI-96	200VA
EI-48	12 VA	EI-105	300VA
EI-54	15 VA	EI-115	400VA
EI-57	25 VA	EI-133	1000VA

WALL PLUG-IN UNITS

INPUT: 115V60 Hz, Also Available — 120-240V 50-60Hz

AC/AC	AC/DC	UNIVERSAL
6.0V, 0 – 500 MA	3.0V, 0 – 100 MA	DC 3.0, 4.5, 6.0, 7.5, 9.0V @ 300 MA
9.0V, 0 – 500 MA	6.0V, 0 – 600 MA	DC 6.0, 7.5, 9.0V, @ 300 MA
12.0V, 0 – 500 MA	9.0V, 0 – 600 MA	DC 3.0, 4.5, 6.0V, @ 400 MA
15.0V, 0 – 300 MA	12.0V, 0 – 500 MA	DC 6.0, 7.5, 9.0V, @ 400 MA
18.0V, 0 – 300 MA	15.0V, 0 – 500 MA	DC 3.0, 4.5, 6.0, 7.5, 9.0V, @ 400 MA
20.0V, 0 – 300 MA	18.0V, 0 – 500 MA	

SPECIALTY ITEMS

- IF and RF Transformers
- Antenna Coils and Assemblies
- Pin cushion Transformers
- Switch Mode Transformers
- Pulse Transformers
- Ballast Transformers
- Deflection Yokes
- Flyback Transformers
- P.C. Board Assemblies
- Delay Lines
- Coil Windings
- Ignition Coils

INDUCTORS

PEAKING COIL AL TYPE

Style ..... Axial lead
Temperature rise ..... 20°C
Ambient temperature.. 80°C
Temperature range.... −20°C to +100°C
Terminal tensile strength ..... 2.5kg.
Inductance range .... 0.22μH – 1000μH

PEAKING COIL EL TYPE

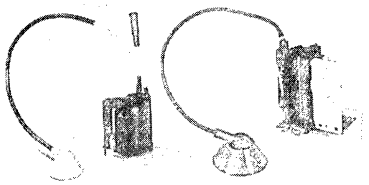
Style ..... Radial lead
Temperature rise ..... 20°C
Ambient temp ..... 80°C
Temperature range.... −20°C to +100°C
Terminal tensile strength ..... 1.5Kg.
Inductance range .... 0.22μH – 1000μH

high voltage components

MURATA ERIE NORTH AMERICA, INC.

Miniature Flyback Transformers

For 14″-20″ color TV and data display



FEATURES

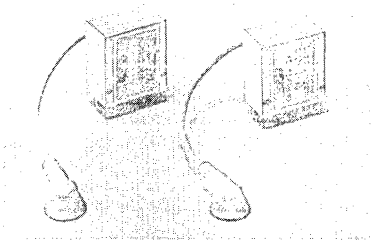
- Integral HV multiplier circuitry
- Small size
- HV resistant epoxy moldings
- Up to 25 KV output

TYPICAL SPECIFICATIONS

Items	Units	MSH-S305	MSH-S477
Input Voltage	V	112	123
Input Current	mA	360	480
Output Voltage	KV	21.0	24.0
Output Current	mA	1.0	1.0
HV Regulation	KV	under 1.4	under 2.0
HV Ringing Ratio	%	under 14	under 16
Collector Peak Voltage	Vp-p	890	1000
Secondary Voltage	V DC	(V_1) 12.5	(V_1) 28.7
Secondary Voltage	V DC	(V_2) 176.6	(V_2) 250
Secondary Voltage	V DC	—	—
Heater Voltage	V rms	6.20	6.30
Collector Pulse Width	μS	11.6	12.12
Def. Yoke Inductance	mH	2.3	1.29
Tuning Capacitance	pF	9520	10000
Primary Inductance	μH	2600	3300

Subminiature Flyback Transformers

For 1.5″ to 3″ black and white TVs, Viewfinders



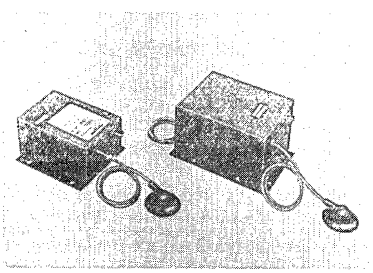
FEATURES

- Just 49mm x 28mm x 19mm
- Integral HV multiplier
- 5 to 6 KV output
- HV resistant epoxy moldings

TYPICAL SPECIFICATIONS

Items	Units	MSH-D618	MSH-T616
Input Voltage	V	5.9	9
Input Current	mA	172	138
Input Power	W	1.01	—
Output Voltage	KV	6.90	5.0
HV Regulation	KV	under 0.7	0.3
Collector Voltage	V	47	79
Collector Pulse Width	μS	12.1	10.4
HV Ringing Ratio	%	under 25	25
Output Current	μA	20	5
G_2 Voltage	V DC	298	700
Video Voltage	V DC	39.5	—
-B Voltage	V DC	−12.0	—

Miniature High Voltage Power Supplies

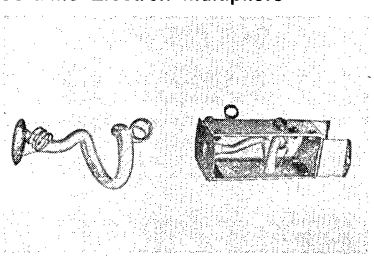


FEATURES

- Up to 17 KV output
- High, 40 KHz conversion frequency reduces size
- Provision for small-signal output control
- Built-in HV output stabilization
- Automatic overload protection
- Low output ripple
- Special epoxy resin for high reliability

CERATRON

Ceramic Electron Multipliers



These units are completely solid-state and may be substituted for standard vacuum-type electron multipliers in a variety of applications including ion, gamma ray, electron, photon and soft x-ray detection. They offer high gains to 10^6 min. and are extremely linear at up to 1 microamp. Noise figures are very low.

MURATA ERIE NORTH AMERICA, INC. 1148 Franklin Rd., S.E., Marietta, Georgia 30067 Tel: (404) 952-9777 Telex: 54-2329 TWX: 810-766-1531

WIDEBAND TRANSFORMERS

North Hills

UNBALANCED TO BALANCED TRANSFORMERS

Balanced secondaries center-tapped and dc-isolated from primaries. Mid-band insertion loss less than 0.5 dB. Bandwidth defined at low frequency end by 3 dB drop from mid-band response, at high end by max. VSWR of 1.25.

LOW POWER SERIES (1W)

Series	Radio Frequency		Medium Frequency		Video	
Cases	BA, BB, HB		BA, BB		LA, LB	
Unb./Bal. (Ω)	Type No.	Bandwidth MHz	Type No.	Bandwidth MHz	Type No.	Bandwidth MHz
50:50	0001	.1-125	0010	.01-80	0009	.001-25
50:75	0101	.1-125	0111	.01-80	0104	.001-25
50:90	0200	.1-125	0202	.01-60	0203	.001-20
50:100	0300	.1-100	0301	.01-60	0311	.001-20
50:124	0307	.1-100	0302	.01-60	0306	.001-20
50:135	0310	.1-100	0312	.01-60	0303	.001-18
50:150	0400	.1-100	0401	.01-60	0415	.001-15
50:200	0500	.1-100	0520	.01-60	0511	.001-15
50:300	0501	.1-100	0521	.01-50	0517	.001-12
50:450	0600	.1-65	0602	.01-40	0603	.001-10
50:600	0700	.1-65	0703	.01-32	0706	.001-8
50:800	0800	.1-60	0801	.01-25	0802	.001-7
50:1200	0900	.1-30	0902	.01-15	0904	.001-6
75:50	1000	.1-100	1001	.01-60	1002	.001-25
75:75	1100	.1-100	1112	.01-60	1102	.001-25
75:90	1200	.1-100	1201	.01-60	1202	.001-20
75:100	1300	.1-100	1310	.01-60	1314	.001-20
75:124	1302	.1-100	1311	.01-60	1301	.001-20
75:135	1317	.1-100	1315	.01-60	1312	.001-20
75:150	1400	.1-100	1405	.01-60	1404	.001-16
75:200	1500	.1-100	1513	.01-60	1516	.001-15
75:300	1501	.1-100	1514	.01-60	1502	.001-15
75:450	1600	.1-60	1601	.01-40	1602	.001-12
75:600	1700	.1-60	1707	.01-32	1704	.001-10
75:800	1800	.1-30	1801	.01-20	1802	.001-10
75:1200	1900	.1-30	1905	.01-15	1902	.001-9
75:1850	1906	.1-15	1901	.01-8	1903	.001-6

EXTENDED VIDEO SERIES Response down to 20 Hz

Type No.	Unb./Bal.	Bandwidth	Case Styles
0014	50:50	20 Hz-6 MHz	PB
0113	50:75	20 Hz-6 MHz	PB
0315	50:100	20 Hz-6 MHz	PB
0316	50:124	20 Hz-6 MHz	PB
0522	50:200	20 Hz-4 MHz	PB
1003	75:50	20 Hz-6 MHz	PB
1111	75:75	20 Hz-6 MHz	LA, LB
1307	75:110	20 Hz-6 MHz	PB
1309	75:124	20 Hz-9 MHz	PB
1408	75:150	20 Hz-6 MHz	PB
1520	75:300	20 Hz-4 MHz	PB

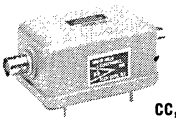
HIGH POWER SERIES

Power Level	10 W	25 W	100 W	1 kW
Cases	HB	BA, BB	BA, BB	KA
MHz Range	.1-30	.1-30	.5-30	2-32
Unb./Bal. (Ω)	Type No.	Type No.	Type No.	Type No.
50:50	0008	0011	0012	0013
50:75	0108	0109	0105	0107
50:100	0309	0308	0304	0314
50:150	0406	0402	0404	0407
50:200	0519	0512	0516	0515
50:300	0514	0518	0506	0513
50:450	0604	0605	0606	0601
50:600	0705	0701	0704	0702
75:75	1105	1110	1118	1108
75:100	1306	1304	1305	1316
75:150	1406	1401	1403	1407
75:200	1517	1519	1512	1518
75:300	1515	1510	1505	1511
75:450	1603	1604	1605	1606
75:600	1709	1703	1708	1705

MANY VARIATIONS AND CUSTOM DESIGNS TO 1 GHz ALSO AVAILABLE

ISOLATION TRANSFORMERS UNBALANCED TO UNBALANCED

Ground Isolation in 50 and 75Ω Coaxial Systems



CC, PA

CD

- Flat frequency, linear phase response.
- Insulated BNC connectors.
- 140 dB isolation at power frequencies.

Type No.	Impedance Unb/Unb(Ω)	Bandwidth
0005-CC	50:50	1 kHz - 25 MHz
1103-CC	75:75	1 kHz - 25 MHz
0112-CC	50:75	1 kHz - 25 MHz
0017-CC	50:50	10 Hz - 5 MHz
1117-CC	75:75	10 Hz - 5 MHz
0016-PA	50:50	20 Hz - 20 MHz
1116-PA	75:75	20 Hz - 20 MHz
1121-TC	75:75	3.5 Hz - 8 MHz

10 KV Isolation for Public Utility Data Transmission
1 kHz to 6 MHz bandwidths.
1115-CD: 75Ω coax to 75Ω coax.
1313-CD: 75Ω coax to 124Ω balanced line.

HUMBUCKING CHOKES

75:75 ohms, Insulated BNC connectors

Type	Bandwidth	Rejection at 60 Hz
1119-PA	DC to 15 MHz	50 dB min.
1120-CC	DC to 20 MHz	40 dB min.

ULTRA-WIDE COAXIAL MATCHING TRANSFORMERS

Unbalanced to unbalanced. BNC male and female input and output connectors in all combinations. Low VSWR.

0003-JA	50:50	.05-300 MHz	Phase Reversing
0102-JA	50:75	.05-300 MHz	Impedance Adapter
0114-JA	50:75	10-1000 MHz	Impedance Adapter
0201-JA	50:90	.05-300 MHz	Impedance Adapter
1106-JA	75:75	.05-300 MHz	Phase Reversing
1203-JA	75:90	.05-300 MHz	Impedance Adapter

SUBMINIATURE SERIES

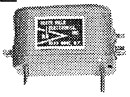
NA molded case.
0.1-300 MHz bandwidth.

.6 x .6 x .4"

0003-NA 1106-NA 2200-NA	50: 50 75: 75 90: 90	Unbalanced to Unbalanced Phase Reversing DC Coupled
0007-NA 1107-NA 2201-NA	50: 50 75: 75 90: 90	Unbalanced to Unbalanced Phase Reversing DC Isolated
0002-NA 0508-NA 1506-NA	50: 12.5 50:200 75:300	Unbalanced to Unbalanced Non-Inverting DC Coupled
0004-NA 0509-NA 1101-NA 1507-NA 2202-NA	50: 50 50:200 75: 75 75:300 100:100	Unbalanced to Balanced DC Coupled
0510-NA 1508-NA	50:200 75:300	Balanced to Balanced DC Coupled

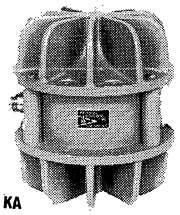
CASE STYLES

HB



BA, LA

BB, LB, PB



KA

OVERALL DIMENSIONS (Inches)

Case	L	W	H
BA	2.3	1.3	1.2
BB	2.6	1.3	1.2
CC	3.5	1.7	1.6
HB	0.9	0.9	0.7
KA	5.4	4.6	5.5
LA	2.9	1.7	1.3
LB	3.2	1.7	1.3
PA	3.0	4.0	2.0
PB	3.0	3.6	2.0

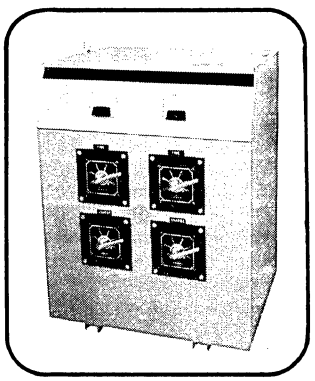
North Hills Electronics, INC.
GLEN COVE, N.Y. 11542 • 516-671-5700

NWL ...the source for industrial and electronic transformers

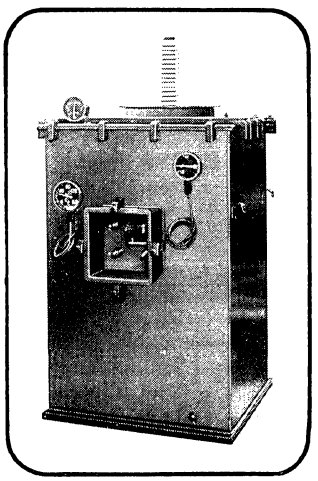
Since 1929, NWL has consistently been in the forefront of transformer design and manufacture.

High voltage, high frequency and high current transformers are particular strengths at NWL — whether for prototype, standard or special applications.

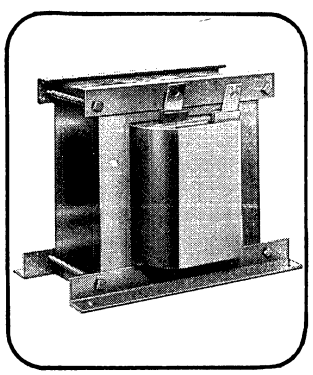
There's another reason you should look to NWL for solutions to your specific transformer problems. We've never hesitated to tackle the tough design problems head-on. In fact, NWL's technological superiority is a recognized fact in the precipitator, furnace, desalting, nuclear, and other fields requiring high technology.



Heating transformers for resistance and induction furnaces

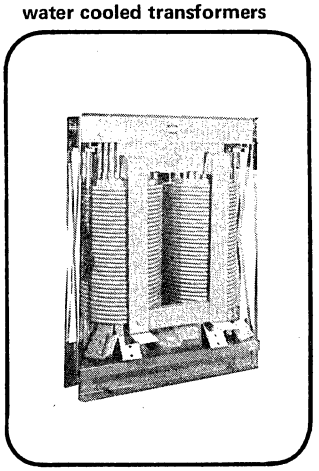


Oil-filled, high voltage Transformer/Rectifier Sets

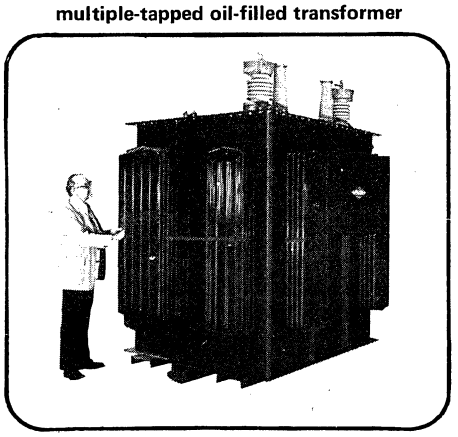


Current limiting reactors

High power and high current water cooled transformers



15 KV Class, 3,000 KVA-equivalent multiple-tapped oil-filled transformer



NWL ...the source for:

TRANSFORMERS ● Furnace ● Filament ● Heating ● Lighting ● SCR Controls ● Plate ● High Frequency ● Instrument ● Phase Changing ● Welding ● High Voltage ● Testing ● High Reactance ● Output

PLUS ● Saturable Core Reactors ● Chokes ● Packaged Controls ● AC Reactors ● Air Core Reactors

MANUFACTURING RANGE

Up to 150 KV
1 ma to 50,000 AMP
4 Hz to 20 kHz
5 KVA to 6,000 KVA
Dry, Oil-Filled, Silicone Fluid-Filled, Water Cooled, and Epoxy Cast Units Available.

NWL TRANSFORMERS
Rising Sun Road ● P.O. Box 358
Bordentown, N.J. 08505
(609) 298-7300 ● TWX: 510-685-3645
Call us for quote or specs

NWL also designs and manufactures custom built AC/DC power supplies, laboratory and industrial types. See our ad under DC POWER SOURCES.

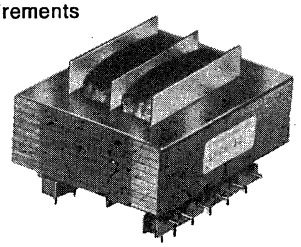
PC TRANSFORMER CORP.

Dept. EM / 64D NANCY ST. / WEST BABYLON, NY 11704 / (516) 491-3300

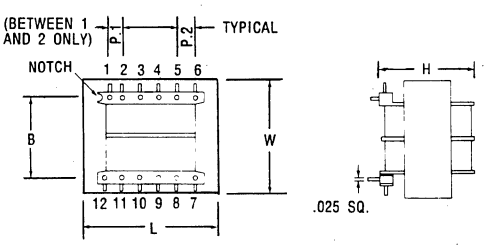
OUR SPECIALTY 1 WEEK DELIVERY FOR CUSTOM PROTOTYPES

LOW PROFILE SPLIT BOBBIN PRINTED CIRCUIT POWER TRANSFORMERS

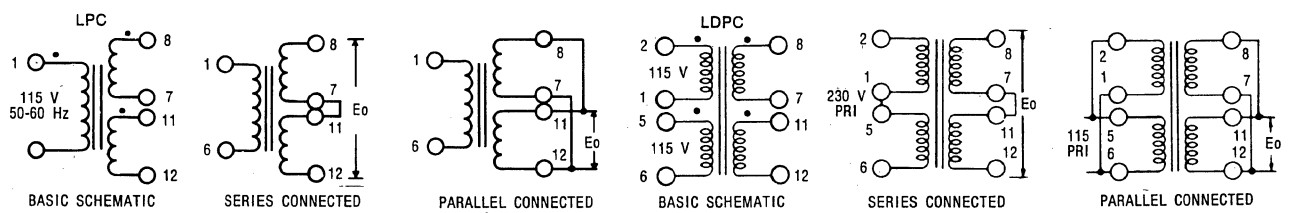
- Low profile — allows closer printed circuit board stacking
- Split bobbin construction — center flange insulation barrier provides 2500 VRMs Hipot — non concentric coil winding results in low interwinding capacitance, eliminates need for electro-static shielding.
- Class S (130°C) insulation system
- Single 115V and dual 115V/230V primaries are standard.
- Dual secondaries for variety of utilization
- 12 pin bobbin design increases available options for multi-winding special orders
- Low regulation
- Units are inspected and tested 100%
- Low prices — no minimum quantity requirements



PRIMARY 50/60HZ		R.M.S. SECONDARY RATINGS			
Single 115V	Dual 115V/230V	Series	Parallel	SIZE	VA
LPC3- 12	LDPC3- 12	12.6VCT @ 105MA	6.3V @ 210MA	3	1.25
LPC3- 16	LDPC3- 16	16 VCT @ 80MA	8 V @ 160MA	3	1.25
LPC3- 20	LDPC3- 20	20 VCT @ 65MA	10 V @ 130MA	3	1.25
LPC3- 24	LDPC3- 24	24 VCT @ 55MA	12 V @ 110MA	3	1.25
LPC3- 34	LDPC3- 34	34 VCT @ 35MA	17 V @ 70MA	3	1.25
LPC3- 40	LDPC3- 40	40 VCT @ 30MA	20 V @ 60MA	3	1.25
LPC3- 56	LDPC3- 56	56 VCT @ 20MA	28 V @ 40MA	3	1.25
LPC3-120	LDPC3-120	120 VCT @ 10MA	60 V @ 20MA	3	1.25
LPC4- 12	LDPC4- 12	12.6VCT @ 360MA	6.3V @ 720MA	4	4.50
LPC4- 16	LDPC4- 16	16 VCT @ 280MA	8 V @ 560MA	4	4.50
LPC4- 20	LDPC4- 20	20 VCT @ 225MA	10 V @ 450MA	4	4.50
LPC4- 24	LDPC4- 24	24 VCT @ 185MA	12 V @ 370MA	4	4.50
LPC4- 34	LDPC4- 34	34 VCT @ 130MA	17 V @ 260MA	4	4.50
LPC4- 40	LDPC4- 40	40 VCT @ 110MA	20 V @ 220MA	4	4.50
LPC4- 56	LDPC4- 56	56 VCT @ 80MA	28 V @ 160MA	4	4.50
LPC4-120	LDPC4-120	120 VCT @ 40MA	60 V @ 80MA	4	4.50
LPC5- 12	LDPC5- 12	12.6VCT @ 795MA	6.3V @ 1.59A	5	10.0
LPC5- 16	LDPC5- 16	16 VCT @ 625MA	8 V @ 1.25A	5	10.0
LPC5- 20	LDPC5- 20	20 VCT @ 500MA	10 V @ 1.00A	5	10.0
LPC5- 24	LDPC5- 24	24 VCT @ 415MA	12 V @ 930MA	5	10.0
LPC5- 34	LDPC5- 34	34 VCT @ 295MA	17 V @ 590MA	5	10.0
LPC5- 40	LDPC5- 40	40 VCT @ 250MA	20 V @ 500MA	5	10.0
LPC5- 56	LDPC5- 56	56 VCT @ 180MA	28 V @ 360MA	5	10.0
LPC5-120	LDPC5-120	120 VCT @ 85MA	60 V @ 170MA	5	10.0
LPC6- 12	LDPC6- 12	12.6VCT @ 1.9A	6.3V @ 3.8A	6	24.0
LPC6- 16	LDPC6- 16	16 VCT @ 1.5A	8 V @ 3.0A	6	24.0
LPC6- 20	LDPC6- 20	20 VCT @ 1.2A	10 V @ 2.4A	6	24.0
LPC6- 24	LDPC6- 24	24 VCT @ 1.0A	12 V @ 2.0A	6	24.0
LPC6- 34	LDPC6- 34	34 VCT @ 705MA	17 V @ 1.4A	6	24.0
LPC6- 40	LDPC6- 40	40 VCT @ 600MA	20 V @ 1.2A	6	24.0
LPC6- 56	LDPC6- 56	56 VCT @ 430MA	28 V @ 860MA	6	24.0
LPC6-120	LDPC6-120	120 VCT @ 200MA	60 V @ 400MA	6	24.0



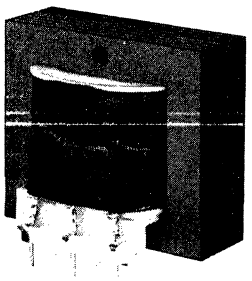
LPC, LDPC SIZE	VA	L″	W″	H″	P-1	P-2	B	WT. (oz.)
3	1.25	1⅜	1 5/16	1 1/16	.150	.200	.862	3
4	4.50	1⅝	1⅜	1 3/16	.200	.250	.950	5
5	10.0	1⅞	1⅝	1 5/16	.200	.300	1.100	9
6	24.0	2¼	1⅞	1 5/16	.200	.300	1.300	14



PC TRANSFORMER CORP.

Dept. EM / 64D NANCY ST. / WEST BABYLON, NY 11704 / (516) 491-3300

OUR SPECIALTY 1 WEEK DELIVERY FOR CUSTOM PROTOTYPES

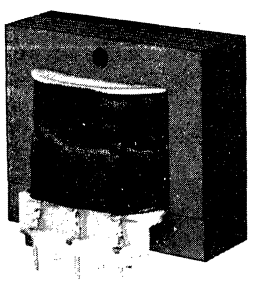


PLUG-IN PRINTED CIRCUIT AUDIO TRANSFORMERS

Designed for Input, Interstage, Output and Isolation Circuits. ±2db 200 Hz-15,000 Hz Frequency Response and 20dbm Power Rating for Entire Series.

P/N	PRI Z	Sec Z	Idc	Schematic
APC1-1	600Ω	600Ω	8mA	1
APC1-2	600Ω C.T.	600Ω C.T.	16mA	2
APC1-3	600Ω	8000/2000Ω Split	8mA	4
APC1-4	2500Ω	600Ω	4mA	1
APC1-5	2500Ω C.T.	600Ω C.T.	8mA	2
APC1-6	2500Ω C.T.	2500Ω C.T.	8mA	2
APC1-7	4000Ω	600Ω/150Ω Split	3mA	4
APC1-8	4000Ω C.T.	600Ω C.T.	6mA	2
APC1-9	4000Ω C.T.	1200Ω C.T.	6mA	2

PLUG-IN PRINTED CIRCUIT TELEPHONE COUPLING TRANSFORMERS

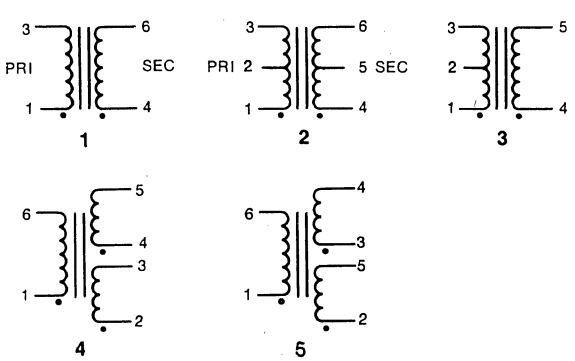


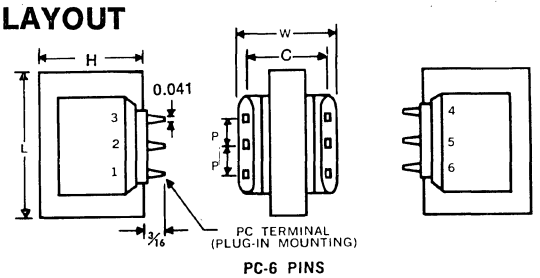
Designed for Interconnection of Voice/Data Modem Terminals to Telephone Lines.

- Frequency response ±0.5dB 300Hz-3500Hz
- Power level −45dbm to +7dbm
- Longitudinal balance — per FCC Part 68
- Distortion — 0.5% max.
- Impedance matching ±10% over frequency range
- Return loss — 26dB min.
- Units are inspected and tested 100%
- Low prices — no minimum quantity requirements

P/N	PRI Z	Sec Z	Application	Schematic
TPC1-1	600Ω	600Ω	Coupling	1
TPC1-2	600Ω C.T.	600Ω C.T.	Coupling	2
TPC1-3	600Ω	900Ω	Coupling	1
TPC1-4	900Ω	900Ω	Coupling	1
TPC1-5	900Ω/600Ω	600Ω	Coupling	3
TPC1-6	4000Ω	600Ω	Bridging	1
TPC1-7	600Ω (4W)	600Ω/600Ω	Hybrid (2) Req'd	5

APC & TPC SCHEMATICS AND MECHANICAL LAYOUT





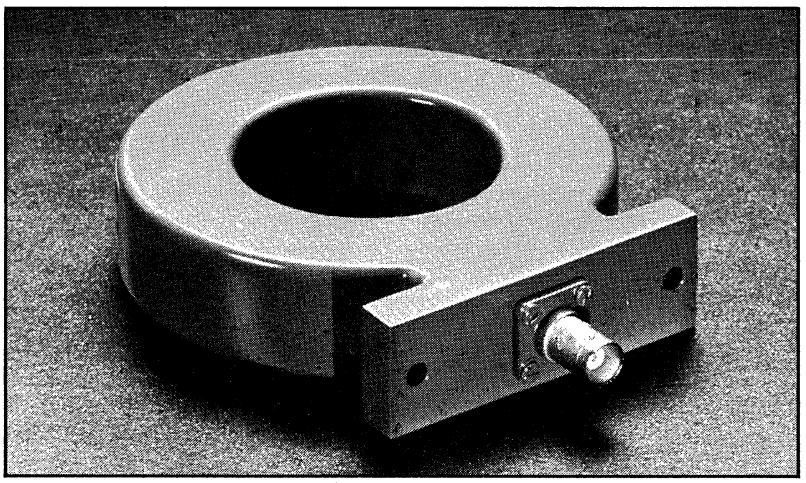
PC-6 PINS

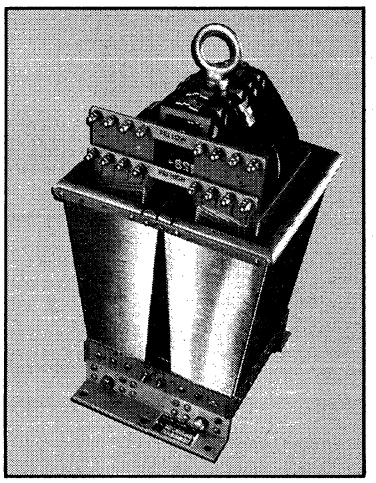
L	W	H	P	C	Wt. (oz.)
13/16	19/32	3/4	.187	.420	.5

Other ratings and configurations are available on special order for your custom requirements.

OVER 25 YEARS OF DESIGN EXPERTISE IS AVAILABLE TO ASSIST YOU WITH YOUR CUSTOM DESIGN AND APPLICATION REQUIREMENTS.

PEARSON ELECTRONICS, INC.





Wide Band, Precision Current Monitor Transformers

With a Pearson current monitor and an oscilloscope, you can measure pulse or ac currents from milliamperes to kiloamperes, in any conductor or beam of charged particles, at any voltage level up to a million volts, at frequencies up to 250 MHz or down to below 1 Hz.

The monitor is physically isolated from the circuit. It is a current transformer capable of highly precise measurement of pulse amplitude and waveshape. The one shown above, for example, offers pulse-amplitude accuracy of + 1%, − 0% (typical of all Pearson current monitors), 20 nanosecond rise time, and droop of only 0.5% per millisecond. Three db bandwidth is 1 Hz to 35 MHz. Whether you wish to measure current in a conductor, an electron device or a particle accelerator, it is likely that one of our off-the-shelf models (ranging from ½" to 10¾" ID) will do the job. In addition to our standard models, we build many custom designed current transformers to meet special needs and applications.

Very High Voltage & Very High Current Pulse Transformers

Pearson Electronics specializes in the development, design and manufacture of high and super high voltage pulse transformers. Typical of the applications for which we have designed and manufactured pulse transformers are units for supplying beam power to high power microwave tubes such as klystrons and traveling wave tubes, units providing pulse voltage to particle accelerator injection systems, pulsed x-ray tubes and high power lasers.

Pearson Current Monitor Transformers

Model Number	Output † (volts/amp.)	Hole Dia. (inches)	Maximum Peak Curr. (amps)	Maximum RMS Curr. (amps)	Droop (%/microsec.)	Useable Rise Time (nanosec.)	IT Max. (amp-sec.)	Approx. Low Freq. 3db pt. (Hz)	I/f (peak amps/ Hz)	Connector
2877	1.0	0.25	100	2.5	0.2	20	0.0004	320	0.0025	SMA
4100	1.0	0.5	500	5	0.09	10	0.002**	140	0.006	UG-290A/U
2100	1.0	2	500	7.5	0.08	20	0.005**	125	0.017	UG-290A/U
3100	1.0	3.5	500	12	0.02	50	0.03**	40	0.096	SO-239
150	0.5	2	1,000	15	0.02	20	0.02**	40	0.067	UG-290A/U
325	0.25	3.5	2,000	60	0.1	30	0.09	160	0.58	SO-239
2878	0.1	0.25	400	10	0.02	5	0.004	32	0.025	SMA
410	0.1	0.5	5,000	50	0.06	20	0.27	120	1.7	UG-290A/U
411	0.1	0.5	5,000	50	0.0009	20	0.19**	1	0.59	UG-290A/U
110	0.1	2	5,000	65	0.0008	20	0.49**	1	1.5	UG-290A/U
110A	0.1	2	10,000	65	0.0008	20	0.49**	1	1.5	UG-568/U
310*	0.1	3.5	5,000	140	0.02	40	0.58	40	3.6	SO-239
1010*	0.1	10.75	5,000	120	0.25	50	0.7	400	4.4	SO-239
1025	0.025	2	20,000	100	0.1	100	0.5	160	3.1	UG-290A/U
3025*	0.025	3.5	20,000	325	0.004	100	3.2	7	20	SO-239
2879	0.01	0.25	2,000	25	0.002	20	0.04	3	0.25	SMA
301X*	0.01	3.5	50,000	400	0.003	200	22.	5	138	SO-239

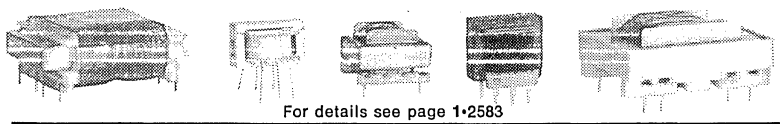
† Initial pulse response with one megohm in parallel with 20 pF load impedance. A 50 ohm termination will cut the output in half.
* Double shielded. ** May need small bias current through secondary for maximum rating.

Contact us and we will send you engineering data.

PEARSON ELECTRONICS, INC.
1860 Embarcadero Road, Palo Alto, California 94303 U.S.A. Telephone (415)494-6444 Telex 171-412

TTC SERIES
COUPLING TRANSFORMERS - HYBRID TRANSFORMERS - HOLDING COILS

The **TTC SERIES** has been developed to meet telephone interconnect, coupling, matching and bridging requirements for use in voice, instrumentation and modem applications. **This series meets FCC PART 68 requirements.**

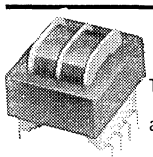


For details see page 1•2583

DP SERIES
ENCAPSULATED AUDIO TRANSFORMERS

The **DP SERIES** is cost effective for applications involving severe environments. This series is tested to the requirements of **MIL-T-27** and several part numbers meet **FCC PART 68.**

For details see page 1•2582



3F SERIES
3-FLANGE BOBBIN POWER TRANSFORMERS

The **3F SERIES** offers 2500V RMS dielectric breakdown testing primary-to-secondary (side-by-side winding type). They are available with single and dual primary connections for 115V, or 115/230V, 50/60 Hz circuits.

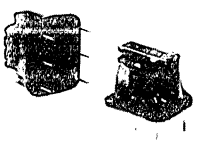
For details see page 1•2585

PEP SERIES
UL-1411 RECOGNIZED POWER TRANSFORMERS

This series complies with the safety requirements of most **WORLDWIDE AGENCIES** (UL, CSA, Europe-IEC 65 and Japan-MITI) including 4000V RMS dielectric breakdown testing primary-to-secondary.

For details see page 1•2584

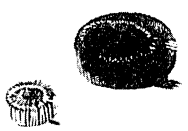
FILE NUMBER E59673 TAMRADIO



STT SERIES
ENCAPSULATED SCR AND TRIAC TRIGGER TRANSFORMERS

The **STT SERIES** provides line isolation in SCR and Triac controlled circuits. **STT TRIGGER** transformers pass **2600V RMS** dielectric breakdown testing and are completely encapsulated for applications involving severe environments.

For details see page 1•2582



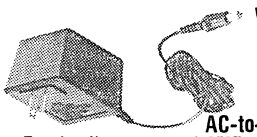
POWER AND NOISE ABSORBING INDUCTORS

The **SKC SERIES** of toroidal power inductors are gapped for energy storage circuits with DC ratings from **5 to 50A DC.**

The **SKL SERIES** is functionally gapped for circuits requiring high "L" at low DC amps and nominal "L" at rated DC amps.

The **SKP SERIES** is designed on powered iron toroidal cores for RFI and EMI filtering and noise absorbing applications.

For details see page 1•2586.



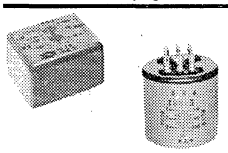
WALL PLUG-IN AC TO DC POWER SOURCES

This series of wall plug-in AC-to-DC battery chargers, battery eliminators and power supplies are available in a complete variety of input plug-in styles and comply with worldwide safety agency requirements.

AC-to-AC Wall Plug-in Transformers Are Available

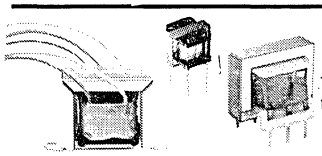
For details see page 1•2587

FILE NUMBERS
UL E82180
CSA LR36236
VDE F-7969-331
TAMRADIO



PROFESSIONAL AUDIO TRANSFORMER SERIES

This series is widely used in high performance applications and meets most requirements of communications, broadcasting, recording and measuring apparatus. Available in solder lug, lead and printed circuit mounting styles; these transformers are metal cased. Several part numbers are electrostatic and MU-metal shielded.

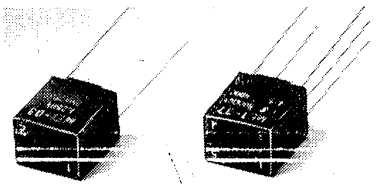


ATT SERIES
AUDIO TRANSFORMERS

These cost effective, volume produced transformers are available for impedance matching circuits and sound distribution systems. They are available as printed circuit, solder lug and lead styles.

Quality magnetic components at competitive prices . . . including COILS, POWER & AUDIO TRANSFORMERS, INDUCTORS, PULSE TRANSFORMERS, NOISE SUPPRESSION COILS, DC-DC CONVERTER TRANSFORMERS, PLUG-IN BATTERY CHARGERS and SWITCH-MODE POWER SUPPLY TRANSFORMERS & INDUCTORS. Our diversified manufacturing facilities are located in Taiwan, Malaysia and Japan. For details on standard and special requirement products, pricing and delivery—contact our headquarters.

MINIATURE ENCAPSULATED TRANSFORMERS



Small Size . . . . . 0.310" x 0.410" X 0.465"
Gold Plated Leads . . . . . 0.020" Nickel
Response . . . . . ±2dB, 300 Hz to 100 KHz
Impedance Range . . . . . 3.2 to 200K Ohms
Meets Requirements of MIL-T-27 as TF5S21ZZ

TRANSFORMERS-MET SERIES

PART NO.	MATCHING IMPEDANCE		DCMA (Max)
	Primary	Secondary	Primary
MET-01	200KCT	1KCT	0
MET-02	100KCT	1KCT	0
MET-03	50KCT	1KCT	0
MET-04	50K	1KCT or 250*	0
MET-05	25KCT	1KCT	0.5
MET-06	25K	1KCT or 250*	0.25
MET-07	25KCT	600CT	0.5
MET-08	20KCT	800CT	0.5
MET-09	10KCT	10KCT	1.0
MET-10	10KCT	4KCT	1.0
MET-11	10KCT	2KCT	1.0
MET-12	10K	2KCT or 500*	0.5
MET-13	10KCT	1.5CT	1.0
MET-14	10KCT	1.2KCT	1.0
MET-15	10K	1.2KCT or 300*	0.5
MET-16	10KCT	600CT	1.0
MET-17	10KCT	500CT	1.0
MET-18	10KCT	4.0	1.0
MET-19	10K	3.2	0.5
MET-20	8KCT	3.2	1.0
MET-21	5KCT	2KCT	1.0
MET-22	2.5KCT	2.5KCT	1.0
MET-23	1.6KCT	3.2	2.5
MET-24	1.5KCT	600	3.0
MET-25	1.2KCT	3.2	3.0
MET-26	1KCT	1KCT	3.0
MET-27	1KCT	600CT	3.0
MET-28	1K	50	3.0
MET-29+	900CT	600	3.0
MET-30	800CT	3.2	3.0
MET-31+	600CT	600CT	3.0
MET-32+	600	600CT or 150*	3.0
MET-33	600CT	250CT	3.0
MET-34	600CT	12	4.5
MET-35	600CT	8	4.5
MET-36	600CT	3.2	4.5
MET-37	500CT	600	3.0
MET-38	500	500CT or 125*	3.0
MET-39	500	50	3.0
MET-40	320CT	3.2	6.0
MET-41	300CT	600	7.0
MET-42	150	12	10.0
MET-43	120CT	3.2	10.0
MET-44	300CT	12.0	7.0
MET-45	10K	10KCT or 2.5K*	1.0
MET-46+	600	600	3.0
MET-48	200K	1K	0
METC-99	Mu-Metal Magnetic Shield		

*As parallel or split winding connection
+Meets **FCC PART 68** requirements and 1000V RMS Pri to Sec Hipot Test

INDUCTORS-MEI SERIES

PART NO.	INDUCTANCE Hy @ 300Hz	DCR ohms	DCMA
MEI-01	6 at 15V	1800	2.0
MEI-02	3.5 at 5V	1200	2.0
MEI-03	1.25 at 3V	180	2.0
MEI-04	0.3 at 3V	40	4.0
MEI-05	0.1 at 3V	15	5.0

PAN-MAGNETICS INTERNATIONAL, INC.
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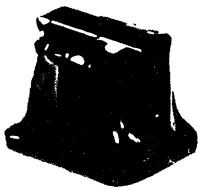
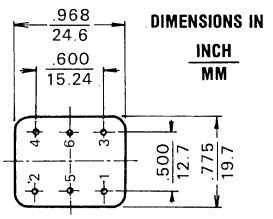
STT SERIES
ENCAPSULATED SCR & TRIAC TRIGGER TRANSFORMERS

The **STT SERIES TRIGGER TRANSFORMERS** are designed for low cost source isolation in half and full wave **SCR** or **TRIAC** control circuits. The **STT TRIGGER TRANSFORMERS** are encapsulated for environmental protection and pass **2600 V RMS** dielectric breakdown testing.



PART NUMBER	TURNS RATIO	PRIMARY "L" MH	LEAKAGE "L" μH	WDG. "C" PF	E.T. V-μSEC	D.C.R. OHMS (Max.)	DIA. NO.
STT-101	1:1	> 1.0	< 15	80	> 90	2.5/2.5	1
STT-102	1:1	> 5.0	< 50	80	>200	5.0/5.0	1
STT-103	1:1	>10.0	<100	80	>280	7.0/7.0	1
STT-104	1:1:1	> 1.0	< 25	80	> 90	2.5/2.5/2.5	2
STT-105	1:1:1	> 5.0	<100	80	>200	5.0/5.0/5.0	2
STT-106	1:1:1	>10.0	<200	80	>280	7.0/7.0/7.0	2
STT-107	2:1	> 1.0	< 20	80	> 90	2.5/1.5	1
STT-108	2:1	> 5.0	< 60	80	>200	5.0/2.5	1
STT-109	2:1	>10.0	<130	80	>280	7.0/3.5	1
STT-110	2:1:1	> 1.0	< 30	80	> 90	2.5/1.5/1.5	2
STT-111	2:1:1	> 5.0	<130	80	>200	5.0/2.5/2.5	2
STT-112	2:1:1	>10.0	<200	80	>280	7.0/3.5/3.5	2



DIMENSIONS IN INCH / MM

MAX. HT. = .775 / 19.7

DIAGRAM 1

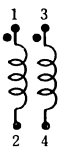
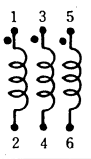


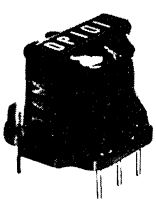
DIAGRAM 2



DP SERIES ENCAPSULATED AUDIO TRANSFORMERS

The **DP SERIES** of encapsulated audio transformers are cost effective for applications involving severe environments. Completely encapsulated, these small audio transformers eliminate environmental and board washing problems associated with open style transformers. The environmental quality of the **DP SERIES** is established through testing for humidity, immersion, solvent resistance and temperature cycling to the exacting reqirements of MIL-T-27. Several part numbers meet the requirements of **FCC PART 68** for telephone or modem applications. All **DP SERIES** audio transformers have frequency response characteristics within ±2dB from 200 Hz to 20 KHz.

EI 19 DP SERIES

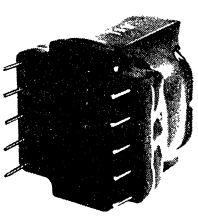


PART NUMBER	IMPEDANCE (Ω) PRI	IMPEDANCE (Ω) SEC	D.C.R. (Ω) PRI	D.C.R. (Ω) SEC	LEVEL (MAX.)	DCMA (MAX.)	REFER FIG	REFER DIA
DP-101+	600CT	600CT	38	48	15dbm	5	A	1
DP-103+	600CT	1.2KCT	38	84	15dbm	5	A	1
DP-105+	4KCT	600CT	277	35	15dbm	1	A	1
DP-107	300	600CT	19	48	15dbm	5	A	2
DP-108+	600	600CT	38	48	15dbm	5	A	2
DP-111	1K	2KCT	53	152	15dbm	2	A	2
DP-114	2.5K	2.5KCT	172	220	15dbm	2	A	2
DP-116	4K	2KCT	277	160	15dbm	1	A	2
DP-118	8K	2KCT	500	143	15dbm	0.5	A	2
DP-119	10K	600CT	370	90	15dbm	0.5	A	2
DP-122	10K	10KCT	695	900	15dbm	0.5	A	2
DP-124	20K	4KCT	1900	305	15dbm	0.5	A	2
DP-126	1KCT	8	55	0.62	15dbm	2	A	3
DP-128+	600	600CT×2	37	42×2	15dbm	0	B	4
DP-129+*	600CT	600CT	26	34	15dbm	0	B	1*

+ Meets requirements of **FCC PART 68**

*Insertion loss 0.9db typical and frequency response ±0.1db, 300 to 3400 Hz and with electrostatic shield.

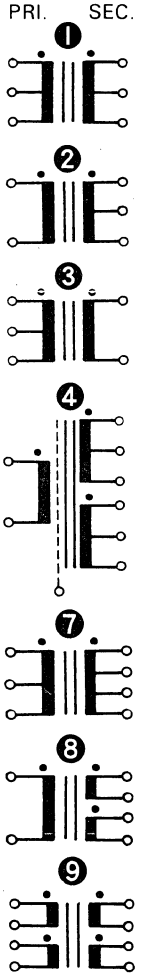
EI 28 DP SERIES



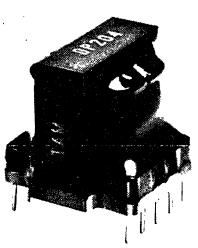
PART NUMBER	IMPEDANCE (Ω) PRI	IMPEDANCE (Ω) SEC	D.C.R. (Ω) PRI	D.C.R. (Ω) SEC	LEVEL (MAX.)	DCMA (MAX.)	REFER FIG	REFER DIA
DP-204+	600	600CT	36	50	28dbm	10	C	2
DP-208	4K	2KCT	250	145	28dbm	3	C	2
DP-210	200CT	4, 8, 16	10	0.4, 0.5, 0.7	28dbm	10	C	7
DP-214	600CT	4, 8, 16	32	0.4, 0.5, 0.7	28dbm	10	C	7
DP-220	1.3K	600/150	72	19×2	28dbm	6	C	8
DP-222+	500/125	500/125	19×2	22×2	28dbm	10	C	9
DP-222+	600/150	600/150	19×2	22×2	28dbm	10	C	9
DP-225+	4K/1K	600/150	63×2	20×2	28dbm	3	C	9
DP-226+	600	600CT×2	41	36×2	28dbm	0	C	4

SCHEMATIC DIAGRAMS

PRI. SEC.



DP SERIES MECHANICAL DIAGRAMS



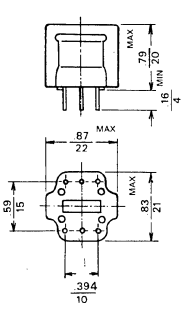


FIGURE A

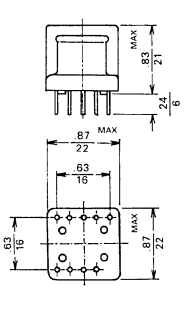


FIGURE B

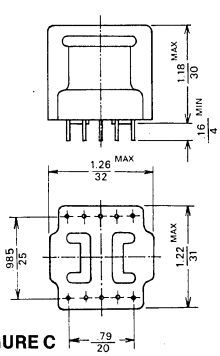


FIGURE C

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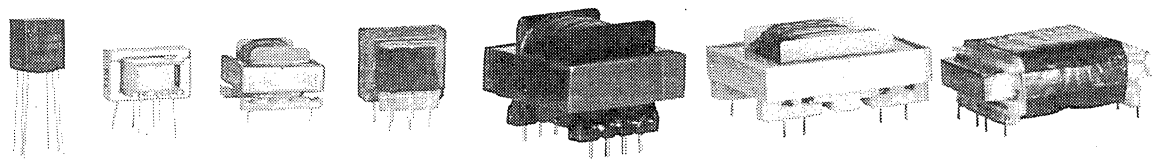
TTC SERIES — MEETS FCC PART 68
COUPLING TRANSFORMERS - HYBRID TRANSFORMERS - HOLDING COILS

TTC SERIES transformers and holding coils are designed to meet the performance requirements of telephone connected apparatus. They are widely used in the voice, data, isolation, bridging, matching, balancing, hybrid, and holding coil circuits of central office, PABX, subscriber telephone, modem and computer terminal equipments. TTC Series transformers provide optimum insertion loss, frequency response, longitudinal balance, distortion, return loss, impedance matching and isolation characteristics.

THESE TRANSFORMERS MEET REQUIREMENTS OF FCC PART 68



1 5 6H 6 9H 11H LP

SCHEMATIC DIAGRAMS

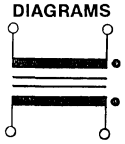


FIGURE 1.

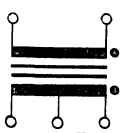


FIGURE 2.

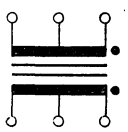


FIGURE 3.

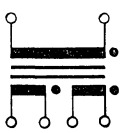


FIGURE 4.

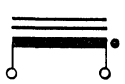


FIGURE 5.

FIGURE 6.

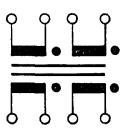


FIGURE 7.

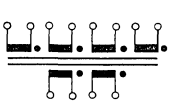


FIGURE 8.

PART NUMBER	APPLICATION	IMPEDANCE (Ω) PRI.	SEC.	SIZE (INCH) L	W	HT.	STYLE NO.	SCHEMATIC FIG. NO.	TYPICAL CROSS REF. OR (COMMENTS)**
MET-46	DRY COUPLING	600	600	0.41	0.31	0.46	1	1	TRIAD SP-70
TTC-02	DRY COUPLING	600	600	0.78	0.67	0.50	5	1	—
TTC-118	DRY COUPLING	600	600	0.78	0.67	0.50	5	1	MICROTRAN T1104
TTC-105	90 MADC COUPLING	600	600	0.80	0.59	0.73	6	1	(For Smart Modem)
TTC-108-1	LOW COST COUPLING	600	600	0.78	0.55	0.71	6	1	—
TTC-109	90 MADC COUPLING	600	600	0.80	0.96	0.55	6H	1	(For Smart Modem)
TTC-110	DRY COUPLING	600	600	0.78	0.55	0.71	6	1	PREM SPT-128
TTC-114	LOW COST COUPLING	600	600	0.78	0.55	0.71	6	1	—
TTC-111	WIDE BAND MATCHING	600	600	1.40	1.20	1.05	9H	1	(40 to 20,000 Hz)
TTC-126-2	90 MADC COUPLING	600	600	1.40	1.20	1.05	9H	1	(300 to 4000 Hz)
TTC-130	90 MADC COUPLING	600	600	1.40	1.20	0.67	9H	1	(1200 Baud Modem)
TTC-131	90 MADC COUPLING	600	600	1.40	1.20	0.67	9H	1	(w/Shield for Europe)
TTC-106	80 MADC COUPLING	600	600	1.63	1.33	0.65	11H	1	(Min. Crosstalk-Type)
TTC-122	80 MADC COUPLING	600	600	1.63	1.33	0.65	11H	1	PREM SPT-109
TTC-125	90 MADC COUPLING	600	600	1.63	1.27	0.60	LP	7	PREM SPT-101
MET-32	DRY COUPLING	600	600CT*	0.41	0.31	0.46	1	4	STANCOR PCT-27
TTC-103	LOW COST COUPLING	600	600CT*	0.78	0.65	0.62	5	4	—
TTC-113	DRY COUPLING	600CT	600	0.78	0.65	0.71	6	2	(Plus electrostatic shield)
TTC-105-1	90 MADC COUPLING	600	600CT	0.80	0.59	0.73	6	2	—
TTC-108-2	LOW COST COUPLING	600	600CT	0.78	0.55	0.71	6	2	—
TTC-109-1	90 MADC COUPLING	600	600CT	0.80	0.96	0.55	6H	2	(Low Profile)
TTC-109-2	90 MADC COUPLING	600	600CT*	0.80	0.96	0.55	6H	4	(Low Profile)
TTC-126-1	90 MADC COUPLING	600	600CT	1.40	1.20	1.05	9H	2	(300 to 4000 Hz)
TTC-121	75 MADC COUPLING	600	600CT*	1.63	1.33	0.65	11H	4	MICROTRAN T5114
TTC-124	90 MADC COUPLING	600CT*	600CT*	1.63	1.27	0.62	LP	8	PREM SPT-125
MET-31	DRY COUPLING	600CT	600CT	0.41	0.31	0.46	1	3	MICROTRAN PM34-M
TTC-03	DRY COUPLING	600CT	600CT	0.78	0.67	0.50	5	3	—
TTC-09	DRY COUPLING	600CT	600CT	0.78	0.55	0.71	6	3	TRIAD TY304P
TTC-100	DRY COUPLING	600CT	600CT*	0.78	0.65	0.62	5	4	(Pri. as in Fig. 3)
TTC-108	DRY COUPLING	600CT	600CT	0.78	0.55	0.71	6	3	TRIAD TY145P
TTC-126	90 MADC COUPLING	600CT*	600CT*	1.40	1.20	1.05	9H	7	(300 to 4000 Hz)
TTC-127	80 MADC COUPLING	600CT*	600CT*	1.63	1.33	0.65	11H	7	—
MET-29	DRY COUPLING	900CT	600	0.41	0.31	0.46	1	2	TRIAD SP-51
TTC-04	DRY COUPLING	900	600	0.78	0.67	0.50	5	1	—
TTC-107	LOW COST COUPLING	900	600	0.78	0.55	0.71	6	1	(Low Cost TTC-112)
TTC-112	DRY COUPLING	900	600	0.78	0.55	0.71	6	1	TRIAD TY301P
TTC-10	HYBRID	600	600/600	0.78	0.65	0.71	6	4	MICROTRAN T2220
TTC-101	HYBRID	600	600/600	1.02	0.94	0.84	6	4	TRIAD TY302P
TTC-115	LOW COST HYBRID	600	600/600	1.02	0.88	0.78	5	4	(with PC Frame)
TTC-05	BRIDGING	4000	600	0.78	0.67	0.50	5	1	—
TTC-13	BRIDGING	4000	600	0.78	0.55	0.71	6	1	TRIAD TY303P
TTC-128	CENTRAL OFFICE LINE MATCHING	PRI-1200-600-150CT SEC-600CT		1.02	0.85	0.78	6H	Contact Factory	—
TTC-129	HYBRID	PRI-600CT/600CT SEC-600CT		1.63	1.27	0.62	LP	8	(Interconnected on PCB)
TTC-119	HOLDING COIL	1.3HY @ 100 MADC		1.42	1.14	1.20	6	5	TRIAD TY350P
TTC-120	HOLDING COIL	1.4HY @ 120 MADC		1.63	1.33	0.65	11H	6	MICROTRAN T5415

*Windings can be connected as 600 ohm with CT or as 2 isolated 150 ohm windings.

**Cross referenced part numbers are offered as equivalents, but user should first determine complete suitability for the particular application.

PAN-MAGNETICS INTERNATIONAL, INC.
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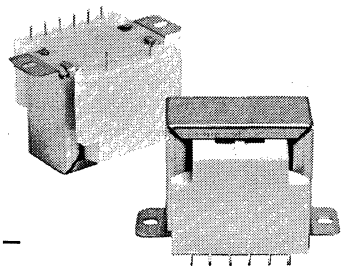
PRINTED CIRCUIT BOARD POWER TRANSFORMERS THAT MEET INTERNATIONAL AND U.S. SAFETY REQUIREMENTS

PEP Series

FILE NO. TAMRADIO E59673



- UL Recognized — Meets IEC-65 Safety Standards.
- Physical Barriers Between Primary and Secondary.
- Double Protection System — 4000V Hipot.

PEP Series • 115V/230V • 50/60Hz Primary

FOR USE IN CONTROL AND POWER SUPPLY APPLICATIONS

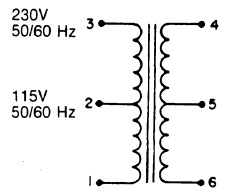
PART NO.	SECONDARY				CIRCUIT NO.	FIG. NO.
	PARALLEL CONNECTED		SERIES CONNECTED			
	V AC	A RMS	V AC	A RMS		
PEP28 x 0.7 VA SERIES						
10A006	(Single Secondary)		10.0 CT	.050	1-115V*	A
10A009			10.0 CT	.050	1-230V*	
10A007			16.0 CT	.031	1-115V*	
10A010			16.0 CT	.031	1-230V*	
10A008			24.0 CT	.021	1-115V*	
10A011			24.0 CT	.021	1-230V*	
*PEP28 Series is not available in Dual Primary versions.						
PEP35 x 2.0 VA SERIES						
10B004	(Single Secondary)		10.0 CT	.110	1	A
10B005			12.6 CT	.090		
10B006			16.0 CT	.070		
11B001H			24.0 CT	.046		
11B002H			36.0 CT	.031		
PEP41 x 5.0 VA SERIES						
10C009	(Single Secondary)		10.0 CT	.350	1	B
10C010			12.6 CT	.280		
10C011			16.0 CT	.220		
10C012			24.0 CT	.150		
11C005H			36.0 CT	.100		
PEP48 x 9.5 VA SERIES						
11D014H	5.0	1.900	10.0 CT	.950	2	B
11D015H	6.3	1.500	12.6 CT	.750		
11D016H	8.0	1.200	16.0 CT	.600		
11D017H	12.0	.800	24.0 CT	.400		
11D018H	18.0	.520	36.0 CT	.260		
11D019H	28.0	.340	56.0 CT	.170		
PEP54 x 15 VA SERIES						
11E006H	5.0	2.500	10.0 CT	1.250	2	C
11E007H	6.3	2.000	12.6 CT	1.000		
11E008H	8.0	1.560	16.0 CT	.780		
11E009H	12.0	1.040	24.0 CT	.520		
11E010H	17.0	.700	36.0 CT	.350		
11E011H	28.0	.446	56.0 CT	.223		

PEP54 SERIES FOR 3-OUTPUT REGULATED AND UNREGULATED POWER SUPPLIES

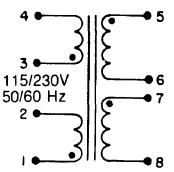
PART NO.	SECONDARY 1		SECONDARY 2		DC OUTPUT 1		DC OUTPUT 2		CIR. NO.	FIG. NO.
	V AC	A RMS	V AC	A RMS	CTFW Vdc	I mAdc	CTFW Vdc	I mAdc		
11E012H	9 CT	.800	24 CT	.300	+5	670	±15	170	3	C
11E013H	16 CT	.550	33 CT	.180	+9†	470	±21†	120	4	C

† +9Vdc and ±21 Vdc outputs are for input to +5 Vdc and ±15 Vdc IC Voltage Regulation (See Circuit 4)

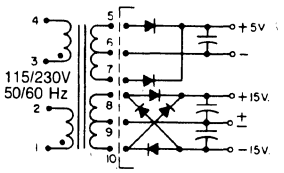
CIRCUIT SCHEMATICS



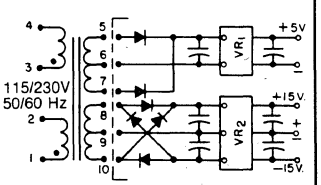
CIRCUIT 1



CIRCUIT 2



CIRCUIT 3



CIRCUIT 4

DIMENSIONS

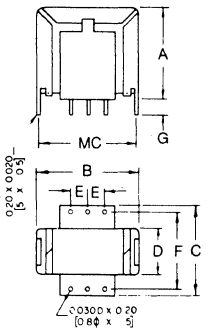


FIGURE A

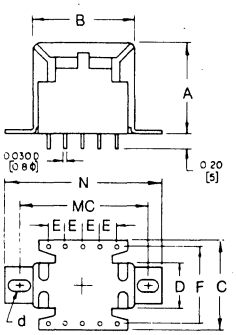


FIGURE B

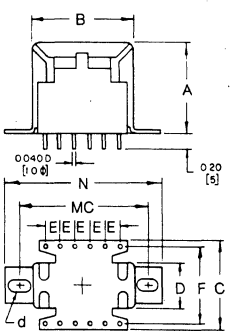


FIGURE C

DIMENSIONS • Inches (mm) WT • Oz. (Gm)

TYPE	A	B	C	MC	D	E	F	G	N	WT.
10A	1.10 (28)	1.16 (29.5)	1.32 (33.5)	1.12 (28.5)	0.50 (12.5)	.197 (5)	0.984 (25)	0.20 (5)	--	2.5 (70)
10B OR 11B	1.26 (32)	1.44 (36.5)	1.69 (43)	1.40 (35.5)	0.61 (15.5)	.295 (7.5)	1.380 (35)	0.24 (6)	--	4.5 (130)
10C OR 11C	1.42 (36)	1.67 (42.5)	1.91 (48.5)	2.05 (52)	0.85 (21.5)	.394 (10)	1.575 (40)	--	2.36 (60)	8 (230)
11D	1.69 (43)	1.99 (50.5)	2.05 (52)	2.32 (59)	1.08 (27.5)	.295 (7.5)	1.772 (45)	--	2.72 (69)	16 (450)
11E	1.93 (49)	2.22 (56.5)	2.09 (53)	2.72 (69)	1.08 (27.5)	.295 (7.5)	1.772 (45)	--	3.15 (80)	19 (540)

Note: d=PEP41 Series; 0.138 x 0.177 (3.5 x 4.5)
d=PEP48 and PEP54 Series; 0.177 x 0.256 (4.5 x 6.5)

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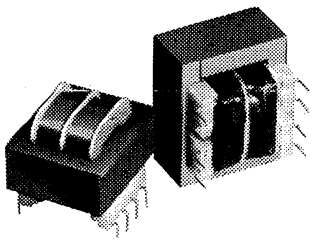
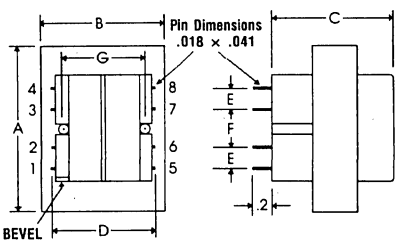
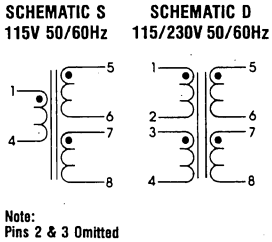
3F SERIES — 3 FLANGE BOBBIN PRINTED CIRCUIT BOARD POWER TRANSFORMERS

The **3F SERIES POWER TRANSFORMERS** are designed to include the most desirable features required for printed circuit board mounted applications. The 3F Series is constructed on a three flanged bobbin which is molded with UL listed material providing low capacitive coupling without electro-static shielding.



- 2500 VAC HIPOT, PRIMARY TO SECONDARY ISOLATION
- 115V SINGLE OR 115/230V DUAL PRIMARY
- TERMINAL NUMBERS ARE MOLDED ON BOBBIN
- COMPLIES WITH MOST UL SAFETY STANDARDS





NOTE: #4 Clearance Hole — 2 Places

3F SERIES PART NUMBER	DIMENSIONS							
	A	B	C	D	E	F	G	WT
3F(*)-2XX	1.38 / 35.0	1.16 / 29.5	0.94 / 23.9	1.200 / 30.48	0.250 / 6.350	0.250 / 6.350	N/A	0.17LB / 77.4GM
3F(*)-3XX	1.38 / 35.0	1.16 / 29.5	1.18 / 30.0	1.200 / 30.48	0.250 / 6.350	0.25 / 6.35	N/A	0.25LB / 114GM
3F(*)-4XX	1.62 / 41.0	1.31 / 33.0	1.31 / 33.3	1.280 / 32.51	0.250 / 6.350	0.350 / 8.890	1.062 / 26.97	0.44LB / 200GM
3F(*)-5XX	1.89 / 48.0	1.58 / 40.0	1.44 / 36.6	1.410 / 35.81	0.300 / 7.62	0.400 / 10.16	1.250 / 31.75	0.70LB / 319GM

DIMENSIONS SHOWN IN: INCH / MM

PART NUMBER	SECONDARY RATINGS - R.M.S.		VA
	SERIES	PARALLEL	
3F(*)-210	10.0VCT @ 0.110A	5.0V @ 0.220A	1.1
3F(*)-310	10.0VCT @ 0.250A	5.0V @ 0.500A	2.4
3F(*)-410	10.0VCT @ 0.600A	5.0V @ 1.200A	6.0
3F(*)-510	10.0VCT @ 1.200A	5.0V @ 2.400A	12.0
3F(*)-212	12.6VCT @ 0.090A	6.3V @ 0.180A	1.1
3F(*)-312	12.6VCT @ 0.200A	6.3V @ 0.400A	2.4
3F(*)-412	12.6VCT @ 0.500A	6.3V @ 1.000A	6.0
3F(*)-512	12.6VCT @ 1.000A	6.3V @ 2.000A	12.0
3F(*)-216	16.0VCT @ 0.070A	8.0V @ 0.140A	1.1
3F(*)-316	16.0VCT @ 0.150A	8.0V @ 0.300A	2.4
3F(*)-416	16.0VCT @ 0.400A	8.0V @ 0.800A	6.0
3F(*)-516	16.0VCT @ 0.800A	8.0V @ 1.600A	12.0
3F(*)-220	20.0VCT @ 0.055A	10.0V @ 0.110A	1.1
3F(*)-320	20.0VCT @ 0.120A	10.0V @ 0.240A	2.4
3F(*)-420	20.0VCT @ 0.300A	10.0V @ 0.600A	6.0
3F(*)-520	20.0VCT @ 0.600A	10.0V @ 1.200A	12.0
3F(*)-224	24.0VCT @ 0.045A	12.0V @ 0.090A	1.1
3F(*)-324	24.0VCT @ 0.100A	12.0V @ 0.200A	2.4
3F(*)-424	24.0VCT @ 0.250A	12.0V @ 0.500A	6.0
3F(*)-524	24.0VCT @ 0.500A	12.0V @ 1.000A	12.0
3F(*)-228	28.0VCT @ 0.040A	14.0V @ 0.080A	1.1
3F(*)-328	28.0VCT @ 0.085A	14.0V @ 0.170A	2.4
3F(*)-428	28.0VCT @ 0.200A	14.0V @ 0.400A	6.0
3F(*)-528	28.0VCT @ 0.420A	14.0V @ 0.840A	12.0
3F(*)-236	36.0VCT @ 0.030A	18.0V @ 0.060A	1.1
3F(*)-336	36.0VCT @ 0.065A	18.0V @ 0.130A	2.4
3F(*)-436	36.0VCT @ 0.170A	18.0V @ 0.340A	6.0
3F(*)-536	36.0VCT @ 0.350A	18.0V @ 0.700A	12.0
3F(*)-248	48.0VCT @ 0.023A	24.0V @ 0.046A	1.1
3F(*)-348	48.0VCT @ 0.050A	24.0V @ 0.100A	2.4
3F(*)-448	48.0VCT @ 0.125A	24.0V @ 0.250A	6.0
3F(*)-548	48.0VCT @ 0.250A	24.0V @ 0.500A	12.0
3F(*)-256	56.0VCT @ 0.020A	28.0V @ 0.040A	1.1
3F(*)-356	56.0VCT @ 0.045A	28.0V @ 0.090A	2.4
3F(*)-456	56.0VCT @ 0.110A	28.0V @ 0.220A	6.0
3F(*)-556	56.0VCT @ 0.220A	28.0V @ 0.440A	12.0
3F(*)-2120	120.0VCT @ 0.010A	60.0V @ 0.020A	1.1
3F(*)-3120	120.0VCT @ 0.020A	60.0V @ 0.040A	2.4
3F(*)-4120	120.0VCT @ 0.050A	60.0V @ 0.100A	6.0
3F(*)-5120	120.0VCT @ 0.100A	60.0V @ 0.200A	12.0

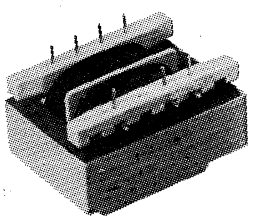
NOTE (*) Insert S for Single Primary 3F Series Transformer
Insert D for Double Primary 3F Series Transformer

3 FLANGE BOBBIN TRANSFORMER FOR UNREGULATED & REGULATED POWER SUPPLIES

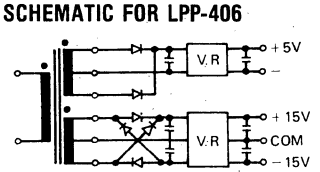
The **LPP SERIES LOW-PROFILE PLUG-IN POWER TRANSFORMERS** offer the circuit designer a variety of options including dual output which may be connected in series or parallel, secondary voltages for unregulated or regulated power supplies, and dual output voltages.

PART NUMBER	SECONDARY RATINGS - R.M.S.		DC OUTPUT	
	SERIES	PARALLEL	VDC	mADC
LPP-401	9.00VCT @ 0.50A	4.5V @ 1.00A	+5.0	600*
LPP-402	15.5V @ 0.33A	7.75VCT @ 0.66A	+5.0	380**
LPP-403	27.00VCT @ 0.19A	13.5V @ 0.38A	±15.0	115*
LPP-404	36.00VCT @ 0.14A	18.0V @ 0.28A	±15.0	70**
LPP-405	9.00VCT @ 0.24A	—	+5.0	200*
	24.00VCT @ 0.08A	—	±15.0	50*
LPP-406	15.50VCT @ 0.14A	—	+5.0	100**
	34.00VCT @ 0.06A	—	±15.0	25**
LPP-408†	15.5V @ 0.33A	7.75VCT @ 0.66A	—	—
LPP-411‡	11.00V @ 0.15A	(Single Secondary)	—	—
LPP-426‡	26.00V @ 0.10A	(Single Secondary)	—	—

*Unregulated DC Output **Regulated DC Output (MADC, typ., depends on regulator efficiency).
†115/230V-Series/Parallel Primary Winding.
‡115V input-connect line to Primary 1 with Primary 2 Open.
‡230V input-connect line across Primary 1 and 2 with Primary 1 and 2 in series.
‡These part numbers have thermal fuse internally connected to Primary 1.



TYPICAL SCHEMATIC FOR LPP-406



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INDUCTORS FOR SWITCH-MODE POWER REGULATOR, CONTROL AND NOISE FILTERING CIRCUITS

The **SKC SERIES INDUCTORS** are designed on gapped toroidal tape wound cores for DC switching power supply, regulator and energy storage circuits — DC current ratings **5 to 50 AMPS DC.**

The **SKL SERIES INDUCTORS** are designed on functional gapped toroidal tape wound cores for power circuits requiring high inductance at low DC currents and nominal inductance at rated DC amps.

The **SKP SERIES INDUCTORS** are designed on powered iron toroidal cores for RFI and EMI filtering and other noise absorbing applications. Also, **SKP SERIES INDUCTORS** are most useful in DC circuit applications, available in a wide range of "L" values and DC current ratings to **40 AMPS DC.**

SKC SERIES POWER INDUCTORS FOR DC SWITCH-MODE CIRCUITS

PART NUMBER	AMPS (DC)	"L" (μH)	DCR (OHMS)	DIMENSIONS (inch/mm)	
				OD (max.)	HT (max.)
SKC-101	5 to 10	30	0.009	1.26/32	.71/18
SKC-102	5 to 10	50	0.011	1.26/32	.71/18
SKC-103	5 to 10	100	0.017	1.26/32	.71/18
SKC-104	5 to 10	150	0.023	1.26/32	.71/18
SKC-105	5 to 10	200	0.024	1.46/37	.79/20
SKC-106	5 to 7.5	400	0.048	1.46/37	.79/20
SKC-107	5 to 7.5	600	0.056	1.73/44	1.02/26
SKC-108	5 to 7.5	800	0.044	2.13/54	.98/25
SKC-109	5 to 6	1200	0.081	2.17/55	1.02/26
SKC-110	5 to 6	1800	0.099	2.17/55	1.02/26
SKC-201	10 to 15	30	0.005	1.26/32	.71/18
SKC-202	10 to 15	50	0.007	1.46/37	.79/20
SKC-203	10 to 15	100	0.012	1.46/37	.79/20
SKC-204	10 to 15	150	0.014	1.73/44	1.02/26
SKC-205	10 to 15	200	0.011	2.13/54	.98/25
SKC-206	10 to 12	400	0.024	2.17/55	1.02/26
SKC-207	10 to 12	600	0.032	2.20/56	1.06/27
SKC-208	10 to 12	800	0.032	2.20/56	1.30/33
SKC-301	15 to 25	30	0.004	1.46/37	.79/20
SKC-302	15 to 25	50	0.006	1.54/39	.83/21
SKC-303	15 to 25	100	0.006	2.13/54	.98/25
SKC-304	15 to 20	150	0.009	2.17/55	1.02/26
SKC-305	15 to 20	200	0.011	2.17/55	1.02/26
SKC-306	15 to 20	400	0.016	2.20/56	1.30/33
SKC-401	20 to 30	30	0.004	1.61/41	.91/23
SKC-402	20 to 30	50	0.005	1.81/46	.98/25
SKC-403	20 to 28	100	0.006	2.17/55	1.02/26
SKC-404	20 to 25	150	0.008	2.20/56	1.06/27
SKC-405	20 to 25	200	0.008	2.20/56	1.30/33
SKC-501	25 to 35	30	0.003	1.77/45	.95/24
SKC-502	25 to 35	50	0.003	2.17/55	1.02/26
SKC-503	25 to 35	100	0.004	2.17/55	1.30/33
SKC-504	25 to 30	150	0.006	2.24/57	1.34/34
SKC-601	30 to 40	30	0.002	2.13/54	.98/25
SKC-602	30 to 40	50	0.003	2.17/55	1.02/26
SKC-603	30 to 35	100	0.004	2.20/56	1.30/33
SKC-801	40 to 50	30	0.002	2.17/55	1.30/33
SKC-802	40 to 50	50	0.002	2.24/57	1.34/34

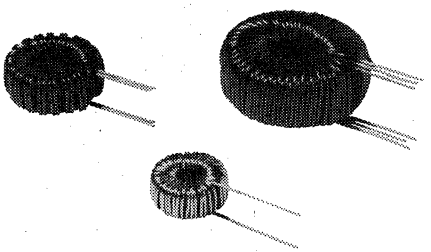
SKL SERIES POWER INDUCTORS WITH HIGH "L" AT LOW DC

PART NUMBER	AMPS (DC)	"L" (μH)		DCR (OHMS)	DIMENSIONS (inch/mm)	
		with DC	0 DC		OD (max.)	HT (max.)
SKL-103	5	100	450	0.017	1.26/32	.71/18
SKL-105	5	200	1000	0.025	1.26/32	.71/18
SKL-203	10	100	500	0.011	1.69/43	.91/23
SKL-205	10	200	1000	0.015	2.13/54	1.15/29
SKL-303	15	100	500	0.008	2.17/55	1.02/26
SKL-305	15	200	1000	0.011	2.20/56	1.06/27
SKL-403	20	100	500	0.008	2.17/55	1.02/26
SKL-404	20	150	750	0.009	2.20/56	1.06/27
SKL-502	25	50	250	0.006	2.17/55	1.02/26
SKL-503	25	100	600	0.007	2.24/57	1.34/34

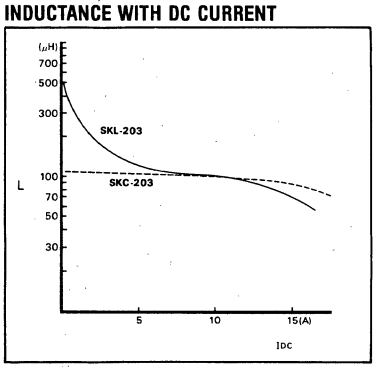
SKP SERIES NOISE ABSORBING INDUCTORS

PART NUMBER	AMPS (AC)	AMPS (DC)	"L" (μH)	DCR (OHMS)	DIMENSIONS (inch/mm) OD (max.)	DIMENSIONS (inch/mm) HT (max.)
SKP1-30	2	1	30	0.039	.62/16	.31/8
SKP1-40	2	1	55	0.050	.62/16	.31/8
SKP1-50	2	1	80	0.061	.62/16	.33/8.5
SKP2-30	2	1	50	0.051	.62/16	.43/11
SKP2-40	2	1	90	0.066	.62/16	.43/11
SKP2-50	2	1	130	0.082	.62/16	.45/11.5
SKP3-30	3	2	40	0.028	.83/21	.43/11
SKP3-40	3	2	80	0.037	.83/21	.43/11
SKP3-50	3	3	120	0.045	.85/21.5	.45/11.5
SKP4-40	5	3	65	0.023	.98/25	.47/12
SKP4-50	5	3	100	0.028	1.02/26	.47/12
SKP5-40	5	3	100	0.033	1.08/27.5	.55/14
SKP5-50	5	3	150	0.041	1.10/28	.59/15

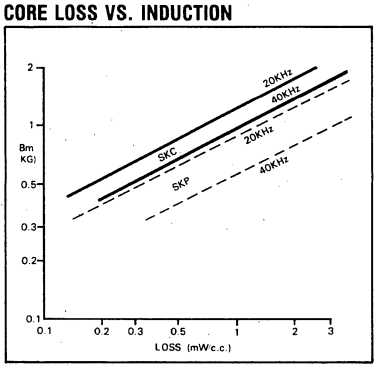
NOTE: SKP SERIES "L" with DC is approximately 50% of value shown.



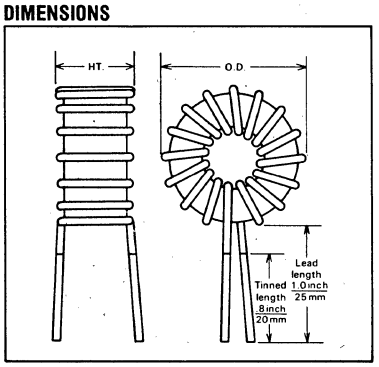
INDUCTANCE WITH DC CURRENT



CORE LOSS VS. INDUCTION

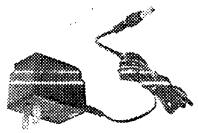


DIMENSIONS



PAN-MAGNETICS INTERNATIONAL, INC.
455-A CARSON PLAZA DRIVE, CARSON, CA 90746 • (213) 532-1790 • TELEX: 664759 (PAN-MAG CRSN)

UL, CSA AND VDE LISTED WALL PLUG-IN AC-TO-DC BATTERY CHARGERS AND ELIMINATORS



These AC-to-DC plug-in power sources are useful as battery chargers, battery eliminators and DC power supplies. They are available in direct plug-in and desk top styles with a variety of output connectors. Most have capacitor filtered outputs. A complete variety of worldwide input plug-in styles are available and each style meets the respective safety agency requirements.

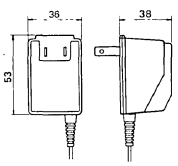
Special order options include:
Multiple listing and your logo; multiple or regulated outputs; UL-1244 for instruments floating above ground; and AC-to-AC direct plug-in transformers.

*Indicates File Numbers under TAMRADIO name.

UL FILE No. E82180*
CSA FILE No. LR38236*

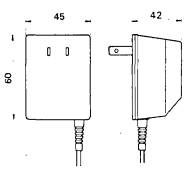
216A SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
216A2211	120	3.0	200
216A2214	120	3.0	400
216A2219	120	4.5	200
216A4222	120	4.5	350
216A2226	120	6.0	150
216A4229	120	6.0	300
216A2134	120	7.5	200
216A4139	120	9.0	200
216A4046	120	12.0	150



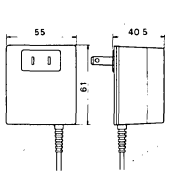
318A SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
318A2210	120	3.0	300
318A2213	120	3.0	600
318A2218	120	4.5	300
318A4220	120	4.5	500
318A2225	120	6.0	200
318A4227	120	6.0	400
318A2134	120	7.5	300
318A4140	120	9.0	300
318A4146	120	12.0	200

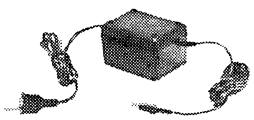


420A SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
420A2210	120	3.0	800
420A2212	120	3.0	1200
420A2214	120	4.5	600
420A2216	120	4.5	800
420A2221	120	6.0	500
420A2223	120	6.0	700
420A2127	120	7.5	400
420A2128	120	7.5	500
420A2132	120	9.0	300
420A4134	120	9.0	500
420A2139	120	12.0	300
420A4141	120	12.0	500

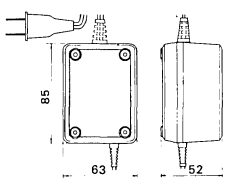


UL FILE No. E50290*
CSA FILE No. LR38236*

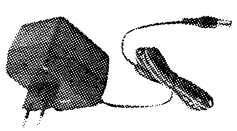


521A SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
521A4310	120	9.0	800
521A4312	120	9.0	1200
521A4315	120	12.0	600
521A4317	120	12.0	1000
521A4320	120	13.5	600
521A4322	120	13.5	1000

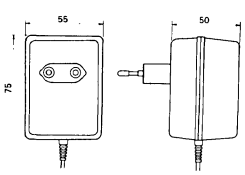


Complies with VDE Requirements

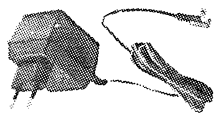


818F SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
818F4310	220	3.0	800
818F4312	220	3.0	1200
818F4313	220	4.5	600
818F4315	220	4.5	1000
818F4216	220	6.0	600
818F4217	220	6.0	800
818F4118	220	7.5	500
818F4119	220	7.5	700
818A4120	220	9.0	500
818F4121	220	9.0	600
818F4022	220	12.0	350
818F4023	220	12.0	450

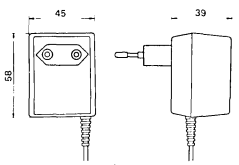


EUROPE
VDE FILE No. F-7969-331*



26D SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
26D3853	220	3.0	150
26D3860	220	3.5	200
26D3856	220	4.5	200
26D3611	220	6.0	200



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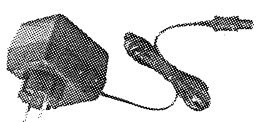
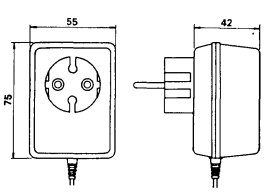


34D SERIES

PART NO.	INPUT (VAC)	OUTPUT (Vdc)	OUTPUT (mAdc)
34D4307	220	3.0	300
34D4301	220	4.5	400
34D4302	220	6.0	300
34D4303	220	7.5	300
34D4304	220	9.0	300
34D4305	220	12.0	200



DIMENSIONS SHOWN IN MILLIMETERS

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PERKIN-ELMER

PRECISION TOROIDAL TRANSFORMERS

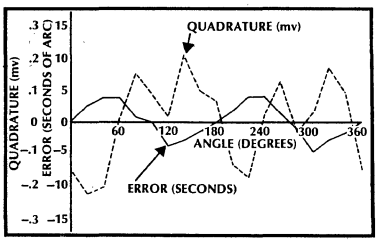
- INPUT SCOTT T
- REFERENCE ISOLATION
- OUTPUT SCOTT T
- DIGITALLY TAPPED
- COMBINATION
- PRECISION RATIO
- RESOLVER ISOLATION
- CUSTOM DESIGNS

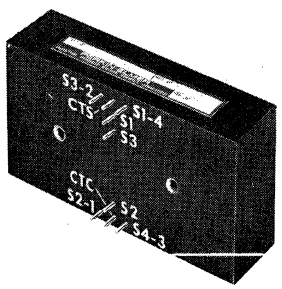
The Electronic Products Department of the Perkin-Elmer Corporation is in a unique position to provide Custom Precision Signal Transformers as a result of 20 years of experience designing and manufacturing very special transformers for the Vernistat® a.c. potentiometer and allied products. **High Performance in small size has always been a successful objective.** Our State of The Art Winding Equipment and Techniques enable close control of turns and taps for close matching of windings and repeatibility of product.

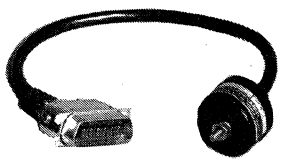
Perkin-Elmer can provide Custom Signal Transformers with high accuracies over the full MIL temperature range. For example, exponential function units with 80 taps to an accuracy of ±0.003% can be provided. SCOTT T Transformers have been built to an accuracy of 5 seconds of arc with a null of 0.1 millivolt. The transformers are fully encapsulated toroidal units and are available with contact pins for PC board mounting. They are manufactured in accordance with MIL-T-27C Grade 5. High input impedance and low output impedance can be matched to specifications. Operating frequency can also be per specifications.

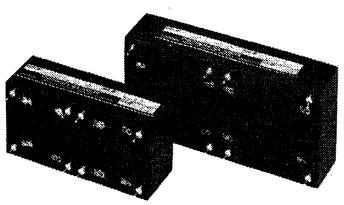
SCOTT T TRANSFORMERS

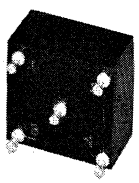
The SCOTT T input transformers converts 3 wire synchro inputs to 4 wire resolver outputs (sin θ and cos θ) with high transformation accuracy and minimum quadrature. SCOTT T Transformers for converting 4 wire resolver inputs to 3 wire synchro outputs can also be supplied. Our output SCOTT T Transformers maintain high accuracies even under heavy load conditions. These units are useful in solid state synchro to digital and digital to synchro converter applications and are particularly applicable in multiplexed conversion systems.











INPUT SCOTT T TRANSFORMERS (SYNCHRO TO RESOLVER)

Input V rms L-L	Output V rms	Load K Ω	Trans. Accuracy Arc. Sec.	Output Quadrature Null mV	Z in K Ω	Z out Ω	Dimensions L x W x H	Mount	Part Number
11.8	2.5	25	45	1.0	40	8	2x1x.625	PC 2x6-32	403-2187
	5.0	20	30	1.0	50	75	2x1x.6	PC 2x4-40	403-2064
	7.2 CT	10 to CT	60	1.0	20	10 to CT	2x1x.6	PC 2x4-40	403-2065
	10.2	10	60	2.0	50	50	2x1x.6	PC 2-4-40	403-2066
12	7.5	10	15	1.0	50	75	2x1x.6	PC 2x4-40	403-2055
90	1.1	10	15	0.03	300	1	2x1x1.1	PC 2x4-40	403-2078
	4.25	10	30	1.0	1000	11	2.5x1.25x.65	PC 2x4-40	403-2034
	4.25 CT	10	30	1.0	1000	11	2.78x1.41x.8	PC 2x4-40	403-2033
	17.8 CT	2.3 to CT	30	.7	100	12 to CT	2.78x1.41x.8	PC 2x4-40	403-2019
	26.0 CT	10 to CT	30	1.4	100	15 to CT	2.78x1.41x.8	PC 2x4-40	403-2051
90 (60 Hz)	14 CT	100 to CT	360	12.0	45	15 to CT	4x2.25x1.15	2x6-32	403-2058
96	14.4 CT	10 to CT	15	.25	200	12 to CT	2.78x1.41x.8	PC 2x4-40	403-2067
			45	.75	200	12 to CT	2.78x1.41x.8	PC 2x4-40	403-2068
			180	5.0	30	12 to CT	2.78x1.41x.8	PC 2x4-40	403-2069
	20 CT	10 to CT	15	.25	200	10 to CT	2.78x1.41x.8	PC 2x4-40	403-2007

COMBINATION INPUT SCOTT T TRANSFORMERS

11.8 2 channel	5.0	20	30	1.0	50	45	2x1x.8	PC 2x4-40	403-2042
11.8 3 channel	3.2	300	45	.5	50	20	2.94x1.06x.8	PC 2x4-40	403-2048

COMBINATION SCOTT T / RESOLVER ISOLATION

Scott T 11.8	6.0	20	30	1.0	35	20	2x1x.6	PC 2x4-40	403-2070
OR									
Resolver 26	6.0	20	30	1.0	300	20			

OUTPUT SCOTT T TRANSFORMERS (RESOLVER TO SYNCHRO)

Output V rms	Input V rms L-L	Load Ω L-L	Trans. Accuracy Arc. Min.	Output Quadrature Null mV	Z in K Ω	Z out Ω	Dimensions L x W x H	Mount	Part Number
11.8	4.7	150	1	15	.25	7	2.78x1.41x.8	PC 2x4-40	403-2027
	6	150	2	8	.5	8	2.78x1.41x.61	PC 2x4-40	403-2071
	5 F.B. 2.5	100	3	8	.35	8	2.78x1.41x.61	PC 2x4-40	403-2075
	11.8 F.B. 6 CT	25	6	12	.8	2	2.78x1.41x.61	PC 2x4-40	403-2056
90	7	6000	1.5	50	3.0	600	2x1x1.1	PC 2x4-40	403-2077
	F.B. 2.8	6000	1.5	80	3.0	500	2.3x1.3x1	PC 4x4-40	403-2176

F.B. = Feedback winding.

RESOLVER ISOLATION TRANSFORMERS

Output V rms L-L	Input V rms L-L	Load K Ω L-L	Trans. Accuracy Arc. Sec.	Output Quadrature Null mV	Z in K Ω	Z out Ω	Dimensions L x W x H	Mount	Part Number
7	7 (5 KHz)	10	.5	2	50	25	2x1x.6	PC 2x4-40	403-2072
9 CT	11.8	25 to CT	.3	1	80	50 to CT	1.63x.81x.5	PC	403-2063
11.1	6	4	2	36	6	14	2.5x1.25x.65	PC 2x4-40	403-2003
26	6	6	3	36	.2	10	2.78x1.41x.61	PC 2x4-40	403-2073

PRECISION REFERENCE ISOLATION TRANSFORMERS

Output V rms	Input V rms	Load K Ω	Trans. Accuracy %	Output Quadrature Null mV	Z in K Ω	Z out Ω	Dimensions L x W x H	Mount	Part Number
3	115	90	.05	2.5	40	.7	1.5x1.5x.75	PC 1x6-32	403-2061
	26			5	4.5				
	115	10	.1	1.3	180	2.75	.814x.814x.5	PC	403-2166
5	26	.4	.1	1	100	5.5	1x1x.58	PC	403-2026
		20	2	6	100	30	.813x.813x.5	PC	403-2189
6	26	10	.01	2.5	70	15	1x1x.58	PC	403-2040
			.02	2.5	70	15	1x1x.58	PC	403-2041
6 CT	26	45 to CT	.1	1.5	100	4 to CT	1.25x1.25x.5	PC	403-2015
20	20	5	.2	2	50	140	1x1x.5	PC	403-2062
30	7.5	50	.2	200	.5	225	.88x.88x.88	2x2-56	403-2047

Operating Temperature Range −55°C to +125°C.
Frequencies 400 Hz except as otherwise stated.

Manufactured in accordance with MIL-T-27 Grade 5.
Specified transformation accuracies are with stated load.

For information on price, delivery and other standard or custom designed transformers call or write
THE PERKIN-ELMER CORPORATION • ELECTRONIC PRODUCTS DEPT. • Main Avenue, Norwalk, Connecticut 06856 • Telephone (203) 762-6574 or 762-4786
Contact us about our **VERNISTAT® a.c. Potentiometers, Adjustable Function Generators and Digital Converters.**

PARALINE
TRANSFORMER SPECIALISTS

PARALINE SS SERIES

THE PARALINE SS SERIES PROVIDES YOU WITH A WIDE RANGE OF SELECTION IN SMALL 117V PRIMARY POWER TRANSFORMERS (50-60 Hz) FROM SHELF STOCK.

AVAILABLE VOLTAGES CENTER TAPPED AND CURRENT RATINGS IN AMPS OF ALL SERIES SS TRANSFORMERS

VOLTS C/T	AMPERES						
	SIZE 3	SIZE 4	SIZE 5	SIZE 6	SIZE 7	SIZE 8	SIZE 9
4	.100	.50	1.2	2.8	5.2	10	14
6.3	.060	.32	.80	1.7	3.5	7.0	10
8	.050	.28	.60	1.4	2.8	5.0	7.0
10	.045	.20	.50	1.0	2.0	4.0	5.6
12.6	.040	.17	.40	.90	1.7	3.6	4.5
14	.040	.15	.35	.80	1.5	3.2	4.0
16	.038	.13	.32	.70	1.3	3.0	3.7
18	.035	.12	.30	.60	1.2	2.8	3.5
20	.032	.11	.27	.55	1.1	2.6	3.2
22	.030	.10	.25	.50	1.0	2.4	3.0
24	.027	.095	.22	.45	.95	2.2	2.7
26	.025	.090	.20	.40	.90	2.0	2.5
28	.022	.080	.18	.38	.85	1.8	2.2
30	.020	.070	.17	.36	.80	1.7	2.0
32	.018	.065	.16	.34	.75	1.6	1.9
34	.017	.060	.15	.32	.70	1.5	1.8
36	.016	.055	.14	.30	.65	1.4	1.7
40	.015	.050	.13	.27	.55	1.3	1.6
44	.014	.050	.12	.25	.50	1.2	1.5
48	.013	.045	.11	.22	.47	1.1	1.3
52	.012	.040	.10	.20	.45	1.0	1.2
56	.011	.040	.09	.19	.42	.90	1.1
60	.010	.035	.08	.18	.40	.80	1.0
66	.009	.030	.077	.17	.37	.75	.90
72	.008	.027	.070	.15	.35	.70	.85
80	.007	.025	.066	.14	.28	.65	.80
88	.007	.024	.060	.13	.25	.60	.70
96	.006	.022	.055	.11	.23	.55	.65
104	.006	.020	.050	.10	.22	.50	.60
120	.005	.017	.040	.09	.20	.40	.50
140		.014	.035	.08	.17	.35	.40
160		.012	.030	.07	.14	.30	.35
180		.011	.260	.06	.12	.26	.30
200		.010	.022	.05	.11	.22	.28
230		.010	.020	.05	.10	.20	.26

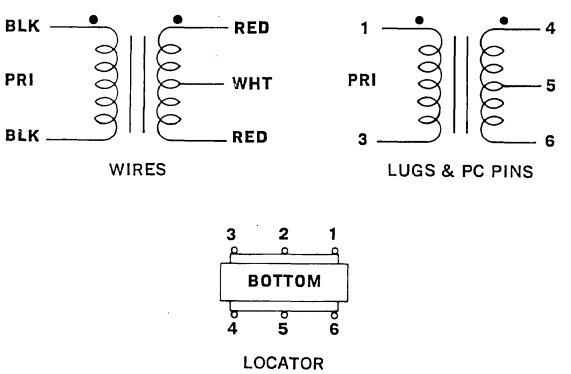
Case A Available in sizes 4, 5, 6, 7, 8 & 9 (Lead Wires)
Case B Available in sizes 4, 5 & 6 (Lugs)
Case C Available in sizes 3, 4, 5 & 6 (6 Pin P.C.)
Case D Available in sizes 4, 5 & 6 (Lugs)

SS SERIES DIMENSIONAL DATA

CASE	SIZE	WIDTH (A)	LENGTH (B)	HEIGHT (C)	MOUNTING CENTERS (D)	PIN CENTERS (JXK)
A	4	1.20	2.10	1.19	1.75	
A	5	1.37	2.38	1.38	2.00	
A	6	1.42	2.83	1.63	2.38	
A	7	1.70	3.25	1.94	2.83	
A	8	2.00	3.88	2.25	3.13	
B	4	1.07	1.83	1.42	1.50	
B	5	1.25	2.00	1.68	1.72	
B	6	1.38	2.38	1.93	2.00	
C	3	0.93	1.10	0.88		.78x.40
C	4	1.15	1.38	1.19		1.0x.63
C	5	1.25	1.63	1.38		1.1x.80
C	6	1.44	1.88	1.63		1.3x.80
D	4	1.07	2.10	1.19	1.75	
D	5	1.25	2.38	1.38	2.00	
D	6	1.38	2.83	1.63	2.38	

REFER TO SS SERIES TRANSFORMERS BY PART NUMBERS. CASES ARE ILLUSTRATED ON LAST PAGE.
SAMPLE: SS-A-4-12.6

SCHEMATICS



PARALINE DS SERIES

THE PARALINE DS SERIES PROVIDES YOU WITH GOOD OFF THE SHELF SELECTION OF 115/230 VOLT 50-60 Hz POWER TRANSFORMERS WITH DUAL SECONDARIES.

AVAILABLE TOTAL SERIES VOLTAGES AND CURRENT RATINGS OF SECONDARIES

VOLTS (SERIES)	AMPERES					
	SIZE 8	SIZE 9	SIZE 10	SIZE 11	SIZE 12	SIZE 13
8	6.0	8.5	12	17	24	30
10	5.0	7.0	10	14	20	24
12.6	4.0	5.6	8.0	11	16	19
14	3.5	5.0	7.0	10	14	17
16	3.0	4.4	6.2	8.7	12	15
18	2.8	3.9	5.5	7.7	11	13
20	2.5	3.5	5.0	7.0	10	12
22	2.3	3.2	4.5	6.3	9.0	11
24	2.0	2.9	4.1	5.8	8.3	10
26	1.9	2.7	3.8	5.4	7.8	9.2
28	1.8	2.5	3.6	5.0	7.1	8.5
30	1.7	2.3	3.3	4.6	6.6	8.0
32	1.6	2.2	3.1	4.3	6.2	7.5
34	1.5	2.0	2.9	4.1	5.8	7.0
36	1.4	1.9	2.7	3.8	5.5	6.6
40	1.3	1.7	2.5	3.5	5.0	6.0
44	1.1	1.6	2.2	3.1	4.5	5.4
48	1.0	1.4	2.1	2.9	4.1	5.0
52	1.0	1.3	1.9	2.7	3.8	4.6
56	.90	1.2	1.8	2.5	3.5	4.2
60	.80	1.1	1.7	2.3	3.3	4.0
66	.75	1.0	1.5	2.1	3.0	3.6
72	.70	1.0	1.4	1.9	2.7	3.3
80	.63	.90	1.2	1.7	2.5	3.0
88	.56	.80	1.1	1.6	2.2	2.7
96	.52	.70	1.0	1.4	2.0	2.5
104	.48	.66	.95	1.3	1.9	2.3
120	.42	.58	.83	1.1	1.6	2.0
140	.36	.50	.71	1.0	1.4	1.7
160	.31	.43	.62	.87	1.2	1.5
180	.28	.38	.55	.77	1.1	1.3
200	.25	.35	.50	.70	1.0	1.2
230	.22	.30	.43	.60	.86	1.0

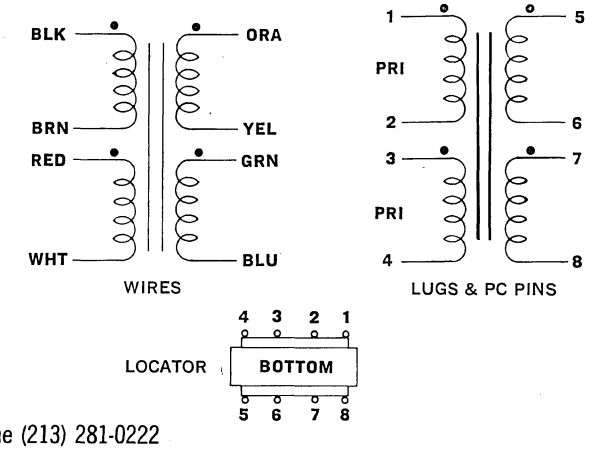
DS SERIES TRANSFORMER SIZES 8 AND 9 ARE AVAILABLE IN STYLES:
"A" (with lead wires)
"B" (with lugs)
"D" (with lugs)

DS SERIES TRANSFORMER SIZES 10 THRU 13 ARE AVAILABLE IN STYLES:
"F" (with lead wires)
"G" (with lugs)
"H" (with lugs)

DS SERIES DIMENSIONAL DATA

CASE	SIZE	A	B	C	D	E	F	G
A	8	2.00	3.70	2.25	3.13		2.70	.19
A	9	2.30	4.00	2.56	3.56		3.06	.19
B	8	2.00	3.13	2.70	2.81		2.27	.19
B	9	2.30	3.56	3.06	3.13		2.56	.19
D	8	2.00	3.70	2.25	3.13		2.70	.19
D	9	2.30	4.00	2.56	3.56		3.06	.19
F	10	3.38	2.50	2.81	2.81	2.13	2.69	.2x.37
F	11	3.75	2.80	3.13	3.13	2.25	2.81	.2x.37
F	12	4.13	3.00	3.44	3.44	2.38	2.94	.2x.37
F	13	4.50	3.30	3.75	3.75	2.50	3.06	.2x.37
G	10	2.81	2.50	3.38	2.25	2.13	2.69	.2x.37
G	11	3.13	2.80	3.75	2.50	2.25	2.81	.2x.37
G	12	3.44	3.00	4.13	2.75	2.38	2.94	.2x.37
G	13	3.75	3.30	4.50	3.00	2.50	3.06	.2x.37
H	10	3.38	2.50	2.81	2.81	2.13	2.69	.2x.37
H	11	3.75	2.80	3.13	3.13	2.25	2.81	.2x.37
H	12	4.13	3.00	3.44	3.44	2.38	2.94	.2x.37
H	13	4.50	3.30	3.75	3.75	2.50	3.06	.2x.37

SCHEMATICS



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PARALINE
TRANSFORMER SPECIALISTS

PARALINE DS SERIES

THE PARALINE DS SERIES IS AVAILABLE IN SIZES 4, 5, & 6 WITH DUAL PRIMARY AND DUAL SECONDARY 8 PIN PRINTED CIRCUIT CONFIGURATION.

AVAILABLE TOTAL SERIES VOLTAGES AND CURRENT RATINGS OF SECONDARIES.

VOLTS (SERIES)	AMPERES		
	SIZE 4	SIZE 5	SIZE 6
4	.50	1.2	2.8
6.3	.32	.80	1.7
8	.28	.60	1.4
10	.20	.50	1.0
12.6	.17	.40	.90
14	.15	.35	.80
16	.13	.32	.70
18	.12	.30	.60
20	.11	.27	.55
22	.10	.25	.50
24	.095	.22	.45
26	.090	.20	.40
28	.080	.18	.38
30	.070	.17	.36
32	.065	.16	.34
34	.060	.15	.32
36	.055	.14	.30
40	.050	.13	.27
44	.050	.12	.25
48	.045	.11	.22
52	.040	.10	.20
56	.040	.09	.19
60	.035	.08	.18
66	.030	.077	.17
72	.027	.070	.15
80	.025	.066	.14
88	.024	.060	.13
96	.022	.055	.11
104	.020	.050	.10
120	.017	.040	.09
140	.014	.035	.08
160	.012	.030	.07
180	.011	.026	.06
200	.010	.022	.05
230	.010	.020	.05

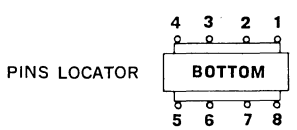
DS SERIES DIMENSIONAL DATA

CASE	SIZE	A	C	F	H	J	K
C	4	1.15	1.19	1.38	.20	1.0	.60
C	5	1.25	1.38	1.63	.25	1.1	.75
C	6	1.44	1.63	1.88	.25	1.3	.75

REFER TO DS SERIES TRANSFORMERS BY PART NUMBERS.

SAMPLE: DS — C — 4 — 12.6

SERIES — STYLE — SIZE — TOTAL SERIES VOLTS



Paraline manufactures a wide variety of power transformers. They are stocked in 11 different sizes with 32 available secondary voltages totaling over 1600 different types.

There are five general series designations, each series designed to suit the requirements of your particular application.

A brief description of each series is as follows:

- The "SS" series has a single 115V primary and a single center-tapped secondary. Also available with a 230V primary.
- The "CS" series has a single 115V primary and two identical and separate secondaries. Also available with a 230V primary.
- The "DS" series has dual primaries for 115V or 230V operation and two identical and separate secondaries.
- The "MS" series has dual primaries for 115V or 230V operation and two center-tapped secondaries designed for 5V and 15V logic and OP amp power supplies.
- The "TT" series includes a number of coupling transformers, holding coils, and telephone associated devices for use in interconnective data modem terminals.

All Paraline stock power transformers may be used for 50 Hz or 60 Hz applications.

PARALINE CS SERIES

THE PARALINE CS SERIES WITH STANDARD 117V (50-60 Hz) PRIMARIES IS AVAILABLE FROM STOCK WITH SINGLE PRIMARY AND DUAL SECONDARY 6 PIN PRINTED CIRCUIT CONFIGURATION.

AVAILABLE TOTAL SERIES VOLTAGES AND CURRENT RATINGS OF SECONDARIES

VOLTS (SERIES)	AMPERES		
	SIZE 4	SIZE 5	SIZE 6
4	.50	1.2	2.8
6.3	.32	.80	1.7
8	.28	.60	1.4
10	.20	.50	1.0
12.6	.17	.40	.90
14	.15	.35	.80
16	.13	.32	.70
18	.12	.30	.60
20	.11	.27	.55
22	.10	.25	.50
24	.095	.22	.45
26	.090	.20	.40
28	.080	.18	.38
30	.070	.17	.36
32	.065	.16	.34
34	.060	.15	.32
36	.055	.14	.30
40	.050	.13	.27
44	.050	.12	.25
48	.045	.11	.22
52	.040	.10	.20
56	.040	.09	.19
60	.035	.08	.18
66	.030	.077	.17
72	.027	.070	.15
80	.025	.066	.14
88	.024	.060	.13
96	.022	.055	.11
104	.020	.050	.10
120	.017	.040	.09
140	.014	.035	.08
160	.012	.030	.07
180	.011	.026	.06
200	.010	.022	.05
230	.010	.020	.05

CS SERIES DIMENSIONAL DATA

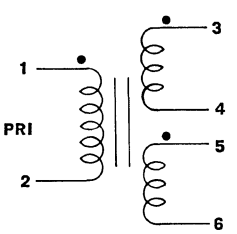
CASE	SIZE	A	C	F	H	J	K
C	4	1.15	1.19	1.38	.31	1.0	.63
C	5	1.25	1.38	1.63	.40	1.1	.80
C	6	1.44	1.63	1.88	.40	1.3	.80

REFER TO CS SERIES TRANSFORMERS BY PART NUMBERS.

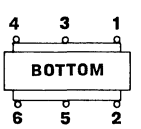
SAMPLE: CS — C — 4 — 12.6

SERIES — STYLE — SIZE — TOTAL SERIES VOLTS

SCHEMATIC



PINS



PINS LOCATOR

PARALINE, 511 South Palm Avenue, Alhambra, CA 91803 • Telephone (213) 281-0222

PARALINE
TRANSFORMER SPECIALISTS

PARALINE MS SERIES

8 PIN P.C. WITH SINGLE 120V PRIMARY. (Fig. 1)

PART NUMBER	SEC. #1 V/CT	MA.	SEC. #2 V/CT	MA.
MSC4-924	9.0	70	24	30
MSC5-924	9.0	240	24	70
MSC6-924	9.0	480	24	150
MSC4-1632	16	50	32	18
MSC5-1632	16	140	32	55
MSC6-1632	16	280	32	100

12 PIN P.C. LOW PROFILE DUAL 120V PRIMARIES WITH 100V TAPS. (Fig. 2)

PART NUMBER	SEC. #1 V/CT	MA.	SEC. #2 V/CT	MA.
MSL4-9024	9.0	70	24	28
MSL5-9024	9.0	240	24	70
MSL6-9024	9.0	480	24	150
MSL7-9024	9.0	800	24	280
MSL4-16032	16	50	32	18
MSL5-16032	16	140	32	55
MSL6-16032	16	280	32	100
MSL7-16032	16	500	32	180

12 LUGS CASE 'H' DUAL 120V PRIMARIES WITH 100V TAPS. (Fig. 3)

PART NUMBER	SEC. #1 V/CT	AMPS	SEC. #2 V/CT	AMPS
MSH10-16032	16	3.8	32	1.2
MSH11-16032	16	5.0	32	1.8
MSH12-16032	16	7.0	32	2.5
MSH13-16032	16	9.0	32	3.0

SCHEMATICS

FIG. 1

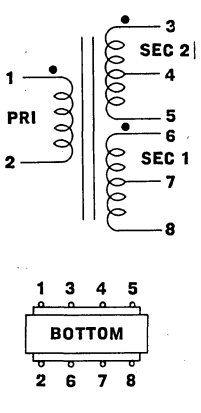


FIG. 2

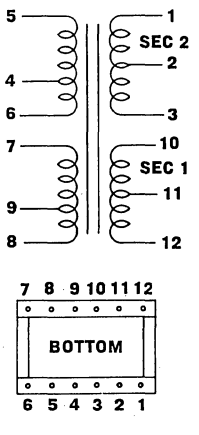
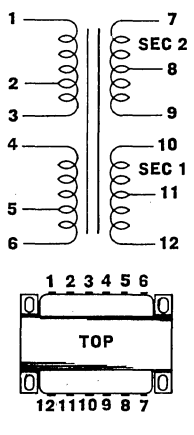


FIG. 3



PARALINE TT SERIES

TRANSFORMERS FOR DATA MODEM TERMINALS DESIGNED TO EXCEED 1200 VAC BREAKDOWN REQUIREMENTS.
FREQUENCY RESPONSE: 300-3500 Hz (TOL. 0.5 DB)
LEVEL: −45DBM TO +7DBM
DISTORTION: 0.4% MAX.
IMPEDANCE: ±10%
RETURN LOSS: 26 DB MIN.

PART NUMBER	PRI. IMP.	SEC. IMP.	FIG.
TTC2-07	600	600	1
TTC3-6549	600	600	1
TTC3-7222	600	600 +900	2
TTC4-7226	600	600	1
TTC4-7657	600	600 +900	2
TTC4-18	Holding Coil 1.3 Hy. @ 100 MA. DC.		—

WIDE RANGE AUDIO MATCHING TRANSFORMERS.
FREQUENCY RESPONSE: 20 Hz (TOL. 2 DB)
LEVEL: 5DBM

PART NUMBER	PRI. IMP.	SEC. IMP.	FIG.
TTC2-8746	400	40K	3
TTC2-8750	200	40K	1
TTC2-8758	200/CT/50	50K	3
TTC2-8761	600/CT/150	50K	3
TTC2-8762	250/CT/62	50K	3
TTC2-8763	50/CT/12	50K	3
TTC2-8772	150	60K	1

SCHEMATICS

FIG. 1

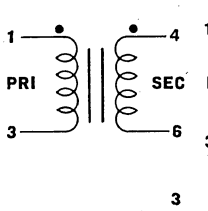


FIG. 2

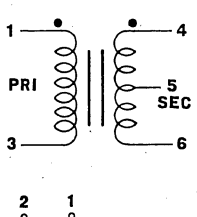
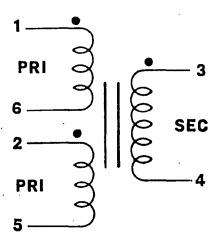
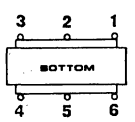
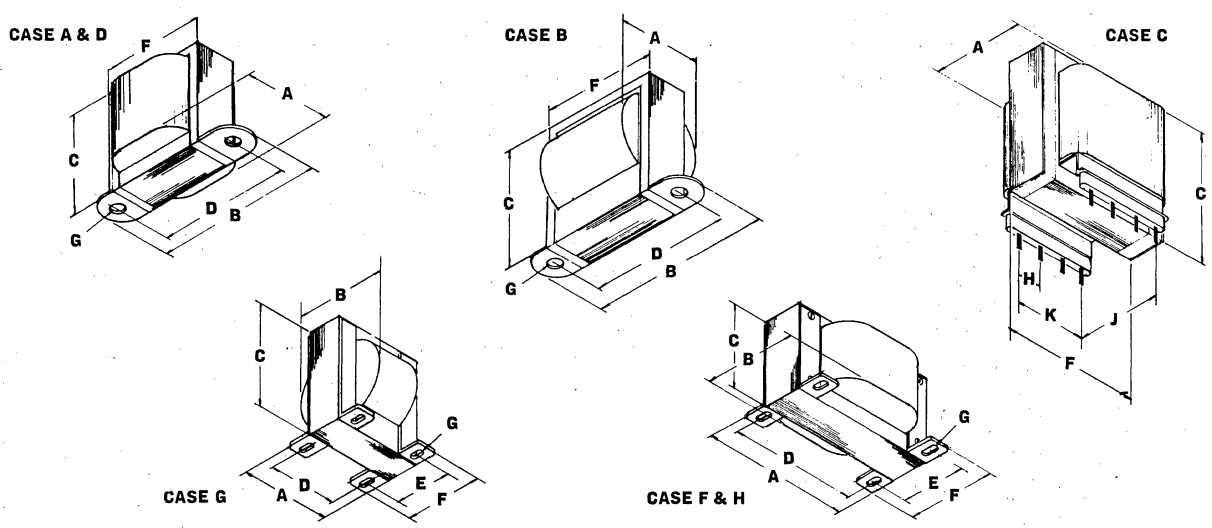


FIG. 3





PINS LOCATOR



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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

PICO Catalog Contents

22 PAGES OF MINIATURIZED TRANSFORMERS OPERATING OVER THE FREQUENCY RANGE OF 20 Hz TO 250 KHz, WITH PULSE TRANSFORMERS OPERATING TO 32MHz.

AUDIO TRANSFORMERS ARE ARRANGED ACCORDING TO SIZE WITH 1/4" X 1/4" (400 Hz-250 KHz) SHOWN FIRST, AND THE 3/4" X 13/16" (20 Hz-25 KHz) SHOWN LAST.

PULSE TRANSFORMERS .05μSEC TO 100μSEC WITH MINIATURIZED PLUG-IN CONSTRUCTION.

400 Hz POWER TRANSFORMERS. PRIMARY VOLTAGES OF 115V OR 26V. PLUG-IN CONSTRUCTION. ULTRA-MINIATURE SIZE.

ULTRA MINIATURE D C —D C CONVERTER TRANSFORMERS.

MICROPHONE/TRANSDUCER AUDIO INPUT TRANSFORMERS.

MINIATURIZED POWER INDUCTORS

EMI COMMON MODE SUPPRESSION INDUCTORS

MINIATURE HIGH "Q" INDUCTORS

Description	Page
1/4" X 1/4"; 2 OHM TO 30K OHM; 400 Hz TO 250 KHz 100 MILLIWATT AT 1 KHz	1•2594, 1•2595
.35" X .32"; 2 OHM TO 40K OHM; 400 Hz TO 100 KHz 400 MILLIWATT AT 1 KHz	1•2596, 1•2597
.35" X .46"; 2 OHM TO 100K OHM; 300 Hz TO 100 KHz 600 MILLIWATT AT 1 KHz	1•2598, 1•2599
.5" X .35"; 2 OHM TO 100K OHM; 300 Hz TO 75 KHz 600 MILLIWATT AT 1 KHz	1•2600, 1•2601
.5" X .5"; 2 OHM TO 250K OHM; 150 Hz TO 75 KHz 1 WATT AT 1 KHz	1•2602, 1•2603
.75" X .375"; 2 OHM TO 135K OHM; 75 Hz TO 30 KHz 1.5 WATT AT 1 KHz	1•2604, 1•2605
.75" X .52"; 2 OHM TO 135K OHM; 50 Hz TO 30KHz 2 WATT AT 1 KHz	1•2606, 1•2607
.75" X .82"; 2 OHM TO 80K OHM; 20 Hz TO 25 KHz 3 WATT AT 1 KHz	1•2608, 1•2609
PULSE TRANSFORMERS .05μSEC TO 100μSEC WITH MINIATURIZED PLUG-IN CONSTRUCTION.	1•2610, 1•2611
ULTRA MINIATURE D C —D C CONVERTER TRANSFORMERS	1•2612, 1•2613
MICROPHONE/TRANSDUCER AUDIO INPUT TRANSFORMERS ***Interchangeable with transformers made by Beyer Dynamic of Germany.***	1•2614
400 Hz POWER TRANSFORMERS. PRIMARY VOLTAGES OF 115V OR 26V. PLUG-IN CONSTRUCTION. ULTRA-MINIATURE SIZE.	1•2615

See EEM Section 1800: Coils, Chokes & Inductors for PICO's latest line of:

• Miniature High "Q" Inductors • Miniaturized Power Inductors

• EMI Common Mode Suppression Inductors

Pages 1•1245 - 1•1249

Delivery— stock to one week

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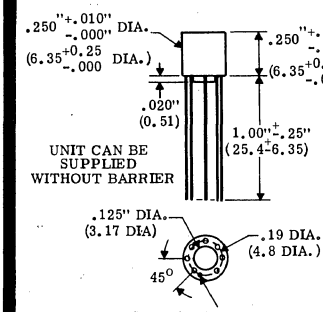
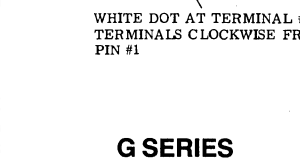
PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

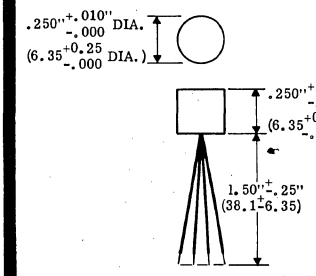
1/4"x1/4" PICO's ultra-miniature transformers

F SERIES Plug-In





G SERIES Insulated Leads



PART NUMBER			SECONDARY IMPEDANCE OHMS SPLIT WINDINGS		POWER MILLIWATTS		PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS		TURNS RATIO PRIM/SEC		PRICES 1-9 ***	
F Series Plug-In	G Series Insulated Leads	PRIMARY IMPEDANCE OHMS	SER	PAR	1 KHz and higher	400 Hz and higher			SER CONN	PAR CONN	SEC SER CONN	SEC PAR CONN	F-Series	G-Series
F-28003	G-29003	10 ct	10 ct	2.5	125	20	11.5	1.1	1.35	.34	1:1	2:1	16.41	15.60
F-28005	G-29005	20 ct	8 ct	2	125	20	8	2.1	1.28	.32	1.58:1	3.16:1	16.41	15.60
F-28010	G-29010	20 ct	20 ct	5	125	20	8	2.1	2.56	.64	1:1	2:1	16.41	15.60
F-28015	G-29015	32 ct	32 ct	8	125	20	6.5	3.52	4.32	1.08	1:1	2:1	16.41	15.60
F-28020	G-29020	40 ct	40 ct	10	125	20	5.6	4	4.77	1.19	1:1	2:1	16.28	15.60
F-28025	G-29025	48 ct	16 ct	4	125	20	5.2	4.3	2.3	.58	1.73:1	3.46:1	14.91	14.20
F-28030	G-29030	50 ct	50 ct	12.5	125	20	5	5.5	6.6	1.65	1:1	2:1	14.91	14.20
F-28035	G-29035	80 ct	32 ct	8	125	20	4	8.5	4.25	1.06	1.58:1	3.16:1	16.28	14.20
F-28040	G-29040	100 ct	40 ct	10	125	20	3.6	12.1	4.85	1.21	1.58:1	3.16:1	16.28	14.20
F-28045	G-29045	100 ct	100 ct	25	125	20	3.6	12.1	12	3	1:1	2:1	14.91	14.20
F-28050	G-29050	120 ct	12.8 ct	3.2	125	20	3.3	13.2	1.6	.4	3.06:1	6.12:1	14.91	14.20
F-28055	G-29055	120 ct	60 ct	15	125	20	3.3	13.2	7.3	1.83	1.41:1	2.83:1	17.83	14.20
F-28060	G-29060	120 ct	120 ct	30	125	20	3.3	13.2	16	4	1:1	2:1	17.83	16.92
F-28065	G-29065	150 ct	12 ct	3	125	20	3	15	1.56	.39	3.54:1	7.07:1	17.25	15.42
F-28070	G-29070	150 ct	50 ct	12.5	125	20	3	15	6.6	1.65	1.73:1	3.46:1	17.83	15.42
F-28075	G-29075	150 ct	100 ct	25	125	20	3	15	14.5	3.63	1.22:1	2.45:1	17.83	16.92
F-28080	G-29080	150 ct	150 ct	37.5	125	20	3	15	18.3	4.58	1:1	2:1	17.83	16.92
F-28085	G-29085	150 ct	600 ct	150	125	20	3	15	72	18	1:2	1:1	17.83	16.92
F-28090	G-29090	200 ct	200 ct	50	125	20	2.5	22	26.8	6.7	1:1	2:1	17.83	16.92
F-28095	G-29095	300 ct	12 ct	3	125	20	2	33	1.56	.39	5:1	10:1	17.83	16.92
F-28100	G-29100	300 ct	50 ct	12.5	125	20	2	33	6.6	1.65	2.45:1	4.9:1	17.83	16.92
F-28105	G-29105	300 ct	150 ct	37.5	125	20	2	33	18.3	4.58	1.41:1	2.83:1	17.83	16.92
F-28110	G-29110	300 ct	300 ct	75	125	20	2	33	40.3	10.08	1:1	2:1	17.83	16.92
F-28115	G-29115	300 ct	600 ct	150	125	20	2	33	72	18	1:1.41	1.41:1	16.20	15.42
F-28120	G-29120	320 ct	12.8ct	3.2	125	20	2	34	1.6	0.4	5:1	10:1	19.11	18.15
F-28125	G-29125	400 ct	40 ct	10	125	20	1.8	49	4.7	1.18	3.16:1	6.32:1	19.11	18.15
F-28130	G-29130	400 ct	120 ct	30	125	20	1.8	49	16.3	4.08	1.83:1	3.65:1	19.11	18.15
F-28135	G-29135	400 ct	200 ct	50	125	20	1.8	49	27.3	6.83	1.41:1	2.83:1	19.11	18.15
F-28140	G-29140	400 ct	400 ct	100	125	20	1.8	49	49	12.25	1:1	2:1	17.37	16.54
F-28145	G-29145	400 ct	1000 ct	250	125	20	1.8	49	120	30	1:1.58	1.26:1	19.11	18.15
F-28150	G-29150	400 ct	2000 ct	500	125	20	1.8	49	270	67.5	1:2.24	1:1.12	19.11	18.15
F-28155	G-29155	400 ct	4000 ct	1000	125	20	1.8	49	476	119	1:3.16	1:1.58	19.11	18.15
F-28160	G-29160	500 ct	12.8ct	3.2	125	20	1.6	54	1.6	0.4	6.25:1	12.5:1	17.37	16.54
F-28165	G-29165	500 ct	16 ct	4	125	20	1.6	54	2.3	0.58	5.6:1	11.2:1	17.37	16.54
F-28170	G-29170	500 ct	50 ct	12.5	125	20	1.6	54	6.6	1.65	3.16:1	6.32:1	17.37	16.54
F-28175	G-29175	500 ct	150 ct	37.5	125	20	1.6	54	18.3	4.58	1.83:1	3.65:1	17.37	16.54
F-28180	G-29180	500 ct	500 ct	125	125	20	1.6	54	65	16.3	1:1	2:1	19.11	18.15
F-28185	G-29185	*500 ct	500 ct	-	125	20	1.6	54	65	-	1:1	-	19.11	18.15
F-28190	G-29190	500 ct	600 ct	150	125	20	1.6	54	72	18	1:1.1	1.83:1	19.11	18.15
F-28195	G-29195	600 ct	12.8 ct	3.2	125	20	1.5	59	1.6	0.4	6.85:1	13.7:1	19.11	18.15
F-28200	G-29200	600 ct	30 ct	7.5	125	20	1.5	59	4.1	1.03	4.47:1	8.94:1	17.37	16.54
F-28205	G-29205	600 ct	48 ct	12	125	20	1.5	59	5.2	1.3	3.54:1	7.07:1	17.37	16.54
F-28210	G-29210	600 ct	200 ct	50	125	20	1.5	59	26.5	6.63	1.73:1	3.46:1	17.37	16.54
F-28215	G-29215	600 ct	600 ct	150	125	20	1.5	59	72	18	1:1	2:1	17.37	16.54
F-28220	G-29220	*600 ct	600 ct	-	125	20	1.5	59	72	-	1:1	-	19.11	18.15
F-28225	G-29225	600 ct	1200 ct	300	125	20	1.5	59	160	40	1:1.41	1.41:1	17.37	16.54
F-28230	G-29230	640 ct	12.8 ct	3.2	125	20	1.5	62	1.6	0.4	7.07:1	14.14:1	17.37	16.54
F-28235	G-29235	700 ct	100 ct	25	125	20	1.35	65	12	3	2.65:1	5.29:1	17.37	16.54
F-28240	G-29240	800 ct	12.8 ct	3.2	125	20	1.3	88	16	4	7.9:1	15.8:1	19.11	18.15
F-28245	G-29245	800 ct	48 ct	12	125	20	1.3	88	6.7	1.68	4.08:1	8.16:1	17.83	16.97
F-28250	G-29250	800 ct	800 ct	200	125	20	1.3	88	106	26.5	1:1	2:1	17.83	16.97
F-28255	G-29255	900 ct	600 ct	150	125	20	1.2	93	74	18.5	1.22:1	2.45:1	17.83	16.97
F-28260	G-29260	1000 ct	12 ct	3	125	20	1.2	120	1.55	0.39	9.13:1	18.3:1	19.61	18.62
F-28265	G-29265	1000 ct	50 ct	12.5	125	20	1.2	120	6.6	1.65	4.47:1	8.94:1	19.61	18.62
F-28270	G-29270	1000 ct	1000 ct	250	125	20	1.2	120	120	30	1:1	2:1	17.83	16.97
F-28275	G-29275	1060 ct	12.8 ct	3.2	125	20	1.2	125	1.6	0.4	9.1:1	18.2:1	19.61	18.62
F-28280	G-29280	1200 ct	12.8 ct	3.2	125	20	1	133	1.6	0.4	9.68:1	19.4:1	19.61	18.62
F-28285	G-29285	1200 ct	500 ct	125	125	20	1	133	65	16.25	1.55:1	3.1:1	19.61	18.62
F-28290	G-29290	1200 ct	1200 ct	300	125	20	1	133	160	40	1:1	2:1	19.61	18.62
F-28295	G-29295	*1200 ct	1200 ct	-	125	20	1	133	160	-	1:1	-	19.61	18.62
F-28300	G-29300	1500 ct	12 ct	3	125	20	1	180	1.55	0.39	11.2:1	22.4:1	19.61	18.62
F-28305	G-29305	1500 ct	500 ct	125	125	20	1	180	65	16.3	1.73:1	3.46:1	17.83	16.97
F-28310	G-29310	*1500 ct	600 ct	-	125	20	1	180	73	-	1.58:1	-	17.83	16.97
F-28315	G-29315	*1500 ct	1500 ct	-	125	20	1	180	215	-	1:1	-	19.61	18.62
F-28320	G-29320	1600 ct	12.8 ct	3.2	125	20	1	190	1.6	0.4	11.2:1	22.4:1	19.61	18.62
F-28325	G-29325	2000 ct	8 ct	2	125	20	0.8	218	1	.25	15.8:1	31.6:1	19.61	18.62
F-28330	G-29330	2000 ct	2000 ct	500	125	20	0.8	218	260	65	1:1	2:1	19.61	18.62
F-28335	G-29335	*2000 ct	2000 ct	-	125	20	0.8	218	260	-	1:1	-	19.61	18.62
F-28340	G-29340	2000 ct	8000 ct	2000	125	20	0.8	218	830	207.5	1:2	1:1	19.11	18.19

*INCLUDES ELECTROSTATIC SHIELD

SPECIFICATIONS

- MIL-T-27: All Units Meet MIL-T-27, Military Designation is TF5R21ZZ for Transformers, TF5R20ZZ for Inductors.
- FREQUENCY RESPONSE: ±3dB, 400 Hz-250 KHz at 1.0 Milliwatt.
- MAXIMUM DISTORTION: 5% With Rated Power Level at 1 KHz and 400 Hz.
- DIELECTRIC STRENGTH: All Units Tested at 200 V RMS.
- INSULATION RESISTANCE: Greater Than 10,000 Megohms at 300 V DC.
- WEIGHT: 1.1 Grams.
- OPERATING TEMPERATURE: -55°c to +105°c (All Units Can Be Supplied to Class S Requirements, +130°c).
- TERMINALS: Solid .012 Diameter Conductor. Conductor is copper clad steel, Tinned 100%. Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: 25 Cycles, Method 107D, MIL-STD-202E, Test Condition A-1.

*** **Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%**
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

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PART NUMBER F Series Plug-In	PART NUMBER G Series Insulated Leads	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER MILLIWATTS 1 KHz and higher	POWER MILLIWATTS 400 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PRICES 1-9 *** F-Series	PRICES 1-9 *** G-Series
F-28345	G-29345	2500 ct	2500 ct	625	125	20	0.75	280	280	70	1:1	2:1	19.11	18.19
F-28350	G-29350	3000 ct	3000 ct	725	125	20	0.65	330	330	82.5	1:1	2:1	19.11	18.19
F-28355	G-29355	*3000 ct	3000 ct	-	125	20	0.65	330	330	-	1:1	-	19.61	18.62
F-28360	G-29360	3600 ct	3600 ct	900	125	20	0.6	370	450	112.5	1:1	2:1	19.11	18.19
F-28365	G-29365	4000 ct	16 ct	4	125	20	0.57	400	2.3	0.58	15.8:1	31.6:1	19.11	18.19
F-28370	G-29370	4000 ct	600 ct	150	125	20	0.57	400	73	18.25	2.58:1	5.16:1	19.11	18.19
F-28375	G-29375	4000 ct	1000 ct	250	125	20	0.57	400	120	30	2:1	4:1	19.11	18.19
F-28380	G-29380	*4000 ct	8000 ct	-	125	20	0.57	400	1070	-	1:1.41	-	21.01	19.97
F-28385	G-29385	5000 ct	500 ct	125	125	20	0.5	540	65	16.25	3.16:1	6.32:1	19.11	18.19
F-28390	G-29390	5000 ct	5000 ct	1250	125	20	0.5	540	650	162.5	1:1	2:1	21.01	19.97
F-28395	G-29395	7500 ct	50 ct	12.5	125	20	0.5	835	6.6	1.65	12.2:1	24.5:1	21.01	19.97
F-28400	G-29400	7500 ct	100 ct	25	125	20	0.4	835	12	3	8.66:1	17.3:1	19.56	18.62
F-28405	G-29405	7500 ct	600 ct	150	125	20	0.4	835	72	18	3.54:1	7.07:1	19.56	18.62
F-28410	G-29410	7500 ct	2500 ct	625	125	20	0.4	835	280	70	1.73:1	3.46:1	19.56	18.62
F-28415	G-29415	*7500 ct	7500 ct	-	125	20	0.4	835	1020	-	1:1	-	19.56	18.62
F-28420	G-29420	8000 ct	12.8 ct	3.2	125	20	0.4	865	1.6	0.4	25:1	50:1	21.01	19.97
F-28425	G-29425	8000 ct	1000 ct	250	125	20	0.4	865	120	30	2.83:1	5.66:1	21.01	19.97
F-28430	G-29430	*8000 ct	1200 ct	-	125	20	0.4	865	160	-	2.58:1	-	21.01	19.97
F-28435	G-29435	*9000 ct	9000 ct	-	125	20	0.4	1160	1160	-	1:1	-	21.01	19.97
F-28440	G-29440	10,000 ct	12.8 ct	3.2	125	20	0.36	1200	1.6	0.4	28:1	56:1	21.01	19.97
F-28445	G-29445	10,000 ct	16 ct	4	125	20	0.36	1200	1.77	0.44	25:1	50:1	19.56	18.62
F-28450	G-29450	10,000 ct	100 ct	25	125	20	0.36	1200	12	3	10:1	20:1	19.56	18.62
F-28455	G-29455	10,000 ct	200 ct	50	125	20	0.36	1200	27	6.75	7.07:1	14.14:1	19.56	18.62
F-28460	G-29460	10,000 ct	500 ct	125	125	20	0.36	1200	65	16.25	4.47:1	8.94:1	19.56	18.62
F-28465	G-29465	10,000 ct	600 ct	150	125	20	0.36	1200	72	18	4.08:1	8.16:1	19.56	18.62
F-28470	G-29470	10,000 ct	1000 ct	250	125	20	0.36	1200	120	30	3.16:1	6.32:1	19.56	18.62
F-28475	G-29475	10,000 ct	1200 ct	300	125	20	0.36	1200	160	40	2.88:1	5.77:1	19.56	18.62
F-28480	G-29480	10,000 ct	1500 ct	375	125	20	0.36	1200	215	53.8	2.58:1	5.16:1	19.97	19.97
F-28485	G-29485	10,000 ct	2000 ct	500	125	20	0.36	1200	260	65	2.24:1	4.47:1	19.56	18.62
F-28490	G-29490	10,000 ct	5000 ct	1250	125	20	0.36	1200	650	162.5	1.41:1	2.83:1	19.56	18.62
F-28495	G-29495	10,000 ct	7500 ct	1875	125	20	0.36	1200	1020	255	1.15:1	2.3:1	19.56	18.62
F-28500	G-29500	10,000 ct	10,000 ct	2500	125	20	0.36	1200	1200	300	1:1	2:1	17.83	16.97
F-28505	G-29505	*10,000 ct	10,000 ct	-	125	20	0.36	1200	1440	-	1:1	-	21.01	19.97
F-28510	G-29510	15,000 ct	400 ct	100	100	15	0.35	1420	43	10.75	6.12:1	12.24:1	19.61	18.62
F-28515	G-29515	15,000 ct	500 ct	125	100	15	0.35	1420	49	12.25	5.48:1	10.95:1	19.61	18.62
F-28520	G-29520	15,000 ct	600 ct	150	100	15	0.35	1420	68	17	5:1	10:1	19.61	18.62
F-28525	G-29525	15,000 ct	10,000 ct	2500	100	15	0.35	1420	1100	275	1.22:1	2.45:1	19.61	18.62
F-28530	G-29530	*15,000 ct	15,000 ct	-	100	15	0.35	1420	1730	-	1:1	-	21.01	19.97
F-28535	G-29535	15,000 ct	15,000 ct	3750	100	15	0.35	1420	1730	433	1:1	2:1	19.61	18.62
F-28540	G-29540	16,000 ct	1000 ct	250	100	15	0.35	1500	115	28.75	4:1	8:1	19.61	18.62
F-28545	G-29545	20,000 ct	500 ct	125	100	15	0.3	1600	60	15	6.33:1	12.65:1	21.01	19.97
F-28550	G-29550	20,000 ct	600 ct	150	100	15	0.3	1600	66	16.5	5.77:1	11.55:1	21.01	19.97
F-28555	G-29555	20,000 ct	800 ct	200	100	15	0.3	1600	94	23.5	5:1	10:1	21.01	19.97
F-28560	G-29560	20,000 ct	1000 ct	250	100	15	0.3	1600	106	26.5	4.47:1	8.94:1	21.01	19.97
F-28565	G-29565	20,000 ct	5000 ct	1250	100	15	0.3	1600	600	150	2:1	4:1	21.01	19.97
F-28570	G-29570	20,000 ct	10,000 ct	2500	100	15	0.3	1600	1100	275	1.41:1	2.83:1	21.01	19.97
F-SHIELD	MU-METAL SHIELD .285" d X .268" h (7.24 mm d X 6.73 mm h) SINGLE SHIELD												1.80	
FYY-SHIELD	MU-METAL SHIELD .315" d X .275" h (8.0 mm d X 6.99 mm h) USE WITH F-SHIELD FOR DOUBLE SHIELDING												1.80	
G-SHIELD	MU-METAL SHIELD .285" d X .335" h (7.24 mm d X 8.51 mm h) SINGLE SHIELD													1.79
GYY-SHIELD	MU-METAL SHIELD .315" d X .40" h (8.00 mm d X 10.16 mm h) USE WITH G-SHIELD FOR DOUBLE SHIELDING													1.79
GXX-SHIELD	MU-METAL SHIELD .35" d X .465" h (8.89 mm d X 11.81 mm h) USE WITH G-SHIELD AND GYY SHIELD FOR TRIPLE SHIELDING													1.79

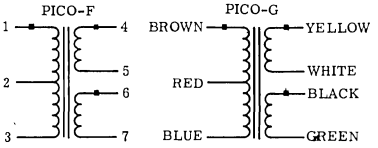
*INCLUDES ELECTROSTATIC SHIELD

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

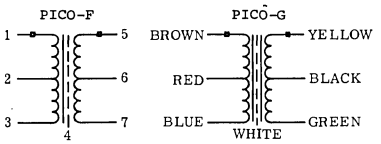
F SERIES Plug-In

G SERIES Insulated Leads

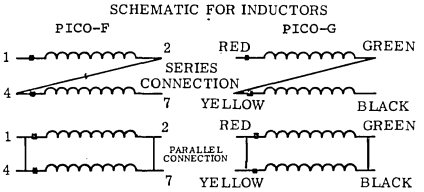
SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



SCHEMATIC FOR INDUCTORS



FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- 5 MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

This Product is Patented

INDUCTORS

PART NUMBER F-SERIES	PART NUMBER G-SERIES	INDUCTANCE HENRIES	DC CURRENT ma	DC RESISTANCE OHMS	PRICES 1-9*** F SERIES	PRICES 1-9*** G SERIES
F-5825	G-6125	SERIES 10.0	0	2250	16.20	15.42
		SERIES 2.75	2			
		PARALLEL 2.5	0	560		
		PARALLEL .65	4			
F-5830	G-6130	SERIES 5.5	0	1000	16.20	15.42
		SERIES 1.5	2			
		PARALLEL 1.3	0	250		
		PARALLEL .40	4			
F-5835	G-6135	SERIES .85	1	240	16.20	15.42
		SERIES .25	6			
		PARALLEL .21	2	60		
		PARALLEL .06	12			
F-5840	G-6140	SERIES .6	0	144	16.20	15.42
		SERIES .15	5			
		PARALLEL .15	0	36		
		PARALLEL .04	10			

INDUCTORS

ALL INDUCTORS HAVE SPLIT WINDINGS AND MEASUREMENTS ARE LISTED FOR BOTH SERIES AND PARALLEL CONNECTIONS. TWO VALUES OF INDUCTANCE, EACH AT A PARTICULAR VALUE OF D.C. CURRENT, ARE LISTED FOR EACH INDUCTOR.

*For immediate engineering assistance or to place an order—**Call Toll Free 800-431-1064***

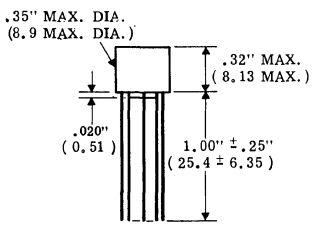
Delivery— stock to one week

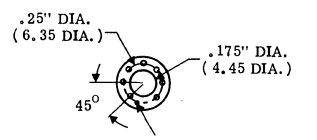
PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

PICO's ultra-miniature transformers

W SERIES Plug-In





WHITE DOT AT TERMINAL #1
TERMINALS CLOCKWISE FROM PIN #1

DIMENSIONS ARE IN INCHES (MM)

PICO PART NUMBER W Series Plug-In	PRIMARY IMPED OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	400 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIM DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9 *** W-Series
W-26003	10 ct	10 ct	2.5	.4	.075	31.6	1.1	1.3	.33	1:1	2:1	12.11
W-26005	20 ct	8 ct	2	.4	.075	22.3	2.2	1	.25	1.58:1	3.16:1	12.11
W-26010	20 ct	20 ct	5	.4	.075	22.3	2.2	2.6	.65	1:1	2:1	12.11
W-26015	32 ct	32 ct	8	.4	.075	17.6	3.5	4.2	1.05	1:1	2:1	12.11
W-26020	40 ct	40 ct	10	.4	.075	15.8	4	4.5	1.2	1:1	2:1	12.11
W-26025	48 ct	16 ct	4	.4	.075	14.4	5.3	1.9	.48	1.73:1	3.46:1	12.84
W-26030	50 ct	50 ct	12.5	.4	.075	14.1	5.6	6.5	1.6	1:1	2:1	12.84
W-26035	80 ct	32 ct	8	.4	.075	11.1	8	4	1	1.58:1	3.16:1	15.24
W-26040	100 ct	40 ct	10	.4	.075	10	10	4.5	1.2	1.58:1	3.16:1	12.84
W-26045	100 ct	100 ct	25	.4	.075	10	10	12	3	1:1	2:1	12.84
W-26050	120 ct	12.8 ct	3.2	.4	.075	9.1	12	1.5	.38	3.06:1	6.12:1	11.55
W-26055	120 ct	60 ct	15	.4	.075	9.1	12	7.2	1.8	1.41:1	2.83:1	15.24
W-26060	120 ct	120 ct	30	.4	.075	9.1	12	14.5	3.6	1:1	2:1	15.24
W-26065	150 ct	12 ct	3	.4	.075	8.2	15	1.5	.38	3.54:1	7.08:1	11.55
W-26070	150 ct	50 ct	12.5	.4	.075	8.2	15	6	1.5	1.73:1	3.46:1	12.84
W-26075	150 ct	100 ct	25	.4	.075	8.2	15	12	3	1.22:1	2.45:1	12.84
W-26080	150 ct	150 ct	37.5	.4	.075	8.2	15	16.8	4.2	1:1	2:1	15.24
W-26085	150 ct	600 ct	150	.4	.075	8.2	15	70	17.5	1:2	1:1	12.84
W-26090	200 ct	200 ct	50	.4	.075	7	20	24	6	1:1	2:1	12.84
W-26095	300 ct	12 ct	3	.4	.075	5.8	30	1.5	.38	5:1	10:1	11.55
W-26100	300 ct	50 ct	12.5	.4	.075	5.8	30	6	1.5	2.45:1	4.9:1	12.84
W-26105	300 ct	150 ct	37.5	.4	.075	5.8	30	18	4.5	1.41:1	2.83:1	12.84
W-26110	300 ct	300 ct	75	.4	.075	5.8	30	36	9	1:1	2:1	15.24
W-26115	300 ct	600 ct	150	.4	.075	5.8	30	72	18	1:1.41	1.41:1	11.55
W-26120	320 ct	12.8 ct	3.2	.4	.075	5.6	32	1.5	.38	5:1	10:1	11.55
W-26125	400 ct	40 ct	10	.4	.075	5	40	4.5	1.1	3.16:1	6.32:1	15.24
W-26130	400 ct	120 ct	30	.4	.075	5	40	14	3.5	1.83:1	3.65:1	15.24
W-26135	400 ct	200 ct	50	.4	.075	5	40	24	6	1.41:1	2.83:1	12.84
W-26140	400 ct	400 ct	100	.4	.075	5	40	48	12	1:1	2:1	15.24
W-26145	400 ct	1000 ct	250	.4	.075	5	40	120	30	1:1.58	1.26:1	17.49
W-26150	400 ct	2000 ct	500	.4	.075	5	40	240	60	1:2.24	1:1.12	17.49
W-26155	400 ct	4000 ct	1000	.4	.075	5	40	480	120	1:3.16	1:1.58	15.79
W-26160	500 ct	12.8 ct	3.2	.4	.075	4.5	50	1.5	.38	6.25:1	12.5:1	13.38
W-26165	500 ct	16 ct	4	.4	.075	4.5	50	2	.5	5.6:1	11.2:1	13.38
W-26170	500 ct	50 ct	12.5	.4	.075	4.5	50	6	1.5	3.16:1	6.32:1	13.38
W-26175	500 ct	150 ct	37.5	.4	.075	4.5	50	18	4.5	1.83:1	3.65:1	13.38
W-26180	500 ct	500 ct	125	.4	.075	4.5	50	60	15	1:1	2:1	13.38
W-26185	*500 ct	500 ct	-	.4	.075	4.5	50	60	-	1:1	-	13.38
W-26190	500 ct	600 ct	150	.4	.075	4.5	50	72	18	1:1.1	1.83:1	13.38
W-26195	600 ct	12.8 ct	3.2	.4	.075	4.1	60	1.5	.38	6.85:1	13.7:1	11.55
W-26200	600 ct	30 ct	7.5	.4	.075	4.1	60	3.6	.9	4.47:1	8.94:1	12.11
W-26205	600 ct	48 ct	12	.4	.075	4.1	60	5.8	1.45	3.54:1	7.07:1	12.11
W-26210	600 ct	200 ct	50	.4	.075	4.1	60	24	6	1.73:1	3.46:1	12.11
W-26215	600 ct	600 ct	150	.4	.075	4.1	60	72	18	1:1	2:1	12.11
W-26220	*600 ct	600 ct	-	.4	.075	4.1	60	72	-	1:1	-	13.38
W-26225	600 ct	1200 ct	300	.4	.075	4.1	60	144	36	1:1.41	1.41:1	12.11
W-26230	640 ct	12.8 ct	3.2	.4	.075	3.9	64	1.5	.38	7.07:1	14.14:1	12.11
W-26235	700 ct	100 ct	25	.4	.075	3.8	70	12	3	2.65:1	5.29:1	12.11
W-26240	800 ct	12.8 ct	3.2	.4	.075	3.5	80	1.5	.38	7.9 :1	15.8:1	12.11
W-26245	800 ct	48 ct	12	.4	.075	3.5	80	5.8	1.45	4.08:1	8.16:1	13.38
W-26250	800 ct	800 ct	200	.4	.075	3.5	80	96	24	1:1	2:1	12.11
W-26255	900 ct	600 ct	150	.4	.075	3.3	90	72	18	1.22:1	2.45:1	12.11
W-26260	1000 ct	12 ct	3	.4	.075	3.2	100	1.5	.38	9.13:1	18.3:1	12.11
W-26265	1000 ct	50 ct	12.5	.4	.075	3.2	100	6	1.5	4.47:1	8.94:1	13.38
W-26270	1000 ct	1000 ct	250	.4	.075	3.2	100	120	30	1:1	2:1	13.38
W-26275	1060 ct	12.8 ct	3.2	.4	.075	3.1	106	1.5	.38	9.1:1	18.2:1	12.11
W-26280	1200 ct	12.8 ct	3.2	.4	.075	2.9	120	1.5	.38	9.68:1	19.4:1	10.90
W-26285	1200 ct	500 ct	125	.4	.075	2.9	120	60	15	1.55:1	3.1:1	10.90
W-26290	1200 ct	1200 ct	300	.4	.075	2.9	120	140	35	1:1	2:1	10.90
W-26295	*1200 ct	1200 ct	-	.4	.075	2.9	120	140	-	1:1	-	14.90
W-26300	1500 ct	12 ct	3	.4	.075	2.6	150	1.5	.38	11.2:1	22.4:1	12.11
W-26305	1500 ct	500 ct	126	4	.075	2.6	150	60	15	1.73:1	3.46:1	13.38
W-26310	*1500 ct	600 ct	-	.4	.075	2.6	150	72	-	1.58:1	-	13.38
W-26315	*1500 ct	1500 ct	-	.4	.075	2.6	150	180	-	1:1	-	13.38
W-26320	1600 ct	12.8 ct	3.2	.4	.075	2.5	160	1.5	.38	11.2:1	22.4:1	12.11
W-26325	2000 ct	8 ct	2	.4	.075	2.2	200	1	.25	15.8:1	31.6:1	15.79
W-26330	2000 ct	2000 ct	500	.4	.075	2.2	200	240	60	1:1	2:1	15.79
W-26335	*2000 ct	2000 ct	-	.4	.075	2.2	200	240	-	1:1	-	17.49
W-26340	2000 ct	8000 ct	2000	.4	.075	2.2	200	960	240	1:2	1:1	15.79
W-26345	2500 ct	2500 ct	625	.4	.075	2	250	300	75	1:1	2:1	15.79

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

*INCLUDES ELECTROSTATIC SHIELD

SPECIFICATIONS

- MIL-T-27: . . . . . All Units Meet MIL-T-27. Military Designation is TF5R21ZZ for Transformers, TF5R20ZZ for Inductors.
- FREQUENCY RESPONSE: . . . . ±3dB, 400 Hz-100 KHz at 1.0 Milliwatt.
- MAXIMUM DISTORTION: . . . . 5% With Rated Power Level at 1 KHz and 400 Hz.
- DIELECTRIC STRENGTH: . . . . All Units Tested at 200 V RMS.

INSULATION RESISTANCE: . . . Greater Than 10,000 Megohms at 300 V DC.

- WEIGHT: . . . . . 2.5 Grams.
- OPERATING TEMPERATURE: . . -55°c to +105°c (All Units Can Be Supplied to Class S Requirements, +130°c)
- TERMINALS: . . . . . Solid .016 Diameter Conductor. Conductor is Copper Clad Steel. Tinned 100%. Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107D, MIL-STD-202E, Test Condition A-1.

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

Delivery— stock to one week

For immediate engineering assistance or to place an order— ***Call Toll Free 800-431-1064***

PICO Electronics, Inc.
453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

PICO PART NUMBER W Series Plug-In	PRIMARY IMPED OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	400 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIM DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9*** W-Series
W-26350	3000 ct	3000 ct	725	.4	.075	1.8	300	360	90	1:1	2:1	12.84
W-26355	*3000 ct	3000 ct	-	.4	.075	1.8	300	360	-	1:1	-	17.49
W-26360	3600 ct	3600 ct	900	.4	.075	1.7	360	432	108	1:1	2:1	12.84
W-26365	4000 ct	16 ct	4	.4	.075	1.6	400	1.9	.47	15.8:1	31.6:1	15.79
W-26370	4000 ct	600 ct	150	.4	.075	1.6	400	72	18	2.58:1	5.16:1	15.79
W-26375	4000 ct	1000 ct	250	.4	.075	1.6	400	120	30	2:1	4:1	17.49
W-26380	*4000 ct	8000 ct	-	.4	.075	1.6	400	960	-	1:1.41	-	17.49
W-26385	5000 ct	500 ct	125	.4	.075	1.4	500	60	15	3.16:1	6.32:1	13.38
W-26390	5000 ct	5000 ct	1250	.4	.075	1.4	500	600	150	1:1	2:1	13.38
W-26395	7500 ct	50 ct	12.5	.33	.075	1.2	750	6	1.5	12.2:1	24.5:1	13.38
W-26400	7500 ct	100 ct	25	.33	.075	1.2	750	12	3	8.66:1	17.3:1	13.38
W-26405	7500 ct	600 ct	150	.33	.075	1.2	750	72	18	3.54:1	7.07:1	14.90
W-26410	7500 ct	2500 ct	625	.33	.075	1.2	750	300	75	1.73:1	3.46:1	14.90
W-26415	*7500 ct	7500 ct	-	.33	.075	1.2	750	900	-	1:1	-	17.49
W-26420	8000 ct	12.8 ct	3.2	.3	.075	1.1	800	1.5	.38	25:1	50:1	13.38
W-26425	8000 ct	1000 ct	250	.3	.075	1.1	800	120	30	2.83:1	5.66:1	14.90
W-26430	*8000 ct	1200 ct	-	.3	.075	1.1	800	144	-	2.58:1	-	17.49
W-26435	*9000 ct	9000 ct	-	.27	.075	1.1	900	1080	-	1:1	-	17.49
W-26440	10,000 ct	12.8 ct	3.2	.25	.075	1.0	1000	1.5	.38	28:1	56:1	12.11
W-26445	10,000 ct	16 ct	4	.25	.075	1.0	1000	1.92	.48	25:1	50:1	12.11
W-26450	10,000 ct	100 ct	25	.25	.075	1.0	1000	12	3	10:1	20:1	13.38
W-26455	10,000 ct	200 ct	50	.25	.075	1.0	1000	24	6	7.07:1	14.14:1	13.38
W-26460	10,000 ct	500 ct	125	.25	.075	1.0	1000	60	15	4.47:1	8.94:1	13.38
W-26465	10,000 ct	600 ct	150	.25	.075	1.0	1000	72	18	4.08:1	8.16:1	13.38
W-26470	10,000 ct	1000 ct	250	.25	.075	1.0	1000	120	30	3.16:1	6.32:1	13.38
W-26475	10,000 ct	1200 ct	300	.25	.075	1.0	1000	144	36	2.89:1	5.77:1	15.79
W-26480	10,000 ct	1500 ct	375	.25	.075	1.0	1000	180	45	2.58:1	5.16:1	15.79
W-26485	10,000 ct	2000 ct	500	.25	.075	1.0	1000	240	60	2.24:1	4.47:1	15.47
W-26490	10,000 ct	5000 ct	1250	.25	.075	1.0	1000	600	150	1.41:1	2.83:1	15.75
W-26495	10,000 ct	7500 ct	1875	.25	.075	1.0	1000	900	225	1.15:1	2.3:1	15.79
W-26500	10,000 ct	10,000 ct	2500	.25	.075	1.0	1000	1200	300	1:1	2:1	15.24
W-26505	*10,000 ct	10,000 ct	-	.25	.075	1.0	1000	1200	-	1:1	-	17.49
W-26510	15,000 ct	400 ct	100	.16	.075	.82	1500	48	12	6.12:1	12.24:1	15.24
W-26515	15,000 ct	500 ct	125	.16	.075	.82	1500	60	15	5.48:1	10.95:1	15.24
W-26520	15,000 ct	600 ct	150	.16	.075	.82	1500	72	18	5:1	10:1	15.24
W-26525	15,000 ct	10,000 ct	2500	.16	.075	.82	1500	1200	300	1.22:1	2.45:1	15.24
W-26530	*15,000 ct	15,000 ct	-	.16	.075	.82	1500	1800	-	1:1	-	17.49
W-26535	15,000 ct	15,000 ct	3750	.16	.075	.82	1500	1800	450	1:1	2:1	15.79
W-26540	16,000 ct	1,000 ct	250	.15	.075	.8	1600	120	30	4:1	8:1	15.79
W-26545	20,000 ct	500 ct	125	.125	.075	.7	2000	60	15	6.33:1	12.65:1	15.24
W-26550	20,000 ct	600 ct	150	.125	.075	.7	2000	72	18	5.77:1	11.55:1	15.24
W-26555	20,000 ct	800 ct	200	.125	.075	.7	2000	96	24	5:1	10:1	13.93
W-26560	20,000 ct	1000 ct	250	.125	.075	.7	2000	120	30	4.47:1	8.94:1	17.49
W-26565	20,000 ct	5000 ct	1250	.125	.075	.7	2000	600	150	2:1	4:1	15.24
W-26570	20,000 ct	10,000 ct	2500	.125	.075	.7	2000	1200	300	1.41:1	2.83:1	15.24
W-26575	*20,000 ct	20,000 ct	-	.125	.075	.7	2000	2400	-	1:1	-	17.49
W-26580	25,000 ct	500 ct	125	.1	.075	.63	2500	60	15	7.07:1	14.14:1	15.79
W-26585	25,000 ct	1000 ct	250	.1	.075	.63	2500	120	30	5:1	10:1	15.79
W-26590	30,000 ct	50 ct	12.5	.083	.075	.58	3000	6	1.5	24.5:1	49:1	15.79
W-26595	30,000 ct	1200 ct	300	.083	.075	.58	3000	144	36	5:1	10:1	15.79
W-26600	30,000 ct	500 ct	125	.083	.075	.58	3000	60	15	7.75:1	15.5:1	15.79
W-26605	30,000 ct	200 ct	50	.083	.075	.58	3000	24	6	12.25:1	24.5:1	15.79
W-26610	30,000 ct	5,000 ct	1250	.083	.075	.58	3000	600	150	2.45:1	4.9:1	15.79
W-26615	30,000 ct	10,000 ct	2500	.083	.075	.58	3000	1200	300	1.73:1	3.46:1	15.79
W-26620	*30,000 ct	30,000 ct	-	.083	.075	.58	3000	3600	-	1:1	-	17.49
W-26625	40,000 ct	400 ct	100	.062	.062	.5	4000	48	12	10:1	20:1	17.49
W-SHIELD	MU-METAL SHIELD .37"D x .32"H (9.4mmD x 8.1mmH) SINGLE SHIELD											1.80
WXX-SHIELD	MU-METAL SHIELD .395"D x .33"H (10mmD x 8.4mmH) USE WITH W SHIELD FOR DOUBLE SHIELDING											1.80

*INCLUDES ELECTROSTATIC SHIELD

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions:
No minimum. Net 30 days
F.O.B. Mt. Vernon, New York.
P.O. Box 1206

INDUCTORS

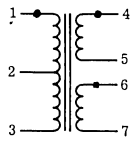
ALL INDUCTORS HAVE SPLIT WINDINGS AND MEASUREMENTS ARE LISTED FOR BOTH SERIES AND PARALLEL CONNECTIONS. TWO VALUES OF INDUCTANCE, EACH AT A PARTICULAR VALUE OF D.C. CURRENT, ARE LISTED FOR EACH INDUCTOR.

PICO PART NUMBER	INDUCTANCE HENRIES	DC CURRENT ma	DC RESISTANCE OHMS	PRICE*** 1-9
W-26705	SERIES 0.1	4	25	12.11
	SERIES .08	10		
	PARALLEL .025	8	6.5	
	PARALLEL .02	20		
W-26710	SERIES 0.9	2	105	12.11
	SERIES 0.5	6		
	PARALLEL .23	4	26	
	PARALLEL .13	12		
W-26715	SERIES 2.5	2	630	12.11
	SERIES 0.9	4		
	PARALLEL 0.6	4	160	
	PARALLEL 0.23	8		
W-26720	SERIES 4.5	2	2300	12.85
	SERIES 1.2	4		
	PARALLEL 1.1	4	575	
	PARALLEL 0.3	8		

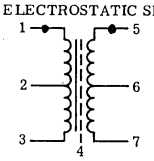
PICO's ultra-miniature transformers

W SERIES Plug-In

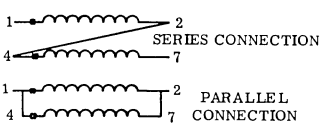
SCHEMATICS FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



SCHEMATIC FOR INDUCTORS



FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

This Product is Patented

Delivery— stock to one week

For immediate engineering assistance or to place an order—

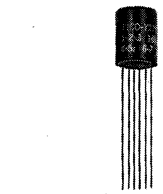
Call Toll Free 800-431-1064

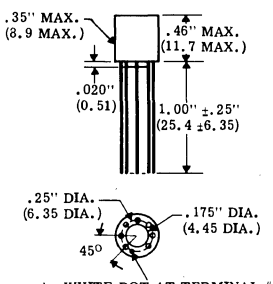
PICO Electronics, Inc.
453 N. MacQuesten Pkwy.
Mt. Vernon, N.Y. 10552

phone
914-699-5514

PICO's ultra-miniature transformers

Y SERIES Plug-In





WHITE DOT AT TERMINAL #1
TERMINALS CLOCKWISE
FROM PIN #1

DIMENSIONS ARE IN INCHES (MM)

SPECIFICATIONS

- MIL-T-27: . . . . . All Units Meet MIL-T-27, Military Designation is TF5R21ZZ, for Transformers, TFR20ZZ for Inductors.
- FREQUENCY RESPONSE: . . . ±3db, 300 Hz - 100 KHz at 1.0 Milliwatt.
- MAXIMUM DISTORTION: . . . . 5% With Rated Power Level at 1 KHz, 400 Hz and 300 Hz.
- DIELECTRIC STRENGTH: . . . All Units Tested at 200 V RMS.
- INSULATION RESISTANCE: . . Greater Than 10,000 Megohms at 300 V DC.
- WEIGHT: . . . . . 3 Grams
- OPERATING TEMPERATURE: . -55°c to +105°c (All Units Can Be Supplied to Class S Requirements, +130°C).
- TERMINALS: . . . . . Solid .016 Diameter Conductor. Conductor is Copper Clad Steel, Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107D, MIL-STD-202E, Test Condition A-1.

For immediate engineering assistance or to place an order—
Call Toll Free 800-431-1064

PICO Electronics, Inc.
453 North Mac Questen Pkwy.
Mt. Vernon, New York 10552
phone
914-699-5514

Delivery— stock to one week

PICO PART NUMBER Y Series Plug-In	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	400 Hz and higher	300 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9 *** Y-Series
Y-27003	10 ct	10 ct	2.5	.6	.2	.1	31.6	1	1.25	.32	1:1	2:1	12.11
Y-27005	20 ct	8 ct	2	.6	.2	.1	22.3	2	.9	.23	1.58:1	3.16:1	12.11
Y-27010	20 ct	20 ct	5	.6	.2	.1	22.3	2.1	2.25	.56	1:1	2:1	12.11
Y-27015	32 ct	32 ct	8	.6	.2	.1	17.6	3.4	4	1	1:1	2:1	12.11
Y-27020	40 ct	40 ct	10	.6	.2	.1	15.8	4.2	4.5	1.13	1:1	2:1	12.11
Y-27025	48 ct	16 ct	4	.6	.2	.1	14.4	5	1.8	.45	1.73:1	3.46:1	12.11
Y-27030	50 ct	50 ct	12.5	.6	.2	.1	14.1	5.25	5.6	1.4	1:1	2:1	12.11
Y-27035	80 ct	32 ct	8	.6	.2	.1	11.1	8.4	4	1	1.58:1	3.16:1	15.23
Y-27040	100 ct	40 ct	10	.6	.2	.1	10	10	4.5	1.13	1.58:1	3.16:1	15.23
Y-27045	100 ct	100 ct	25	.6	.2	.1	10	11	11.25	2.8	1:1	2:1	15.23
Y-27050	120 ct	12.8 ct	3.2	.6	.2	.1	9.1	14.4	1.8	.45	3.06:1	6.12:1	11.55
Y-27055	120 ct	60 ct	15	.6	.2	.1	9.1	14.4	8.4	2.1	1.41:1	2.83:1	15.23
Y-27060	120 ct	120 ct	30	.6	.2	.1	9.1	14.4	16.8	4.2	1:1	2:1	15.23
Y-27065	150 ct	12 ct	3	.6	.2	.1	8.2	15	1.5	.38	3.54:1	7.08:1	11.55
Y-27070	150 ct	50 ct	12.5	.6	.2	.1	8.2	15	6	1.5	1.73:1	3.46:1	12.83
Y-27075	150 ct	100 ct	25	.6	.2	.1	8.2	15	12	3	1.22:1	2.45:1	12.83
Y-27080	150 ct	150 ct	37.5	.6	.2	.1	8.2	15	18	4.5	1:1	2:1	15.13
Y-27085	150 ct	600 ct	150	.6	.2	.1	8.2	15	72	18	1:2	1:1	12.83
Y-27090	200 ct	200 ct	50	.6	.2	.1	7	22	24	6	1:1	2:1	12.83
Y-27095	300 ct	12 ct	3	.6	.2	.1	5.8	30	1.4	.35	5:1	10:1	11.55
Y-27100	300 ct	50 ct	12.5	.6	.2	.1	5.8	30	6	1.5	2.45:1	4.9:1	12.83
Y-27105	300 ct	150 ct	37.5	.6	.2	.1	5.8	30	18	4.5	1.41:1	2.83:1	12.83
Y-27110	300 ct	300 ct	75	.6	.2	.1	5.8	30	36	9	1:1	2:1	15.23
Y-27115	300 ct	600 ct	150	.6	.2	.1	5.8	30	72	18	1:1.41	1.41:1	12.11
Y-27120	320 ct	12.8 ct	3.2	.6	.2	.1	5.6	36	1.8	.45	5:1	10:1	11.55
Y-27125	400 ct	40 ct	10	.6	.2	.1	5	40	4.8	1.2	3.16:1	6.32:1	15.23
Y-27130	400 ct	120 ct	30	.6	.2	.1	5	40	14.5	3.6	1.83:1	3.65:1	15.23
Y-27135	400 ct	200 ct	50	.6	.2	.1	5	40	24	6	1.4:1	2.83:1	12.83
Y-27140	400 ct	400 ct	100	.6	.2	.1	5	40	48	12	1:1	2:1	15.23
Y-27145	400 ct	1000 ct	250	.6	.2	.1	5	40	125	31	1:1.58	1.26:1	17.48
Y-27150	400 ct	2000 ct	500	.6	.2	.1	5	40	240	60	1:2.24	1:1.12	17.48
Y-27155	400 ct	4000 ct	1000	.6	.2	.1	5	40	480	120	1:3.16	1:1.58	15.78
Y-27160	500 ct	12.8 ct	3.2	.6	.2	.1	4.5	50	1.5	.38	6.25:1	12.5:1	13.56
Y-27165	500 ct	16 ct	4	.6	.2	.1	4.5	50	1.9	.48	5.6:1	11.2:1	13.56
Y-27170	500 ct	50 ct	12.5	.6	.2	.1	4.5	50	6	1.5	3.16:1	6.32:1	13.56
Y-27175	500 ct	150 ct	37.5	.6	.2	.1	4.5	50	18	4.5	1.83:1	3.65:1	13.56
Y-27180	500 ct	500 ct	125	.6	.2	.1	4.5	50	60	15	1:1	2:1	13.56
Y-27185	*500 ct	500 ct	-	.6	.2	.1	4.5	50	60	-	1:1	-	13.56
Y-27190	500 ct	600 ct	150	.6	.2	.1	4.5	50	72	18	1:1.1	1.83:1	12.11
Y-27195	600 ct	12.8 ct	3.2	.6	.2	.1	4.1	60	1.5	.38	6.85:1	13.7:1	10.90
Y-27200	600 ct	30 ct	7.5	.6	.2	.1	4.1	60	3.6	.9	4.47:1	8.94:1	12.11
Y-27205	600 ct	48 ct	12	.6	.2	.1	4.1	60	5.8	1.45	3.54:1	7.07:1	12.11
Y-27210	600 ct	200 ct	50	.6	.2	.1	4.1	60	24	6	1.73:1	3.46:1	12.11
Y-27215**	600 ct	600 ct	150	.6	.2	.1	4.1	60	72	18	1:1	2:1	12.11
Y-27220**	*600 ct	600 ct	-	.6	.2	.1	4.1	60	72	-	1:1	-	12.11
Y-27225**	600 ct	1200 ct	300	.6	.2	.1	4.1	60	144	36	1:1.41	1.41:1	12.11
Y-27230	640 ct	12.8 ct	3.2	.6	.2	.1	3.9	64	1.5	.38	7.07:1	14.14:1	12.11
Y-27235	700 ct	100 ct	25	.6	.2	.1	3.8	70	12	3	2.65:1	5.29:1	12.11
Y-27240	800 ct	12.8 ct	3.2	.6	.2	.1	3.5	80	1.5	.38	7.9:1	15.8:1	12.11
Y-27245	800 ct	48 ct	12	.6	.2	.1	3.5	80	5.8	1.45	4.06:1	8.16:1	13.56
Y-27250	800 ct	800 ct	200	.6	.2	.1	3.5	80	96	24	1:1	2:1	13.56
Y-27255	900 ct	600 ct	150	.6	.2	.1	3.3	90	72	18	1.22:1	2.45:1	12.11
Y-27260	1000 ct	12 ct	3	.6	.2	.1	3.2	100	1.4	.35	9.13:1	18.3:1	12.11
Y-27265	1000 ct	50 ct	12.5	.6	.2	.1	3.2	100	6	1.5	4.47:1	8.94:1	13.56
Y-27270	1000 ct	1000 ct	250	.6	.2	.1	3.2	100	120	30	1:1	2:1	13.56
Y-27275	1060 ct	12.8 ct	3.2	.6	.2	.1	3.1	106	1.5	.38	9.1:1	18.2:1	12.11
Y-27280	1200 ct	12.8 ct	3.2	.6	.2	.1	2.9	120	1.5	.38	9.68:1	19.4:1	10.90
Y-27285	1200 ct	500 ct	125	.6	.2	.1	2.9	120	60	15	1.55:1	3.1:1	10.90
Y-27290	1200 ct	1200 ct	300	.6	.2	.1	2.9	120	144	36	1:1	2:1	10.90
Y-27295	*1200 ct	1200 ct	-	.6	.2	.1	2.9	120	144	-	1:1	-	12.11
Y-27300	1500 ct	12 ct	3	.6	.2	.1	2.6	150	1.44	.36	11.2:1	22.4:1	12.11
Y-27305	1500 ct	500 ct	125	.6	.2	.1	2.6	150	60	15	1.73:1	3.46:1	13.56
Y-27310	*1500 ct	600 ct	-	.6	.2	.1	2.6	150	72	-	1.58:1	-	17.48
Y-27315	*1500 ct	1500 ct	-	.6	.2	.1	2.6	150	180	-	1:1	-	13.56
Y-27320	1600 ct	12.8 ct	3.2	.6	.2	.1	2.5	160	1.5	.38	11.2:1	22.4:1	12.11
Y-27325	2000 ct	8 ct	2	.6	.2	.1	2.2	200	.96	.24	15.8:1	31.6:1	13.56
Y-27330	2000 ct	2000 ct	500	.6	.2	.1	2.2	200	240	60	1:1	2:1	15.78
Y-27335	*2000 ct	2000 ct	-	.6	.2	.1	2.2	200	240	-	1:1	-	17.48
Y-27340	2000 ct	8000 ct	2000	.6	.2	.1	2.2	200	960	240	1:2	1:1	15.78
Y-27345	2500 ct	2500 ct	625	.6	.2	.1	2	250	300	75	1:1	2:1	15.78
Y-27350	3000 ct	3000 ct	725	.6	.2	.1	1.8	300	360	90	1:1	2:1	12.70
Y-27355	*3000 ct	3000 ct	-	.6	.2	.1	1.8	300	360	-	1:1	-	17.48
Y-27360	3600 ct	3600 ct	900	.6	.2	.1	1.7	360	432	108	1:1	2:1	15.78
Y-27365	4000 ct	16 ct	4	.6	.2	.1	1.6	400	1.92	.48	15.8:1	31.6:1	15.78
Y-27370**	4000 ct	600 ct	150	.6	.2	.1	1.6	400	72	18	2.58:1	5.16:1	15.78
Y-27375	4000 ct	1000 ct	250	.6	.2	.1	1.6	400	120	30	2:1	4:1	15.78
Y-27380	*4000 ct	8000 ct	-	.6	.2	.1	1.6	400	960	-	1:1.41	-	15.78
Y-27385	5000 ct	500 ct	125	.5	.2	.1	1.4	500	60	15	3.16:1	6.32:1	12.70
Y-27390	5000 ct	5000 ct	1250	.5	.2	.1	1.4	500	600	150	1:1	2:1	12.70
Y-27395	7500 ct	50 ct	12.5	.33	.2	.1	1.2	750	6	1.5	12.2:1	24.5:1	12.70
Y-27400	7500 ct	100 ct	25	.33	.2	.1	1.2	750	12	3	8.66:1	17.3:1	13.56
Y-27405	7500 ct	600 ct	150	.33	.2	.1	1.2	750	72	18	3.54:1	7.07:1	14.89

***Discount Prices: 1-9 Net: 10-24 less 10%: 25-49 less 16%: 50-99 less 23%: 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York P.O. Box 1206

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

PICO PART NUMBER Y Series Plug-In	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	400 Hz and higher	300 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9 *** Y-Series
Y-27410	7500 ct	2500 ct	625	.33	.2	.1	1.2	750	300	75	1.73:1	3.46:1	14.89
Y-27415	*7500 ct	7500 ct	-	.33	.2	.1	1.2	750	900	-	1:1	-	17.48
Y-27420	8000 ct	12.8 ct	3.2	.3	.2	.1	1.1	800	1.5	.38	25:1	50:1	12.70
Y-27425	8000 ct	1000 ct	250	.3	.2	.1	1.1	800	120	30	2.83:1	5.66:1	14.89
Y-27430	*8000 ct	1200 ct	-	.3	.2	.1	1.1	800	144	-	2.58:1	-	15.78
Y-27435	*9000 ct	9000 ct	-	.27	.2	.1	1.1	900	1080	-	1:1	-	16.42
Y-27440	10,000 ct	12.8 ct	3.2	.25	.2	.1	1.0	1000	1.5	.38	28:1	56:1	12.11
Y-27445	10,000 ct	16 ct	4	.25	.2	.1	1.0	1000	1.92	.48	25:1	50:1	13.37
Y-27450	10,000 ct	100 ct	25	.25	.2	.1	1.0	1000	12	3	10:1	20:1	13.37
Y-27455	10,000 ct	200 ct	50	.25	.2	.1	1.0	1000	24	6	7.07:1	14.14:1	13.37
Y-27460	10,000 ct	500 ct	125	.25	.2	.1	1.0	1000	60	15	4.47:1	8.94:1	13.37
Y-27465	10,000 ct	600 ct	150	.25	.2	.1	1.0	1000	72	18	4.08:1	8.16:1	13.37
Y-27470	10,000 ct	1000 ct	250	.25	.2	.1	1.0	1000	120	30	3.16:1	6.32:1	13.37
Y-27475	10,000 ct	1200 ct	300	.25	.2	.1	1.0	1000	144	36	2.89:1	5.77:1	13.37
Y-27480	10,000 ct	1500 ct	375	.25	.2	.1	1.0	1000	180	45	2.58:1	5.16:1	14.58
Y-27485	10,000 ct	2000 ct	500	.25	.2	.1	1.0	1000	240	60	2.24:1	4.47:1	14.58
Y-27490	10,000 ct	5000 ct	1250	.25	.2	.1	1.0	1000	600	150	1.41:1	2.83:1	15.61
Y-27495	10,000 ct	7500 ct	1875	.25	.2	.1	1.0	1000	900	225	1.15:1	2.3:1	15.61
Y-27500	10,000 ct	10,000 ct	2500	.25	.2	.1	1.0	1000	1200	300	1:1	2:1	15.23
Y-27505	*10,000 ct	10,000 ct	-	.25	.2	.1	1.0	1000	1200	-	1:1	-	16.98
Y-27510	15,000 ct	400 ct	100	.16	.16	.1	.82	1500	48	12	6.12:1	12.24:1	15.23
Y-27515	15,000 ct	500 ct	125	.16	.16	.1	.82	1500	60	15	5.48:1	10.95:1	15.23
Y-27520	15,000 ct	600 ct	150	.16	.16	.1	.82	1500	72	18	5:1	10:1	15.23
Y-27525	15,000 ct	10,000 ct	2500	.16	.16	.1	.82	1500	1200	300	1.22:1	2.45:1	16.98
Y-27530	*15,000 ct	15,000 ct	-	.16	.16	.1	.82	1500	1800	-	1:1	-	16.98
Y-27535	15,000 ct	15,000 ct	3750	.16	.16	.1	.82	1500	1800	450	1:1	2:1	16.98
Y-27540	16,000 ct	1000 ct	250	.15	.15	.1	.8	1600	120	30	4:1	8:1	15.78
Y-27545	20,000 ct	500 ct	125	.125	.125	.1	.7	2000	60	15	6.33:1	12.65:1	15.23
Y-27550	20,000 ct	600 ct	150	.125	.125	.1	.7	2000	72	18	5.77:1	11.55:1	15.23
Y-27555	20,000 ct	800 ct	200	.125	.125	.1	.7	2000	96	24	5:1	10:1	12.11
Y-27560	20,000 ct	1000 ct	250	.125	.125	.1	.7	2000	120	30	4.47:1	8.94:1	15.23
Y-27565	20,000 ct	5000 ct	1250	.125	.125	.1	.7	2000	600	150	2:1	4:1	15.23
Y-27570	20,000 ct	10,000 ct	2500	.125	.125	.1	.7	2000	1200	300	1.41:1	2.83:1	15.23
Y-27575	*20,000 ct	20,000 ct	-	.125	.125	.1	.7	2000	2400	-	1:1	-	15.23
Y-27580	25,000 ct	500 ct	125	.1	.1	.1	.63	2500	60	15	7.07:1	14.14:1	15.23
Y-27585	25,000 ct	1000 ct	250	.1	.1	.1	.63	2500	120	30	5:1	10:1	15.23
Y-27590	30,000 ct	50 ct	12.5	.08	.08	.08	.58	3000	6	1.5	24.5:1	49:1	15.23
Y-27595	30,000 ct	1200 ct	300	.08	.08	.08	.58	3000	144	36	5:1	10:1	15.23
Y-27600	30,000 ct	500 ct	125	.08	.08	.08	.58	3000	60	15	7.75:1	15.5:1	15.23
Y-27605	30,000 ct	200 ct	50	.08	.08	.08	.58	3000	24	6	12.25:1	24.5:1	15.23
Y-27610	30,000 ct	5000 ct	1250	.08	.08	.08	.58	3000	600	150	2.45:1	4.9:1	16.98
Y-27615	30,000 ct	10,000 ct	2500	.08	.08	.08	.58	3000	1200	300	1.73:1	3.46:1	16.98
Y-27620	*30,000 ct	30,000 ct	-	.08	.08	.08	.58	3000	3600	-	1:1	-	16.98
Y-27625	40,000 ct	400 ct	100	.06	.06	.06	.5	4000	48	12	10:1	20:1	16.98
Y-27630	40,000 ct	2,000 ct	500	.06	.06	.06	.5	4000	240	60	4.47:1	8.94:1	16.98
Y-27635	40,000 ct	4,000 ct	1000	.06	.06	.06	.5	4000	480	120	3.16:1	6.32:1	17.62
Y-27640	40,000 ct	20,000 ct	5000	.06	.06	.06	.5	4000	2400	600	1.41:1	2.83:1	16.98
Y-27645	*40,000 ct	40,000 ct	-	.06	.06	.06	.5	4000	4800	-	1:1	-	16.98
Y-27650	50,000 ct	200 ct	50	.05	.05	.05	.45	5000	24	6	15.8:1	31.6:1	18.56
Y-27655	50,000 ct	500 ct	125	.05	.05	.05	.45	5000	60	15	10:1	20:1	18.56
Y-27660	50,000 ct	600 ct	150	.05	.05	.05	.45	5000	72	18	9.13:1	18.26:1	18.56
Y-27665	60,000 ct	15,000 ct	3750	.04	.04	.04	.41	6000	1800	450	2:1	4:1	18.56
Y-27670	62,500 ct	50 ct	12.5	.04	.04	.04	.4	6250	6	1.5	35.4:1	70.7:1	18.56
Y-27675	80,000 ct	15,000 ct	3750	.03	.03	.03	.35	8000	1800	450	2.3:1	4.6:1	18.56
Y-27680	90,000 ct	10,000 ct	2500	.028	.028	.028	.33	9000	1200	300	3:1	6:1	18.56
Y-27685	95,000 ct	15,000 ct	3750	.026	.026	.026	.32	9500	1800	450	2.52:1	5.03:1	18.56
Y-27690	100,000 ct	60 ct	15	.025	.025	.025	.31	10,000	7.2	1.8	40.8:1	81.6:1	19.49
Y-27695	100,000 ct	100 ct	25	.025	.025	.025	.31	10,000	12	3	31.6:1	63.2:1	19.49
Y-27700	100,000 ct	500 ct	125	.025	.025	.025	.31	10,000	60	15	14.1:1	28.3:1	19.49
Y-27705	100,000 ct	10,000 ct	2500	.025	.025	.025	.31	10,000	1200	300	3.16:1	6.32:1	19.49
Y-SHIELD	MU-METAL SHIELD .37" DIA. X .46" HT. (9.4MM DIA. X 11.7MM HT.) SINGLE SHIELD												1.79
YXX-SHIELD	MU-METAL SHIELD .395" DIA. X .47" HT. (10.1MM DIA. X 11.9"MM HT.) USE WITH Y-SHIELD FOR DOUBLE SHIELDING												1.79

***Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

* INCLUDES ELECTROSTATIC SHIELD

INDUCTORS

ALL INDUCTORS HAVE SPLIT WINDINGS AND MEASUREMENTS ARE LISTED FOR BOTH SERIES AND PARALLEL CONNECTIONS.

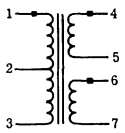
TWO VALUES OF INDUCTANCE, EACH AT A PARTICULAR VALUE OF DC CURRENT, ARE LISTED FOR EACH INDUCTOR.

Y-Series Plug-In	INDUCTANCE HENRIES	DC CURRENT ma	DC RESISTANCE OHMS	PRICES 1-9***
Y-27750	SERIES .075 / .06	10 / 30	10.5	11.56
	PARALLEL .018 / .015	20 / 60	2.6	
Y-27760	SERIES .3 / .15	4 / 20	25	12.84
	PARALLEL .075 / .04	8 / 40	6.2	
Y-27770	SERIES 3.5 / 1.0	2 / 5	560	12.84
	PARALLEL 0.9 / 0.25	4 / 10	140	
Y-27780	SERIES 6.0 / 1.5	2 / 5	2100	12.84
	RARALLEL 1.5 / 0.38	4 / 10	525	
Y-27790	SERIES 20 / 8	1 / 3	5100	15.78
	PARALLEL 5 / 2	2 / 6	1275	

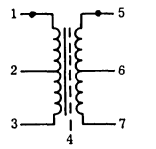
PICO's ultra-miniature transformers

Y SERIES Plug-In

SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



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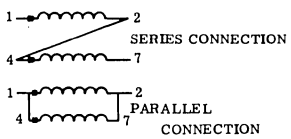


FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS

This Product is Patented

Delivery— stock to one week

PICO Electronics, Inc.

453 N. MacQuesten Pkwy.
Mt. Vernon, N.Y. 10552

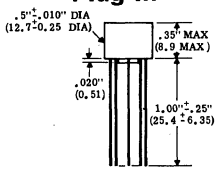
phone
914-699-5514

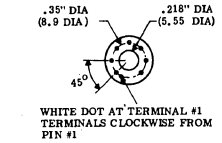
For immediate engineering assistance or to place an order—

Call Toll Free 800-431-1064

PICO's ultra-miniature transformers

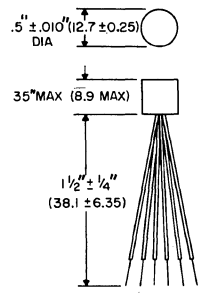
L SERIES Plug-In





WHITE DOT AT TERMINAL #1
TERMINALS CLOCKWISE FROM PIN #1

P SERIES Insulated Leads



Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-27 . . . . . All Units Meet MIL-T-27 and are Hermetically Sealed in a Metal Case. Audio Transformers are Type TF5R21ZZ.
- FREQUENCY RESPONSE: . . . . ±3db, 300 Hz - 75 KHz At 1.0 Milliwatt
- MAXIMUM DISTORTION: . . . . . 5% With Rated Power Level at 1 KHz, 400 Hz and 300 Hz
- DIELECTRIC STRENGTH: . . . . All Units Tested at 200 V RMS
- INSULATION RESISTANCE: . . . Greater than 10,000 Megohms at 300 V DC
- WEIGHT: . . . . . 5 Grams
- OPERATING TEMPERATURE: . . -55°c to 105°c (All Units Can Be Supplied to Class S Requirements 130°c maximum)
- TERMINALS: . . . . . Solid .016 Diameter Conductor. Conductor is Copper Clad Steel, Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107C, MIL-STD-202D, Test Condition A-1

This Product is Patented

PICO PART NUMBER L-Series Plug-in	P-Series Insulated Leads	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	400 Hz and higher	300 Hz and higher	PRIMARY UNBALANCED DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9 *** L-Series	P-Series
L-8203	P-9203	20 ct	8 ct	2	.6	.4	.3	30.0	2	1.2	.3	1.58:1	3.16:1	14.38	13.89
L-8205	P-9205	20 ct	20 ct	5	.6	.4	.3	30.0	2	2.8	.7	1:1	2:1	14.38	13.89
L-8210	P-9210	32 ct	32 ct	8	.6	.4	.3	23.0	3.3	4.5	1.13	1:1	2:1	14.38	13.89
L-8215	P-9215	40 ct	40 ct	10	.6	.4	.3	21.0	3.7	5	1.25	1:1	2:1	14.38	13.89
L-8218	P-9218	48 ct	16 ct	4	.6	.4	.3	19.0	3.75	3	.75	1.73:1	3.46:1	14.38	13.89
L-8220	P-9220	50 ct	50 ct	12.5	.6	.4	.3	19.0	5	7	1.75	1:1	2:1	14.38	13.89
L-8225	P-9225	80 ct	32 ct	8	.6	.4	.3	15.0	7.5	4.3	1.13	1.58:1	3.16:1	14.38	13.89
L-8228	P-9228	100 ct	40 ct	10	.6	.4	.3	13.0	10.8	5	1.25	1.58:1	3.16:1	14.38	13.89
L-8230	P-9230	100 ct	100 ct	25	.6	.4	.3	13.0	10.8	12	3	1:1	2:1	14.38	13.89
L-8235	P-9235	120 ct	12.8 ct	3.2	.6	.4	.3	12.0	9.3	2.2	55	3.06:1	6.12:1	14.38	13.89
L-8240	P-9240	120 ct	60 ct	15	.6	.4	.3	12.0	9	7.2	1.8	1.41:1	2.83:1	14.38	13.89
L-8245	P-9245	120 ct	120 ct	30	.6	.4	.3	12.0	11.6	13	3.3	1:1	2:1	14.38	13.89
L-8250	P-9250	150 ct	12 ct	3	.6	.4	.3	11.0	11.2	2.2	.55	3.54:1	7.08:1	14.38	13.89
L-8255	P-9255	150 ct	50 ct	12.5	.6	.4	.3	11.0	13	6.8	1.7	1.73:1	3.46:1	14.38	13.89
L-8260	P-9260	150 ct	100 ct	25	.6	.4	.3	11.0	13	11.8	3	1.22:1	2.45:1	14.38	13.89
L-8265	P-9265	150 ct	150 ct	37.5	.6	.4	.3	11.0	13	18.3	4.6	1:1	2:1	14.38	13.89
L-8270	P-9270	150 ct	600 ct	150	.6	.4	.3	11.0	13	75	19	1:2	1:1	14.38	13.89
L-8275	P-9275	200 ct	200 ct	50	.6	.4	.3	10.0	19	21.3	5.4	1:1	2:1	14.38	13.89
L-8280	P-9280	300 ct	12 ct	3	.6	.4	.3	8.0	24	1.7	.43	5:1	10:1	14.38	13.89
L-8285	P-9285	300 ct	50 ct	12.5	.6	.4	.3	8.0	30	6.8	1.7	2.45:1	4.9:1	14.38	13.89
L-8290	P-9290	300 ct	150 ct	37.5	.6	.4	.3	8.0	30	18	4.6	1.41:1	2.83:1	14.38	13.89
L-8295	P-9295	300 ct	300 ct	75	.6	.4	.3	8.0	30	34	8.5	1:1	2:1	14.38	13.89
L-8300	P-9300	300 ct	600 ct	150	.6	.4	.3	8.0	30	60	15	1:1.41	1.41:1	14.38	13.89
L-8305	P-9305	320 ct	12.8 ct	3.2	.6	.4	.3	7.5	31	1.7	.43	5:1	10:1	14.38	13.89
L-8310	P-9310	400 ct	40 ct	10	.6	.4	.3	7.0	41	4.5	1.13	3.16:1	6.32:1	14.38	13.89
L-8315	P-9315	400 ct	120 ct	30	.6	.4	.3	7.0	41	12	3	1.83:1	3.65:1	14.38	13.89
L-8320	P-9320	400 ct	200 ct	50	.6	.4	.3	7.0	41	21.3	5.4	1.41:1	2.83:1	14.38	13.89
L-8325	P-9325	400 ct	400 ct	100	.6	.4	.3	7.0	41	37.5	9.4	1:1	2:1	14.38	13.89
L-8330	P-9330	400 ct	1000 ct	250	.6	.4	.3	7.0	41	96	24	1:1.58	1.26:1	14.38	13.89
L-8335	P-9335	400 ct	2000 ct	500	.6	.4	.3	7.0	41	212	53	1:2.24	1:1.12	14.38	13.89
L-8340	P-9340	400 ct	4000 ct	1000	.6	.4	.3	7.0	41	375	94	1:3.16	1:1.58	14.38	13.89
L-8342	P-9342	500 ct	12.8 ct	3.2	.6	.4	.3	6.0	48	1.7	.43	6.25:1	12.5:1	14.38	13.89
L-8344	P-9344	500 ct	16 ct	4	.6	.4	.3	6.0	48	1.9	.5	5.6:1	11.2:1	14.38	13.89
L-8345	P-9345	500 ct	50 ct	12.5	.6	.4	.3	6.0	39	6.8	1.7	3.16:1	6.32:1	14.38	13.89
L-8347	P-9347	500 ct	150 ct	37.5	.6	.4	.3	6.0	48	18	4.6	1.83:1	3.65:1	14.38	13.89
L-8350	P-9350	500 ct	500 ct	125	.6	.4	.3	6.0	48	54	13.5	1:1	2:1	14.38	13.89
L-8355	P-9355	*500 ct	500 ct	-	.6	.4	.3	6.0	48	68	-	1:1	-	14.98	14.38
L-8360	P-9360	500 ct	600 ct	150	.6	.4	.3	6.0	48	59	15	1:1.1	1.83:1	14.38	14.38
L-8365	P-9365	600 ct	12.8 ct	3.2	.6	.4	.3	5.5	53	1.7	.43	6.85:1	13.7:1	14.38	14.38
L-8367	P-9367	600 ct	30 ct	7.5	.6	.4	.3	5.5	53	4.2	1.1	4.47:1	8.94:1	14.38	14.38
L-8370	P-9370	600 ct	48 ct	12	.6	.4	.3	5.5	53	6.8	1.7	3.54:1	7.07:1	14.38	14.38
L-8375	P-9375	600 ct	200 ct	50	.6	.4	.3	5.5	53	21.3	5.3	1.73:1	3.46:1	14.38	13.89
L-8380**	P-9380	600 ct	600 ct	150	.6	.4	.3	5.5	57	79	20	1:1	2:1	14.38	13.89
L-8385**	P-9385	*600 ct	600 ct	-	.6	.4	.3	5.5	53	75	-	1:1	-	14.98	14.38
L-8387**	P-9387	600 ct	1200 ct	300	.6	.4	.3	5.5	53	105	26	1:1.41	1.41:1	14.38	13.89
L-8390	P-9390	640 ct	12.8 ct	3.2	.6	.4	.3	5.5	66	1.7	.43	7.07:1	14.14:1	14.38	13.89
L-8395	P-9395	700 ct	100 ct	25	.6	.4	.3	5.0	69	12	3	2.65:1	5.29:1	14.38	13.89
L-8400	P-9400	800 ct	12.8 ct	3.2	.6	.4	.3	5.0	75	1.7	.43	7.9:1	15.8:1	14.38	13.89
L-8405	P-9405	800 ct	48 ct	12	.6	.4	.3	5.0	75	6.8	1.7	4.08:1	8.16:1	14.38	13.89
L-8410	P-9410	800 ct	800 ct	200	.6	.4	.3	5.0	75	105	26	1:1	2:1	14.38	13.89
L-8415	P-9415	900 ct	600 ct	150	.6	.4	.3	4.5	79	75	19	1.22:1	2.45:1	14.38	13.89
L-8420	P-9420	1000 ct	12 ct	3	.6	.4	.3	4.5	103	1.6	.4	9.13:1	18.3:1	14.38	13.89
L-8425	P-9425	1000 ct	50 ct	12.5	.6	.4	.3	4.5	103	6.4	1.6	4.47:1	8.94:1	14.38	13.89
L-8430	P-9430	1000 ct	1000 ct	250	.6	.4	.3	4.5	103	115	29	1:1	2:1	14.38	13.89
L-8435	P-9435	1060 ct	12.8 ct	3.2	.6	.4	.3	4.0	108	1.7	.43	9.1:1	18.2:1	14.38	13.89
L-8440	P-9440	1200 ct	12.8 ct	3.2	.6	.4	.3	4.0	113	1.7	.43	9.68:1	19.4:1	14.38	13.89
L-8445	P-9445	1200 ct	500 ct	125	.6	.4	.3	4.0	113	54	13.5	1.55:1	3.1:1	14.38	13.89
L-8450	P-9450	1200 ct	1200 ct	300	.6	.4	.3	4.0	113	126	31.6	1:1	2:1	14.38	13.89
L-8455	P-9455	*1200 ct	1200 ct	-	.6	.4	.3	4.0	111	125	-	1:1	-	14.98	14.38
L-8460	P-9460	1500 ct	12 ct	3	.6	.4	.3	3.5	126	1.6	.4	11.2:1	22.4:1	14.38	13.89
L-8465	P-9465	1500 ct	500 ct	125	.6	.4	.3	3.5	126	68	17	1.73:1	3.46:1	14.38	13.89
L-8470	P-9470	*1500 ct	600 ct	-	.6	.4	.3	3.5	126	94	-	1.58:1	-	14.98	14.38
L-8475	P-9475	*1500 ct	1500 ct	-	.6	.4	.3	3.5	126	176	-	1:1	-	14.98	14.38
L-8480	P-9480	1600 ct	12.8 ct	3.2	.6	.4	.3	3.5	130	1.7	.43	11.2:1	22.4:1	14.38	13.89
L-8483	P-9483	2000 ct	8 ct	2	.6	.4	.3	3.0	210	1.2	.3	15.8:1	31.6:1	14.38	13.89
L-8485	P-9485	2000 ct	2000 ct	500	.6	.4	.3	3.0	198	218	55	1:1	2:1	14.38	13.89
L-8490	P-9490	*2000 ct	2000 ct	-	.6	.4	.3	3.0	198	218	-	1:1	-	14.38	13.89
L-8495	P-9495	2000 ct	8000 ct	2000	.6	.4	.3	3.0	198	850	213	1:2	1:1	14.38	13.89
L-8497	P-9497	2500 ct	2500 ct	625	.6	.4	.3	2.5	220	305	76	1:1	2:1	14.38	13.89
L-8500	P-9500	3000 ct	3000 ct	750	.6	.4	.3	2.5	243	335	84	1:1	2:1	14.38	13.89

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

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Delivery— stock to one week

PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

PICO PART NUMBER L-Series Plug-in	PICO PART NUMBER P-Series Insulated Leads	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 400 Hz and higher	POWER WATTS 300 Hz and higher	PRIMARY UNBALANCED DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9 *** L-Series	PICO PRICES 1-9 *** P-Series
L-8505	P-9505	*3000 ct	3000 ct	-	.6	.4	.3	2.5	304	335	-	1:1	-	14.98	14.38
L-8510	P-9510	3600 ct	3600 ct	900	.6	.4	.3	2.5	330	366	92	1:1	2:1	14.38	13.89
L-8512	P-9512	4000 ct	16 ct	4	.6	.4	.3	2.0	350	3	.75	15.8:1	31.6:1	14.38	13.89
L-8514	P-9514	4000 ct	600 ct	150	.6	.4	.3	2.0	350	76	19	2.58:1	5.16:1	14.38	13.89
L-8515	P-9515	4000 ct	1000 ct	250	.6	.4	.3	2.0	350	115	29	2:1	4:1	14.38	13.89
L-8520	P-9520	*4000 ct	8000 ct	-	.6	.4	.3	2.0	350	1062	-	1:1.41	-	14.98	14.38
L-8525	P-9525	5000 ct	500 ct	125	.6	.4	.3	2.0	350	67	17	3.16:1	6.32:1	14.38	13.89
L-8530	P-9530	5000 ct	5000 ct	1250	.6	.4	.3	2.0	390	538	135	1:1	2:1	14.38	13.89
L-8535	P-9535	7500 ct	50 ct	12.5	.6	.4	.3	1.5	600	7	1.75	12.2:1	24.5:1	15.96	15.49
L-8540	P-9540	7500 ct	100 ct	25	.6	.4	.3	1.5	600	12	3	8.66:1	17.3:1	15.96	15.49
L-8545	P-9545	7500 ct	600 ct	150	.6	.4	.3	1.5	600	78	19.5	3.54:1	7.07:1	15.96	15.49
L-8550	P-9550	7500 ct	2500 ct	625	.6	.4	.3	1.5	600	305	77	1.73:1	3.46:1	15.96	15.49
L-8555	P-9555	*7500 ct	7500 ct	-	.6	.4	.3	1.5	750	828	-	1:1	-	17.09	15.95
L-8560	P-9560	8000 ct	12.8 ct	3.2	.6	.4	.3	1.5	750	1.7	.43	25:1	50:1	15.96	15.49
L-8565	P-9565	8000 ct	1000 ct	250	.6	.4	.3	1.5	750	115	29	2.83:1	5.66:1	15.96	15.49
L-8570	P-9570	*8000 ct	1200 ct	-	.6	.4	.3	1.5	750	158	-	2.58:1	-	17.09	15.95
L-8575	P-9575	*9000 ct	9000 ct	-	.6	.4	.3	1.4	796	1100	-	1:1	-	17.09	15.95
L-8580	P-9580	10,000 ct	12.8 ct	3.2	.6	.4	.3	1.4	1048	1.7	.43	28:1	56:1	15.96	15.49
L-8585	P-9585	10,000 ct	16 ct	4	.6	.4	.3	1.4	1048	3	.75	25:1	50:1	15.96	15.49
L-8590	P-9590	10,000 ct	100 ct	25	.6	.4	.3	1.4	839	12	3	10:1	20:1	15.96	15.49
L-8595	P-9595	10,000 ct	200 ct	50	.6	.4	.3	1.4	839	27	6.7	7.07:1	14.14:1	15.96	15.49
L-8600	P-9600	10,000 ct	500 ct	125	.6	.4	.3	1.4	850	67	17	4.47:1	8.94:1	15.96	15.49
L-8605	P-9605	10,000 ct	600 ct	150	.6	.4	.3	1.4	850	74	18.5	4.08:1	8.16:1	15.96	15.49
L-8610	P-9610	10,000 ct	1000 ct	250	.6	.4	.3	1.4	850	115	29	3.16:1	6.32:1	15.96	15.49
L-8615	P-9615	10,000 ct	1200 ct	300	.6	.4	.3	1.4	850	158	39.5	2.89:1	5.77:1	15.96	15.49
L-8620	P-9620	10,000 ct	1500 ct	375	.6	.4	.3	1.4	850	177	44	2.58:1	5.16:1	15.96	15.49
L-8625	P-9625	10,000 ct	2000 ct	500	.6	.4	.3	1.4	850	255	64	2.24:1	4.47:1	15.96	15.49
L-8630	P-9630	10,000 ct	5000 ct	1250	.6	.4	.3	1.4	850	630	158	1.41:1	2.83:1	15.96	15.49
L-8635	P-9635	10,000 ct	7500 ct	1875	.6	.4	.3	1.4	850	772	193	1.15:1	2.3:1	15.96	15.49
L-8640	P-9640	10,000 ct	10,000 ct	2500	.6	.4	.3	1.4	866	1215	304	1:1	2:1	15.96	15.49
L-8645	P-9645	*10,000 ct	10,000 ct	-	.6	.4	.3	1.4	1060	1215	-	1:1	-	17.09	15.95
L-8650	P-9650	15,000 ct	400 ct	100	.6	.4	.3	1.0	1305	47	12	6.12:1	12.24:1	15.96	15.49
L-8652	P-9652	15,000 ct	500 ct	125	.6	.4	.3	1.0	1305	53	13	5.48:1	10.95:1	15.96	15.49
L-8655	P-9655	15,000 ct	600 ct	150	.6	.4	.3	1.0	1305	72.5	18	5:1	10:1	15.96	15.49
L-8660	P-9660	15,000 ct	10,000 ct	2500	.6	.4	.3	1.0	1305	1215	304	1.22:1	2.45:1	15.96	15.49
L-8665	P-9665	*15,000 ct	15,000 ct	-	.6	.4	.3	1.0	1305	1800	-	1:1	-	17.09	15.95
L-8670	P-9670	15,000 ct	15,000 ct	3750	.6	.4	.3	1.0	1305	1800	450	1:1	2:1	15.96	15.49
L-8675	P-9675	16,000 ct	1000 ct	250	.6	.4	.3	1.0	1343	115	29	4:1	8:1	15.96	15.49
L-8680	P-9680	20,000 ct	500 ct	125	.5	.4	.3	1.0	1560	68	17	6.33:1	12.65:1	17.09	15.95
L-8685	P-9685	20,000 ct	600 ct	150	.5	.4	.3	1.0	1560	75	19	5.77:1	11.55:1	17.09	15.95
L-8690	P-9690	20,000 ct	800 ct	200	.5	.4	.3	1.0	1560	108	27	5:1	10:1	17.09	15.95
L-8695	P-9695	20,000 ct	1000 ct	250	.5	.4	.3	1.0	1560	121	30.5	4.47:1	8.94:1	17.09	15.95
L-8700	P-9700	20,000 ct	5000 ct	1250	.5	.4	.3	1.0	1560	672	168	2:1	4:1	17.09	15.95
L-8705	P-9705	20,000 ct	10,000 ct	2500	.5	.4	.3	1.0	1560	1520	380	1.41:1	2.83:1	17.09	15.95
L-8710	P-9710	*20,000 ct	20,000 ct	-	.5	.4	.3	1.0	1560	2727	682	1:1	-	17.76	17.09
L-8715	P-9715	25,000 ct	500 ct	125	.4	.4	.3	0.8	2170	68	17	7.07:1	14.14:1	17.09	15.95
L-8720	P-9720	25,000 ct	1000 ct	250	.4	.4	.3	0.8	2170	120	30	5:1	10:1	17.09	15.95
L-8725	P-9725	30,000 ct	50 ct	12.5	.33	.33	.3	0.8	2400	7	1.75	24.5:1	49:1	17.76	17.09
L-8730	P-9730	30,000 ct	1200 ct	300	.33	.33	.3	0.8	2400	156	39	5:1	10:1	17.76	17.09
L-8732	P-9732	30,000 ct	500 ct	125	.33	.33	.3	0.8	2400	68	17	7.75:1	15.5:1	17.76	17.09
L-8734	P-9734	30,000 ct	200 ct	50	.33	.33	.3	0.8	2400	29	7.2	12.25:1	24.5:1	17.76	17.09
L-8735	P-9735	30,000 ct	5000 ct	1250	.33	.33	.3	0.8	2400	673	169	2.45:1	4.9:1	17.76	17.09
L-8740	P-9740	30,000 ct	10,000 ct	2500	.33	.33	.3	0.8	2400	1520	380	1.73:1	3.46:1	17.76	17.09
L-8745	P-9745	*30,000 ct	30,000 ct	-	.33	.33	.3	0.8	3000	3310	-	1:1	-	19.08	17.94
L-8750	P-9750	40,000 ct	400 ct	100	.25	.25	.25	0.7	3400	57	14.3	10:1	20:1	19.08	17.94
L-8755	P-9755	40,000 ct	2000 ct	500	.25	.25	.25	0.7	3400	268	67	4.47:1	8.94:1	19.08	17.94
L-8760	P-9760	40,000 ct	4000 ct	1000	.25	.25	.25	0.7	3400	476	119	3.16:1	6.32:1	19.08	17.94
L-8765	P-9765	40,000 ct	20,000 ct	5000	.25	.25	.25	0.7	3400	2700	675	1.41:1	2.83:1	19.08	17.94
L-8770	P-9770	*40,000 ct	40,000 ct	-	.25	.25	.25	0.7	3400	4750		1:1	-	21.27	20.34
L-8775	P-9775	50,000 ct	200 ct	50	.2	.2	.2	0.6	4850	27	6.7	15.8:1	31.6:1	21.27	20.34
L-8777	P-9777	50,000 ct	500 ct	125	.2	.2	.2	0.6	4850	68	17	10:1	20:1	21.27	20.34
L-8779	P-9779	50,000 ct	600 ct	150	.2	.2	.2	0.6	4850	75	18.5	9.13:1	18.26:1	21.27	20.34
L-8780	P-9780	60,000 ct	15,000 ct	3750	.16	.16	.16	0.5	5275	2250	563	2:1	4:1	22.94	22.37
L-8785	P-9785	62,500 ct	50 ct	12.5	.16	.16	.16	0.5	5445	8.7	2.2	35.4:1	70.7:1	22.94	22.37
L-8787	P-9787	80,000 ct	15,000 ct	3750	.12	.12	.12	0.4	6130	2250	563	2.3:1	4.6:1	22.94	22.37
L-8790	P-9790	90,000 ct	10,000 ct	2500	.1	.1	.1	0.4	8140	1520	380	3:1	6:1	24.09	23.22
L-8795	P-9795	95,000 ct	15,000 ct	3750	.1	.1	.1	0.4	8400	2250	563	2.52:1	5.03:1	24.09	23.22
L-8800	P-9800	100,000 ct	60 ct	15	.1	.1	.1	0.4	8750	9.2	2.3	40.8:1	81.6:1	24.09	23.22
L-8805	P-9805	100,000 ct	100 ct	25	.1	.1	.1	0.4	8750	15	3.8	31.6:1	63.2:1	24.09	23.22
L-8810	P-9810	100,000 ct	500 ct	125	.1	.1	.1	0.4	8750	68	17	14.1:1	28.3:1	24.09	23.22
L-8815	P-9815	100,000 ct	10,000 ct	2500	.1	.1	.1	0.4	8750	1535	385	3.16:1	6.32:1	24.09	23.22
L-SHIELD	MU-METAL SHIELD .53" d X .41" h (13.46 mm d X 10.41 mm h)													1.80	
P-SHIELD	MU-METAL SHIELD .53" d X .41" h (13.46 mm d X 10.41 mm h)														1.79

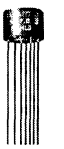
*INCLUDES ELECTROSTATIC SHIELD

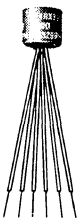
*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

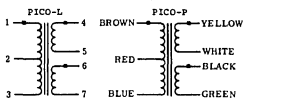
L SERIES Plug-In

P SERIES Insulated Leads

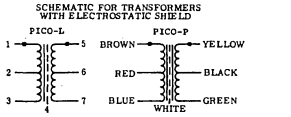




SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

PICO Electronics, Inc.

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Mt. Vernon, N.Y. 10552

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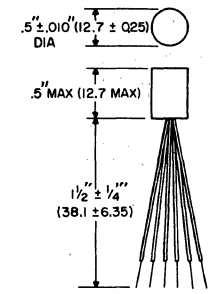
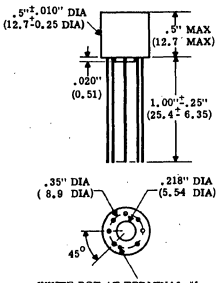
PICO's ultra-miniature transformers

K SERIES Insulated Leads



N SERIES Plug-In



Dimensions are in inches (MM)

SPECIFICATIONS

- **MIL-T-27** . . . . . All Units Meet MIL-T-27, and Are Hermetically Sealed in a Metal Case, Audio Transformers Are Type TF5R21ZZ.
- **FREQUENCY RESPONSE:** . . . ±3 db, 150 Hz - 75 KHz at 1.0 Milliwatt (When Primary Impedance ≧ 50K Ohms, ±3 db 150 Hz to 20 KHz)
- **MAXIMUM DISTORTION:** . . . . 5% With Rated Power Level at 1 KHz, 400 Hz and 150 Hz
- **DIELECTRIC STRENGTH:** . . . . All Units Tested at 200 V RMS
- **INSULATION RESISTANCE:** . . . Greater Than 10, 000 Megohms at 300 V DC
- **WEIGHT:** . . . . . 7.5 Grams
- **OPERATING TEMPERATURE:** . . -55°c to 105°c (All Units Can Be Supplied to Class S Requirements 130°c maximum)
- **TERMINALS:** . . . . . Solid .016 Diameter Conductor. Conductor is Copper Clad Steel, Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452.
- **THERMAL SHOCK:** . . . . . 25 Cycles, Method 107C, MIL-STD-202D, Test Condition A-1

Delivery: Stock to one week

This Product is Patented

PICO PART NUMBER K-Series Insulated Leads	PICO PART NUMBER N-Series Plug-In	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 400 Hz and higher	POWER WATTS 150 Hz and higher	PRIMARY UNBALANCED DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9 *** K-Series	PICO PRICES 1-9 *** N-Series
K-7203	N-6203	20 ct	8 ct	2	1.0	.75	.11	22.0	1.75	1.0	.25	1.58:1	3.16:1	13.89	14.39
K-7205	N-6205	20 ct	20 ct	5	1.0	.75	.11	22.0	1.75	2.5	.63	1:1	2:1	13.89	14.39
K-7210	N-6210	32 ct	32 ct	8	1.0	.75	.11	18.0	2.7	3.7	.93	1:1	2:1	13.89	14.39
K-7215	N-6215	40 ct	40 ct	10	1.0	.75	.11	16.0	3	5.2	1.3	1:1	2:1	13.89	14.39
K-7218	N-6218	48 ct	16 ct	4	1.0	.75	.11	13.0	4.5	2.4	.6	1.73:1	3.46:1	13.89	14.39
K-7220	N-6220	50 ct	50 ct	12.5	1.0	.75	.11	13.0	4.5	6.2	1.6	1:1	2:1	13.89	14.39
K-7225	N-6225	80 ct	32 ct	8	1.0	.75	.11	11.0	6.6	3.7	.93	1.58:1	3.16:1	13.89	14.39
K-7228	N-6228	100 ct	40 ct	10	1.0	.75	.11	10.0	9.7	5.6	1.4	1.58:1	3.16:1	13.89	14.39
K-7230	N-6230	100 ct	100 ct	25	1.0	.75	.11	10.0	9.7	11	2.8	1:1	2:1	13.89	14.39
K-7235	N-6235	120 ct	12.8 ct	3.2	1.0	.75	.11	9.0	10.8	1.6	.4	3.06:1	6.12:1	13.89	14.39
K-7240	N-6240	120 ct	60 ct	15	1.0	.75	.11	9.0	10.8	8.5	2.2	1.41:1	2.83:1	13.89	14.39
K-7245	N-6245	120 ct	120 ct	30	1.0	.75	.11	9.0	10.8	15	3.8	1:1	2:1	13.89	14.39
K-7250	N-6250	150 ct	12 ct	3	1.0	.75	.11	8.0	13.5	1.75	.44	3.54:1	7.08:1	13.89	14.39
K-7255	N-6255	150 ct	50 ct	12.5	1.0	.75	.11	8.0	12	5.8	1.5	1.73:1	3.46:1	13.89	14.39
K-7260	N-6260	150 ct	100 ct	25	1.0	.75	.11	8.0	12	13	3.3	1.22:1	2.44:1	13.89	14.39
K-7265	N-6265	150 ct	150 ct	37.5	1.0	.75	.11	8.0	12	20	5	1:1	2:1	13.89	14.39
K-7270	N-6270	150 ct	600 ct	150	1.0	.75	.11	8.0	12	82	20.5	1:2	1:1	13.89	14.39
K-7275	N-6275	200 ct	200 ct	50	1.0	.75	.11	7.0	17	24	6.0	1:1	2:1	13.89	14.39
K-7280	N-6280	300 ct	12 ct	3	1.0	.75	.11	5.0	30	1.75	.44	5:1	10:1	13.89	14.39
K-7285	N-6285	300 ct	50 ct	12.5	1.0	.75	.11	5.0	27	6.2	1.6	2.45:1	4.9:1	13.89	14.39
K-7290	N-6290	300 ct	150 ct	37.5	1.0	.75	.11	5.0	26	21	5.3	1.41:1	2.83:1	13.89	14.39
K-7295	N-6295	300 ct	300 ct	75	1.0	.75	.11	5.0	27	38	9.5	1:1	2:1	13.89	14.39
K-7300	N-6300	300 ct	600 ct	150	1.0	.75	.11	5.0	27	66	17	1:1.41	1.41:1	13.89	14.39
K-7305	N-6305	320 ct	12.8 ct	3.2	1.0	.75	.11	5.0	30	1.75	.44	5:1	10:1	13.89	14.39
K-7310	N-6310	400 ct	40 ct	10	1.0	.75	.11	5.0	39	4.3	1.1	3.16:1	6.32:1	13.89	14.39
K-7315	N-6315	400 ct	120 ct	30	1.0	.75	.11	5.0	30	14	3.5	1:83:1	3.65:1	13.89	14.39
K-7320	N-6320	400 ct	200 ct	50	1.0	.75	.11	5.0	39	24	6	1.41:1	2.83:1	13.89	14.39
K-7325	N-6325	400 ct	400 ct	100	1.0	.75	.11	5.0	39	42	10.5	1:1	2:1	13.89	14.39
K-7330	N-6330	400 ct	1000 ct	250	1.0	.75	.11	5.0	39	109	28	1:1.58	1.26:1	13.89	14.39
K-7335	N-6335	400 ct	2000 ct	500	1.0	.75	.11	5.0	39	198	49	1:2.24	1:1.12	13.89	14.39
K-7340	N-6340	400 ct	4000 ct	1000	1.0	.75	.11	5.0	39	436	109	1:3.16	1:1.58	13.89	14.39
K-7342	N-6342	500 ct	12.8 ct	3.2	1.0	.75	.11	4.5	43	1.6	.4	6.25:1	12.5:1	13.89	14.39
K-7344	N-6344	500 ct	16 ct	4	1.0	.75	.11	4.5	43	2.3	.56	5.6:1	11.2:1	13.89	14.39
K-7345	N-6345	500 ct	50 ct	12.5	1.0	.75	.11	4.5	43	5.8	1.5	3.16:1	6.32:1	13.89	14.39
K-7347	N-6347	500 ct	150 ct	37.5	1.0	.75	.11	4.5	43	19.8	5	1.83:1	3.65:1	13.89	14.39
K-7350	N-6350	500 ct	500 ct	125	1.0	.75	.11	4.5	43	60	15	1:1	2:1	13.89	14.39
K-7355	N-6355	*500 ct	500 ct	-	1.0	.75	.11	4.5	43	60	-	1:1	-	14.38	14.98
K-7360	N-6360	500 ct	600 ct	150	1.0	.75	.11	4.5	43	66	17	1:1.1	1.83:1	13.89	14.39
K-7365	N-6365	600 ct	12.8 ct	3.2	1.0	.75	.11	4.0	68	1.75	.44	6.85:1	13.7:1	13.89	14.39
K-7367	N-6367	600 ct	30 ct	7.5	1.0	.75	.11	4.0	60	3.7	.93	4.47:1	8.94:1	13.89	14.39
K-7370	N-6370	600 ct	48 ct	12	1.0	.75	.11	4.0	60	5.9	1.5	3.54:1	7.07:1	13.89	14.39
K-7375	N-6375	600 ct	200 ct	50	1.0	.75	.11	4.0	60	25	6.3	1.73:1	3.46:1	13.89	14.39
K-7380**	N-6380**	600 ct	600 ct	150	1.0	.75	.11	4.0	60	66	17	1:1	2:1	13.89	14.39
K-7385**	N-6385**	*600 ct	600 ct	-	1.0	.75	.11	4.0	60	68	-	1:1	-	14.38	14.98
K-7386**	N-6386**	*600 ct	900 ct	-	1.0	.75	.11	4.0	60	104	-	1:1.22	-	14.38	14.98
K-7387**	N-6387**	600 ct	1200 ct	300	1.0	.75	.11	4.0	60	116	29	1:1.41	1.41:1	13.89	14.39
K-7390	N-6390	640 ct	12.8 ct	3.2	1.0	.75	.11	4.0	69	1.75	.44	7.07:1	14.14:1	13.89	14.39
K-7395	N-6395	700 ct	100 ct	25	1.0	.75	.11	4.0	62	10.6	2.7	2.65:1	5.29:1	13.89	14.39
K-7400	N-6400	800 ct	12.8 ct	3.2	1.0	.75	.11	3.5	78	1.75	.44	7.91:1	15.8:1	13.89	14.39
K-7405	N-6405	800 ct	48 ct	12	1.0	.75	.11	3.5	74	6	1.5	4.08:1	8.16:1	13.89	14.39
K-7410	N-6410	800 ct	800 ct	200	1.0	.75	.11	3.5	74	102	26	1:1	2:1	13.89	14.39
K-7415	N-6415	900 ct	600 ct	150	1.0	.75	.11	3.0	90	66	17	1.23:1	2.45:1	13.89	14.39
K-7417**	N-6417**	*900 ct	900 ct	-	1.0	.75	.11	3.0	90	102	-	1:1	-	14.38	14.98
K-7420	N-6420	1000 ct	12 ct	3	1.0	.75	.11	3.0	115	1.75	.44	9.13:1	18.26:1	13.89	14.39
K-7425	N-6425	1000 ct	50 ct	12.5	1.0	.75	.11	3.0	100	5.8	1.5	4.47:1	8.94:1	13.89	14.39
K-7430	N-6430	1000 ct	1000 ct	250	1.0	.75	.11	3.0	75	103	26	1:1	2:1	13.89	14.39
K-7435	N-6435	1060 ct	12.8 ct	3.2	1.0	.75	.11	3.0	115	1.75	.44	9.1:1	18.2:1	13.89	14.39
K-7440	N-6440	1200 ct	12.8 ct	3.2	1.0	.75	.11	3.0	122	1.75	.44	9.68:1	19.4:1	13.89	14.39
K-7445	N-6445	1200 ct	500 ct	125	1.0	.75	.11	3.0	113	63	16	1.55:1	3.1:1	13.89	14.39
K-7450	N-6450	1200 ct	1200 ct	300	1.0	.75	.11	3.0	113	155	39	1:1	2:1	13.89	14.39
K-7455	N-6455	*1200 ct	1200 ct	-	1.0	.75	.11	3.0	109	150	-	1:1	-	14.38	14.98
K-7460	N-6460	1500 ct	12 ct	3	1.0	.75	.11	2.5	140	1.75	.44	11.18:1	22.36:1	13.89	14.39
K-7465	N-6465	1500 ct	500 ct	125	1.0	.75	.11	2.5	150	60	15	1.73:1	3.46:1	13.89	14.39
K-7470	N-6470	*1500 ct	600 ct	-	1.0	.75	.11	2.5	150	66	-	1.58:1	-	14.38	14.98
K-7475	N-6475	*1500 ct	1500 ct	-	1.0	.75	.11	2.5	150	168	-	1:1	-	14.38	14.98
K-7480	N-6480	1600 ct	12.8 ct	3.2	1.0	.75	.11	2.5	140	1.75	.44	11.18:1	22.36:1	13.89	14.39
K-7483	N-6483	2000 ct	8 ct	2	1.0	.75	.11	2.0	250	1.0	.25	15.8:1	31.6:1	13.89	14.39
K-7485	N-6485	2000 ct	2000 ct	500	1.0	.75	.11	2.0	185	255	64	1:1	2:1	13.89	14.39
K-7490	N-6490	*2000 ct	2000 ct	-	1.0	.75	.11	2.0	175	240	-	1:1	-	14.38	14.98
K-7495	N-6495	2000 ct	8000 ct	2000	1.0	.75	.11	2.0	185	1015	254	1:2	1:1	13.89	14.39
K-7497	N-6497	2500 ct	2500 ct	625	1.0	.75	.11	2.0	245	268	68	1:1	2:1	13.89	14.39
K-7500	N-6500	3000 ct	3000 ct	750	1.0	.75	.11	1.8	267	295	74	1:1	2:1	13.89	14.39
K-7505	N-6505	*3000 ct	3000 ct	-	1.0	.75	.11	1.8	267	368	-	1:1	-	14.38	14.98
K-7510	N-6510	3600 ct	3600 ct	900	1.0	.75	.11	1.5	300	413	103	1:1	2:1	13.89	14.39
K-7512	N-6512	4000 ct	16 ct	4	1.0	.75	.11	1.5	395	2.5	.65	15.8:1	31.6:1	13.89	14.39
K-7514**	N-6514**	4000 ct	600 ct	150	1.0	.75	.11	1.5	395	66	17	2.58:1	5.16:1	13.89	14.39

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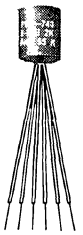
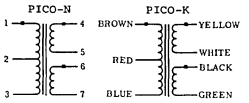
PICO PART NUMBER K-Series Insulated Leads	PICO PART NUMBER N-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 400 Hz and higher	POWER WATTS 150 Hz and higher	PRIMARY UNBALANCED DC CURRENT ma	PRIMARY DC RESISTANCE OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9 * * * K-Series	PICO PRICES 1-9 * * * N-Series
K-7515	N-6515	4000 ct	1000 ct	250	1.0	.75	.11	1.5	395	108	27	2:1	4:1	13.89	14.39
K-7520	N-6520	*4000 ct	8000 ct	-	1.0	.75	.11	1.5	390	955	-	1:1.41	-	14.38	14.98
K-7525	N-6525	5000 ct	500 ct	125	1.0	.75	.11	1.3	450	62	16	3.16:1	6.32:1	13.89	14.39
K-7530	N-6530	5000 ct	5000 ct	1250	1.0	.75	.11	1.3	450	620	155	1:1	2:1	13.89	14.39
K-7535	N-6535	7500 ct	50 ct	12.5	1.0	.75	.11	1.0	670	6	1.5	12.25:1	24.5:1	15.49	15.96
K-7540	N-6540	7500 ct	100 ct	25	1.0	.75	.11	1.0	670	11	2.8	8.66:1	17.32:1	15.49	15.96
K-7545	N-6545	7500 ct	600 ct	150	1.0	.75	.11	1.0	670	66	16.5	3.54:1	7.07:1	15.49	15.96
K-7550	N-6550	7500 ct	2500 ct	625	1.0	.75	.11	1.0	670	268	67	1.73:1	3.46:1	15.49	15.96
K-7555	N-6555	*7500 ct	7500 ct	-	1.0	.75	.11	1.0	670	925	-	1:1	-	15.95	17.09
K-7560	N-6560	8000 ct	12.8 ct	3.2	1.0	.75	.11	1.0	765	1.75	.44	25:1	50:1	15.49	15.96
K-7565	N-6565	8000 ct	1000 ct	250	1.0	.75	.11	1.0	695	106	26.5	2.83:1	5.66:1	15.49	15.96
K-7570	N-6570	*8000 ct	1200 ct	-	1.0	.75	.11	1.0	715	153	-	2.58:1	-	15.95	17.09
K-7575	N-6575	*9000 ct	9000 ct	-	1.0	.75	.11	1.0	925	1020	-	1:1	-	15.95	17.09
K-7580	N-6580	10,000 ct	12.8 ct	3.2	1.0	.75	.11	1.0	768	1.6	.4	28:1	56:1	15.49	15.96
K-7585	N-6585	10,000 ct	16 ct	4	1.0	.75	.11	1.0	756	1.7	.43	25:1	50:1	15.49	15.96
K-7590	N-6590	10,000 ct	100 ct	25	1.0	.75	.11	1.0	780	10	2.5	10:1	20:1	15.49	15.96
K-7595	N-6595	10,000 ct	200 ct	50	1.0	.75	.11	1.0	780	24	6	7.07:1	14.14:1	15.49	15.96
K-7600	N-6600	10,000 ct	500 ct	125	1.0	.75	.11	1.0	780	60	15	4.47:1	8.94:1	15.49	15.96
K-7605	N-6605	10,000 ct	600 ct	150	1.0	.75	.11	1.0	780	83	21	4.08:1	8.16:1	15.49	15.96
K-7610	N-6610	10,000 ct	1000 ct	250	1.0	.75	.11	1.0	780	106	27	3.16:1	6.32:1	15.49	15.96
K-7615	N-6615	10,000 ct	1200 ct	300	1.0	.75	.11	1.0	780	145	36	2.89:1	5.77:1	15.49	15.96
K-7620	N-6620	10,000 ct	1500 ct	375	1.0	.75	.11	1.0	780	160	40	2.58:1	5.16:1	15.49	15.96
K-7625	N-6625	10,000 ct	2000 ct	500	1.0	.75	.11	1.0	780	300	75	2.24:1	4.47:1	15.49	15.96
K-7630	N-6630	10,000 ct	5000 ct	1250	1.0	.75	.11	1.0	780	610	153	1.41:1	2.83:1	15.49	15.96
K-7635	N-6635	10,000 ct	7500 ct	1875	1.0	.75	.11	1.0	780	932	233	1.16:1	2.31:1	15.49	15.96
K-7640	N-6640	10,000 ct	10,000 ct	2500	1.0	.75	.11	1.0	780	1075	269	1:1	2:1	15.49	15.96
K-7645	N-6645	*10,000 ct	10,000 ct	-	1.0	.75	.11	1.0	715	985	-	1:1	-	15.95	17.09
K-7650	N-6650	15,000 ct	400 ct	100	.66	.66	.11	0.8	1165	52	13	6.12:1	12.25:1	15.49	15.96
K-7652	N-6652	15,000 ct	500 ct	125	.66	.66	.11	0.8	1165	60	15	5.48:1	10.95:1	15.49	15.96
K-7655	N-6655	15,000 ct	600 ct	150	.66	.66	.11	0.8	1165	80	20	5:1	10:1	15.49	15.96
K-7660	N-6660	15,000 ct	10,000 ct	2500	.66	.66	.11	0.8	1165	1050	263	1.22:1	2.45:1	15.49	15.96
K-7665	N-6665	*15,000 ct	15,000 ct	-	.66	.66	.11	0.8	1165	1600	-	1:1	-	15.95	17.09
K-7670	N-6670	15,000 ct	15,000 ct	3750	.66	.66	.11	0.8	1165	1600	400	1:1	2:1	15.49	15.96
K-7675	N-6675	16,000 ct	1000 ct	250	.62	.62	.11	0.8	1560	108	27	4:1	8:1	15.49	15.96
K-7680	N-6680	20,000 ct	500 ct	125	.5	.5	.11	0.7	1750	60	15	6.32:1	12.65:1	15.95	17.09
K-7685	N-6685	20,000 ct	600 ct	150	.5	.5	.11	0.7	1750	82	20.5	5.77:1	11.55:1	15.95	17.09
K-7690	N-6690	20,000 ct	800 ct	200	.5	.5	.11	0.7	1750	98	24.5	5:1	10:1	15.95	17.09
K-7695	N-6695	20,000 ct	1000 ct	250	.5	.5	.11	0.7	1750	135	34	4.47:1	8.94:1	15.95	17.09
K-7700	N-6700	20,000 ct	5000 ct	1250	.5	.5	.11	0.7	1750	610	153	2:1	4:1	15.95	17.09
K-7705	N-6705	20,000 ct	10,000 ct	2500	.5	.5	.11	0.7	1750	1075	269	1.41:1	2.83:1	15.95	17.09
K-7710	N-6710	*20,000 ct	20,000 ct	-	.5	.5	.11	0.7	1715	2370	-	1:1	-	17.09	17.76
K-7715	N-6715	25,000 ct	500 ct	125	.4	.4	.11	0.6	2470	60	15	7.07:1	14.14:1	15.95	17.09
K-7720	N-6720	25,000 ct	1000 ct	250	.4	.4	.11	0.6	2470	106	27	5:1	10:1	15.95	17.09
K-7725	N-6725	30,000 ct	50 ct	12.5	.33	.33	.11	0.5	2730	6.2	1.6	24.5:1	49:1	17.09	17.76
K-7730	N-6730	30,000 ct	1200 ct	300	.33	.33	.11	0.5	2815	156	39	5:1	10:1	17.09	17.76
K-7732	N-6732	30,000 ct	500 ct	125	.33	.33	.11	0.5	2730	61	15.3	7.7:1	15.5:1	17.09	17.76
K-7734	N-6734	30,000 ct	200 ct	50	.33	.33	.11	0.5	2730	24	6	12.2:1	24.5:1	17.09	17.76
K-7735	N-6735	30,000 ct	5000 ct	1250	.33	.33	.11	0.5	2730	620	155	2.45:1	4.9:1	17.09	17.76
K-7740	N-6740	30,000 ct	10,000 ct	2500	.33	.33	.11	0.5	2730	1090	272	1.73:1	3.46:1	17.09	17.76
K-7745	N-6745	*30,000 ct	30,000 ct	-	.33	.33	.11	0.5	2730	3740	-	1:1	-	17.94	19.08
K-7750	N-6750	40,000 ct	400 ct	100	.25	.25	.11	0.5	3150	53	13	10:1	20:1	17.94	19.08
K-7755	N-6755	40,000 ct	2000 ct	500	.25	.25	.11	0.5	3150	300	75	4.47:1	8.94:1	17.94	19.08
K-7760	N-6760	40,000 ct	4000 ct	1000	.25	.25	.11	0.5	3150	548	137	3.16:1	6.32:1	17.94	19.08
K-7765	N-6765	40,000 ct	20,000 ct	5000	.25	.25	.11	0.5	3150	3075	769	1.41:1	2.83:1	17.94	19.08
K-7770	N-6770	*40,000 ct	40,000 ct	-	.25	.25	.11	0.5	3940	4350	-	1:1	-	20.34	21.27
K-7775	N-6775	50,000 ct	200 ct	50	.2	.2	.11	0.4	4275	24	6	15.8:1	31.6:1	20.34	21.27
K-7777	N-6777	50,000 ct	500 ct	125	.2	.2	.11	0.4	4275	60	15	10:1	20:1	20.34	21.27
K-7778	N-6778	50,000 ct	600 ct	150	.2	.2	.11	0.4	4275	82	21	9.13:1	18.26:1	20.34	21.27
K-7779	N-6779	50,000 ct	50,000 ct	12,500	.2	.2	.11	0.4	4500	6270	1568	1:1	2:1	20.34	21.27
K-7780	N-6780	60,000 ct	15,000 ct	3750	.16	.16	.11	0.4	5960	1650	412	2:1	4:1	22.37	23.02
K-7785	N-6785	62,500 ct	50 ct	12.5	.16	.16	.11	0.4	5960	6	1.5	35.4:1	70.7:1	22.37	23.02
K-7787	N-6787	80,000 ct	15,000 ct	3750	.12	.12	.11	0.3	7200	1690	423	2.3:1	4.6:1	22.37	23.02
K-7789	N-6789	80,000 ct	80,000 ct	20,000	.12	.12	.11	0.3	7200	9920	2480	1:1	2:1	22.37	23.02
K-7790	N-6790	90,000 ct	10,000 ct	2500	.11	.11	.11	0.3	7500	1350	338	3:1	6:1	23.22	24.09
K-7795	N-6795	95,000 ct	15,000 ct	3750	.1	.1	.10	0.3	9550	1635	410	2.5:1	5:1	23.22	24.09
K-7800	N-6800	100,000 ct	60 ct	15	.1	.1	.10	0.3	10,000	8.5	2.2	40.8:1	81.6:1	23.22	24.09
K-7805	N-6805	100,000 ct	100 ct	25	.1	.1	.10	0.3	10,000	14	3.5	31.6:1	63.2:1	23.22	24.09
K-7810	N-6810	100,000 ct	500 ct	125	.1	.1	.10	0.3	10,000	62	15.5	14.1:1	28.3:1	23.22	24.09
K-7813	N-6813	100,000 ct	1000 ct	250	.1	.1	.10	0.3	10,000	140	35	10:1	20:1	23.22	24.09
K-7814	N-6814	100,000 ct	2000 ct	500	.1	.1	.10	0.3	10,000	248	62	7.07:1	14.14:1	23.22	24.09
K-7815	N-6815	100,000 ct	10,000 ct	2500	.1	.1	.10	0.3	10,000	1075	270	3.16:1	6.32:1	23.22	24.09
K-7820	N-6820	135,000 ct	82 ct	20.5	.074	.074	.074	0.25	13,700	9.5	2.4	40.6:1	81.2:1	24.45	25.17
K-7823	N-6823	200,000 ct	500 ct	125	.05	.05	.05	0.2	17,340	75	19	20:1	40:1	24.45	25.17
K-7825	N-6825	200,000 ct	1000 ct	250	.05	.05	.05	0.2	17,340	133	33	14.1:1	28.3:1	24.45	25.17
K-7830	N-6830	200,000 ct	10,000 ct	2500	.05	.05	.05	0.2	17,340	1350	336	4.47:1	8.94:1	24.45	25.17
K-7835	N-6835	200,000 ct	20,000 ct	5000	.05	.05	.05	0.2	17,340	3000	750	3.16:1	6.32:1	24.45	25.17
K-7837	N-6837	250,000 ct	200 ct	50	.04	.04	.04	0.2	17,340	28	7	35.4:1	70.7:1	25.17	25.82
K-7840	N-6840	250,000 ct	1000 ct	250	.04	.04	.04	0.2	17,340	118	30	15.8:1	31.6:1	25.17	25.82
K-SHIELD	MU-METAL SHIELD .53" d X .56" h (13.46 mm d X 14.22 mm h)													1.79	
N-SHIELD	MU-METAL SHIELD .53" d X .56" h (13.46 mm d X 14.22 mm h)														1.80

K SERIES Insulated Leads

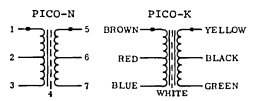


N SERIES Plug-In

SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

PICO Electronics, Inc.

453 N. MacQuesten Pkwy.
Mt. Vernon, N.Y. 10552

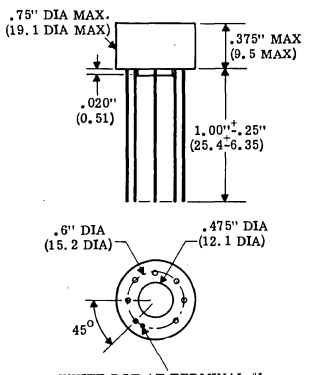
phone
914-699-5514

For immediate engineering assistance or to place an order—

Call Toll Free 800-431-1064

PICO's ultra-miniature transformers

R SERIES Plug-In



Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-27: . . . . . All Units Meet MIL-T-27 And Are Hermetically Sealed in a Metal Case, Audio Transformers Are Type TF5R21ZZ.
- FREQUENCY RESPONSE: . . . ± 3 db, 75 Hz - 30 KHz at 1.0 Milliwatt.
- MAXIMUM DISTORTION: . . . 5% With Rated Power Level at 1 KHz, 300 Hz and 75 Hz
- DIELECTRIC STRENGTH: . . . All Units Tested at 200 V RMS.
- INSULATION RESISTANCE: . . Greater Than 10,000 Megohms at 300 V DC.
- WEIGHT: . . . . . 12 Grams
- OPERATING TEMPERATURE: . -55°c to 105°c (All Units Can Be Supplied to Class S Requirements 130°c Maximum).
- TERMINALS: . . . . . Solid .016 Diameter Conductor. Conductor is Copper Clad Steel, Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107C, MIL-STD-202D, Test Condition A-1

This Product is Patented

Delivery— stock to one week

PICO PART NUMBER R-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 300 Hz and higher	POWER WATTS 75 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9*** R-Series
R-20003	20 ct	8 ct	2	1.5	.9	.03	22	1.6	.76	.19	1.58:1	3.16:1	15.76
R-20005	20 ct	20 ct	5	1.5	.9	.03	22	1.6	1.9	.48	1:1	2:1	15.76
R-20010	32 ct	32 ct	8	1.5	.9	.03	17.5	2.56	3	.75	1:1	2:1	15.76
R-20015	40 ct	40 ct	10	1.5	.9	.03	16	3.2	3.8	.95	1:1	2:1	15.76
R-20018	48 ct	16 ct	4	1.5	.9	.03	14.5	3.84	1.52	.38	1.73:1	3.46:1	15.76
R-20020	50 ct	50 ct	12.5	1.5	.9	.03	14	4	4.75	1.19	1:1	2:1	15.76
R-20025	80 ct	32 ct	8	1.5	.9	.03	11	6.4	3	.75	1.58:1	3.16:1	15.76
R-20028	100 ct	40 ct	10	1.5	.9	.03	10	8	3.8	.95	1.58:1	3.16:1	15.76
R-20030	100 ct	100 ct	25	1.5	.9	.03	10	8	9.5	2.38	1:1	2:1	15.76
R-20035	120 ct	12.8 ct	3.2	1.5	.9	.03	9	9.6	1.22	.3	3.06:1	6.12:1	15.76
R-20040	120 ct	60 ct	15	1.5	.9	.03	9	9.6	5.7	1.4	1.41:1	2.83:1	15.76
R-20045	120 ct	120 ct	30	1.5	.9	.03	9	9.6	11.4	2.85	1:1	2:1	15.76
R-20050	150 ct	12 ct	3	1.5	.9	.03	8	12	1.14	.29	3.54:1	7.08:1	15.76
R-20055	150 ct	50 ct	12.5	1.5	.9	.03	8	12	4.75	1.19	1.73:1	3.46:1	15.76
R-20060	150 ct	100 ct	25	1.5	.9	.03	8	12	9.5	2.38	1.22:1	2.44:1	15.76
R-20065	150 ct	150 ct	37.5	1.5	.9	.03	8	12	14.3	3.56	1:1	2:1	15.76
R-20070	150 ct	600 ct	150	1.5	.9	.03	8	12	57	14.3	1:2	1:1	15.76
R-20075	200 ct	200 ct	50	1.5	.9	.03	7	16	19	4.75	1:1	2:1	15.76
R-20080	300 ct	12 ct	3	1.5	.9	.03	5.5	24	1.14	.29	5:1	10:1	15.76
R-20085	300 ct	50 ct	12.5	1.5	.9	.03	5.5	24	4.75	1.19	2.45:1	4.9:1	15.76
R-20090	300 ct	150 ct	37.5	1.5	.9	.03	5.5	24	14.25	3.56	1.41:1	2.83:1	15.76
R-20095	300 ct	300 ct	75	1.5	.9	.03	5.5	24	28.5	7.13	1:1	2:1	15.76
R-20100	300 ct	600 ct	150	1.5	.9	.03	5.5	24	57	14.25	1:1.41	1.41:1	15.76
R-20105	320 ct	12.8 ct	3.2	1.5	.9	.03	5.5	25.6	1.22	.3	5:1	10:1	15.76
R-20110	400 ct	40 ct	10	1.5	.9	.03	5	32	3.8	.95	3.16:1	6.32:1	15.76
R-20115	400 ct	120 ct	30	1.5	.9	.03	5	32	11.4	2.85	1.83:1	3.65:1	15.76
R-20120	400 ct	200 ct	50	1.5	.9	.03	5	32	19	4.75	1.41:1	2.83:1	15.76
R-20125	400 ct	400 ct	100	1.5	.9	.03	5	32	38	9.5	1:1	2:1	15.76
R-20130	400 ct	1000 ct	250	1.5	.9	.03	5	32	95	23.8	1:1.58	1.26:1	15.76
R-20135	400 ct	2000 ct	500	1.5	.9	.03	5	32	190	47.5	1:2.24	1:1.12	15.76
R-20140	400 ct	4000 ct	1000	1.5	.9	.03	5	32	380	95	1:3.16	1:1.58	15.76
R-20142	500 ct	12.8 ct	3.2	1.5	.9	.03	4.5	40	1.22	.3	6.25:1	12.5:1	15.76
R-20144	500 ct	16 ct	4	1.5	.9	.03	4.5	40	1.52	.38	5.6:1	11.2:1	15.76
R-20145	500 ct	50 ct	12.5	1.5	.9	.03	4.5	40	4.75	1.19	3.16:1	6.32:1	15.76
R-20147	500 ct	150 ct	37.5	1.5	.9	.03	4.5	40	14.25	3.56	1.83:1	3.65:1	15.76
R-20150	500 ct	500 ct	125	1.5	.9	.03	4.5	40	47.5	11.88	1:1	2:1	15.76
R-20155	*500 ct	500 ct	-	1.5	.9	.03	4.5	40	47.5	-	1:1	-	16.42
R-20160	500 ct	600 ct	150	1.5	.9	.03	4.5	40	57	14.25	1:1.1	1.83:1	15.76
R-20165	600 ct	12.8 ct	3.2	1.5	.9	.03	4	48	1.22	.3	6.85:1	13.7	15.76
R-20167	600 ct	30 ct	7.5	1.5	.9	.03	4	48	2.85	.71	4.47:1	8.94:1	15.76
R-20170	600 ct	48 ct	12	1.5	.9	.03	4	48	4.56	1.14	3.54:1	7.07:1	15.76
R-20175	600 ct	200 ct	50	1.5	.9	.03	4	48	19	4.75	1.73:1	3.46:1	15.76
R-20180**	600 ct	600 ct	150	1.5	.9	.03	4	48	57	14.25	1:1	2:1	15.76
R-20185**	*600 ct	600 ct	-	1.5	.9	.03	4	48	57	-	1:1	-	16.42
R-20186**	*600 ct	900 ct	-	1.5	.9	.03	4	48	85.5	-	1:1.22	-	16.42
R-20187**	600 ct	1200 ct	300	1.5	.9	.03	4	48	114	28.5	1:1.41	1.41:1	15.76
R-20190	640 ct	12.8 ct	3.2	1.5	.9	.03	4	51.2	1.22	.3	7.07:1	14.14:1	15.76
R-20195	700 ct	100 ct	25	1.5	.9	.03	3.5	56	9.5	2.38	2.65:1	5.29:1	15.76
R-20200	800 ct	12.8 ct	3.2	1.5	.9	.03	3.5	64	1.22	.3	7.91:1	15.8:1	15.76
R-20205	800 ct	48 ct	12	1.5	.9	.03	3.5	64	4.56	1.14	4.08:1	8.16:1	15.76
R-20210	800 ct	800 ct	200	1.5	.9	.03	3.5	64	76	19	1:1	2:1	15.76
R-20215	900 ct	600 ct	150	1.5	.9	.03	3	72	57	14.3	1.23:1	2.45:1	15.76
R-20217**	*900 ct	900 ct	-	1.5	.9	.03	3	72	85.5	-	1:1	-	16.42
R-20220	1000 ct	12 ct	3	1.5	.9	.03	3	80	1.14	.29	9.13:1	18.26:1	15.76
R-20225	1000 ct	50 ct	12.5	1.5	.9	.03	3	80	4.75	1.19	4.47:1	8.94:1	15.76
R-20230	1000 ct	1000 ct	250	1.5	.9	.03	3	80	95	23.8	1:1	2:1	15.76
R-20235	1060 ct	12.8 ct	3.2	1.5	.9	.03	3	85	1.22	.3	9.1:1	18.2:1	15.76
R-20240	1200 ct	12.8 ct	3.2	1.5	.9	.03	3	96	1.22	.3	9.68:1	19.4:1	15.76
R-20245	1200 ct	500 ct	125	1.5	.9	.03	3	96	47.5	11.88	1.55:1	3.1:1	15.76
R-20250	1200 ct	1200 ct	300	1.5	.9	.03	3	96	114	28.5	1:1	2:1	15.76
R-20255	*1200 ct	1200 ct	-	1.5	.9	.03	3	96	114	-	1:1	-	16.42
R-20260	1500 ct	12 ct	3	1.5	.9	.03	2.5	120	1.14	.29	11.18:1	22.36:1	15.76
R-20265	1500 ct	500 ct	125	1.5	.9	.03	2.5	120	47.5	11.88	1.73:1	3.46:1	15.76
R-20270	*1500 ct	600 ct	-	1.5	.9	.03	2.5	120	57	-	1.58:1	-	16.42
R-20275	*1500 ct	1500 ct	-	1.5	.9	.03	2.5	120	142	-	1:1	-	16.42
R-20280	1600 ct	12.8 ct	3.2	1.5	.9	.03	2.5	128	1.22	3	11.18:1	22.36:1	15.76
R-20283	2000 ct	8 ct	2	1.5	.9	.03	2.2	160	.76	.19	15.8:1	31.6:1	15.76
R-20285	2000 ct	2000 ct	500	1.5	.9	.03	2.2	160	190	47.5	1:1	2:1	15.76
R-20290	*2000 ct	2000 ct	-	1.5	.9	.03	2.2	160	190	-	1:1	-	16.42
R-20295	2000 ct	8000 ct	2000	1.5	.9	.03	2.2	160	760	190	1:2	1:1	15.76
R-20297	2500 ct	2500 ct	625	1.5	.9	.03	2	200	238	59.5	1:1	2:1	15.76
R-20300	3000 ct	3000 ct	750	1.5	.9	.03	1.8	240	285	71.3	1:1	2:1	15.76
R-20305	*3000 ct	3000 ct	-	1.5	.9	.03	1.8	240	285	-	1:1	-	16.42

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
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*For immediate engineering assistance or to place an order—**Call Toll Free 800-431-1064***

PICO PART NUMBER R-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	PAR	POWER WATTS 1KHz and higher	300 Hz and higher	75 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9*** R-Series
R-20310	3600 ct	3600 ct	900	1.5	.9	.03	1.7	288	342	86	1:1	2:1	15.76
R-20312	4000 ct	16 ct	4	1.5	.9	.03	1.6	320	1.52	.38	15.8:1	31.6:1	15.76
R-20314**	4000 ct	600 ct	150	1.5	.9	.03	1.6	320	57	14.3	2.58:1	5.16:1	15.76
R-20315	4000 ct	1000 ct	250	1.5	.9	.03	1.6	320	95	23.8	2:1	4:1	15.76
R-20320	*4000 ct	8000 ct	-	1.5	.9	.03	1.6	320	760	-	1:1.41	-	16.42
R-20325	5000 ct	500 ct	125	1.5	.9	.03	1.4	400	47.5	11.88	3.16:1	6.32:1	15.76
R-20330	5000 ct	5000 ct	1250	1.5	.9	.03	1.4	400	475	119	1:1	2:1	15.76
R-20335	7500 ct	50 ct	12.5	1.3	.9	.03	1.2	600	4.75	1.19	12.25:1	24.5:1	17.49
R-20340	7500 ct	100 ct	25	1.3	.9	.03	1.2	600	9.5	2.38	8.66:1	17.32:1	17.49
R-20345	7500 ct	600 ct	150	1.3	.9	.03	1.2	600	57	14.3	3.54:1	7.07:1	17.49
R-20350	7500 ct	2500 ct	625	1.3	.9	.03	1.2	600	238	59.5	1.73:1	3.46:1	17.49
R-20355	*7500 ct	7500 ct	-	1.3	.9	.03	1.2	600	713	-	1:1	-	18.72
R-20360	8000 ct	12.8 ct	3.2	1.2	.9	.03	1.1	640	1.22	.3	25:1	50:1	17.49
R-20365	8000 ct	1000 ct	250	1.2	.9	.03	1.1	640	95	23.8	2.83:1	5.66:1	17.49
R-20370	*8000 ct	1200 ct	-	1.2	.9	.03	1.1	640	114	-	2.58:1	-	18.72
R-20375	*9000 ct	9000 ct	-	1.1	.9	.03	1.1	720	855	-	1:1	-	18.72
R-20380	10,000 ct	12.8 ct	3.2	1.0	.9	.03	1	800	1.22	.3	28:1	56:1	17.49
R-20385	10,000 ct	16 ct	4	1.0	.9	.03	1	800	1.52	.38	25:1	50:1	17.49
R-20390	10,000 ct	100 ct	25	1.0	.9	.03	1	800	9.5	2.38	10:1	20:1	17.49
R-20395	10,000 ct	200 ct	50	1.0	.9	.03	1	800	19	4.75	7.07:1	14.14:1	17.49
R-20400	10,000 ct	500 ct	125	1.0	.9	.03	1	800	47.5	11.88	4.47:1	8.94:1	17.49
R-20405	10,000 ct	600 ct	150	1.0	.9	.03	1	800	57	14.25	4.08:1	8.16:1	17.49
R-20410	10,000 ct	1000 ct	250	1.0	.9	.03	1	800	95	23.8	3.16:1	6.32:1	17.49
R-20415	10,000 ct	1200 ct	300	1.0	.9	.03	1	800	114	28.5	2.89:1	5.77:1	17.49
R-20420	10,000 ct	1500 ct	375	1.0	.9	.03	1	800	143	35.8	2.58:1	5.16:1	17.49
R-20425	10,000 ct	2000 ct	500	1.0	.9	.03	1	800	190	47.5	2.24:1	4.47:1	17.49
R-20430	10,000 ct	5000 ct	1250	1.0	.9	.03	1	800	475	119	1.41:1	2.83:1	17.49
R-20435	10,000 ct	7500 ct	1875	1.0	.9	.03	1	800	713	178	1.16:1	2.31:1	17.49
R-20440	10,000 ct	10,000 ct	2500	1.0	.9	.03	1	800	950	238	1:1	2:1	17.49
R-20445	*10,000 ct	10,000 ct	-	1.0	.9	.03	1	800	950	-	1:1	-	18.72
R-20450	15,000 ct	400 ct	100	.66	.66	.03	.8	1200	38	9.5	6.12:1	12.25:1	17.49
R-20452	15,000 ct	500 ct	125	.66	.66	.03	.8	1200	48	12	5.48:1	10.95:1	17.49
R-20455	15,000 ct	600 ct	150	.66	.66	.03	.8	1200	57	14.3	5:1	10:1	17.49
R-20460	15,000 ct	10,000 ct	2500	.66	.66	.03	.8	1200	950	238	1.22:1	2.45:1	17.49
R-20465	*15,000 ct	15,000 ct	-	.66	.66	.03	.8	1200	1430	-	1:1	-	18.72
R-20470	15,000 ct	15,000 ct	3750	.66	.66	.03	.8	1200	1430	357	1:1	2:1	17.49
R-20475	16,000 ct	1000 ct	250	.62	.62	.03	.8	1280	95	23.8	4:1	8:1	17.49
R-20480	20,000 ct	500 ct	125	.5	.5	.03	.7	1600	47.5	11.88	6.32:1	12.65:1	18.72
R-20485	20,000 ct	600 ct	150	.5	.5	.03	.7	1600	57	14.25	5.77:1	11.55:1	18.72
R-20490	20,000 ct	800 ct	200	.5	.5	.03	.7	1600	76	19	5:1	10:1	18.72
R-20495	20,000 ct	1000 ct	250	.5	.5	.03	.7	1600	95	23.8	4.47:1	8.94:1	18.72
R-20500	20,000 ct	5000 ct	1250	.5	.5	.03	.7	1600	475	119	2:1	4:1	18.72
R-20505	20,000 ct	10,000 ct	2500	.5	.5	.03	.7	1600	950	238	1.41:1	2.83:1	18.72
R-20510	*20,000 ct	20,000 ct	-	.5	.5	.03	.7	1600	1900	-	1:1	-	19.46
R-20515	25,000 ct	500 ct	125	.4	.4	.03	.6	2000	47.5	11.88	7.07:1	14.14:1	18.72
R-20520	25,000 ct	1000 ct	250	.4	.4	.03	.6	2000	95	23.8	5:1	10:1	18.72
R-20525	30,000 ct	50 ct	12.5	.33	.33	.03	.6	2400	4.75	1.19	24.5:1	49:1	19.46
R-20530	30,000 ct	1200 ct	300	.33	.33	.03	.6	2400	114	28.5	5:1	10:1	19.46
R-20532	30,000 ct	500 ct	125	.33	.33	.03	.6	2400	47.5	11.88	7.7:1	15.5:1	19.46
R-20534	30,000 ct	200 ct	50	.33	.33	.03	.6	2400	19	4.75	12.2:1	24.5:1	19.46
R-20535	30,000 ct	5000 ct	1250	.33	.33	.03	.6	2400	475	119	2.45:1	4.9:1	19.46
R-20540	30,000 ct	10,000 ct	2500	.33	.33	.03	.6	2400	950	238	1.73:1	3.46:1	19.46
R-20545	*30,000 ct	30,000 ct	-	.33	.33	.03	.6	2400	2850	-	1:1	-	20.91
R-20550	40,000 ct	400 ct	100	.25	.25	.03	.5	3200	38	9.5	10:1	20:1	20.91
R-20555	40,000 ct	2000 ct	500	.25	.25	.03	.5	3200	190	47.5	4.47:1	8.94:1	20.91
R-20560	40,000 ct	4000 ct	1000	.25	.25	.03	.5	3200	380	95	3.16:1	6.32:1	20.91
R-20565	40,000 ct	20,000 ct	5000	.25	.25	.03	.5	3200	1900	475	1.41:1	2.83:1	20.91
R-20570	*40,000 ct	40,000 ct	-	.25	.25	.03	.5	3200	3800	-	1:1	-	23.28
R-20575	50,000 ct	200 ct	50	.2	.2	.03	.4	4000	19	4.75	15.8:1	31.6:1	23.28
R-20577	50,000 ct	500 ct	125	.2	.2	.03	.4	4000	47.5	11.88	10:1	20:1	23.28
R-20578	50,000 ct	600 ct	150	.2	.2	.03	.4	4000	57	14.3	9.13:1	18.26:1	23.28
R-20579	50,000 ct	50,000 ct	12,500	.2	.2	.03	.4	4000	4750	1190	1:1	2:1	23.28
R-20580	60,000 ct	15,000 ct	3750	.16	.16	.03	.4	4800	1430	358	2:1	4:1	25.14
R-20585	62,500 ct	50 ct	12.5	.16	.16	.03	.4	5000	4.75	1.19	35.4:1	70.7:1	25.14
R-20587	80,000 ct	15,000 ct	3750	.12	.12	.03	.3	6400	1430	358	2.3:1	4.6:1	25.14
R-20590	90,000 ct	10,000 ct	2500	.11	.11	.03	.3	7200	950	238	3:1	6:1	26.39
R-20595	95,000 ct	15,000 ct	3750	.1	.1	.03	.3	7600	1430	358	2.5:1	5:1	26.39
R-20600	100,000 ct	60 ct	15	.1	.1	.03	.3	8000	5.7	1.43	40.8:1	81.6:1	26.39
R-20605	100,000 ct	100 ct	25	.1	.1	.03	.3	8000	9.5	2.38	31.6:1	63.2:1	26.39
R-20610	100,000 ct	500 ct	125	.1	.1	.03	.3	8000	47.5	11.88	14.1:1	28.3:1	26.39
R-20613	100,000 ct	1000 ct	250	.1	.1	.03	.3	8000	95	23.8	10:1	20:1	26.39
R-20614	100,000 ct	2000 ct	500	.1	.1	.03	.3	8000	190	47.5	7.07:1	14.14:1	26.39
R-20615	100,000 ct	10,000 ct	2500	.1	.1	.03	.3	8000	950	238	3.16:1	6.32:1	26.39
R-20620	135,000 ct	82 ct	20.5	.07	.07	.03	.2	10,800	7.8	1.9	40.6:1	81.2:1	27.57

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

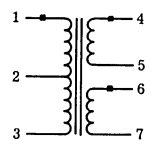
PICO's ultra-miniature transformers

R SERIES Plug-In

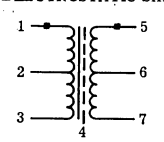
FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



SCHEMATIC FOR TRANSFORMERS WITH ELECTROSTATIC SHIELD



PICO Electronics, Inc.
453 N. MacQuesten Pkwy.
Mt. Vernon, N.Y. 10552

phone
914-699-5514

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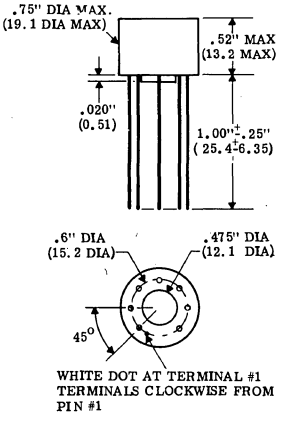
Delivery— stock to one week

Call Toll Free 800-431-1064

PICO's ultra-miniature transformers

S SERIES Plug-In



Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-27: . . . . . All Units Meet MIL-T-27 And Are Hermetically Sealed in a Metal Case, Audio Transformers Are Type TF5R21ZZ.
- FREQUENCY RESPONSE: . . . ± 3 db, 50 Hz - 30 KHz at 1.0 Milliwatt. (±0.5 db, 300 Hz-5 KHz)
- MAXIMUM DISTORTION: . . . 5% With Rated Power Level at 1 KHz, 300 Hz and 50 Hz.
- DIELECTRIC STRENGTH: . . . All Units Tested at 200 V RMS.
- INSULATION RESISTANCE: . . Greater Than 10,000 Megohms at 300 V DC.
- WEIGHT: . . . . . 17 Grams
- OPERATING TEMPERATURE: . -55°c to 105°c (All Units Can Be Supplied to Class S Requirements 130°c Maximum).
- TERMINALS: . . . . . Solid .020 Conductor, Copper Clad Steel Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107C, MIL-STD-202D, Test Condition A-1

This Product is Patented

PICO PART NUMBER S-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 300 Hz and higher	POWER WATTS 50 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9*** S-Series
S-21003	20 ct	8 ct	2	2.0	1.5	.05	22	1.6	.88	.22	1.58:1	3.16:1	15.76
S-21005	20 ct	20 ct	5	2.0	1.5	.05	22	1.6	2.2	.55	1:1	2:1	15.76
S-21010	32 ct	32 ct	8	2.0	1.5	.05	17.5	2.56	3.52	.88	1:1	2:1	15.76
S-21015	40 ct	40 ct	10	2.0	1.5	.05	16	3.2	4.4	1.1	1:1	2:1	15.76
S-21018	48 ct	16 ct	4	2.0	1.5	.05	14.5	3.84	1.76	.44	1.73:1	3.46:1	15.76
S-21020	50 ct	50 ct	12.5	2.0	1.5	.05	14	4	5.5	1.38	1:1	2:1	15.76
S-21025	80 ct	32 ct	8	2.0	1.5	.05	11	6.4	3.52	.88	1.58:1	3.16:1	15.76
S-21028	100 ct	40 ct	10	2.0	1.5	.05	10	8	4.4	1.1	1.58:1	3.16:1	15.76
S-21030	100 ct	100 ct	25	2.0	1.5	.05	10	8	11	2.75	1:1	2:1	15.76
S-21035	120 ct	12.8 ct	3.2	2.0	1.5	.05	9	9.6	1.41	.35	3.06:1	6.12:1	15.76
S-21040	120 ct	60 ct	15	2.0	1.5	.05	9	9.6	6.6	1.65	1.41:1	2.83:1	15.76
S-21045	120 ct	120 ct	30	2.0	1.5	.05	9	9.6	13.2	3.3	1:1	2:1	15.76
S-21050	150 ct	12 ct	3	2.0	1.5	.05	8	12	1.32	.33	3.54:1	7.08:1	15.76
S-21055	150 ct	50 ct	12.5	2.0	1.5	.05	8	12	5.5	1.38	1.73:1	3.46:1	15.76
S-21060	150 ct	100 ct	25	2.0	1.5	.05	8	12	11	2.75	1.22:1	2.44:1	15.76
S-21065	150 ct	150 ct	37.5	2.0	1.5	.05	8	12	16.5	4.13	1:1	2:1	15.76
S-21070	150 ct	600 ct	150	2.0	1.5	.05	8	12	66	16.5	1:2	1:1	15.76
S-21075	200 ct	200 ct	50	2.0	1.5	.05	7	16	22	5.5	1:1	2:1	15.76
S-21080	300 ct	12 ct	3	2.0	1.5	.05	5.5	24	1.32	.33	5:1	10:1	15.76
S-21085	300 ct	50 ct	12.5	2.0	1.5	.05	5.5	24	5.5	1.38	2.45:1	4.9:1	15.76
S-21090	300 ct	150 ct	37.5	2.0	1.5	.05	5.5	24	16.5	4.13	1.41:1	2.83:1	15.76
S-21095	300 ct	300 ct	75	2.0	1.5	.05	5.5	24	33	8.25	1:1	2:1	15.76
S-21100	300 ct	600 ct	150	2.0	1.5	.05	5.5	24	66	16.5	1:1.41	1.41:1	15.76
S-21105	320 ct	12.8 ct	3.2	2.0	1.5	.05	5.5	25.6	1.41	.35	5:1	10:1	15.76
S-21110	400 ct	40 ct	10	2.0	1.5	.05	5	32	4.4	1.1	3.16:1	6.32:1	15.76
S-21115	400 ct	120 ct	30	2.0	1.5	.05	5	32	13.2	3.3	1.83:1	3.65:1	15.76
S-21120	400 ct	200 ct	50	2.0	1.5	.05	5	32	22	5.5	1.41:1	2.83:1	15.76
S-21125	400 ct	400 ct	100	2.0	1.5	.05	5	32	44	11	1:1	2:1	15.76
S-21130	400 ct	1000 ct	250	2.0	1.5	.05	5	32	110	27.5	1:1.58	1.26:1	15.76
S-21135	400 ct	2000 ct	500	2.0	1.5	.05	5	32	220	55	1:2.24	1:1.12	15.76
S-21140	400 ct	4000 ct	1000	2.0	1.5	.05	5	32	440	110	1:3.16	1:1.58	15.76
S-21142	500 ct	12.8 ct	3.2	2.0	1.5	.05	4.5	40	1.41	.35	6.25:1	12.5:1	15.76
S-21144	500 ct	16 ct	4	2.0	1.5	.05	4.5	40	1.76	.44	5.6:1	11.2:1	15.76
S-21145	500 ct	50 ct	12.5	2.0	1.5	.05	4.5	40	5.5	1.38	3.16:1	6.32:1	15.76
S-21147	500 ct	150 ct	37.5	2.0	1.5	.05	4.5	40	16.5	4.13	1.83:1	3.65:1	15.76
S-21150	500 ct	500 ct	125	2.0	1.5	.05	4.5	40	55	13.75	1:1	2:1	15.76
S-21155	*500 ct	500 ct	-	2.0	1.5	.05	4.5	40	55	-	1:1	-	16.42
S-21160	500 ct	600 ct	150	2.0	1.5	.05	4.5	40	66	16.5	1:1.1	1.83:1	15.76
S-21165	600 ct	12.8 ct	3.2	2.0	1.5	.05	4	48	1.41	.35	6.85:1	13.7	15.76
S-21167	600 ct	30 ct	7.5	2.0	1.5	.05	4	48	3.3	.83	4.47:1	8.94:1	15.76
S-21170	600 ct	48 ct	12	2.0	1.5	.05	4	48	5.28	1.37	3.54:1	7.07:1	15.76
S-21175	600 ct	200 ct	50	2.0	1.5	.05	4	48	22	5.5	1.73:1	3.46:1	15.76
S-21180**	600 ct	600 ct	150	2.0	1.5	.05	4	48	66	16.5	1:1	2:1	15.76
S-21185**	*600 ct	600 ct	-	2.0	1.5	.05	4	48	66	-	1:1	-	16.42
S-21186**	*600 ct	900 ct	-	2.0	1.5	.05	4	48	99	-	1:1.22	-	16.42
S-21187**	600 ct	1200 ct	300	2.0	1.5	.05	4	48	132	33	1:1.41	1.41:1	15.76
S-21190	640 ct	12.8 ct	3.2	2.0	1.5	.05	4	51	1.41	.35	7.07:1	14.14:1	15.76
S-21195	700 ct	100 ct	25	2.0	1.5	.05	3.5	56	11	2.75	2.65:1	5.29:1	15.76
S-21200	800 ct	12.8 ct	3.2	2.0	1.5	.05	3.5	64	1.41	.35	7.91:1	15.8:1	15.76
S-21205	800 ct	48 ct	12	2.0	1.5	.05	3.5	64	5.28	1.32	4.08:1	8.16:1	15.76
S-21210	800 ct	800 ct	200	2.0	1.5	.05	3.5	64	88	22	1:1	2:1	15.76
S-21215	900 ct	600 ct	150	2.0	1.5	.05	3	72	66	16.5	1.23:1	2.45:1	15.76
S-21217**	*900 ct	900 ct	-	2.0	1.5	.05	3	72	99	-	1:1	-	16.42
S-21220	1000 ct	12 ct	3	2.0	1.5	.05	3	80	1.32	.33	9.13:1	18.26:1	15.76
S-21225	1000 ct	50 ct	12.5	2.0	1.5	.05	3	80	5.5	1.38	4.47:1	8.94:1	15.76
S-21230	1000 ct	1000 ct	250	2.0	1.5	.05	3	80	110	27.5	1:1	2:1	15.76
S-21235	1060 ct	12.8 ct	3.2	2.0	1.5	.05	3	85	1.41	.35	9.1:1	18.2:1	15.76
S-21240	1200 ct	12.8 ct	3.2	2.0	1.5	.05	3	96	1.41	.35	9.68:1	19.4:1	15.76
S-21245	1200 ct	500 ct	125	2.0	1.5	.05	3	96	55	13.75	1.55:1	3.1:1	15.76
S-21250	1200 ct	1200 ct	300	2.0	1.5	.05	3	96	132	33	1:1	2:1	15.76
S-21255	*1200 ct	1200 ct	-	2.0	1.5	.05	3	96	132	-	1:1	-	16.42
S-21260	1500 ct	12 ct	3	2.0	1.5	.05	2.5	120	1.32	.33	11.18:1	22.36:1	15.76
S-21265	1500 ct	500 ct	125	2.0	1.5	.05	2.5	120	55	13.75	1.73:1	3.46:1	15.76
S-21270	*1500 ct	600 ct	-	2.0	1.5	.05	2.5	120	66	-	1.58:1	-	16.42
S-21275	*1500 ct	1500 ct	-	2.0	1.5	.05	2.5	120	165	-	1:1	-	16.42
S-21280	1600 ct	12.8 ct	3.2	2.0	1.5	.05	2.5	128	1.41	.35	11.18:1	22.36:1	15.76
S-21283	2000 ct	8 ct	2	2.0	1.5	.05	2.2	160	.88	.22	15.8:1	31.6:1	15.76
S-21285	2000 ct	2000 ct	500	2.0	1.5	.05	2.2	160	220	55	1:1	2:1	15.76
S-21290	*2000 ct	2000 ct	-	2.0	1.5	.05	2.2	160	220	-	1:1	-	16.42
S-21295	2000 ct	8000 ct	2000	2.0	1.5	.05	2.2	160	880	220	1:2	1:1	16.42
S-21297	2500 ct	2500 ct	625	2.0	1.5	.05	2	200	275	69	1:1	2:1	16.42
S-21300	3000 ct	3000 ct	750	2.0	1.5	.05	1.8	240	330	83	1:1	2:1	16.42
S-21305	*3000 ct	3000 ct	-	2.0	1.5	.05	1.8	240	330	-	1:1	-	16.42

*INCLUDES ELECTROSTATIC SHIELD
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453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

PICO PART NUMBER S-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 300 Hz and higher	POWER WATTS 50 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9*** S-Series
S-21310	3600 ct	3600 ct	900	2.0	1.5	.05	1.7	288	396	99	1:1	2:1	16.42
S-21312	4000 ct	16 ct	4	2.0	1.5	.05	1.6	320	1.76	.44	15.8:1	31.6:1	16.42
S-21314**	4000 ct	600 ct	150	2.0	1.5	.05	1.6	320	66	16.5	2.58:1	5.16:1	16.42
S-21315	4000 ct	1000 ct	250	2.0	1.5	.05	1.6	320	110	27.5	2:1	4:1	16.42
S-21320	*4000 ct	8000 ct	-	2.0	1.5	.05	1.6	320	880	-	1:1.41	-	16.42
S-21325	5000 ct	500 ct	125	2.0	1.5	.05	1.4	400	55	13.8	3.16:1	6.32:1	15.76
S-21330	5000 ct	5000 ct	1250	2.0	1.5	.05	1.4	400	550	138	1:1	2:1	15.76
S-21335	7500 ct	50 ct	12.5	1.3	1.3	.05	1.2	600	5.5	1.38	12.25:1	24.5:1	17.48
S-21340	7500 ct	100 ct	25	1.3	1.3	.05	1.2	600	11	2.75	8.66:1	17.32:1	17.48
S-21345	7500 ct	600 ct	150	1.3	1.3	.05	1.2	600	66	16.5	3.54:1	7.07:1	17.48
S-21350	7500 ct	2500 ct	625	1.3	1.3	.05	1.2	600	275	69	1.73:1	3.46:1	17.48
S-21355	*7500 ct	7500 ct	-	1.3	1.3	.05	1.2	600	825	-	1:1	-	18.72
S-21360	8000 ct	12.8 ct	3.2	1.2	1.2	.05	1.1	640	1.4	.35	25:1	50:1	17.48
S-21365	8000 ct	1000 ct	250	1.2	1.2	.05	1.1	640	110	27.5	2.83:1	5.66:1	17.48
S-21370	*8000 ct	1200 ct	-	1.2	1.2	.05	1.1	640	132	-	2.58:1	-	18.72
S-21375	*9000 ct	9000 ct	-	1.1	1.1	.05	1.1	720	990	-	1:1	-	18.72
S-21380	10,000 ct	12.8 ct	3.2	1.0	1.0	.05	1	800	1.4	.35	28:1	56:1	17.48
S-21385	10,000 ct	16 ct	4	1.0	1.0	.05	1	800	1.76	.44	25:1	50:1	17.48
S-21390	10,000 ct	100 ct	25	1.0	1.0	.05	1	800	11	2.75	10:1	20:1	17.48
S-21395	10,000 ct	200 ct	50	1.0	1.0	.05	1	800	22	5.5	7.07:1	14.14:1	17.48
S-21400	10,000 ct	500 ct	125	1.0	1.0	.05	1	800	55	13.75	4.47:1	8.94:1	17.48
S-21405	10,000 ct	600 ct	150	1.0	1.0	.05	1	800	66	16.5	4.08:1	8.16:1	17.48
S-21410	10,000 ct	1000 ct	250	1.0	1.0	.05	1	800	110	27.5	3.16:1	6.32:1	17.48
S-21415	10,000 ct	1200 ct	300	1.0	1.0	.05	1	800	132	33	2.89:1	5.77:1	17.48
S-21420	10,000 ct	1500 ct	375	1.0	1.0	.05	1	800	165	41.3	2.58:1	5.16:1	17.48
S-21425	10,000 ct	2000 ct	500	1.0	1.0	.05	1	800	220	55	2.24:1	4.47:1	17.48
S-21430	10,000 ct	5000 ct	1250	1.0	1.0	.05	1	800	550	138	1.41:1	2.83:1	17.48
S-21435	10,000 ct	7500 ct	1875	1.0	1.0	.05	1	800	825	206	1.16:1	2.31:1	17.48
S-21440	10,000 ct	10,000 ct	2500	1.0	1.0	.05	1	800	1100	275	1:1	2:1	17.48
S-21445	*10,000 ct	10,000 ct	-	1.0	1.0	.05	1	800	1100	-	1:1	-	18.72
S-21450	15,000 ct	400 ct	100	.65	.65	.05	.8	1200	44	11	6.12:1	12.25:1	17.48
S-21452	15,000 ct	500 ct	125	.65	.65	.05	.8	1200	55	13.8	5.48:1	10.95:1	17.48
S-21455	15,000 ct	600 ct	150	.65	.65	.05	.8	1200	66	16.5	5:1	10:1	17.48
S-21460	15,000 ct	10,000 ct	2500	.65	.65	.05	.8	1200	1100	275	1.22:1	2.45:1	17.48
S-21465	*15,000 ct	15,000 ct	-	.65	.65	.05	.8	1200	1650	-	1:1	-	18.72
S-21470	15,000 ct	15,000 ct	3750	.65	.65	.05	.8	1200	1650	413	1:1	2:1	17.48
S-21475	16,000 ct	1000 ct	250	.62	.62	.05	.8	1280	110	27.5	4:1	8:1	17.48
S-21480	20,000 ct	500 ct	125	.5	.5	.05	.7	1600	55	13.8	6.32:1	12.65:1	18.72
S-21485	20,000 ct	600 ct	150	.5	.5	.05	.7	1600	66	16.5	5.77:1	11.55:1	18.72
S-21490	20,000 ct	800 ct	200	.5	.5	.05	.7	1600	88	22	5:1	10:1	18.72
S-21495	20,000 ct	1000 ct	250	.5	.5	.05	.7	1600	110	27.5	4.47:1	8.94:1	18.72
S-21500	20,000 ct	5000 ct	1250	.5	.5	.05	.7	1600	550	138	2:1	4:1	18.72
S-21505	20,000 ct	10,000 ct	2500	.5	.5	.05	.7	1600	1100	275	1.41:1	2.83:1	18.72
S-21510	*20,000 ct	20,000 ct	-	.5	.5	.05	.7	1600	2200	-	1:1	-	19.46
S-21515	25,000 ct	500 ct	125	.4	.4	.05	.6	2000	55	13.8	7.07:1	14.14:1	18.72
S-21520	25,000 ct	1000 ct	250	.4	.4	.05	.6	2000	110	27.5	5:1	10:1	18.72
S-21525	30,000 ct	50 ct	12.5	.33	.33	.05	.6	2400	5.5	1.38	24.5:1	49:1	19.46
S-21530	30,000 ct	1200 ct	300	.33	.33	.05	.6	2400	132	33	5:1	10:1	19.46
S-21532	30,000 ct	500 ct	125	.33	.33	.05	.6	2400	55	13.8	7.7:1	15.5:1	19.46
S-21534	30,000 ct	200 ct	50	.33	.33	.05	.6	2400	22	5.5	12.2:1	24.5:1	19.46
S-21535	30,000 ct	5000 ct	1250	.33	.33	.05	.6	2400	550	137.5	2.45:1	4.9:1	19.46
S-21540	30,000 ct	10,000 ct	2500	.33	.33	.05	.6	2400	1100	275	1.73:1	3.46:1	19.46
S-21545	*30,000 ct	30,000 ct	-	.33	.33	.05	.6	2400	3300	-	1:1	-	20.91
S-21550	40,000 ct	400 ct	100	.25	.25	.05	.5	3200	44	11	10:1	20:1	20.91
S-21555	40,000 ct	2000 ct	500	.25	.25	.05	.5	3200	220	55	4.47:1	8.94:1	20.91
S-21560	40,000 ct	4000 ct	1000	.25	.25	.05	.5	3200	440	110	3.16:1	6.32:1	20.91
S-21565	40,000 ct	20,000 ct	5000	.25	.25	.05	.5	3200	2200	550	1.41:1	2.83:1	20.91
S-21570	*40,000 ct	40,000 ct	-	.25	.25	.05	.5	3200	4400	-	1:1	-	23.28
S-21575	50,000 ct	200 ct	50	.2	.2	.05	.4	4000	22	5.5	15.8:1	31.6:1	23.28
S-21577	50,000 ct	500 ct	125	.2	.2	.05	.4	4000	55	13.8	10:1	20:1	23.28
S-21578	50,000 ct	600 ct	150	.2	.2	.05	.4	4000	66	16.5	9.13:1	18.26:1	23.28
S-21579	50,000 ct	50,000 ct	12,500	.2	.2	.05	.4	4000	5500	1380	1:1	2:1	23.28
S-21580	60,000 ct	15,000 ct	3750	.16	.16	.05	.4	4800	1650	413	2:1	4:1	25.14
S-21585	62,500 ct	50 ct	12.5	.16	.16	.05	.4	5000	5.5	1.38	35.4:1	70.7:1	25.14
S-21587	80,000 ct	15,000 ct	3750	.12	.12	.05	.3	6400	1650	413	2.3:1	4.6:1	25.14
S-21590	90,000 ct	10,000 ct	2500	.11	.11	.05	.3	7200	1100	275	3:1	6:1	26.39
S-21595	95,000 ct	15,000 ct	3750	.1	.1	.05	.3	7600	1650	413	2.5:1	5:1	26.39
S-21600	100,000 ct	60 ct	15	.1	.1	.05	.3	8000	6.6	1.65	40.8:1	81.6:1	26.39
S-21605	100,000 ct	100 ct	25	.1	.1	.05	.3	8000	11	2.75	31.6:1	63.2:1	26.39
S-21610	100,000 ct	500 ct	125	.1	.1	.05	.3	8000	55	13.8	14.1:1	28.3:1	26.39
S-21613	100,000 ct	1000 ct	250	.1	.1	.05	.3	8000	110	27.5	10:1	20:1	26.39
S-21614	100,000 ct	2000 ct	500	.1	.1	.05	.3	8000	220	55	7.07:1	14.14:1	26.39
S-21615	100,000 ct	10,000 ct	2500	.1	.1	.05	.3	8000	1100	275	3.16:1	6.32:1	26.39
S-21620	135,000 ct	82 ct	20.5	.07	.07	.05	.2	10,800	9	2.25	40.6:1	81.2:1	27.57

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

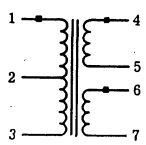
PICO's ultra-miniature transformers

S SERIES Plug-In

FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



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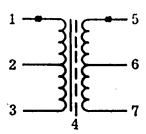

PICO Electronics, Inc.
453 N. MacQuesten Pkwy.
Mt. Vernon, N.Y. 10552

phone
914-699-5514

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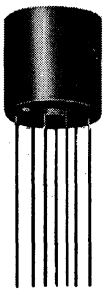
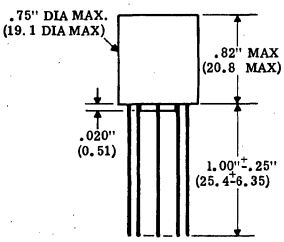
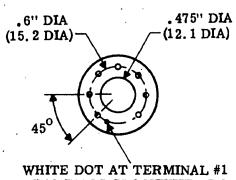
Delivery— stock to one week

PICO's ultra-miniature transformers

T SERIES Plug-In







Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-27: . . . . . All Units Meet MIL-T-27 And Are Hermetically Sealed in a Metal Case, Audio Transformers Are Type TF5R21ZZ.
- FREQUENCY RESPONSE: . . . ± 3 db, 20 Hz - 25 KHz at 1.0 Milliwatt.
- MAXIMUM DISTORTION: . . . 5% With Rated Power Level at 1 KHz and 300 Hz. 10% Distortion at 20 Hz.
- DIELECTRIC STRENGTH: . . . All Units Tested at 200 V RMS.
- INSULATION RESISTANCE: . . Greater Than 10,000 Megohms at 300 V DC.
- WEIGHT: . . . . . 28 Grams
- OPERATING TEMPERATURE: . -55°c to 105°c (All Units Can Be Supplied to Class S Requirements 130°c Maximum).
- TERMINALS: . . . . . Solid .020 Conductor, Copper Clad Steel Tinned 100%, Electroplated Per MIL-T-10727A and ASTM CCS B452
- THERMAL SHOCK: . . . . . 25 Cycles, Method 107C, MIL-STD-202D, Test Condition A-1

This Product is Patented

Delivery— stock to one week

PICO PART NUMBER T-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SER	POWER WATTS 1KHz and higher	300 Hz and higher	20 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	SEC PAR CONN	PICO PRICES 1-9*** T-Series
T-22003	20 ct	8 ct	2	3.0	2.0	.006	22	1.6	.8	.2	1.58:1	3.16:1	17.32
T-22005	20 ct	20 ct	5	3.0	2.0	.006	22	1.6	2	.5	1:1	2:1	17.32
T-22010	32 ct	32 ct	8	3.0	2.0	.006	17.5	2.56	3.2	.8	1:1	2:1	17.32
T-22015	40 ct	40 ct	10	3.0	2.0	.006	16	3.2	4	1	1:1	2:1	17.32
T-22018	48 ct	16 ct	4	3.0	2.0	.006	14.5	3.84	1.6	.4	1.73:1	3.46:1	17.32
T-22020	50 ct	50 ct	12.5	3.0	2.0	.006	14	4	5	1.25	1:1	2:1	17.32
T-22025	80 ct	32 ct	8	3.0	2.0	.006	11	6.4	3.2	.8	1.58:1	3.16:1	17.32
T-22028	100 ct	40 ct	10	3.0	2.0	.006	10	8	4	1	1.58:1	3.16:1	17.32
T-22030	100 ct	100 ct	25	3.0	2.0	.006	10	8	10	2.5	1:1	2:1	17.32
T-22035	120 ct	12.8 ct	3.2	3.0	2.0	.006	9	9.6	1.3	.32	3.06:1	6.12:1	17.32
T-22040	120 ct	60 ct	15	3.0	2.0	.006	9	9.6	6	1.5	1.41:1	2.83:1	17.32
T-22045	120 ct	120 ct	30	3.0	2.0	.006	9	9.6	12	3	1:1	2:1	17.32
T-22050	150 ct	12 ct	3	3.0	2.0	.006	8	12	1.2	.3	3.54:1	7.08:1	17.32
T-22055	150 ct	50 ct	12.5	3.0	2.0	.006	8	12	5	1.25	1.73:1	3.46:1	17.32
T-22060	150 ct	100 ct	25	3.0	2.0	.006	8	12	10	2.5	1.22:1	2.44:1	17.32
T-22065	150 ct	150 ct	37.5	3.0	2.0	.006	8	12	15	3.75	1:1	2:1	17.32
T-22070	150 ct	600 ct	150	3.0	2.0	.006	8	12	60	15	1:2	1:1	17.32
T-22075	200 ct	200 ct	50	3.0	2.0	.006	7	16	20	5	1:1	2:1	17.32
T-22080	300 ct	12 ct	3	3.0	2.0	.006	5.5	24	1.2	.3	5:1	10:1	17.32
T-22085	300 ct	50 ct	12.5	3.0	2.0	.006	5.5	24	5	1.25	2.45:1	4.9:1	17.32
T-22090	300 ct	150 ct	37.5	3.0	2.0	.006	5.5	24	15	3.75	1.41:1	2.83:1	17.32
T-22095	300 ct	300 ct	75	3.0	2.0	.006	5.5	24	30	7.5	1:1	2:1	17.32
T-22100	300 ct	600 ct	150	3.0	2.0	.006	5.5	24	60	15	1:1.41	1.41:1	17.32
T-22105	320 ct	12.8 ct	3.2	3.0	2.0	.006	5.5	25.6	1.3	.32	5:1	10:1	17.32
T-22110	400 ct	40 ct	10	3.0	2.0	.006	5	32	4	1	3.16:1	6.32:1	17.32
T-22115	400 ct	120 ct	30	3.0	2.0	.006	5	32	12	3	1.83:1	3.65:1	17.32
T-22120	400 ct	200 ct	50	3.0	2.0	.006	5	32	20	5	1.41:1	2.83:1	17.32
T-22125	400 ct	400 ct	100	3.0	2.0	.006	5	32	40	10	1:1	2:1	17.32
T-22130	400 ct	1000 ct	250	3.0	2.0	.006	5	32	100	25	1:1.58	1.26:1	17.32
T-22135	400 ct	2000 ct	500	3.0	2.0	.006	5	32	200	50	1:2.24	1:1.12	17.32
T-22140	400 ct	4000 ct	1000	3.0	2.0	.006	5	32	400	100	1:3.16	1:1.58	17.32
T-22142	500 ct	12.8 ct	3.2	3.0	2.0	.006	4.5	40	1.3	.32	6.25:1	12.5:1	17.32
T-22144	500 ct	16 ct	4	3.0	2.0	.006	4.5	40	1.6	.4	5.6:1	11.2:1	17.32
T-22145	500 ct	50 ct	12.5	3.0	2.0	.006	4.5	40	5	1.25	3.16:1	6.32:1	17.32
T-22147	500 ct	150 ct	37.5	3.0	2.0	.006	4.5	40	15	3.75	1.83:1	3.65:1	17.32
T-22150	500 ct	500 ct	125	3.0	2.0	.006	4.5	40	50	12.5	1:1	2:1	17.32
T-22155	*500 ct	500 ct	-	3.0	2.0	.006	4.5	40	50	-	1:1	-	18.05
T-22160	500 ct	600 ct	150	3.0	2.0	.006	4.5	40	60	15	1:1.1	1.83:1	17.32
T-22165	600 ct	12.8 ct	3.2	3.0	2.0	.006	4	48	1.3	.32	6.85:1	13.7:1	17.32
T-22167	600 ct	30 ct	7.5	3.0	2.0	.006	4	48	3	.75	4.47:1	8.94:1	17.32
T-22170	600 ct	48 ct	12	3.0	2.0	.006	4	48	4.8	1.2	3.54:1	7.07:1	17.32
T-22175	600 ct	200 ct	50	3.0	2.0	.006	4	48	20	5	1.73:1	3.46:1	17.32
T-22180**	600 ct	600 ct	150	3.0	2.0	.006	4	48	60	15	1:1	2:1	17.32
T-22185**	*600 ct	600 ct	-	3.0	2.0	.006	4	48	60	-	1:1	-	18.05
T-22186**	*600 ct	900 ct	-	3.0	2.0	.006	4	48	90	-	1:1.22	-	18.05
T-22187**	600 ct	1200 ct	300	3.0	2.0	.006	4	48	120	30	1:1.41	1.41:1	17.32
T-22190	640 ct	12.8 ct	3.2	3.0	2.0	.006	4	51	1.3	.32	7.07:1	14.14:1	17.32
T-22195	700 ct	100 ct	25	3.0	2.0	.006	3.5	56	10	2.5	2.65:1	5.29:1	17.32
T-22200	800 ct	12.8 ct	3.2	3.0	2.0	.006	3.5	64	1.3	.32	7.91:1	15.8:1	17.32
T-22205	800 ct	48 ct	12	3.0	2.0	.006	3.5	64	4.8	1.2	4.08:1	8.16:1	17.32
T-22210	800 ct	800 ct	200	3.0	2.0	.006	3.5	64	80	20	1:1	2:1	17.32
T-22215	900 ct	600 ct	150	3.0	2.0	.006	3	72	60	15	1.22:1	2.45:1	17.32
T-22217**	*900 ct	900 ct	-	3.0	2.0	.006	3	72	90	-	1:1	-	18.05
T-22220	1000 ct	12 ct	3	3.0	2.0	.006	3	80	1.2	.3	9.13:1	18.26:1	17.32
T-22225	1000 ct	50 ct	12.5	3.0	2.0	.006	3	80	5	1.25	4.47:1	8.94:1	17.32
T-22230	1000 ct	1000 ct	250	3.0	2.0	.006	3	80	100	25	1:1	2:1	17.32
T-22235	1060 ct	12.8 ct	3.2	3.0	2.0	.006	3	85	1.3	.32	9.1:1	18.2:1	17.32
T-22240	1200 ct	12.8 ct	3.2	3.0	2.0	.006	3	96	1.3	.32	9.68:1	19.4:1	17.32
T-22245	1200 ct	500 ct	125	3.0	2.0	.006	3	96	50	12.5	1.55:1	3.1:1	17.32
T-22250	1200 ct	1200 ct	300	3.0	2.0	.006	3	96	120	30	1:1	2:1	17.32
T-22255	*1200 ct	1200 ct	-	3.0	2.0	.006	3	96	120	-	1:1	-	18.05
T-22260	1500 ct	12 ct	3	3.0	2.0	.006	2.5	120	1.2	.3	11.18:1	22.36:1	17.32
T-22265	1500 ct	500 ct	125	3.0	2.0	.006	2.5	120	50	12.5	1.73:1	3.46:1	17.32
T-22270	*1500 ct	600 ct	-	3.0	2.0	.006	2.5	120	60	-	1.58:1	-	18.05
T-22275	*1500 ct	1500 ct	-	3.0	2.0	.006	2.5	120	150	-	1:1	-	18.05
T-22280	1600 ct	12.8 ct	3.2	3.0	2.0	.006	2.5	128	1.3	.32	11.18:1	22.36:1	17.32
T-22283	2000 ct	8 ct	2	3.0	2.0	.006	2.2	160	.8	.2	15.8:1	31.6:1	17.32
T-22285	2000 ct	2000 ct	500	3.0	2.0	.006	2.2	160	200	50	1:1	2:1	17.32
T-22290	*2000 ct	2000 ct	-	3.0	2.0	.006	2.2	160	200	-	1:1	-	18.05
T-22295	2000 ct	8000 ct	2000	3.0	2.0	.006	2.2	160	800	200	1:2	1:1	17.32
T-22297	2500 ct	2500 ct	625	3.0	2.0	.006	2	200	250	63	1:1	2:1	17.32
T-22300	3000 ct	3000 ct	750	3.0	2.0	.006	1.8	240	300	75	1:1	2:1	17.32
T-22305	*3000 ct	3000 ct	-	3.0	2.0	.006	1.8	240	300	-	1:1	-	17.32

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*For immediate engineering assistance or to place an order—**Call Toll Free 800-431-1064***

PICO PART NUMBER T-Series Plug-in	PRIMARY IMPEDANCE OHMS	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS SER	SECONDARY IMPEDANCE OHMS SPLIT WINDINGS PAR	POWER WATTS 1KHz and higher	POWER WATTS 300 Hz and higher	POWER WATTS 20 Hz and higher	PRIMARY UNBAL DC CURRENT ma	PRIMARY DC RESIST OHMS	SECONDARY DC RESISTANCE OHMS SER CONN	SECONDARY DC RESISTANCE OHMS PAR CONN	TURNS RATIO PRIM/SEC SEC SER CONN	TURNS RATIO PRIM/SEC SEC PAR CONN	PICO PRICES 1-9*** T-Series
T-22310	3600 ct	3600 ct	900	2.7	2.0	.006	1.7	288	360	90	1:1	2:1	17.32
T-22312	4000 ct	16 ct	4	2.5	2.0	.006	1.6	320	1.6	.4	15.8:1	31.6:1	17.32
T-22314**	4000 ct	600 ct	150	2.5	2.0	.006	1.6	320	60	15	2.58:1	5.16:1	17.32
T-22315	4000 ct	1000 ct	250	2.5	2.0	.006	1.6	320	100	25	2:1	4:1	17.32
T-22320	*4000 ct	8000 ct	-	2.5	2.0	.006	1.6	320	800	-	1:1.41	-	18.05
T-22325	5000 ct	500 ct	125	2.0	2.0	.006	1.4	400	50	12.5	3.16:1	6.32:1	17.32
T-22330	5000 ct	5000 ct	1250	2.0	2.0	.006	1.4	400	500	125	1:1	2:1	17.32
T-22335	7500 ct	50 ct	12.5	1.3	1.3	.006	1.2	600	5	1.25	12.25:1	24.5:1	19.22
T-22340	7500 ct	100 ct	25	1.3	1.3	.006	1.2	600	10	2.5	8.66:1	17.32:1	19.22
T-22345	7500 ct	600 ct	150	1.3	1.3	.006	1.2	600	60	15	3.54:1	7.07:1	19.22
T-22350	7500 ct	2500 ct	625	1.3	1.3	.006	1.2	600	250	63	1.73:1	3.46:1	19.22
T-22355	*7500 ct	7500 ct	-	1.3	1.3	.006	1.2	600	750	-	1:1	-	20.59
T-22360	8000 ct	12.8 ct	3.2	1.2	1.2	.006	1.1	640	1.3	.32	25:1	50:1	19.22
T-22365	8000 ct	1000 ct	250	1.2	1.2	.006	1.1	640	100	25	2.83:1	5.66:1	19.22
T-22370	*8000 ct	1200 ct	-	1.2	1.2	.006	1.1	640	120	-	2.58:1	-	20.59
T-22375	*9000 ct	9000 ct	-	1.1	1.1	.006	1.1	720	900	-	1:1	-	20.59
T-22380	10,000 ct	12.8 ct	3.2	1.0	1.0	.006	1	800	1.3	.32	28:1	56:1	19.22
T-22385	10,000 ct	16 ct	4	1.0	1.0	.006	1	800	1.6	.4	25:1	50:1	19.22
T-22390	10,000 ct	100 ct	25	1.0	1.0	.006	1	800	10	2.5	10:1	20:1	19.22
T-22395	10,000 ct	200 ct	50	1.0	1.0	.006	1	800	20	5	7.07:1	14.14:1	19.22
T-22400	10,000 ct	500 ct	125	1.0	1.0	.006	1	800	50	12.5	4.47:1	8.94:1	19.22
T-22405	10,000 ct	600 ct	150	1.0	1.0	.006	1	800	60	15	4.08:1	8.16:1	19.22
T-22410	10,000 ct	1000 ct	250	1.0	1.0	.006	1	800	100	25	3.16:1	6.32:1	19.22
T-22415	10,000 ct	1200 ct	300	1.0	1.0	.006	1	800	120	30	2.89:1	5.77:1	19.22
T-22420	10,000 ct	1500 ct	375	1.0	1.0	.006	1	800	150	38	2.58:1	5.16:1	19.22
T-22425	10,000 ct	2000 ct	500	1.0	1.0	.006	1	800	200	50	2.24:1	4.47:1	19.22
T-22430	10,000 ct	5000 ct	1250	1.0	1.0	.006	1	800	500	125	1.41:1	2.83:1	19.22
T-22435	10,000 ct	7500 ct	1875	1.0	1.0	.006	1	800	750	188	1.16:1	2.31:1	19.22
T-22440	10,000 ct	10,000 ct	2500	1.0	1.0	.006	1	800	1000	250	1:1	2:1	19.22
T-22445	*10,000 ct	10,000 ct	-	1.0	1.0	.006	1	800	1000	-	1:1	-	20.59
T-22450	15,000 ct	400 ct	100	.66	.66	.006	.8	1200	40	10	6.12:1	12.25:1	19.22
T-22452	15,000 ct	500 ct	125	.66	.66	.006	.8	1200	50	12.5	5.48:1	10.95:1	19.22
T-22455	15,000 ct	600 ct	150	.66	.66	.006	.8	1200	60	15	5:1	10:1	19.22
T-22460	15,000 ct	10,000 ct	2500	.66	.66	.006	.8	1200	1000	250	1.22:1	2.45:1	19.22
T-22465	*15,000 ct	15,000 ct	-	.66	.66	.006	.8	1200	1500	-	1:1	-	20.59
T-22470	15,000 ct	15,000 ct	3750	.66	.66	.006	.8	1200	1500	375	1:1	2:1	19.22
T-22475	16,000 ct	1000 ct	250	.62	.62	.006	.8	1280	100	25	4:1	8:1	19.22
T-22480	20,000 ct	500 ct	125	.5	.5	.006	.7	1600	50	12.5	6.32:1	12.65:1	20.59
T-22485	20,000 ct	600 ct	150	.5	.5	.006	.7	1600	60	15	5.77:1	11.55:1	20.59
T-22490	20,000 ct	800 ct	200	.5	.5	.006	.7	1600	80	20	5:1	10:1	20.59
T-22495	20,000 ct	1000 ct	250	.5	.5	.006	.7	1600	100	25	4.47:1	8.94:1	20.59
T-22500	20,000 ct	5000 ct	1250	.5	.5	.006	.7	1600	500	125	2:1	4:1	20.59
T-22505	20,000 ct	10,000 ct	2500	.5	.5	.006	.7	1600	1000	250	1.41:1	2.83:1	20.59
T-22510	*20,000 ct	20,000 ct	-	.5	.5	.006	.7	1600	2000	-	1:1	-	21.40
T-22515	25,000 ct	500 ct	125	.4	.4	.006	.6	2000	50	12.5	7.07:1	14.14:1	20.59
T-22520	25,000 ct	1000 ct	250	.4	.4	.006	.6	2000	100	25	5:1	10:1	20.59
T-22525	30,000 ct	50 ct	12.5	.33	.33	.006	.6	2400	5	1.25	24.5:1	49:1	21.40
T-22530	30,000 ct	1200 ct	300	.33	.33	.006	.6	2400	120	30	5:1	10:1	21.40
T-22532	30,000 ct	500 ct	125	.33	.33	.006	.6	2400	50	12.5	7.7:1	15.5:1	21.40
T-22534	30,000 ct	200 ct	50	.33	.33	.006	.6	2400	20	5	12.2:1	24.5:1	21.40
T-22535	30,000 ct	5000 ct	1250	.33	.33	.006	.6	2400	500	125	2.45:1	4.9:1	21.40
T-22540	30,000 ct	10,000 ct	2500	.33	.33	.006	.6	2400	1000	250	1.73:1	3.46:1	21.40
T-22545	*30,000 ct	30,000 ct	-	.33	.33	.006	.6	2400	3000	-	1:1	-	22.96
T-22550	40,000 ct	400 ct	100	.25	.25	.006	.5	3200	40	10	10:1	20:1	22.96
T-22555	40,000 ct	2000 ct	500	.25	.25	.006	.5	3200	200	50	4.47:1	8.94:1	22.96
T-22560	40,000 ct	4000 ct	1000	.25	.25	.006	.5	3200	400	100	3.16:1	6.32:1	22.96
T-22565	40,000 ct	20,000 ct	5000	.25	.25	.006	.5	3200	2000	500	1.41:1	2.83:1	22.96
T-22570	*40,000 ct	40,000 ct	-	.25	.25	.006	.5	3200	4000	-	1:1	-	25.60
T-22575	50,000 ct	200 ct	50	.2	.2	.006	.4	4000	20	5	15.8:1	31.6:1	25.60
T-22577	50,000 ct	500 ct	125	.2	.2	.006	.4	4000	50	12.5	10:1	20:1	25.60
T-22578	50,000 ct	600 ct	150	.2	.2	.006	.4	4000	60	15	9.13:1	18.26:1	25.60
T-22579	50,000 ct	50,000 ct	12,500	.2	.2	.006	.4	4000	5000	1250	1:1	2:1	25.60
T-22580	60,000 ct	15,000 ct	3750	.16	.16	.006	.4	4800	1500	375	2:1	4:1	27.64
T-22585	62,500 ct	50 ct	12.5	.16	.16	.006	.4	5000	5	1.25	35.4:1	70.7:1	27.64
T-22587	80,000 ct	15,000 ct	3750	.12	.12	.006	.3	6400	1500	375	2.3:1	4.6:1	27.64

*INCLUDES ELECTROSTATIC SHIELD
**MINIATURIZED TELEPHONE COUPLING APPLICATION

***Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

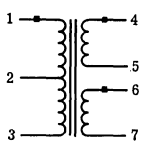
PICO's ultra-miniature transformers

T SERIES Plug-In

FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- PICO IS APPROVED QPL SOURCE (MIL-T-27)
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- PRIMARY AND SECONDARY WINDINGS CAN BE USED EITHER AS INPUT OR OUTPUT
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

SCHEMATIC FOR TRANSFORMERS WITH SPLIT SECONDARIES



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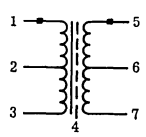

For immediate engineering assistance or to place an order—

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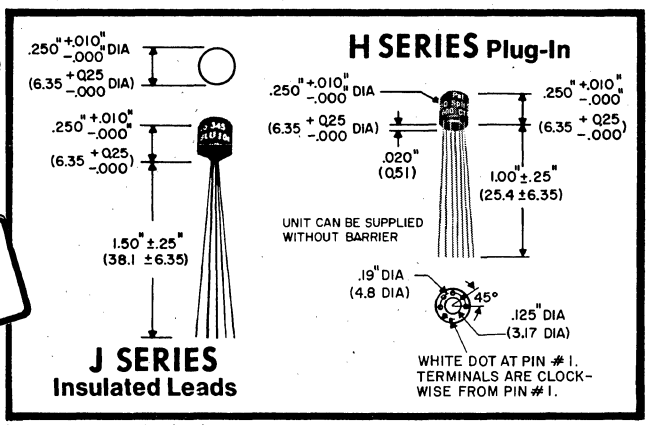
Delivery— stock to one week

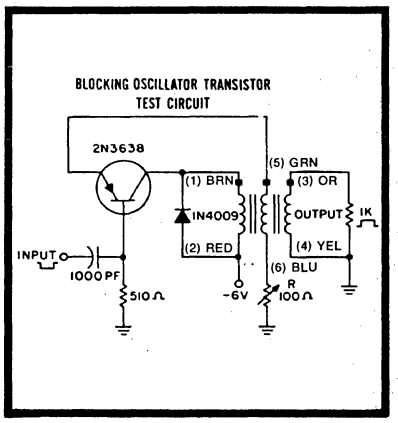
PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

PICO's ultra-miniature PULSE transformers

1/4" x 1/4"





Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-21038: Units Meet MIL-T-21038 and are Hermetically Sealed in a Metal Case
- DIELECTRIC STRENGTH: All Units tested at 200 V RMS
- INSULATION RESISTANCE: Greater than 10,000 Megohms at 300 V DC
- WEIGHT: 1.1 Grams
- OPERATING TEMPERATURE: -55°c to 105°c (All Units Can be Supplied to Class S Requirements 130°c maximum)
- TERMINALS: . . . . . Solid .012 Diameter Conductor. Conductor is copper clad steel, Tinned 100%. Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: 25 Cycles, Method 107C, MIL-STD-202D. Test Conduction A-1

FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- BUILT TO MIL-T-21038
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

This Product is Patented

MILITARY DESIGNATION TP7RX4410CZ TURNS RATIO 4:4:1

PICO PART NUMBER		COUPLING CIRCUIT CHARACTERISTICS							BLOCKING OSCILLATOR CIRCUIT					PICO PRICES 1-9 *	
H-Series Plug-In	J-Series Insulated Leads	P Width μSec	Volt Out	Rise Time	Over Shoot %	Droop %	Back Swing %	Imp* in/out,	P Width μSec	Rise Time	Over Shoot %	Droop %	Back Swing %	H-Series	J-Series
H-5400	J-5600	0.05	0.2	0.01	0	0	20	50	0.05	0.01	0	0	35	13.60	12.48
H-5405	J-5605	0.1	0.5	0.015	0	0	20	50	0.1	0.012	0	0	25	13.60	12.48
H-5410	J-5610	0.2	1.2	0.02	0	0	20	100	0.2	0.02	0	0	15	13.60	12.48
H-5415	J-5615	0.5	1.5	0.023	0	5	25	100	0.5	0.023	0	5	15	13.60	12.48
H-5420	J-5620	1	1.5	0.025	0	20	28	100	1	0.03	0	10	15	13.60	12.48
H-5425	J-5625	2	1.5	0.028	0	15	23	100	2	0.035	0	10	15	13.60	12.48
H-5430	J-5630	3	1.5	0.030	0	15	28	100	3	0.04	0	10	15	13.60	12.48
H-5435	J-5635	5	2	0.035	0	20	20	200	5	0.040	0	15	15	13.60	12.48
H-5440	J-5640	10	2	0.05	0	25	25	200	10	0.060	0	15	10	13.60	12.48
H-5445	J-5645	15	2	0.06	0	25	18	200	15	0.07	0	15	15	13.60	12.48
H-5450	J-5650	25	3	0.1	0	30	30	500	25	0.08	0	15	15	13.60	12.48
H-5455	J-5655	50	3	0.3	0	20	20	500	50	0.2	0	10	5	13.60	12.48
H-5460	J-5660	100	6	0.4	0	15	18	500	100	0.35	0	10	15	13.60	12.48

Coupling circuit measurements made with (1) BRN—(2) RED as input and (3) OR—(4) YEL as output, (5) GRN—(6) BLU winding is open: Input Voltage = 1 V

* Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

Delivery— stock to one week

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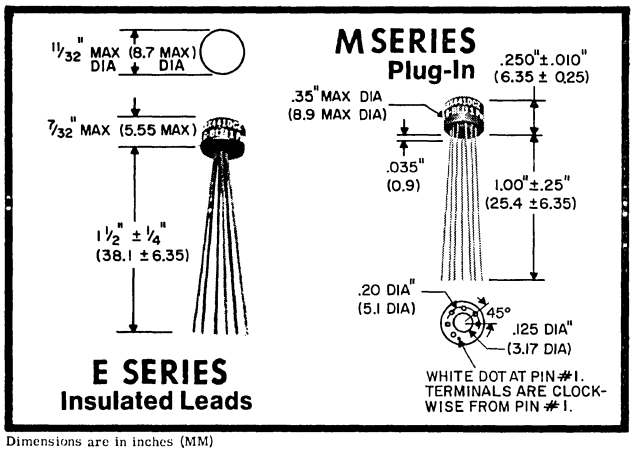
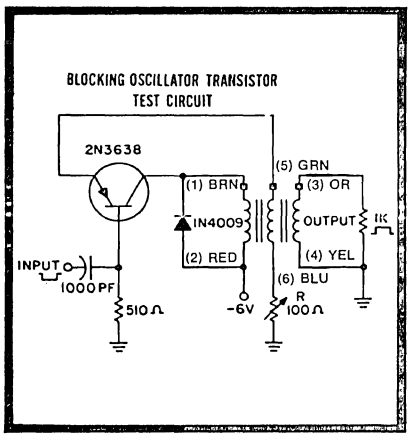




PICO's ultra-miniature PULSE transformers

Dimensions are in inches (MM)

SPECIFICATIONS

- MIL-T-21038: All Units Meet MIL-T-21038 and are Hermetically Sealed in a Metal Case
- DIELECTRIC STRENGTH: All Units tested at 200 V RMS
- INSULATION RESISTANCE: Greater than 10,000 Megohms at 300 V DC
- WEIGHT: 1/20 Ounce
- OPERATING TEMPERATURE: -55°c to 105°c (All Units Can be Supplied to Class S Requirements 130°c maximum)
- TERMINALS: . . . . . Solid .012 Diameter Conductor. Conductor is copper clad steel, Tinned 100%. Electroplated Per MIL-T-10727A and ASTM CCS B452.
- THERMAL SHOCK: 25 Cycles, Method 107C, MIL-STD-202D. Test Conduction A-1

This Product is Patented

FEATURES

- EXTREME RESISTANCE TO THERMAL SHOCK
- ULTRA MINIATURE SIZE
- BUILT TO MIL-T-21038
- MAGNETIC SHIELDS AVAILABLE
- ELECTROSTATIC SHIELDING CAN BE ADDED
- VARIATION OF STANDARD DESIGNS AVAILABLE
- SPECIAL PRODUCTION TECHNIQUES ENSURE UNIFORM SIZE AND LEADS WHICH ARE FREE OF ENCAPSULANT. NO MENISCUS IN LEAD AREA.
- EVERY UNIT IN THIS CATALOG CAN BE MADE WITH A 300 THERMAL CYCLE GUARANTEE USING PICO'S SPECIAL SR CONSTRUCTION. CONTACT FACTORY FOR DETAILS.

MILITARY DESIGNATION TP6RX4410CZ TURNS RATIO 4:4:1

PICO PART NUMBER		COUPLING CIRCUIT CHARACTERISTICS								BLOCKING OSCILLATOR CIRCUIT					D.C. RESISTANCE			PICO PRICES 1-9 *	
E-Series Insulated Leads	M-Series Plug-In	P. WIDTH μ SEC.	VOLT OUT	RISE TIME μ SEC.	% OVER SHOOT	DROOP %	% BACK SWING	IMP IN/OUT	FREQ RESP. WITHIN 2DB	P. WIDTH μ SEC.	RISE TIME μ SEC.	% OVER SHOOT	DROOP %	% BACK SWING	4 TNS BRN RED	4 TNS OR YEL	1 TURN GRN BLU	E-Series	M-Series
E5020	M5300	0.05	10	0.018	0	0	10	50	150 KHz-30 MHz	0.05	0.02	0	0	35	0.21	0.23	0.13	9.45	10.48
E5040	M5305	0.1	10	0.02	0	0	5	50	100 KHz-17 MHz	0.1	0.025	0	0	25	0.47	0.56	0.17	9.45	10.48
E5060	M5310	0.2	8	0.035	0	0	5	100	16 KHz-10 MHz	0.2	0.030	0	0	15	1.0	1.25	0.37	9.45	10.48
E5080	M5315	0.5	8	0.06	0	0	0	100	7 KHz-3.3 MHz	0.5	0.05	0	0	15	1.5	1.80	0.54	9.45	10.48
E5100	M5320	1	8	0.15	0	0	5	100	7 KHz-2.3 MHz	1	0.08	0	0	15	2.5	3.1	0.9	9.45	10.48
E5120	M5325	2	8	0.17	0	0	10	100	2.2 KHz-1.3 MHz	2	0.10	0	0	15	3.0	3.7	1.1	9.45	10.48
E5140	M5330	3	8	0.20	0	0	10	100	1.7 KHz-1.5 MHz	3	0.20	0	0	15	4.9	6.0	1.8	9.45	10.48
E5160	M5335	5	8	0.20	0	15	25	200	1.8 KHz-1.5 MHz	5	0.30	0	0	3	8.0	9.7	2.9	9.45	10.48
E5180	M5340	10	8	0.4	0	15	20	200	1.5 KHz-1.2 MHz	10	0.35	0	5	10	13.0	15.8	4.7	9.45	10.48

MILITARY DESIGNATION TP6RX5310CZ TURNS RATIO 5:3:1

															5 TURNS	3 TURNS	1 TURN		
E5200	M5345	0.1	8	0.01	0	0	5	140/50	170 KHz-32 MHz	0.1	0.01	0	0	20	0.55	0.40	0.15	9.45	10.48
E5220	M5350	1	8	0.05	0	6	10	280/100	12.5 KHz-3.3 MHz	1	0.02	5	5	5	3.0	2.2	0.9	9.45	10.48
E5240	M5355	5	8	0.09	0	12	25	560/200	15 KHz-4 MHz	5	0.05	0	10	10	9.5	7.0	2.6	9.45	10.48

MILITARY DESIGNATION TP6RX4440CZ TURNS RATIO 4:4:4

PICO PART NUMBER		COUPLING CIRCUIT CHARACTERISTICS											PICO PRICES 1-9 *	
E-Series Insulated Leads	M-Series Plug-In	P. WIDTH μ SEC.	VOLT OUT	RISE TIME μ SEC.	% OVER SHOOT	DROOP %	% BACK SWING	IMP IN/OUT	FREQ RESP. WITHIN 2DB	4 TNS BRN RED	4 TNS OR YEL	4 TURNS GRN BLU	E-Series	M-Series
E5181	M-5356	0.05	10	0.018	0	0	10	50	150 KHz-30 MHz	0.21	0.23	0.25	10.48	10.48
E5182	M-5357	0.1	10	0.02	0	0	5	50	100 KHz-17 MHz	0.47	0.56	0.67	10.48	10.48
E5183	M-5358	0.2	8	0.035	0	0	5	100	16 KHz-10 MHz	1.0	1.25	1.56	10.48	10.48
E5184	M-5359	0.5	8	0.06	0	0	0	100	7 KHz-3.3 MHz	1.5	1.80	2.2	10.48	10.48
E5185	M-5360	1	8	0.15	0	0	5	100	7 KHz-2.3 MHz	2.5	3.1	3.9	10.48	10.48
E5186	M-5361	2	8	0.17	0	0	10	100	2.2 KHz-1.3 MHz	3.0	3.7	4.6	10.48	10.48
E5187	M-5362	3	8	0.20	0	0	10	100	1.7 KHz-1.5 MHz	4.9	6.0	7.4	10.48	10.48
E5188	M-5363	5	8	0.20	0	15	25	200	1.8 KHz-1.5 MHz	8.0	9.7	11.8	10.48	10.48
E5189	M-5364	10	8	0.4	0	15	20	200	1.5 KHz-1.2 MHz	13.0	15.8	19.2	10.48	10.48

Coupling circuit measurements made with (1) BRN—(2) RED as input and (3) OR—(4) YEL as output, (5) GRN—(6) BLU winding is open: Input Voltage = 1V

* Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

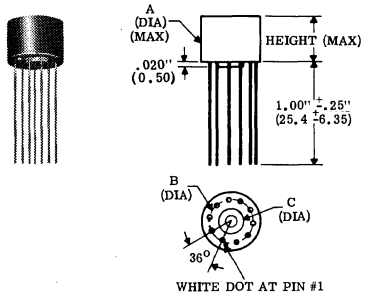
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

Delivery— stock to one week

For immediate engineering assistance or to place an order— ***Call Toll Free 800-431-1064***

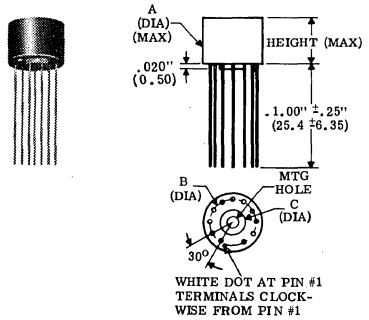
PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514



SIZE	MAX. HEIGHT	A MAX. DIA	B BOLT CIRCLE	C STAND-OFF
1	.280 (7.11)	.410 (10.41)	.260 (6.6)	.160 (4.06)
2	.340 (6.63)	.500 (12.7)	.350 (8.89)	.250 (6.35)
3	.415 (10.54)	.630 (16.0)	.440 (11.17)	.340 (8.64)

All dimensions are in inches, ( )=MM



SIZE	MAX. HEIGHT	A MAX. DIA	B BOLT CIRCLE	C STAND-OFF	MTG HOLE
4	.500 (12.7)	.800 (20.32)	.560 (14.22)	.460 (11.68)	—
5	.635 (16.12)	.950 (24.13)	.670 (17.0)	.570 (14.48)	.140 (3.55)
6	.745 (18.92)	1.125 (28.57)	.800 (20.32)	.700 (17.78)	.170 (4.31)

All dimensions are in inches, ( )=MM

Ultra Miniature DC-DC Converter Transformers

Input Voltages of: 5V, 12V, 24V and 48V

Power Levels up to 40 Watts

All units are magnetically shielded

All units can be supplied with higher or lower output voltages. (Example, size 2 can have output voltage of 400V D.C.)

Delivery- stock to one week, special voltages 9 days.

INPUT 5 VOLTS

PART NUMBER	D.C. OUT VOLTS FULL WAVE BRIDGE	FULL WAVE	DUAL BRIDGE	MAX. POWER OUT -55°c-+105°c	-55°c -+70°c	APPROX. SWITCH FREQ. SELF-SATURATED	SQUARE-WAVE DRIVEN**	SIZE	*** PRICE 1-9
31020	10	5	± 5	1.5W	3W	15K	30K to 60K	1	22.38
31040	12	6	± 6	1.5W	3W	15K	30K to 60K	1	22.38
31060	28	14	±14	1.5W	3W	15K	30K to 60K	1	22.38
31080	48	24	±24	1.5W	3W	20K	40K to 60K	1	22.38
31100	100	50	±50	1.5W	3W	20K	40K to 60K	1	22.38
32105	10	5.	± 5	3W	4.5W	15K	30K to 60K	2	22.38
32125	12	6	± 6	3W	4.5W	15K	30K to 60K	2	22.38
32145	28	14	±14	3W	4.5W	15K	30K to 60K	2	22.38
32165	48	24	±24	3W	4.5W	20K	40K to 60K	2	22.38
32185	100	50	±50	3W	4.5W	20K	40K to 60K	2	22.38
33103	10	5	± 5	5W	7.5W	10K	20K to 50K	3	22.38
33123	12	6	± 6	5W	7.5W	10K	20K to 50K	3	22.38
33143	28	14	±14	5W	7.5W	10K	20K to 50K	3	22.38
33163	48	24	±24	5W	7.5W	10K	20K to 50K	3	22.38
33183	100	50	±50	5W	7.5W	10K	20K to 50K	3	22.38
34500	10	5	± 5	10W	14W	10K	20K to 40K	4	22.38
34520	28	14	±14	10W	14W	10K	20K to 40K	4	22.38
34540	48	24	±24	10W	14W	10K	20K to 40K	4	22.38

** Lower switching frequency may be used at lower output power.

INPUT 12 VOLTS

PART NUMBER	D.C. OUT VOLTS FULL WAVE BRIDGE	FULL WAVE	DUAL BRIDGE	MAX. POWER OUT -55°c-+105°c	-55°c -+70°c	APPROX. SWITCH FREQ. SELF-SATURATED	SQUARE-WAVE DRIVEN**	SIZE	*** PRICE 1-9
31120	12	6	± 6	1.5W	3W	15K	30K to 60K	1	22.38
31140	24	12	±12	1.5W	3W	15K	30K to 60K	1	22.38
31160	28	14	±14	1.5W	3W	15K	30K to 60K	1	22.38
31180	48	24	±24	1.5W	3W	20K	40K to 60K	1	22.38
31200	100	50	±50	1.5W	3W	20K	40K to 60K	1	22.38
32205	12	6	± 6	3W	4.5W	15K	30K to 60K	2	22.38
32225	24	12	±12	3W	4.5W	15K	30K to 60K	2	22.38
32245	28	14	±14	3W	4.5W	15K	30K to 60K	2	22.38
32265	48	24	±24	3W	4.5W	20K	40K to 60K	2	22.38
32285	100	50	±50	3W	4.5W	20K	40K to 60K	2	22.38
33203	12	6	± 6	5W	7.5W	15K	30K to 60K	3	22.38
33223	28	14	±14	5W	7.5W	15K	30K to 60K	3	22.38
33243	48	24	±24	5W	7.5W	20K	40K to 60K	3	22.38
33263	100	50	±50	5W	7.5W	20K	40K to 60K	3	22.38
34560	24	12	±12	10W	14W	15K	30K to 50K	4	22.38
34580	28	14	±14	10W	14W	15K	30K to 50K	4	22.38
34600	48	24	±24	10W	14W	15K	30K to 50K	4	22.38
35107	24	12	±12	17W	25W	15K	30K to 50K	5	33.57
35127	28	14	±14	17W	25W	15K	30K to 50K	5	33.57
35147	48	24	±24	17W	25W	15K	30K to 50K	5	33.57

**Lower switching frequency may be used at lower output power.

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%

Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

FEATURES

1) Units can be used as self-saturating or for linear switching applications. Operation over ambient temperature range from −55°c to +105°c. All units meet the requirements of MIL-T-27 (TF5S40ZZ)
2) All units can be supplied with higher or lower secondary voltages at the same power levels.
3) Secondary can be connected for full-wave bridge or dual bridge.
4) All units are magnetically shielded.

For immediate engineering assistance or to place an order—

Call Toll Free 800-431-1064

PICO Electronics, Inc.

453 North Mac Questen Pkwy.
Mt. Vernon, New York 10552

phone
914-699-5514

INPUT 24 VOLTS

PART NUMBER	D.C. OUT VOLTS FULL WAVE BRIDGE	FULL WAVE	DUAL BRIDGE	MAX. POWER OUT -55°c -+105°c	-55°c -+70°c	APPROX. SWITCH FREQ. SELF-SATURATED	SQUARE-WAVE DRIVEN**	SIZE	*** PRICE 1-9
31220	10	5	± 5	1.5W	3W	15K	30K to 60K	1	22.38
31240	28	14	±14	1.5W	3W	15K	30K to 60K	1	22.38
31260	48	24	±24	1.5W	3W	20K	40K to 60K	1	22.38
31280	100	50	±50	1.5W	3W	20K	40K to 60K	1	22.38
32305	10	5	± 5	3W	4.5W	15K	30K to 60K	2	22.38
32325	28	14	±14	3W	4.5W	15K	30K to 60K	2	22.38
32345	48	24	±24	3W	4.5W	20K	40K to 60K	2	22.38
32365	100	50	±50	3W	4.5W	20K	40K to 60K	2	22.38
33283	10	5	± 5	5W	7.5W	15K	30K to 60K	3	22.38
33303	28	14	±14	5W	7.5W	15K	30K to 60K	3	22.38
33323	48	24	±24	5W	7.5W	20K	40K to 60K	3	22.38
33343	100	50	±50	5W	7.5W	20K	40K to 60K	3	22.38
34620	28	14	±14	10W	14W	15K	30K to 50K	4	22.38
34640	48	24	±24	10W	14W	15K	30K to 50K	4	22.38
35167	24	12	±12	17W	25W	15K	30K to 50K	5	33.57
35187	28	14	±14	17W	25W	15K	30K to 50K	5	33.57
35207	48	24	±24	17W	25W	15K	30K to 50K	5	33.57
36705	48	24	±24	25W	40W	15K	30K to 40K	6	38.72
36725	56	28	±28	25W	40W	15K	30K to 40K	6	38.72

** Lower switching frequency may be used at lower output power.

INPUT 48 VOLTS

PART NUMBER	D.C. OUT VOLTS FULL WAVE BRIDGE	FULL WAVE	DUAL BRIDGE	MAX. POWER OUT -55°c -+105°c	-55°c -+70°c	APPROX. SWITCH FREQ. SELF-SATURATED	SQUARE-WAVE DRIVEN**	SIZE	*** PRICE 1-9
31300	24	12	±12	1.5W	3W	15K	30K to 60K	1	22.38
31320	48	24	±24	1.5W	3W	20K	40K to 60K	1	22.38
31340	100	50	±50	1.5W	3W	20K	40K to 60K	1	22.38
31360	150	75	±75	1.5W	3W	20K	40K to 60K	1	22.38
32385	24	12	±12	3W	4.5W	15K	30K to 60K	2	22.38
32405	48	24	±24	3W	4.5W	20K	40K to 60K	2	22.38
32425	100	50	±50	3W	4.5W	20K	40K to 60K	2	22.38
32445	150	75	±75	3W	4.5W	20K	40K to 60K	2	22.38
33363	24	12	±12	5W	7.5W	15K	30K to 60K	3	22.38
33383	48	24	±24	5W	7.5W	20K	40K to 60K	3	22.38
33403	100	50	±50	5W	7.5W	20K	40K to 60K	3	22.38
33423	150	75	±75	5W	7.5W	20K	40K to 60K	3	22.38
34660	24	12	±12	10W	14W	15K	30K to 50K	4	22.38
34680	48	24	±24	10W	14W	15K	30K to 50K	4	22.38
34700	56	28	±28	10W	14W	15K	30K to 50K	4	22.38
35227	24	12	±12	17W	25W	15K	30K to 50K	5	33.57
35247	48	24	±24	17W	25W	15K	30K to 50K	5	33.57
35267	56	28	±28	17W	25W	15K	30K to 50K	5	33.57
36745	48	24	±24	25W	40W	15K	30K to 40K	6	38.72
36765	56	28	±28	25W	40W	15K	30K to 40K	6	38.72
36785	100	50	±50	25W	40W	15K	30K to 40K	6	38.72

** Lower switching frequency may be used at lower output power.

*** Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

For immediate engineering assistance or to place an order—
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PICO Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552 • 914-699-5514

SCHEMATIC FOR SIZES 1, 2 & 3 USING TRANSFORMERS AS SELF-SATURATING

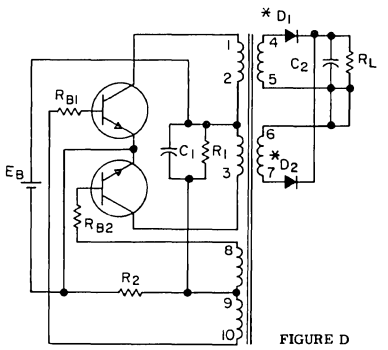


FIGURE D

SCHEMATIC FOR SIZES 1, 2, AND 3 USING TRANSFORMERS AS LINEAR SWITCHING

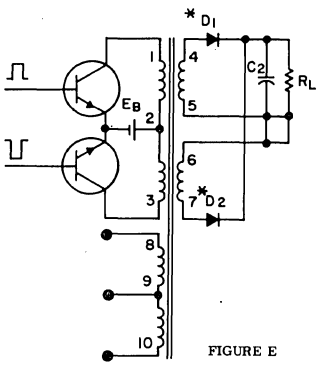


FIGURE E

* D1 AND D2 USE SCHOTTKY OR FAST SWITCHING DIODES

SCHEMATIC FOR SIZES 4, 5 & 6 USING TRANSFORMER AS SELF-SATURATING

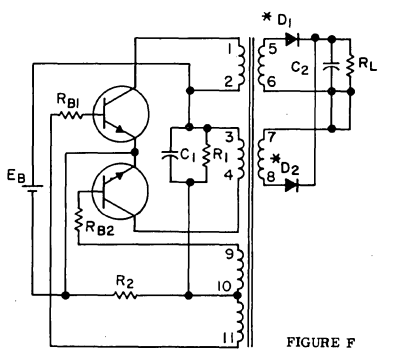


FIGURE F

SCHEMATIC FOR SIZES 4, 5 & 6 USING TRANSFORMERS AS LINEAR SWITCHING.

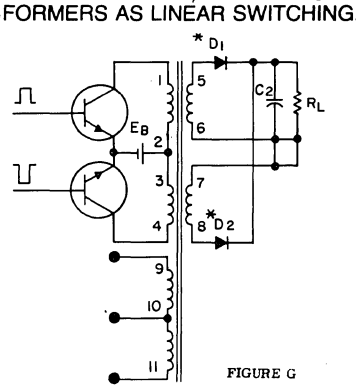


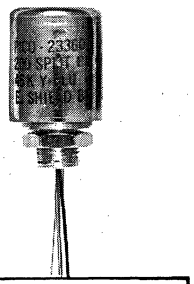
FIGURE G

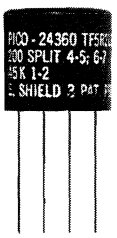
*D1 & D2 USE SCHOTTKY OR FAST SWITCHING DIODES

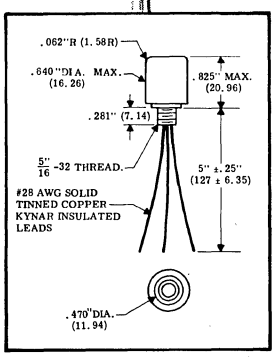
PICO Microphone/Transducer Audio Input Transformers

Used for Professional Sound Studios/Broadcast Mixing Consoles/Control and Instrument Amplifiers.

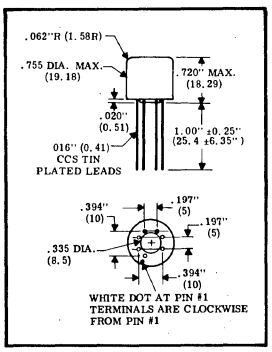
Interchangeable with transformers made by Beyer Dynamic of Germany.







NOTE:
ALL DIMENSIONS ARE IN INCHES, ( ) = MM



NOTES:
ALL DIMENSIONS ARE IN INCHES, ( )=MM.
CCS-COPPER CLAD STEEL, TINNED 100%.
ELECTROPLATED PER MIL-T-10727A AND ASTM CCS B452.

- ***Large step-up ratios with flat frequency response over the entire audio range.***
- ***Gapless laminations provide wide bandwidth with extremely low distortion. Use of two magnetic shields made with extra thick mu-metal and gapless core provide negligible hum pick up. All units provided with electrostatic shield.***
- ***Your choice of two package styles, stud mounting with flying leads or low profile plug-in. Identical electrical performance regardless of package style.***
- ***Frequency response ±1 dB, 30 Hz – 15 kHz.***
- ***Low profile plug-in (24000 series) meets MIL-T-27D (TF5R21ZZ).***
- ***Because of gapless laminations, unbalanced DC current should be avoided.***
- ***Typical distortion of 1% at power level of 0 dBm (1 Milliwatt), 30 Hz – 15 kHz. If the low frequency is raised, the power level for 1% distortion is as follows:***

50 Hz	-	3 Milliwatts (4.7 dBm)
100 Hz	-	10 Milliwatts (10 dBm)
300 Hz	-	150 Milliwatts (21.7 dBm)

For immediate engineering assistance or to place an order—
Call Toll Free 800-431-1064

All units have two extra thick mu-metal shields.

Delivery-Stock to 1 week

Modification of standards 9 days!

This Product is Patented

PART NUMBER		IMPEDANCE OHMS		TURNS RATIO PRIM/SEC		D.C. RESISTANCE			TYPICAL PRIM OPEN CIRCUIT IMPEDANCE AT 50 Hz	REPLACES BEYER/GERMANY PART NUMBER		PRICES 1-9***	
STUD MOUNTING	PLUG-IN	PRIM	SEC	PRIM SERIES CONN	PRIM PAR CONN	PRIM SERIES CONN	PRIM PAR CONN	SEC		STUD MOUNTING (23000 SERIES)	PLUG-IN (24000 SERIES)	STUD MOUNTING	PLUG-IN
23120	24120	12.5	5K	1:20	-	4.6	-	1K	125	TR-BV35704	STR-BV37704	16.82	20.19
23140	24140	200	200	1:1	-	50	-	75	2K	351 001 001	370 001 001	15.91	18.56
23160	24160	200 ct/50 SPLIT	200	1:1	1:2	50	12.5	75	2K	351 201 001	370 201 001	15.69	19.07
23180	24180	200	2K	1:3.16	-	50	-	580	2K	351 003 002	370 003 002	15.91	18.56
23200	24200	200 ct/50 SPLIT	2K	1:3.16	1:6.33	50	12.5	580	2K	351 203 002	370 203 002	15.69	19.07
23220	24220	200	5K	1:5	-	50	-	1.45K	2K	351 005 003	370 005 003	15.91	18.56
23240	24240	200 ct/50 SPLIT	5K	1:5	1:10	50	12.5	1.45K	2K	351 205 003	370 205 003	15.91	20.81
23260	24260	200	10K	1:7.07	-	50	-	3.45K	2K	351 007 004	370 007 004	15.69	19.07
23280	24280	200 ct/50 SPLIT	10K	1:7.07	1:14.14	50	12.5	3.45K	2K	351 207 004	370 207 004	17.94	21.32
23300	24300	200	20K	1:10	-	85	-	4.75K	2K	351 010 005	370 010 005	16.31	19.69
23320	24320	200 ct/50 SPLIT	20K	1:10	1:20	85	21	4.75K	2K	351 210 005	370 210 005	18.56	21.94
23340	24340	200	45K	1:15	-	85	-	10.4 K	2K	351 015 006	370 015 006	19.07	22.44
23360	24360	200 ct/50 SPLIT	45K	1:15	1:30	85	21	10.4 K	2K	351 215 006	370 215 006	21.32	24.70
23380	24380	200	80K	1:20	-	115	-	13.5 K	2K	351 020 007	370 020 007	20.19	23.57
23400	24400	200 ct/50 SPLIT	80K	1:20	1:40	115	29	13.5 K	2K	351 220 007	370 220 007	22.44	25.82
23420	24420	600 ct	600	1:1	-	140	-	190	6K	TR-145/BV35508 351 101 031	STR-145/BV37508 370 101 031	15.69	19.07
23440	24440	600 ct/150 SPLIT	600	1:1	1:2	140	35	190	6K	351 201 031	370 201 031	16.82	20.19
23460	24460	600 ct/150 SPLIT	2.4K	1:2	1:4	140	35	575	6K	351 202 032	370 202 032	17.94	21.32
23480	24480	600 ct/150 SPLIT	6K	1:3.16	1:6.33	140	35	1.45K	6K	351 203 033	370 203 033	19.07	22.44
23500	24500	600 ct/150 SPLIT	15K	1:5	1:10	140	35	3.9 K	6K	351 205 034	370 205 034	20.19	23.57
23520	24520	600 ct/150 SPLIT	30K	1:7.07	1:14.14	140	35	7.05K	6K	351 207 035	370 207 035	21.32	24.70
23540	24540	600 ct/150 SPLIT	60K	1:10	1:20	199	50	11 K	6K	351 210 036	370 210 036	22.44	25.82
23560	24560	1.2K ct/300 SPLIT	1.2K	1:1	1:2	310	78	430	12K	351 201 061	370 201 061	16.82	20.19
23580	24580	1.2K ct/300 SPLIT	5K	1:2.04	1:4.08	310	78	1.4 K	12K	351 202 062	370 202 062	17.94	21.32
23600	24600	1.2K ct/300 SPLIT	12K	1:3.16	1:6.33	310	78	3.75K	12K	351 203 063	370 203 063	19.07	22.44
23620	24620	1.2K ct/300 SPLIT	30K	1:5	1:10	475	119	8.45K	12K	351 205 064	370 205 064	20.19	23.57
23640	24640	10K	10K	1:1	-	2.5 K	-	3.1K	100K	TR-145/BV35590	STR-145/BV37590	15.91	18.56

***Discount Prices: 1-9 Net; 10-24 less 10%; 25-49 less 16%; 50-99 less 23%; 100-499 less 30%
Ordering Instructions: No minimum. Net 30 days F.O.B. Mt. Vernon, New York. P.O. Box 1206

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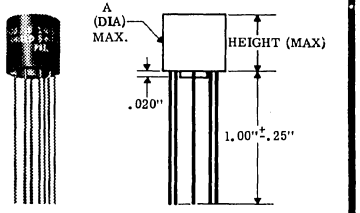
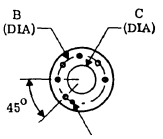
PICO's miniature 400 Hz transformers

115V/26V Primary
Printed Circuit Construction





WHITE DOT AT TERMINAL #1
TERMINALS CLOCKWISE FROM
PIN #1

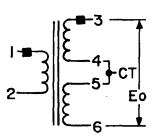
CASE SIZE	HEIGHT (MAX)	A (DIA) MAX	B (DIA)	C (DIA)
L	.35	.51	.35	.218
N	.5	.51	.35	.218
R	.375	.75	.6	.475
S	.52	.75	.6	.475
T	.82	.75	.6	.475

FEATURES

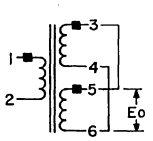
- 400 Hz Aerospace Application
- Smallest Possible Size
- Printed Circuit Plug-In Construction
- Secondary Has Split Winding (Secondary can Be Used at Half Voltage Twice the Current.)

SPECIFICATIONS

- MIL-T-27D (TF5S03ZZ)
- 90°c Ambient
- Input Primary 115v-400 Hz ±20 Hz or 26V-400HZ-±20 Hz (Your Choice-Just Choose The Proper Part No.)
- Regulation is 24% (T Units Have Regulation of 17%)
- Secondary Voltage Adjusted to Nominal Value at Half Load.



SERIES CONNECTED SECONDARY



PARALLEL CONNECTED SECONDARY

This Product is Patented

SEC/ VOLT	SEC/ CURRENT ma	SIZE	MODEL NUMBER 115V PRIMARY	MODEL NUMBER 26V PRIMARY	PICO PRICES 1-9*
5.0 CT	75	L	L-8948	L-8951	19.08
	150	N	N-6948	N-6951	19.08
	204	R	R-20650	R-20815	22.97
	338	S	S-21650	S-21815	25.06
	480	T	T-22650	T-22815	26.12
6.3 CT	59.5	L	L-8947	L-8952	19.08
	119	N	N-6947	N-6952	19.08
	162	R	R-20655	R-20820	22.97
	268	S	S-21655	S-21820	25.06
	381	T	T-22655	T-22820	26.12
8.0 CT	47	L	L-8946	L-8953	19.08
	94	N	N-6946	N-6953	19.08
	128	R	R-20660	R-20825	22.97
	211	S	S-21660	S-21825	25.06
	300	T	T-22660	T-22825	26.12
10 CT	37.5	L	L-8945	L-8954	19.08
	75	N	N-6945	N-6954	19.08
	102	R	R-20665	R-20830	22.97
	169	S	S-21665	S-21830	25.06
	240	T	T-22665	T-22830	26.12
12.8 CT	29	L	L-8940	L-8956	19.08
	58.6	N	N-6940	N-6956	19.08
	79.7	R	R-20670	R-20835	22.97
	132	S	S-21670	S-21835	25.06
	188	T	T-22670	T-22835	26.12
14 CT	26.8	L	L-8937	L-8957	19.08
	53.6	N	N-6937	N-6957	19.08
	72.9	R	R-20675	R-20840	22.97
	121	S	S-21675	S-21840	25.06
	171	T	T-22675	T-22840	26.12
16 CT	23	L	L-8935	L-8958	19.08
	47	N	N-6935	N-6958	19.08
	63.8	R	R-20680	R-20845	22.97
	106	S	S-21680	S-21845	25.06
	150	T	T-22680	T-22845	26.12
18 CT	20.8	L	L-8934	L-8959	19.08
	41.7	N	N-6934	N-6959	19.08
	56.7	R	R-20685	R-20850	22.97
	93.9	S	S-21685	S-21850	25.06
	133	T	T-22685	T-22850	26.12
20 CT	18.8	L	L-8933	L-8961	19.08
	37.5	N	N-6933	N-6961	19.08
	51	R	R-20690	R-20855	22.97
	84.5	S	S-21690	S-21855	25.06
	120	T	T-22690	T-22855	26.12
22 CT	17	L	L-8932	L-8962	19.08
	34	N	N-6932	N-6962	19.08
	46.4	R	R-20695	R-20860	22.97
	76.8	S	S-21695	S-21860	25.06
	109	T	T-22695	T-22860	26.12
24 CT	15.5	L	L-8930	L-8963	19.08
	31	N	N-6930	N-6963	19.08
	42.5	R	R-20700	R-20865	22.97
	70.4	S	S-21700	S-21865	25.06
	100	T	T-22700	T-22865	26.12
28 CT	13.4	L	L-8929	L-8964	19.08
	26.8	N	N-6929	N-6964	19.08
	36.4	R	R-20705	R-20870	22.97
	60.4	S	S-21705	S-21870	25.06
	85.7	T	T-22705	T-22870	26.12
31 CT	12	L	L-8927	L-8966	19.08
	24	N	N-6927	N-6966	19.08
	32.9	R	R-20710	R-20875	22.97
	54.5	S	S-21710	S-21875	25.06
	77.4	T	T-22710	T-22875	26.12
36 CT	10.4	L	L-8925	L-8967	19.08
	20.8	N	N-6925	N-6967	19.08
	28.3	R	R-20715	R-20880	22.97
	46.9	S	S-21715	S-21880	25.06
	66.7	T	T-22715	T-22880	26.12
39 CT	9.6	L	L-8924	L-8968	19.08
	19.2	N	N-6924	N-6968	19.08
	26.2	R	R-20720	R-20885	22.97
	43.3	S	S-21720	S-21885	25.06
	61.5	T	T-22720	T-22885	26.12

SEC/ VOLT	SEC/ CURRENT ma	SIZE	MODEL NUMBER 115V PRIMARY	MODEL NUMBER 26V PRIMARY	PICO PRICES 1-9*
43 CT	8.7	L	L-8923	L-8969	19.08
	17.4	N	N-6923	N-6969	19.08
	23.7	R	R-20725	R-20890	22.97
	39.3	S	S-21725	S-21890	25.06
	55.8	T	T-22725	T-22890	26.12
48 CT	7.8	L	L-8922	L-8971	19.08
	15.6	N	N-6922	N-6971	19.08
	21.1	R	R-20730	R-20895	22.97
	35.2	S	S-21730	S-21895	25.06
	50	T	T-22730	T-22895	26.12
56 CT	6.6	L	L-8920	L-8972	19.08
	13.2	N	N-6920	N-6972	19.08
	18.2	R	R-20735	R-20900	22.97
	30.2	S	S-21735	S-21900	25.06
	42.9	T	T-22735	T-22900	26.12
63 CT	6	L	L-8917	L-8973	19.08
	11.9	N	N-6917	N-6973	19.08
	16.2	R	R-20740	R-20905	22.97
	26.9	S	S-21740	S-21905	25.06
	38.2	T	T-22740	T-22905	26.12
68 CT	5.5	L	L-8915	L-8974	19.08
	11	N	N-6915	N-6974	19.08
	15	R	R-20745	R-20910	22.97
	24.9	S	S-21745	S-21910	25.06
	35.3	T	T-22745	T-22910	26.12
80 CT	4.6	L	L-8910	L-8976	19.08
	9.4	N	N-6910	N-6976	19.08
	12.1	R	R-20750	R-20915	22.97
	21.1	S	S-21750	S-21915	25.06
	30	T	T-22750	T-22915	26.12
88 CT	4.2	L	L-8905	L-8977	19.08
	8.5	N	N-6905	N-6977	19.08
	11.6	R	R-20755	R-20920	22.97
	19.2	S	S-21755	S-21920	25.06
	27.3	T	T-22755	T-22920	26.12
100 CT	3.7	L	L-8902	L-8978	19.08
	8.5	N	N-6902	N-6978	19.08
	10.2	R	R-20760	R-20925	22.97
	16.9	S	S-21760	S-21925	25.06
	24	T	T-22760	T-22925	26.12
115 CT	3.2	L	L-8900	L-8979	19.08
	6.5	N	N-6900	N-6979	19.08
	8.9	R	R-20765	R-20930	22.97
	14.7	S	S-21765	S-21930	25.06
	20.9	T	T-22765	T-22930	26.12
123 CT	8.3	R	R-20770	R-20935	22.97
	13.7	S	S-21770	S-21935	25.06
	19.5	T	T-22770	T-22935	26.12
138 CT	7.4	R	R-20775	R-20940	22.97
	12.2	S	S-21775	S-21940	25.06
	17.4	T	T-22775	T-22940	26.12
157 CT	6.5	R	R-20780	R-20945	22.97
	10.8	S	S-21780	S-21945	25.06
	15.3	T	T-22780	T-22945	26.12
175 CT	5.8	R	R-20785	R-20950	22.97
	9.6	S	S-21785	S-21950	25.06
	13.7	T	T-22785	T-22950	26.12
200 CT	5.1	R	R-20790	R-20955	22.97
	8.4	S	S-21790	S-21955	25.06
	12	T	T-22790	T-22955	26.12
220 CT	7.7	S	S-21795	S-21960	26.32
	10.9	T	T-22795	T-22960	27.43
250 CT	6.8	S	S-21800	S-21965	27.57
	9.6	T	T-22800	T-22965	28.73
275 CT	6.1	S	S-21805	S-21970	28.84
	8.7	T	T-22805	T-22970	30.02
310 CT	5.4	S	S-21810	S-21975	30.08
	7.7	T	T-22810	T-22975	31.37

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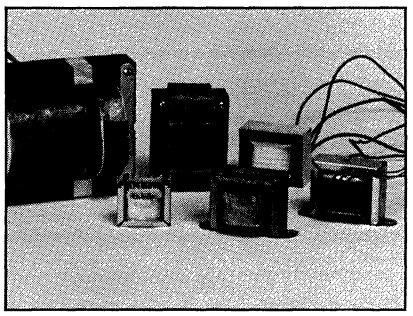

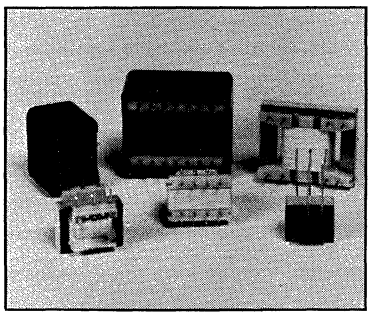

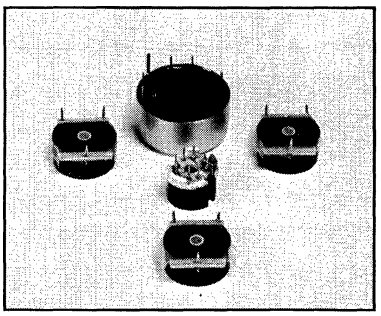

Power Transformers

- Isolation up to 1 KVA
- Converter DC to DC
- Constant voltage up to 1 KVA
- Ringing
- PCB Plug-in
- Wall Plug-in

Audio-Frequency Transformers

- Dimmer
- Filament
- Line
- Matching
- Output
- Pulse
- Rectifier
- Telephone
- Coupling
- Hybrid

Inductors

- Payback
- Toroidal
- High Frequency
- Repeat Coils

DESIGN SPECIFICATIONS SHOULD INCLUDE:

1 Input voltages and frequencies
2 Secondary full load voltages and currents
3 Regulation of secondary voltages, if required
4 Rectifier type, if DC output is required (half wave, full wave center tap, full wave bridge, voltage doubler, etc.)
5 Type of filter circuit (choke or capacitor input, etc.)
6 DC full load voltage and current at filter input
7 DC regulation, if required
8 Static and magnetic shields
9 Ambient temperature in which the transformer is to operate
10 Any limiting dimensions
11 Preferred mounting type and dimensions, if any
12 Type of leads or terminals

1 Operating level
2 Open circuit impedance or enductance of any winding (usually primary), if required
3 Value of DC, if any, flowing through any winding
4 Impedance or turns ratio
5 Source and source impedance
6 Load and load impedance
7 Frequency response with permissible deviation, from a reference frequency, generally 1000 Hz
8 Permissible harmonic distortion at specified operating level and frequency
9 Minimum resonant frequency
10 Insertion loss
11 Longitudinal balance, if required
12 Hybrid balance, if required
13 Return loss, if required
14 DC resistance
15 Any limiting dimension
16 Preferred mounting type and dimensions
17 Type of leads or terminals

1 Inductance
2 Alternating voltage across the coil
3 Direct current through the coil, if any
4 Test frequency
5 DC resistance
6 Self-resonance frequency
7 Minimum Q over frequency range
8 Frequency of maximum Q
9 Shielding, if required
10 Size and weight limitations
11 Mounting type
12 Type of leads or terminals
13 Insulation requirements

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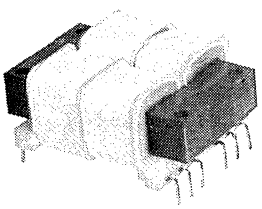
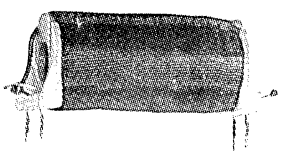
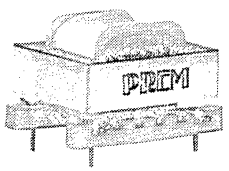


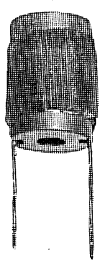
Low profile PC power transformers



Ferrite power inductors bobbin cores and slug cores

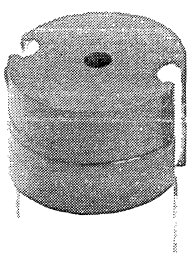


Ultra-compact hybrid transformers and feed-bridge inductors

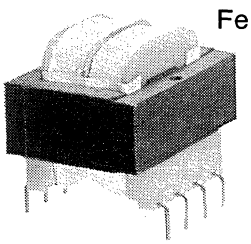


Ferrite power inductors drum core type

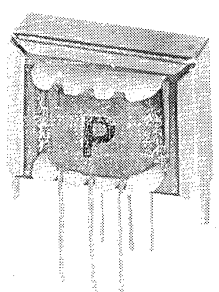
Economy high current inductors



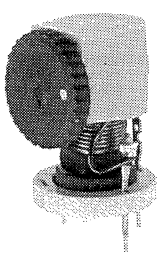
Power pot core inductors



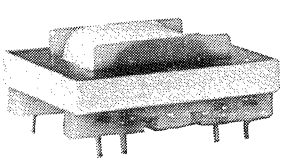
Horizontal, 3 flange PC power transformers



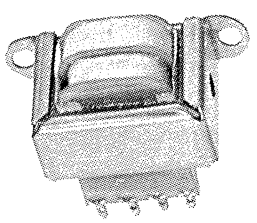
Economy audio transformers



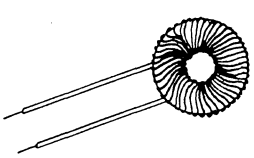
Adjustable linearity coils



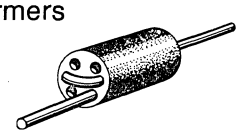
Telephone coupling transformers



Horizontal 3 flange power transformers



Precision toroidal inductors



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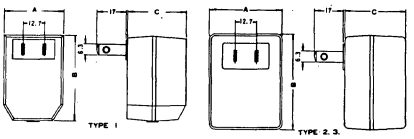
ADAPTORS—AC/DC MODEL UL/CSA APPROVED

Model	Input	Output	Type	Model	Input	Output	Type
AD-1	105-120V 60Hz 3W	3 VDC 100mA	1	AD-17	117V 60Hz 5W	7.5VDC 200mA	2
AD-2	105-120V 60Hz 3W	3 VDC 200mA	1	AD-18	117V 60Hz 3W	9 VDC 100mA	2
AD-3	105-120V 60Hz 3W	4.5VDC 100mA	1	AD-19	117V 60Hz 5W	9 VDC 200mA	2
AD-4	105-120V 60Hz 3W	4.5VDC 200mA	1	AD-20	117V 60Hz 6W	9 VDC 300mA	2
AD-5	105-120V 60Hz 3W	6 VDC 100mA	1	AD-21	110-120V 60Hz 3W	3 VDC 100mA	2
AD-6	105-120V 60Hz 3W	6 VDC 200mA	1	AD-22	110-120V 60Hz 3W	3 VDC 200mA	2
AD-7	105-120V 60Hz 3W	7.5VDC 100mA	1	AD-23	110-120V 60Hz 3W	4 VDC 60mA	2
AD-8	105-120V 60Hz 3W	9 VDC 100mA	1	AD-24	110-120V 60Hz 3W	6 VDC 100mA	2
AD-9	117V 60Hz 3W	3 VDC 100mA	2	AD-25	110-120V 60Hz 5W	6 VDC 200mA	3
AD-10	117V 60Hz 3W	3 VDC 200mA	2	AD-26	110-120V 60Hz 5W	6 VDC 300mA	3
AD-11	117V 60Hz 3W	4.5VDC 100mA	2	AD-27	110-120V 60Hz 3W	9 VDC 100mA	2
AD-12	117V 60Hz 3W	4.5VDC 200mA	2	AD-28	110-120V 60Hz 5W	9 VDC 200mA	3
AD-13	117V 60Hz 3W	6 VDC 100mA	2	AD-29	110-120V 60Hz 5W	9 VDC 300mA	3
AD-14	117V 60Hz 3W	6 VDC 200mA	2	AD-30	110-120V 60Hz 5W	12 VDC 300mA	3
AD-15	117V 60Hz 5W	6 VDC 300mA	2	AD-31	117V 60Hz 5W	18 VDC 140mA	3
AD-16	117V 60Hz 3W	7.5VDC 100mA	2				



TYPE	DIMENSIONS (MM) A	B	C
1	35.4	50	34.5
2	44	57	36
3	50	60	39

TRANSFORMERS T & L TYPE TO UL STANDARD 1411

HAZARDOUS OUTPUT (SELF-LEAD TYPE)

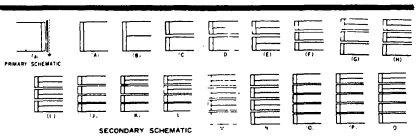
Cat. No.	Input (V)	Reference Schematic Pri.	Sec.	Total Output VA	A ±1	B	Dimensions (mm) C Min.-Max.	D	Horizontal Type / Vertical Type E Max.	F Max.	G	H ±2
TL-1	120	a	A-N	30	78	Optional	25-54	Optional	78	110	Optional	67
					66							79
TL-2	120	a	A-N	110	88	Optional	28-59	Optional	83	120	Optional	75
					74							89
TL-3	120	a	A-N	145	98	Optional	32-64	Optional	88	130	Optional	83
					82							99
TL-4	120	a	A-Q	180	107	Optional	35-64	Optional	91	140	Optional	91
					90							108
TL-5	120	a	A-Q	240	116	Optional	38-69	Optional	100	150	Optional	98
					97							117

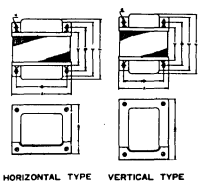
DESIGNED ESPECIALLY FOR COLOR TV SETS AND STEREOS

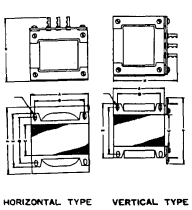
HAZARDOUS OUTPUT (METAL TERMINAL TYPE)

Cat. No.	Input (V)	Reference Schematic Pri.	Sec.	Total Output VA	A ±1	B	Dimensions (mm) C Min.-Max.	D	Horizontal Type / Vertical Type E Max.	F Max.	G	H ±2
TL-6	120	a	A-N	30	78	Optional	25-54	Optional	78	110	Optional	84
					66							96
TL-7	120	a	A-N	110	88	Optional	28-59	Optional	83	120	Optional	92
					74							106
TL-8	120	a	A-N	145	98	Optional	32-64	Optional	88	130	Optional	100
					82							116
TL-9	120	a	A-Q	180	107	Optional	35-64	Optional	91	140	Optional	108
					90							125
TL-10	120	a	A-Q	240	116	Optional	38-69	Optional	100	150	Optional	115
					97							134

DESIGNED ESPECIALLY FOR COLOR TV SETS AND STEREOS







POWER TRANSFORMERS—UL APPROVED

FAMILY 1 NON-HAZARDOUS OUTPUT (BOBBIN WOUND)

Cat. No.	Input (V)	Reference Schematic Pri.	Sec.	Total Output VA	Dimensions (mm) A±1	B	C Max.	D Min.-Max.	Horizontal Type / Vertical Type E Min.-Max.	F	H ±2
PT-1	120	A	a-e	0.7 Min.	29.5	Optional	52	9-15	25-34	Optional	28
					26.5		49				31
PT-2	120	A	a-e	2.0	36.5	Optional	59	10-17	31-40	Optional	32
					31		54				38
PT-3	120	A	a-i	7.8	42.5	Optional	65	14-24	32-46	Optional	36
					34.5		57				44
PT-4	120	A	a-i	10.0 Max.	50.0	Optional	72	17-25	37-50	Optional	43
					42		64				51

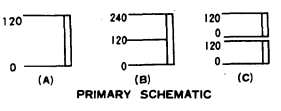
FAMILY 2 HAZARDOUS OUTPUT (BOBBIN WOUND)

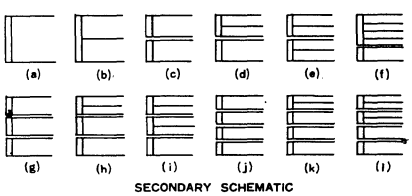
Cat. No.	Input (V)	Reference Schematic Pri.	Sec.	Total Output VA	Dimensions (mm) A ±1	B	C Max.	D Min.-Max.	Horizontal Type / Vertical Type E Min.-Max.	F	H ±2
PT-6	120	A	a-i	4 Min.	42.5	Optional	65	14-24	32-46	Optional	36
					34.5		57				44
PT-7	120	A	a-i	7	50	Optional	72	17-25	37-50	Optional	43
					42		64				51
PT-8	120	A	a-j	16	56	Optional	80	19-29	43-54	Optional	48
					47		71				57
PT-9	120	A	a-j	22	59	Optional	85	20-33	44-62	Optional	51
					49.5		76				60
PT-10	120	A	a-j	31	62	Optional	88	21-33	45-62	Optional	53
					52		78				63
PT-11	120	A	a-j	39 Max.	68	Optional	95	23-41	53-76	Optional	58
					57		84				69

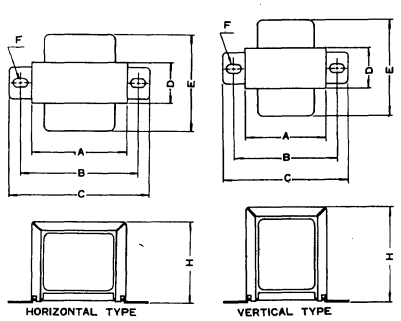
FAMILY 3 HAZARDOUS OUTPUT (LAYER WOUND)

Cat. No.	Input (V)	Reference Schematic Pri.	Sec.	Total Output VA	Dimensions (mm) A ±1	B	C Max.	D Min.-Max.	Horizontal Type / Vertical Type E Min.-Max.	F	H ±2
PT-12	120	A	a-i	7 Min.	50	Optional	72	17-25	37-56	Optional	43
					42		64				51
PT-13	120	A	a-j	16	56	Optional	80	19-29	43-64	Optional	48
					47		71				57
PT-14	120	A	a-j	22	59	Optional	85	20-33	44-68	Optional	51
					49.5		76				60
PT-15	120	A	a-j	32	62	Optional	88	21-33	45-72	Optional	53
					52		78				63
PT-16	120	A	a-j	38 Max.	68	Optional	95	23-41	53-83	Optional	58
					57		84				69

UL APPROVED AND CSA APPROVEABLE

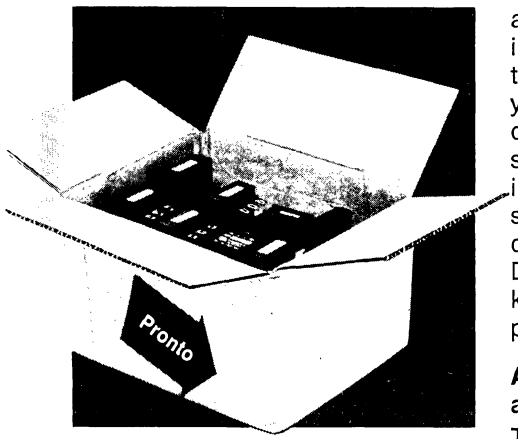






SEE OUR OTHER CATALOG PAGES IN EEM SECTIONS 1300/2100/2450/2950/4750

THE SIGNAL WAY OF DOING BUSINESS



PRONTO 48-Hour Shipment

We have long recognized that, in most instances, engineers and buyers need immediate delivery of transformers and chokes. To meet this challenge, Signal maintains an extensive inventory of every item in these pages — over 1,000 different transformers and chokes. More importantly, we're dedicated to shipping out each and every order (1-4 pieces guaranteed) within 48 hours, and we can usually fill your entire order. We call this service "PRONTO." Last year we shipped over 10,000 such orders and we didn't disappoint anyone.

How and Why We Are Able to Maintain Our Low Price Policy

At Signal, we sell direct. There are no salesmen or distributors — no middlemen, no extra mark-ups. We pass the savings on to you. We answer your questions directly. There is no chance of misinterpretation and you get fast accurate answers. We maintain larger inventories than any distributors could. We're able to react to your order requirements more quickly and efficiently. These savings have enabled us to install modern machinery, specify better materials and continuously invest in new R & D. In this manner our prices are kept as low as possible. We both profit from this policy.

Advanced Technology and Innovation

The basic transformer concept and design has been with us for many years. But, the state-of-the-art in electronics has changed drastically in the last 20 years, especially the last ten. We now live in a digital as well as analog world. Circuit size has shrunk and new termination methods have evolved. Again, Signal has recognized the need to develop new designs to meet these new low weight and height constraints. The result has been the development of such new and exclusive products as the SPLIT/TRAN® (see opposite page), the miniature PC board transformer featuring non-concentric windings which result in high isolation and the elimination of the need for electro-static shielding. The FLATHEAD® which has a height of only 0.65" is still another example of creative innovation. Therefore, what many of our competitors call custom designs (matched by custom prices) often turn out to be a Signal standard product. You can depend on Signal to have the products you need when you're ready for them and, of course, always in stock.

Custom Requirements Are Welcome

We also recognize that no matter how hard we try, it is impossible to anticipate everyone's need. Therefore, we are eager to discuss and evaluate your transformer and choke requirements. If we can't recommend a standard product that will do the job and save you money and time, we'll gladly quote on your requirement. Many times all that is needed is a modification of one of our standards. Again, you will get consistently high quality and very competitive prices, whether your order is for 10 or 10,000 pieces.

We don't have anyone out in the field telling you how good we are. We have to prove it to you by deed. Thank you for considering Signal.

CONTENTS (See Following Pages)

P.C. Board Power Transformer
SPLIT/TRAN® — High Isolation
FLATHEAD® — Low Profile
Standard Miniature
Lightweight/Low-Cost Small Power Transformers ("2-4-1" Series)
Rectifier Power Transformers
Chokes
Filter
Dual
Constant-Voltage Transformers for dc supplies
Step-down Auto Transformers
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split/tran® p.c. board transformers

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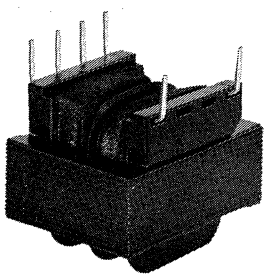
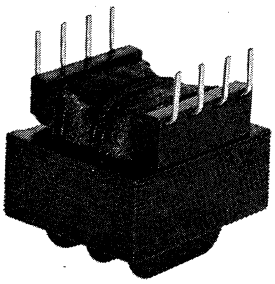
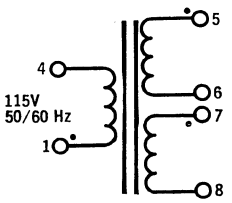
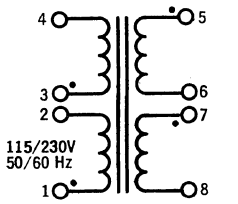
Recognized Component
Underwriters Labs Inc.



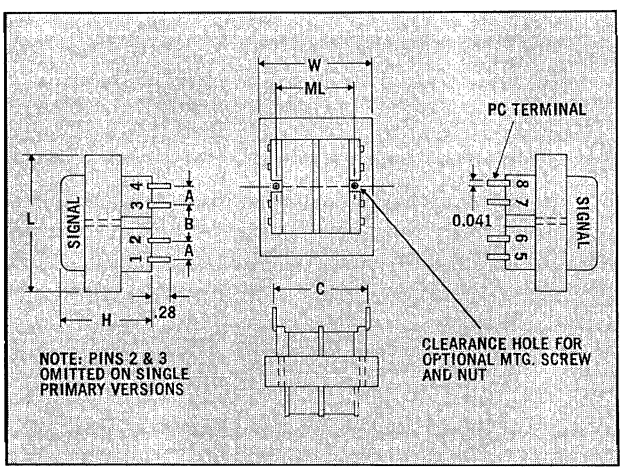




6 PIN TYPE ST



8 PIN TYPE DST



Size	VA	L	W	H	ML	A	B	C	Optional Mtg. Screw & Nut*	Lbs.
2	1.1	1⅜	1⅛	15/16	—	.250	.250	1.200	None	0.17
3	2.4	1⅜	1⅛	1⅜16	—	.250	.250	1.200	None	0 25
4	6	1⅝	1⅝16	1⅝16	1⅛16	.250	.350	1.280	4-40 x 1⅜ Nylon	0.44
5	12	1⅞	1⅝16	1⅞16	1¼	.300	.400	1.410	4-40 x 1⅜ Nylon	0.70
6	20	2¼	1⅞	1⅞16	1½	.300	.400	1.600	4-40 x 1⅜ Nylon	0.80
7	36	2⅝	2⅜16	1⅝16	†	.400	.400	1.850	†	1.1

* Available from Signal: Part No. ST-MS (Screw) & Part No. ST-MN (Nut).
† Size 7 has 4 mtg. holes on 2⅜16 x 1¾ centers for a #6 screw. Need not be nylon.

"Split-Tran" transformers combine the best features of our "2-4-1" Series and Signal's pioneering line of pc board miniature transformers.

The use of a "split bobbin" allows the primaries and secondaries to be wound non-concentrically, i.e., side by side rather than one over the other. This results in cost savings and superior performance, namely:

- High isolation — **2500V** hipot is standard.
- Low capacitive coupling — no electro-static shield necessary.
- Less manufacturing time — no cross-overs of primary and secondary leads.
- PC pins — allow direct insertion in PC boards.
- Class S insulation — 130°C.

Each transformer is available with single 115V or dual 115/230V primaries. In addition, secondaries are split so that they can be series or parallel connected.

Special variations will be quoted and shipped promptly.

PART NUMBER*		SECONDARY RMS RATING	
Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel
ST 2-10	DST 2-10	10V C.T. @ 0.11A	5V @ 0.22A
ST 3-10	DST 3-10	10V C.T. @ 0.25A	5V @ 0.5A
ST 4-10	DST 4-10	10V C.T. @ 0.6A	5V @ 1.2A
ST 5-10	DST 5-10	10V C.T. @ 1.2A	5V @ 2.4A
ST 6-10	DST 6-10	10V C.T. @ 2A	5V @ 4A
ST 7-10	DST 7-10	10V C.T. @ 3.6A	5V @ 7.2A
ST 2-12	DST 2-12	12.6V C.T. @ 0.09A	6.3V @ 0.18A
ST 3-12	DST 3-12	12.6V C.T. @ 0.2A	6.3V @ 0.4A
ST 4-12	DST 4-12	12.6V C.T. @ 0.5A	6.3V @ 1.0A
ST 5-12	DST 5-12	12.6V C.T. @ 1.0A	6.3V @ 2.0A
ST 6-12	DST 6-12	12.6V C.T. @ 1.6A	6.3V @ 3.2A
ST 7-12	DST 7-12	12.6V C.T. @ 2.85A	6.3V @ 5.7A
ST 2-16	DST 2-16	16V C.T. @ 0.07A	8V @ 0.14A
ST 3-16	DST 3-16	16V C.T. @ 0.15A	8V @ 0.3A
ST 4-16	DST 4-16	16V C.T. @ 0.4A	8V @ 0.8A
ST 5-16	DST 5-16	16V C.T. @ 0.8A	8V @ 1.6A
ST 6-16	DST 6-16	16V C.T. @ 1.25A	8V @ 2.5A
ST 7-16	DST 7-16	16V C.T. @ 2.25A	8V @ 4.5A
ST 2-20	DST 2-20	20V C.T. @ 0.055A	10V @ 0.11A
ST 3-20	DST 3-20	20V C.T. @ 0.12A	10V @ 0.24A
ST 4-20	DST 4-20	20V C.T. @ 0.3A	10V @ 0.6A
ST 5-20	DST 5-20	20V C.T. @ 0.6A	10V @ 1.2A
ST 6-20	DST 6-20	20V C.T. @ 1A	10V @ 2A
ST 7-20	DST 7-20	20V C.T. @ 1.8A	10V @ 3.6A
ST 2-24	DST 2-24	24V C.T. @ 0.045A	12V @ 0.09A
ST 3-24	DST 3-24	24V C.T. @ 0.1A	12V @ 0.2A
ST 4-24	DST 4-24	24V C.T. @ 0.25A	12V @ 0.5A
ST 5-24	DST 5-24	24V C.T. @ 0.5A	12V @ 1.0A
ST 6-24	DST 6-24	24V C.T. @ 0.8A	12V @ 1.6A
ST 7-24	DST 7-24	24V C.T. @ 1.5A	12V @ 3.0A
ST 2-28	DST 2-28	28V C.T. @ 0.04A	14V @ 0.08A
ST 3-28	DST 3-28	28V C.T. @ 0.085A	14V @ 0.17A
ST 4-28	DST 4-28	28V C.T. @ 0.2A	14V @ 0.4A
ST 5-28	DST 5-28	28V C.T. @ 0.42A	14V @ 0.84A
ST 6-28	DST 6-28	28V C.T. @ 0.7A	14V @ 1.4A
ST 7-28	DST 7-28	28V C.T. @ 1.3A	14V @ 2.6A
ST 2-36	DST 2-36	36V C.T. @ 0.03A	18V @ 0.06A
ST 3-36	DST 3-36	36V C.T. @ 0.065A	18V @ 0.13A
ST 4-36	DST 4-36	36V C.T. @ 0.17A	18V @ 0.34A
ST 5-36	DST 5-36	36V C.T. @ 0.35A	18V @ 0.7A
ST 6-36	DST 6-36	36V C.T. @ 0.55A	18V @ 1.1A
ST 7-36	DST 7-36	36V C.T. @ 1A	18V @ 2A
ST 2-48	DST 2-48	48V C.T. @ 0.023A	24V @ 0.046A
ST 3-48	DST 3-48	48V C.T. @ 0.05A	24V @ 0.1A
ST 4-48	DST 4-48	48V C.T. @ 0.125A	24V @ 0.25A
ST 5-48	DST 5-48	48V C.T. @ 0.25A	24V @ 0.5A
ST 6-48	DST 6-48	48V C.T. @ 0.4A	24V @ 0.8A
ST 7-48	DST 7-48	48V C.T. @ 0.75A	24V @ 1.5A
ST 2-56	DST 2-56	56V C.T. @ 0.02A	28V @ 0.04A
ST 3-56	DST 3-56	56V C.T. @ 0.045A	28V @ 0.09A
ST 4-56	DST 4-56	56V C.T. @ 0.11A	28V @ 0.22A
ST 5-56	DST 5-56	56V C.T. @ 0.22A	28V @ 0.44A
ST 6-56	DST 6-56	56V C.T. @ 0.35A	28C @ 0.7A
ST 7-56	DST 7-56	56V C.T. @ 0.65A	28V @ 1.3A
ST 2-120	DST 2-120	120V C.T. @ 0.01A	60V @ 0.02A
ST 3-120	DST 3-120	120V C.T. @ 0.02A	30V @ 0.04A
ST 4-120	DST 4-120	120V C.T. @ 0.05A	60V @ 0.1A
ST 5-120	DST 5-120	120V C.T. @ 0.1A	60V @ 0.2A
ST 6-120	DST 6-120	120V C.T. @ 0.16A	60V @ 0.32A
ST 7-120	DST 7-120	120V C.T. @ 0.3A	60V @ 0.6A

* Explanation of Part Number: Series - ST; Size 4; Series Secondary Volts - 36

Always in Stock —"THE PRONTO CHALLENGE":—We ship your order (up to 4 pieces) in 48 hours and that's a promise we intend to keep."

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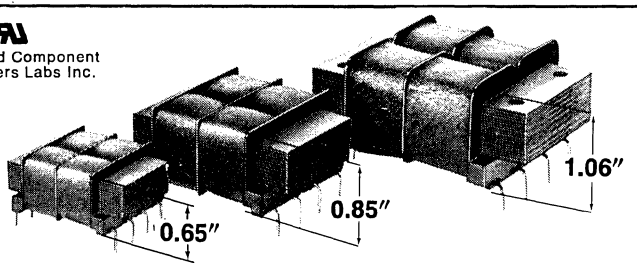
"See page 1•2631 for prices"

flathead® plug in power transformers

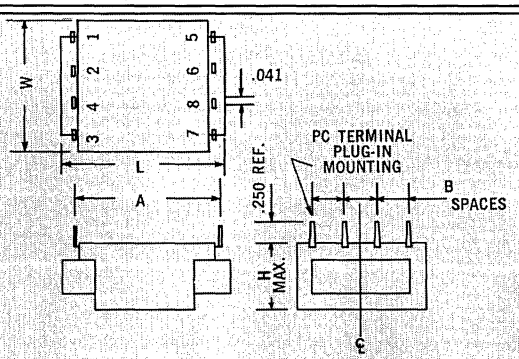
FOR PRINTED CIRCUIT APPLICATIONS
3 SIZES — 2.5VA — 0.650 inches high
6VA — 0.850 inches high
12VA — 1.065 inches high

Recognized Component Underwriters Labs Inc.



Part No.	Size	SECONDARY* Series	SECONDARY* Parallel
LP 10-250	2	10V C.T. @ 250MA	5V @ 500MA
LP 10-600	6	10V C.T. @ 600MA	5V @ 1.2A
LP 10-1200	12	10V C.T. @ 1200MA	5V @ 2.4A
LP 12-200	2	12.6V C.T. @ 200MA	6.3V @ 400MA
LP 12-450	6	12.6V C.T. @ 450MA	6.3V @ 900MA
LP 12-900	12	12.6V C.T. @ 900MA	6.3V @ 1.8A
LP 16-150	2	16V C.T. @ 150MA	8V @ 300MA
LP 16-350	6	16V C.T. @ 350MA	8V @ 700MA
LP 16-700	12	16V C.T. @ 700MA	8V @ 1.4A
LP 20-125	2	20V C.T. @ 125MA	10V @ 250MA
LP 20-300	6	20V C.T. @ 300MA	10V @ 600MA
LP 20-600	12	20V C.T. @ 600MA	10V @ 1.2A
LP 24-100	2	24V C.T. @ 100MA	12V @ 200MA
LP 24-250	6	24V C.T. @ 250MA	12V @ 500MA
LP 24-500	12	24V C.T. @ 500MA	12V @ 1A
LP 30-85	2	30V C.T. @ 85MA	15V @ 170MA
LP 30-200	6	30V C.T. @ 200MA	15V @ 400MA
LP 30-400	12	30V C.T. @ 400MA	15V @ 800MA
LP 34-75	2	34V C.T. @ 75MA	17V @ 150MA
LP 34-170	6	34V C.T. @ 170MA	17V @ 340MA
LP 34-340	12	34V C.T. @ 340MA	17V @ 680MA
LP 40-60	2	40V C.T. @ 60MA	20V @ 120MA
LP 40-150	6	40V C.T. @ 150MA	20V @ 300MA
LP 40-300	12	40V C.T. @ 300MA	20V @ 600MA
LP 56-45	2	56V C.T. @ 45MA	28V @ 90MA
LP 56-100	6	56V C.T. @ 100MA	28V @ 200MA
LP 56-200	12	56V C.T. @ 200MA	28V @ 400MA
LP 88-28	2	88V C.T. @ 28MA	44V @ 56MA
LP 88-65	6	88V C.T. @ 65MA	44V @ 130MA
LP 88-130	12	88V C.T. @ 130MA	44V @ 260MA
LP 120-20	2	120V C.T. @ 20MA	60V @ 40MA
LP 120-50	6	120V C.T. @ 50MA	60V @ 100MA
LP 120-100	12	120V C.T. @ 100MA	60V @ 200MA
LP 230-10	2	230V C.T. @ 10MA	115V @ 20MA
LP 230-25	6	230V C.T. @ 25MA	115V @ 50MA
LP 230-50	12	230V C.T. @ 50MA	115V @ 100MA

* Regulation of Size 2 and 6 units is 30%, i.e., no load-secondary voltage is 30% higher than full load. Regulation of Size 12 units is 20%.



Size	L	W	H	A	B	Oz.
2	1⅞	1⅝	0.650	1.600	0.375	5
6	1⅞	1⅝	0.850	1.600	0.375	7
12	2½	2	1.065	2.000	0.500	11

LOW PROFILE: Allows ¾″ card spacing for 2.5va units, 1 inch card spacing for 6va units, or 1¼″ inch card spacing for 12va units.

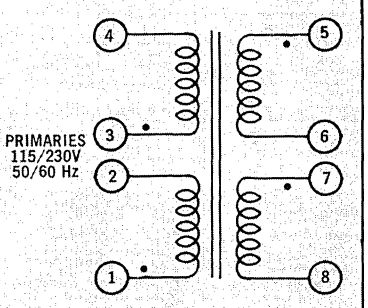
DUAL PRIMARIES: 115/230v, 50/60 Hz.

NON-CONCENTRIC WINDING: Where secondary is wound alongside primary rather than directly over it. This added isolation reduces inter-winding capacitance and **eliminates the need for an electro-static shield.**

1500V. RMS HIPOT: Is standard because of the advantage of non-concentric windings.

HUM-BUCKING CONSTRUCTION: (Semi-toroidal) results in reduced radiated magnetic field and balanced windings.

The LP line of transformers is ideal for low height, critical pc board power applications in semi-conductor control and instrumentation. They are used extensively in single or dual output dc supplies and isolated control circuit and reference supplies.



*INDICATES LIKE POLARITY

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"See page 1•2631 for prices"

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p.c. board transformers for triple-output regulated supplies

IDEAL FOR MICROPROCESSOR APPLICATIONS

"MP" types have been developed specifically for use in triple-output regulated DC supplies that are commonly used in **Microprocessor Circuits** and other logic, op-amp combinations. Two output combinations have been provided, namely 5V and ±12V, and 5V and ±15V.

All "MP" units are rated in terms of the final **DC** output after a standard three terminal IC regulator. They are designed to provide these outputs with AC line inputs of 100 to 130V 50/60 Hz (or 200 to 260V for nominal 230V lines).

Two basic mechanical configurations are available. Standard PC types (MPC or DMPC) are tested to pass 1500V RMS hipot. Optional mounting brackets are available. MPL types are based on Signal's "flat-head" style and feature low profile, 115/230V primaries, hum-bucking construction, 1500V RMS hipot and the advantages of non-concentric winding (low inter-winding capacitance, high isolation, and no need for an electro-static shield).

All MP's are stocked in depth for immediate delivery. In addition, special variations can be supplied with reasonable delivery times.

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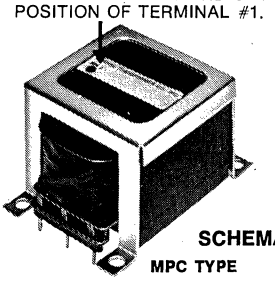
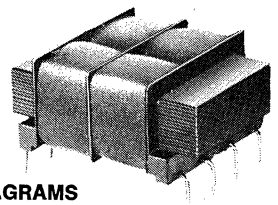
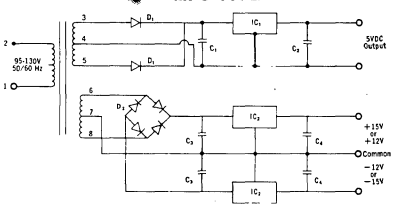


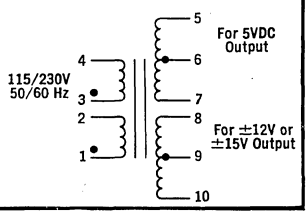


SCHEMATIC DIAGRAMS

MPC TYPE



DMPC & MPL TYPES

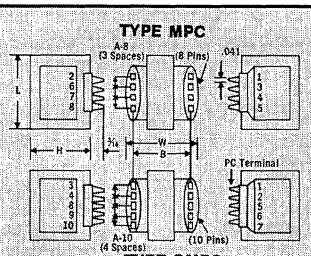


MPC & DMPC TYPES

PART NUMBER PRIMARY 50/60 Hz		DC OUTPUT			SUGGESTED COMPONENTS							
115V (8 Pin)	115/230V (10 Pin)	Regulator I	Regulator II	Size	C_1	C_2	C_3	C_4	D_1(2)	D_2(4)	IC_1*	IC_2*
MPC-X-12	DMPC-X-12	5VDC 360ma	±12VDC 60ma	X	2100MFD 30V	2.7MFD 20V	250MFD 50V	10MFD 20V	1N4001	1N4002	LM341P-5.0	LM326N
MPC-X-15	DMPC-X-15	5VDC 360ma	±15VDC 50ma	X	2100MFD 30V	2.7MFD 20V	250MFD 50V	10MFD 20V	1N4001	1N4002	LM341P-5.0	LM325N
MPC-Y-12	DMPC-Y-12	5VDC 835ma	±12VDC 150ma	Y	4000MFD 20V	2.7MFD 20V	1000MFD 50V	2.7MFD 20V	1N4001	1N4002	LM340K-5.0	LM326N
MPC-Y-15	DMPC-Y-15	5VDC 835ma	±15VDC 130ma	Y	4000MFD 20V	2.7MFD 20V	1000MFD 50V	2.7MFD 20V	1N4001	1N4002	LM340K-5.0	LM325N
MPL TYPES (Dual 115/230V Primary is Standard)												
MPL- 6-12		5VDC 135ma	±12VDC 40ma	6	1000MFD 20V	2.7MFD 20V	150MFD 50V	10MFD 20V	1N4001	1N4002	LM342P-5.0	LM326N
MPL- 6-15		5VDC 135ma	±15VDC 35ma	6	1000MFD 20V	2.7MFD 20V	150MFD 50V	10MFD 20V	1N4001	1N4002	LM342P-5.0	LM325N
MPL-12-12		5VDC 270ma	±12VDC 85ma	12	2100MFD 30V	2.7MFD 20V	250MFD 50V	10MFD 20V	1N4001	1N4002	LM341P-5.0	LM326N
MPL-12-15		5VDC 270ma	±15VDC 70ma	12	2100MFD 30V	2.7MFD 20V	250MFD 50V	10MFD 20V	1N4001	1N4002	LM341P-5.0	LM325N

*National Semiconductor

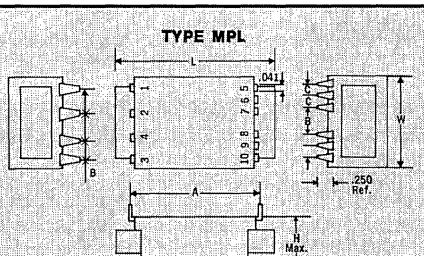
TYPE MPC



TYPE DMPC

Size	L	W	H	A-8 (8 Pin)	A-10 (10 Pin)	B	Lbs.	Optional Bracket No.	MW	MD
X	1⅞	1⁷⁄₁₆	1⅝	.250	.200	1.300	.56	10-BR	1¹¹⁄₆₄	1⅛
Y	1⅝	2¼	1⅜	.250	.200	2.100	.75	24-BR	1⅜	2

TYPE MPL



Size	L	W	H	A	B	C	Lbs.
6	1⅞	1⁹⁄₁₆	0.850	1.600	0.375	0.187	.43
12	2½	2	1.065	2.000	0.500	0.250	.68

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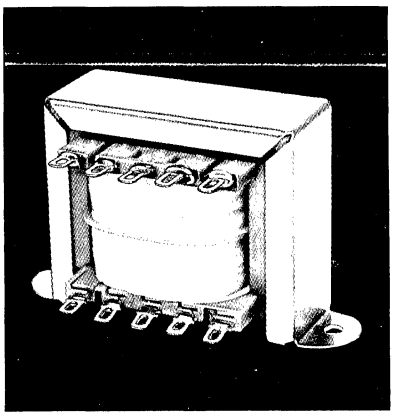
2-4-1 style split-bobbin transformers for triple-output (μp) applications (type MT)



Signal has extended its line of triple-output transformers for microprocessor applications with three new sizes rated to 100VA (35 watts DC regulated). Similar to the split-bobbin design used in Signal's "2-4-1" series, the chassis-mounted style allows for these new higher power applications.

Two output combinations are provided: 5V and ±12V; and 5V and ±15V. Designated "MT" (single primary) and "DMT" (dual primary), these transformers are rated in terms of the final DC output after a 3-terminal IC regulator. They are designed to provide these outputs with AC line inputs of 100-130V, 50/60 Hz (or 200-260V for nominal 230V lines). All auxiliary components required to complete the DC supply are tabulated.

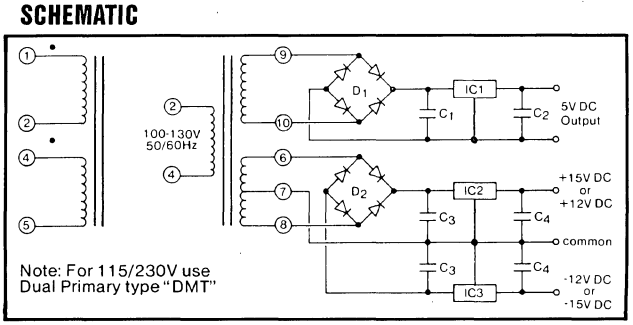
All MT types are stocked in depth for immediate delivery. In addition, custom variations can be supplied with minimal turnaround time.

Specifications

PART NUMBER PRIMARY 50/60Hz		DC OUTPUT		SIZE	SUGGESTED COMPONENTS C_2, C_4 See Note ①						
115V	115/230V	Regulator 1	Regulator 2		C_1	C_3	IC1③	IC2③	IC3③	D1④	D2④
MT-6-12	DMT-6-12	5V @ 1.75A	±12V @ 210MA	6	10 KMFD @ 20V DC	1.5 KMFD @ 50V DC	LM-323K-5	LM-340K-12	LM-320K-12	3N253	3N247
MT-6-15	DMT-6-15	5V @ 1.75A	±15V @ 175MA	6			LM-323K-5	LM-340K-15	LM-320K-15	3N253	3N247
MT-7-12	DMT-7-12	5V @ 2.8A	±12V @ 350MA	7	15 KMFD @ 20V DC	2 KMFD @ 50V DC	LM-323K-5	LM-340K-12	LM-320K-12	MDA-400	3N247
MT-7-15	DMT-7-15	5V @ 2.8A	±15V @ 280MA	7			LM-323K-5	LM-340K-15	LM-320K-15	MDA-400	3N247
MT-8-12	DMT-8-12	5V @ 4A	±12V @ 600MA	8	26 KMFD @ 20V DC	3.1 KMFD @ 50V DC	LM-338②	LM-340K-12	LM-320K-12	MDA-800	3N247
MT-8-15	DMT-8-15	5V @ 4A	±15V @ 500MA	8			LM-338②	LM-340K-15	LM-320K-15	MDA-800	3N247

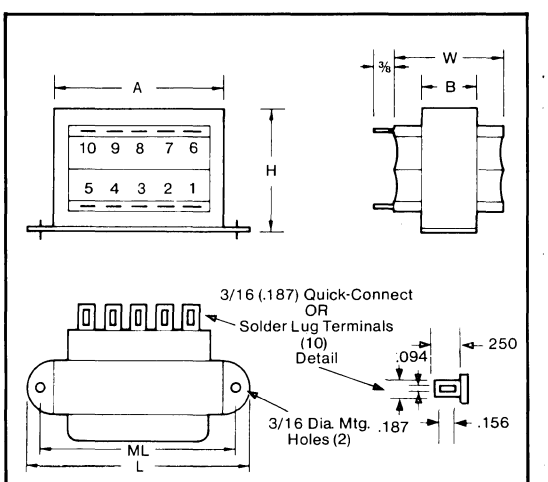
Note ① : Output capacitors C_2 and C_4 are required to stabilize regulators. Values can be 1 MFD min. tantalum or 10 MFD min. electrolytic, 20V min.
Note ② : LM-338 is an adjustable regulator and MFR's specifications (National Semiconductor) should be consulted for values of external components.
Note ③ : All IC's are National Semiconductor types.
Note ④ : All diodes are Motorola types.

SCHEMATIC



DIMENSIONS

Size	L	W	H	A	B	ML	Lbs.
6	3 1/4	1 11/16	1 15/16	2 5/16	1 1/16	2 13/16	1.1
7	3 11/16	1 13/16	2 1/4	2 11/16	1 1/16	3 1/8	1.7
8	4 1/32	2 1/4	2 9/16	3 1/16	1 5/16	3 9/16	2.75



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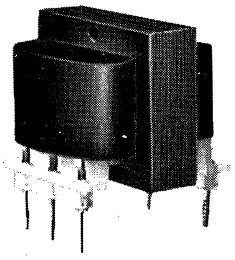
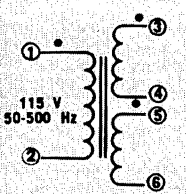
miniature plug in power transformers

SINGLE 115V PRIMARY TYPE PC 6 PINS





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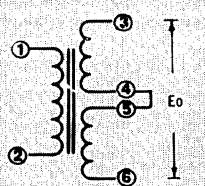
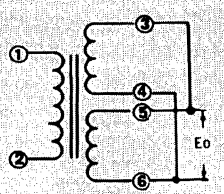


SERIES CONNECTED

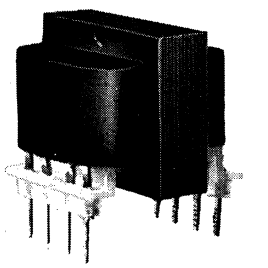


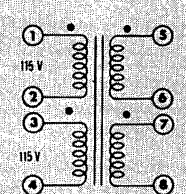
PARALLEL CONNECTED

PRIMARY 50/500 Hz		SECONDARY RMS RATING*		
Single 115V (6 Pin)	Dual 115/230V (8 Pin)	Series	Parallel	Size (VA)
PC 10-90	DPC 10-90	10V C.T. @ 90MA	5V @ 180MA	1.0
PC 10-120	DPC 10-120	10V C.T. @ 120MA	5V @ 240MA	1.2
PC 10-440	DPC 10-440	10V C.T. @ 440MA	5V @ 880MA	4.4
PC 10-1000	DPC 10-1000	10V C.T. @ 1A	5V @ 2A	10
PC 10-2400	DPC 10-2400	10V C.T. @ 2.4A	5V @ 4.8A	24
PC 12-70	DPC 12-70	12.6V C.T. @ 70MA	6.3V @ 140MA	1.0
PC 12-100	DPC 12-100	12.6V C.T. @ 100MA	6.3V @ 200MA	1.2
PC 12-350	DPC 12-350	12.6V C.T. @ 350MA	6.3V @ 700MA	4.4
PC 12-800	DPC 12-800	12.6V C.T. @ 800MA	6.3V @ 1.6A	10
PC 12-2000	DPC 12-2000	12.6V C.T. @ 2A	6.3V @ 4A	24
PC 16-55	DPC 16-55	16V C.T. @ 55MA	8V @ 110MA	1.0
PC 16-75	DPC 16-75	16V C.T. @ 75MA	8V @ 150MA	1.2
PC 16-260	DPC 16-260	16V C.T. @ 260MA	8V @ 520MA	4.4
PC 16-640	DPC 16-640	16V C.T. @ 640MA	8V @ 1.28A	10
PC 16-1500	DPC 16-1500	16V C.T. @ 1.5A	8V @ 3A	24
PC 20-45	DPC 20-45	20V C.T. @ 45MA	10V @ 90MA	1.0
PC 20-60	DPC 20-60	20V C.T. @ 60MA	10V @ 120MA	1.2
PC 20-220	DPC 20-220	20V C.T. @ 220MA	10V @ 440MA	4.4
PC 20-500	DPC 20-500	20V C.T. @ 500MA	10V @ 1A	10
PC 20-1200	DPC 20-1200	20V C.T. @ 1.2A	10V @ 2.4A	24
PC 24-35	DPC 24-35	24V C.T. @ 35MA	12V @ 70MA	1.0
PC 24-50	DPC 24-50	24V C.T. @ 50MA	12V @ 100MA	1.2
PC 24-180	DPC 24-180	24V C.T. @ 180MA	12V @ 360MA	4.4
PC 24-450	DPC 24-450	24V C.T. @ 450MA	12V @ 900MA	10
PC 24-1000	DPC 24-1000	24V C.T. @ 1A	12V @ 2A	24
PC 28-30	DPC 28-30	28V C.T. @ 30MA	14V @ 60MA	1.0
PC 28-40	DPC 28-40	28V C.T. @ 40MA	14V @ 80MA	1.2
PC 28-160	DPC 28-160	28V C.T. @ 160MA	14V @ 320MA	4.4
PC 28-360	DPC 28-360	28V C.T. @ 360MA	14V @ 720MA	10
PC 28-800	DPC 28-800	28V C.T. @ 800MA	14V @ 1.6A	24
PC 34-25	DPC 34-25	34V C.T. @ 25MA	17V @ 50MA	1.0
PC 34-35	DPC 34-35	34V C.T. @ 35MA	17V @ 70MA	1.2
PC 34-125	DPC 34-125	34V C.T. @ 125MA	17V @ 250MA	4.4
PC 34-300	DPC 34-300	34V C.T. @ 300MA	17V @ 600MA	10
PC 34-700	DPC 34-700	34V C.T. @ 700MA	17V @ 1.4A	24
PC 40-20	DPC 40-20	40V C.T. @ 20MA	20V @ 40MA	1.0
PC 40-30	DPC 40-30	40V C.T. @ 30MA	20V @ 60MA	1.2
PC 40-110	DPC 40-110	40V C.T. @ 110MA	20V @ 220MA	4.4
PC 40-250	DPC 40-250	40V C.T. @ 250MA	20V @ 500MA	10
PC 40-600	DPC 40-600	40V C.T. @ 600MA	20V @ 1.2A	24
PC 56-15	DPC 56-15	56V C.T. @ 15MA	28V @ 30MA	1.0
PC 56-20	DPC 56-20	56V C.T. @ 20MA	28V @ 40MA	1.2
PC 56-80	DPC 56-80	56V C.T. @ 80MA	28V @ 160MA	4.4
PC 56-180	DPC 56-180	56V C.T. @ 180MA	28V @ 360MA	10
PC 56-420	DPC 56-420	56V C.T. @ 420MA	28V @ 840MA	24
PC 120-8	DPC 120-8	120V C.T. @ 8MA	60V @ 16MA	1.0
PC 120-10	DPC 120-10	120V C.T. @ 10MA	60V @ 20MA	1.2
PC 120-35	DPC 120-35	120V C.T. @ 35MA	60V @ 70MA	4.4
PC 120-85	DPC 120-85	120V C.T. @ 85MA	60V @ 170MA	10
PC 120-200	DPC 120-200	120V C.T. @ 200MA	60V @ 400MA	24

* See Table on opposite page for method of determining RMS Secondary Current.

DUAL 115/230V PRIMARY TYPE DPC 8 PINS





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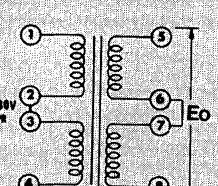
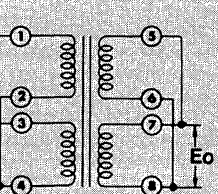


SERIES CONNECTED



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. . . for printed circuits applications

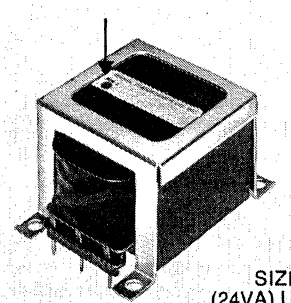
Signal has the most complete and diversified selection of miniature plug-in power transformers.

Primary ratings of 115V (Style PC - 6 Pin) or Dual 115/230V (Style DPC -8 Pin) are standard for the entire line. 1500V. Hipot is standard.

Size 1.0 is used extensively where height is a limiting factor since its height of 0.83 inches allows 1 inch spacing of PC boards. Size 24 is unusual since 24 watt PC transformers are not readily available, especially with a height of 1⅜ inches.

The RMS current ratings are based on a load regulation of 15-20% and not on temperature rise (except for the largest item, size 24). Therefore, these ratings may be exceeded without overheating, if the additional drop in full load voltage is acceptable. There is, of course, a limit and it would be best to check with our engineering department on specific units.

BLACK DOT ON LABEL INDICATES POSITION OF TERMINAL #1.



SIZE 24 (24VA) UNIT WITH 24-BR SLIDE-ON MOUNTING BRACKET

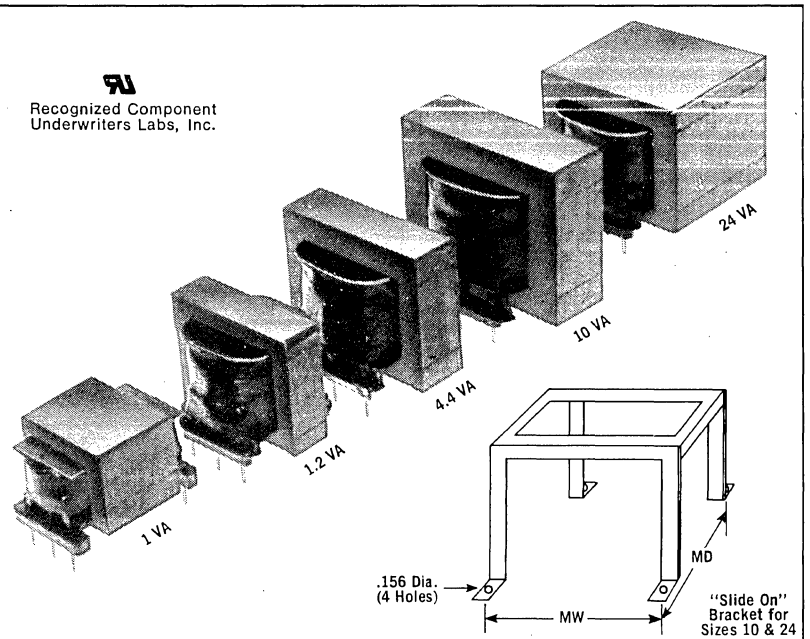
METHOD OF DETERMINING SECONDARY CURRENT RATINGS

The secondary currents shown in the tables are RMS ratings. Depending upon rectifier circuit configurations, the RMS secondary current is different than the DC output current. This is indicated in the chart below:

Rectifier Type	Filter Type	RMS Secondary Current Is
Full Wave Center-Tap	Choke Input	= 0.7 x DC Amps
Full Wave Center-Tap	Capacitor Input	= 1 to 1.2 x DC Amps
Full Wave Bridge	Choke Input	= DC Amps
Full Wave Bridge	Capacitor Input	= 1.6 to 1.8 x DC Amps

For example, in a F.W. Bridge circuit with a capacitive filter, if the load is 1 Amp DC, the RMS Secondary current is 1.6 to 1.8 Amp RMS.

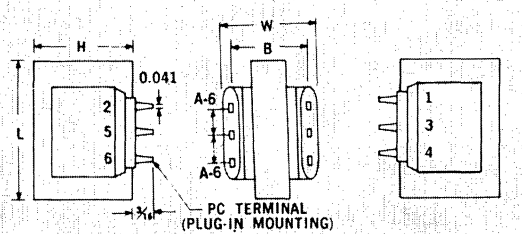
Recognized Component
Underwriters Labs, Inc.



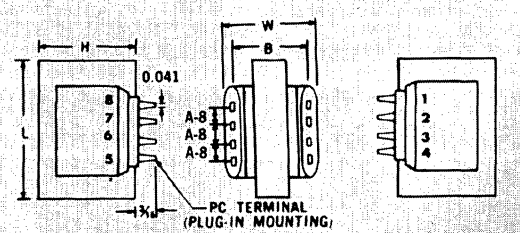
DIMENSIONS

Size (VA)	L	W	H	A-6 (6 Pin)	A-8 (8 Pin)	B	WT. (oz.)	OPTIONAL BRACKET* No.	MW	MD
1.0	1	1⅜	0.83	0.250	0.200	1.200	2.5	—	—	—
1.2	1⅜	1⅛	1 3/16	0.312	0.200	1.000	3	—	—	—
4.4	1⅝	1¼	1⅜	0.400	0.250	1.100	5	—	—	—
10	1⅞	1 7/16	1⅝	0.400	0.250	1.300	9	10-BR	1 41/64	1⅛
24	1⅝	2¼	1⅜	0.400	0.250	2.100	12	24-BR	1⅜	2

* An optional "Slide On" Mounting Bracket is available for sizes 10 and 24. The brackets do not use up any extra "Floor Space" but add 1/32" to the height of the transformer.



TYPE PC 6 PINS



TYPE DPC 8 PINS

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cut size and weight with "2-4-1"

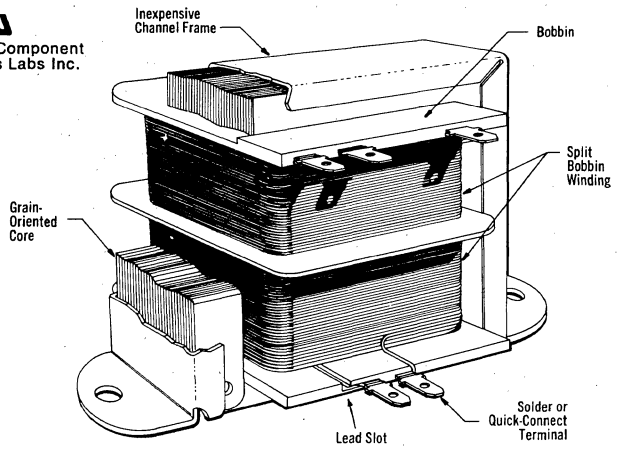
The 2-4-1 series is an illustration of the use of creative design applied to small power transformers. The result is a line where, for a given va rating, size and weight are reduced almost 50%. Hence the name "241" series.

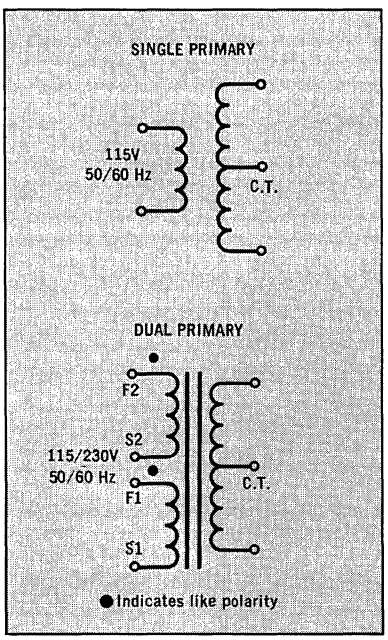
- GRAIN ORIENTED CORE — High Saturation Density — Lower Core Loss — Less Steel and Copper.
- BOBBIN WOUND — Maximum Utilization of Winding Area — Space and Size Reduced.
- SPLIT BOBBIN — NON-CONCENTRIC WINDING — Lower Capacitance — Better Insulation — 2500V RMS Hipot — No need for Electro-Static Shield — High Isolation and Insulation Resistance. No Cross-Overs of Primary and Secondary Leads.
- SPECIAL TERMINAL — Solder or Quick-Connect.

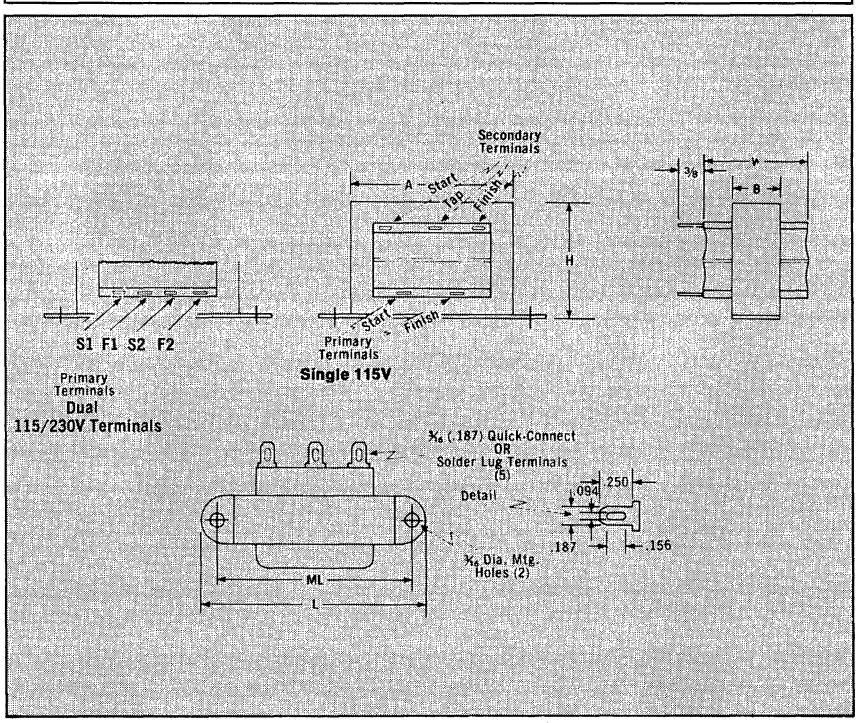
The series is available with single 115V or dual 115/230V primary, rated 50/60 Hz. Class S insulation is used for a maximum total temperature rating of 130°C continuous.

AVAILABLE WITH SINGLE (115V) OR DUAL (115/230V) PRIMARIES

Recognized Component Underwriters Labs Inc.







DIMENSIONS

Size	VA	L	W	H	A	B	ML	Lbs.
3	2.4	2 1/16	1 1/16	1 3/16	1 5/8	9/16	1 3/4	0.25
4	6	2 3/8	1 1/4	1 3/8	1 11/16	11/16	2	0.44
5	12	2 13/16	1 3/8	1 5/8	1 15/16	13/16	2 3/8	0.7
6	30	3 1/4	1 11/16	1 15/16	2 5/16	1 1/16	2 13/16	1.1
7	56	3 11/16	1 13/16	2 1/4	2 11/16	1 1/16	3 1/8	1.7
8	100	4 1/32	2 1/4	2 9/16	3 1/16	1 5/16	3 5/16	2.75

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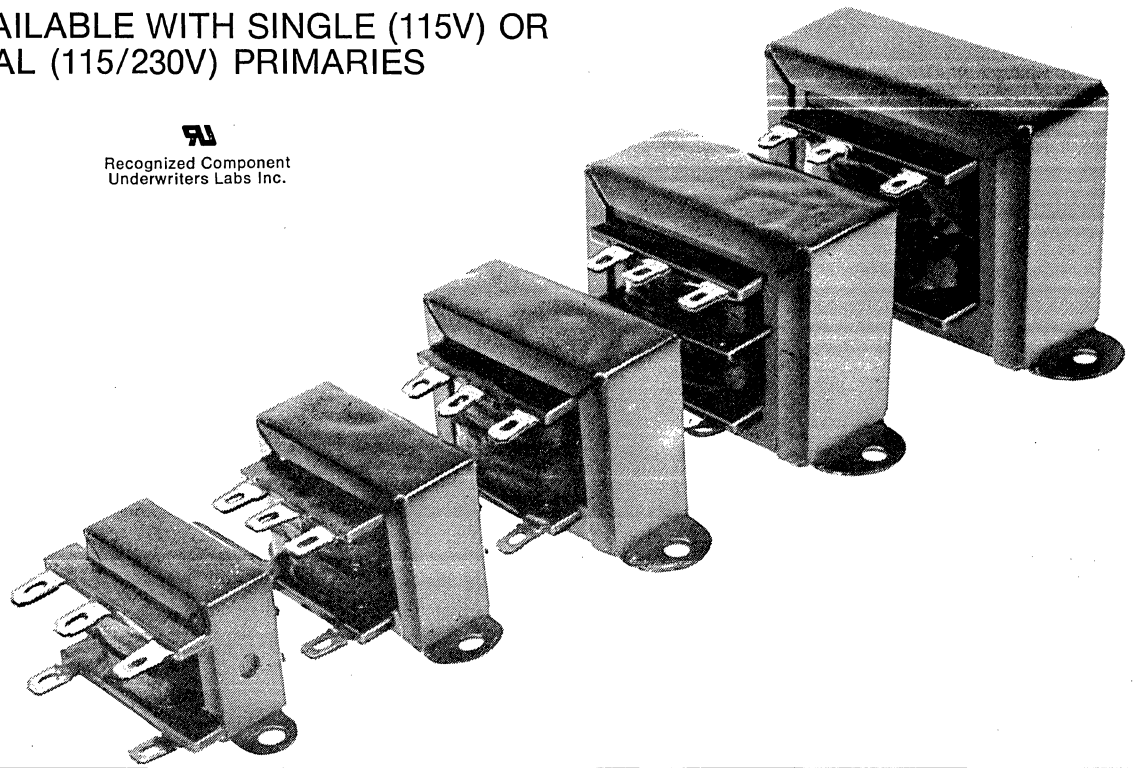
series of small power transformers

AVAILABLE WITH SINGLE (115V) OR DUAL (115/230V) PRIMARIES

Recognized Component
Underwriters Labs Inc.



METHOD OF DETERMINING SECONDARY CURRENT RATINGS

The secondary currents shown in the tables are RMS ratings. Depending upon rectifier circuit configurations, the RMS secondary current is different than the DC output current. This is indicated in the chart below:

Rectifier Type	Filter Type	RMS Secondary Current Is
Full Wave Center-Tap	Choke Input	= 0.7 x DC Amps
Full Wave Center-Tap	Capacitor Input	= 1 to 1.2 x DC Amps
Full Wave Bridge	Choke Input	= DC Amps
Full Wave Bridge	Capacitor Input	= 1.6 to 1.8 x DC Amps

For example, in a F. W. Bridge circuit with a capacitive filter, if the load is 1 Amp DC, the RMS Secondary current is 1.6 to 1.8 Amp RMS.

CUSTOM VARIATIONS

Signal is equipped to quote on Custom Variations of "241" types. The secondary combinations are restricted by the number of secondary terminals available, as follows:

Size	Maximum Number of Secondary Terminals	VA Rating
3	3	2.4
4	4	6
5	4	12
6	5	30
7	5	56
8	5	100

We answer requests promptly and can deliver prototypes in one to three weeks. Production lead times can be scheduled with very reasonable lead times.

Part Number Single 115V	Part Number Dual 115/230V	Secondary RMS Rating	Part Number Single 115V	Part Number Dual 115/230V	Secondary RMS Rating
241-3-10	Not Available	10V C.T. @ 0.25A	241-3-28	Not Available	28V C.T. @ 0.085A
241-4-10	DP 241-4-10	10V C.T. @ 0.6A	241-4-28	DP 241-4-28	28V C.T. @ 0.2A
241-5-10	DP 241-5-10	10V C.T. @ 1.2A	241-5-28	DP 241-5-28	28V C.T. @ 0.42A
241-6-10	DP 241-6-10	10V C.T. @ 3.0A	241-6-28	DP 241-6-28	28V C.T. @ 1.1A
241-7-10	DP 241-7-10	10V C.T. @ 5.0A	241-7-28	DP 241-7-28	28V C.T. @ 2.0A
241-8-10	DP 241-8-10	10V C.T. @ 10A	241-8-28	DP 241-8-28	28V C.T. @ 3.6A
241-3-12	Not Available	12.6V C.T. @ 0.2A	241-3-36	Not Available	36V C.T. @ 0.065A
241-4-12	DP 241-4-12	12.6V C.T. @ 0.5A	241-4-36	DP 241-4-36	36V C.T. @ 0.17A
241-5-12	DP 241-5-12	12.6V C.T. @ 1.0A	241-5-36	DP 241-5-36	36V C.T. @ 0.35A
241-6-12	DP 241-6-12	12.6V C.T. @ 2.5A	241-6-36	DP 241-6-36	36V C.T. @ 0.85A
241-7-12	DP 241-7-12	12.6V C.T. @ 4.0A	241-7-36	DP 241-7-36	36V C.T. @ 1.5A
241-8-12	DP 241-8-12	12.6V C.T. @ 8.0A	241-8-36	DP 241-8-36	36V C.T. @ 2.8A
241-3-16	Not Available	16V C.T. @ 0.15A	241-3-48	Not Available	48V C.T. @ 0.05A
241-4-16	DP 241-4-16	16V C.T. @ 0.4A	241-4-48	DP 241-4-48	48V C.T. @ 0.125A
241-5-16	DP 241-5-16	16V C.T. @ 0.8A	241-5-48	DP 241-5-48	48V C.T. @ 0.25A
241-6-16	DP 241-6-16	16V C.T. @ 2.0A	241-6-48	DP 241-6-48	48V C.T. @ 0.63A
241-7-16	DP 241-7-16	16V C.T. @ 3.5A	241-7-48	DP 241-7-48	48V C.T. @ 1.2A
241-8-16	DP 241-8-16	16V C.T. @ 6.25A	241-8-48	DP 241-8-48	48V C.T. @ 2.0A
241-3-20	Not Available	20V C.T. @ 0.12A	241-3-56	Not Available	56V C.T. @ 0.045A
241-4-20	DP 241-4-20	20V C.T. @ 0.3A	241-4-56	DP 241-4-56	56V C.T. @ 0.11A
241-5-20	DP 241-5-20	20V C.T. @ 0.6A	241-5-56	DP 241-5-56	56V C.T. @ 0.22A
241-6-20	DP 241-6-20	20V C.T. @ 1.5A	241-6-56	DP 241-6-56	56V C.T. @ 0.54A
241-7-20	DP 241-7-20	20V C.T. @ 2.8A	241-7-56	DP 241-7-56	56V C.T. @ 1.0A
241-8-20	DP 241-8-20	20V C.T. @ 5.0A	241-8-56	DP 241-8-56	56V C.T. @ 1.8A
241-3-24	Not Available	24V C.T. @ 0.1A	241-3-120	Not Available	120V C.T. @ 0.02A
241-4-24	DP 241-4-24	24V C.T. @ 0.25A	241-4-120	DP 241-4-120	120V C.T. @ 0.05A
241-5-24	DP 241-5-24	24V C.T. @ 0.5A	241-5-120	DP 241-5-120	120V C.T. @ 0.1A
241-6-24	DP 241-6-24	24V C.T. @ 1.25A	241-6-120	DP 241-6-120	120V C.T. @ 0.25A
241-7-24	DP 241-7-24	24V C.T. @ 2.4A	241-7-120	DP 241-7-120	120V C.T. @ 0.5A
241-8-24	DP 241-8-24	24V C.T. @ 4.0A	241-8-120	DP 241-8-120	120V C.T. @ 0.85A

Explanation of part number series 241 Size-4 Sec. Volts - 36 Prefix "DP" used for dual primary versions

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rectifier power transformers

CHOICE OF SINGLE 115V OR DUAL 115/230V PRIMARIES

Primary 50/60 Hz		Secondary RMS Rating*									
Single 115V.	Dual* 115/230V.	Series	Parallel	Mtg. Style	L	W	H	ML	MW	Mtg. Screw	Approx. Lbs.
10-1	DL 10-1	10V C.T. @ 1A	5V C.T. @ 2A	C	2⅞	1¾	2⅝	2⅜	—	#8	1.0
10-2	DL 10-2	10V C.T. @ 2A	5V C.T. @ 4A	C	3⅛	2⅛	2¾	2 13/16	—	#8	1.5
10-4	DL 10-4	10V C.T. @ 4A	5V C.T. @ 8A	C	3⅜	2⅜	3 1/16	3⅛	—	#8	2.3
10-6	DL 10-6	10V C.T. @ 6A	5V C.T. @ 12A	B	3⅜	2¾	2 13/16	2 13/16	2⅛	#8	3.3
10-8	DL 10-8	10V C.T. @ 8A	5V C.T. @ 16A	B	3⅜	3⅛	2 13/16	2 13/16	2½	#8	4.0
10-12	DL 10-12	10V C.T. @ 12A	5V C.T. @ 24A	B	3¾	3¼	3⅛	3⅛	2½	#8	5.0
10-25	DL 10-25	10V C.T. @ 25A	5V C.T. @ 50A	B	4½	3¾	3¾	3¾	2¾	#10	8.7
10-50‡	DL 10-50	10V C.T. @ 50A	5V C.T. @ 100A	B	5¼	5½	4⅜	4⅜	3⅝	¼	17.0
10-100‡	DL 10-100	10V C.T. @ 100A	5V C.T. @ 200A	B	6⅜	7¼	5 5/16	5 5/16	4⅜	¼	34.5
12.8-1	DL 12.8-1	12.8V C.T. @ 1A	6.4V C.T. @ 2A	C	2⅞	2	2 5/16	2⅜	—	#8	1.2
12.8-2	DL 12.8-2	12.8V C.T. @ 2A	6.4V C.T. @ 4A	B	3	2½	2½	2½	2	#8	2.3
12.8-4	DL 12.8-4	12.8V C.T. @ 4A	6.4V C.T. @ 8A	B	3	2⅞	2½	2½	2⅜	#8	2.8
12.8-6	DL 12.8-6	12.8V C.T. @ 6A	6.4V C.T. @ 12A	B	3⅜	3 1/16	2 13/16	2 13/16	2½	#8	4.0
12.8-8	DL 12.8-8	12.8V C.T. @ 8A	6.4V C.T. @ 16A	B	3¾	3⅛	3⅛	3⅛	2¼	#8	4.5
12.8-12	DL 12.8-12	12.8V C.T. @ 12A	6.4V C.T. @ 24A	B	4⅛	3¼	3 1/16	3 1/16	2⅜	#10	6.0
12.8-25	DL 12.8-25	12.8V C.T. @ 25A	6.4V C.T. @ 50A	B	5¼	4¼	4⅜	4⅜	2⅞	#10	12.5
12.8-50‡	DL 12.8-50	12.8V C.T. @ 50A	6.4V C.T. @ 100A	B	5¼	6	4⅜	4⅜	4⅛	¼	20.7
12.8-100‡	DL 12.8-100	12.8V C.T. @ 100A	6.4V C.T. @ 200A	B	6⅜	7¼	5 5/16	5 5/16	4⅜	¼	34.5
16-1	DL 16-1	16V C.T. @ 1A	8V C.T. @ 2A	C	2⅞	2	2 5/16	2⅜	—	#8	1.2
16-2	DL 16-2	16V C.T. @ 2A	8V C.T. @ 4A	C	3⅛	2¼	2¾	2 13/16	—	#8	1.7
16-4	DL 16-4	16V C.T. @ 4A	8V C.T. @ 8A	B	3⅜	2¾	2 13/16	2 13/16	2⅛	#8	3.3
16-6	DL 16-6	16V C.T. @ 6A	8V C.T. @ 12A	B	3¾	3⅛	3⅛	3⅛	2¼	#10	4.5
16-8	DL 16-8	16V C.T. @ 8A	8V C.T. @ 16A	B	3¾	3½	3⅛	3⅛	2⅝	#10	5.4
16-12	DL 16-12	16V C.T. @ 12A	8V C.T. @ 24A	B	4⅛	3⅞	3 1/16	3 1/16	3	#10	7.9
16-25	DL 16-25	16V C.T. @ 25A	8V C.T. @ 50A	B	4½	5⅜	3¾	3¾	4	#10	14.5
16-50‡	DL 16-50	16V C.T. @ 50A	8V C.T. @ 100A	B	6⅜	5¾	5 5/16	5 5/16	3¾	¼	26.5
16-100‡	DL 16-100	16V C.T. @ 100A	8V C.T. @ 200A	B	7½	7½	6⅜	6¾	4⅝	¼	50.0
24-1	DL 24-1	24V C.T. @ 1A	12V C.T. @ 2A	B	3	2½	2½	2½	2	#8	2.3
24-2	DL 24-2	24V C.T. @ 2A	12V C.T. @ 4A	B	3	2⅞	2½	2½	2⅜	#8	2.9
24-4	DL 24-4	24V C.T. @ 4A	12V C.T. @ 8A	B	3¾	3⅛	3⅛	3⅛	2¼	#8	4.5
24-6	DL 24-6	24V C.T. @ 6A	12V C.T. @ 12A	B	4⅛	3¼	3 1/16	3 1/16	2⅜	#10	5.8
24-8	DL 24-8	24V C.T. @ 8A	12V C.T. @ 16A	B	4⅛	3⅞		3 1/16	3	#10	7.9
24-12‡	DL 24-12	24V C.T. @ 12A	12V C.T. @ 24A	B	4½	4½	3¾	3¾	3⅜	#10	11.0
24-20‡	DL 24-20	24V C.T. @ 20A	12V C.T. @ 40A	B	5¼	4¾	4⅜	4⅜	3⅜	¼	15.3
24-25‡	DL 24-25	24V C.T. @ 25A	12V C.T. @ 50A	B	5¼	5⅝	4⅜	4⅜	4⅛	¼	19.5
24-50‡	DL 24-50	24V C.T. @ 50A	12V C.T. @ 100A	B	6⅜	6¼	5 5/16	5 5/16	4⅜	¼	31.3
——	24-100 △	24V C.T. @ 100A	12V C.T. @ 200A	B	7½	7	6⅜	6¾	4⅛	¼	43.0
36-1	DL 36-1	36V C.T. @ 1A	18V C.T. @ 2A	B	3	2¾	2½	2½	2¼	#8	2.6
36-2	DL 36-2	36V C.T. @ 2A	18V C.T. @ 4A	B	3⅜	2 13/16	2 13/16	2 13/16	2⅜	#8	3.8
36-4	DL 36-4	36V C.T. @ 4A	18V C.T. @ 8A	B	4⅛	3⅜	3 1/16	3 1/16	2⅝	#10	6.8
36-6	DL 36-6	36V C.T. @ 6A	18V C.T. @ 12A	B	4½	3¾	3¾	3¾	2¾	#10	8.7
36-8‡	DL 36-8	36V C.T. @ 8A	18V C.T. @ 16A	B	4½	4½	3¾	3¾	3⅜	#10	11.0
36-12‡	DL 36-12	36V C.T. @ 12A	18V C.T. @ 24A	B	5¼	5	4⅜	4⅜	3⅜	¼	15.0
36-20‡	DL 36-20	36V C.T. @ 20A	18V C.T. @ 40A	B	6⅜	5⅜	5 5/16	5 5/16	3⅜	¼	22.8
36-25‡	DL 36-25	36V C.T. @ 25A	18V C.T. @ 50A	B	6⅜	5¾	5 5/16	5 5/16	3¾	¼	26.5
36-30‡	DL 36-30	36V C.T. @ 30A	18V C.T. @ 60A	B	6⅜	6	5 5/16	5 5/16	4⅜	¼	31.5
——	36-50△	36V C.T. @ 50A	18V C.T. @ 100A	B	6⅜	7¼	5 5/16	5 5/16	5⅛	¼	40.0
56-1	DL 56-1	56V C.T. @ 1A	28V C.T. @ 2A	B	3⅜	2⅞	2 13/16	2 13/16	2¼	#8	3.5
56-2	DL 56-2	56V C.T. @ 2A	28V C.T. @ 4A	B	3¾	3¼	3⅛	3⅛	2½	#8	5.0
56-4	DL 56-4	56V C.T. @ 4A	28V C.T. @ 8A	B	4⅛	3¾	3 1/16	3 1/16	3	#10	7.7
56-6	DL 56-6	56V C.T. @ 6A	28V C.T. @ 12A	B	5¼	4¼	4⅜	4⅜	2⅞	#10	12.0
56-8‡	DL 56-8	56V C.T. @ 8A	28V C.T. @ 16A	B	5¼	5	4⅜	4⅜	3⅝	¼	17.0
56-12†	DL 56-12	56V C.T. @ 12A	28V C.T. @ 24A	B	6⅜	5¼	5 5/16	5 5/16	3⅜	¼	22.0
56-25‡	DL 56-25	56V C.T. @ 25A	28V C.T. @ 50A	B	6⅜	7⅛	5 5/16	5 5/16	5⅛	¼	38.0
——	56-50△	56V C.T. @ 50A	28V C.T. @ 100A	B	7½	7½	6¼	6¾	4⅞	¼	56.3
68-1	DL 68-1	68V C.T. @ 1A	34V C.T. @ 2A	B	3⅜	2 15/16	2 13/16	2 13/16	2⅜	#8	3.8
68-2	DL 68-2	68V C.T. @ 2A	34V C.T. @ 4A	B	4⅛	3⅜	3 1/16	3 1/16	2⅝	#10	6.8
68-4	DL 68-4	68V C.T. @ 4A	34V C.T. @ 8A	B	4½	4½	3¾	3¾	3⅜	#10	11.5
68-6‡	DL 68-6	68V C.T. @ 6A	34V C.T. @ 12A	B	5¼	5	4⅜	4⅜	3⅜	¼	15.0
68-8‡	DL 68-8	68V C.T. @ 8A	34V C.T. @ 16A	B	5¼	5½	4⅜	4⅜	3⅞	¼	19.0
68-12‡	DL 68-12	68V C.T. @ 12A	34V C.T. @ 24A	B	6⅜	5¾	5 5/16	5 5/16	3¾	¼	26.5
——	68-25△	68V C.T. @ 25A	34V C.T. @ 50A	B	6⅜	7¼	5 5/16	5 5/16	5⅛	¼	39.7
80-1	DL 80-1	80V C.T. @ 1A	40V C.T. @ 2A	B	3⅜	3 1/16	2 13/16	2 13/16	2½	#8	4.0
80-2	DL 80-2	80V C.T. @ 2A	40V C.T. @ 4A	B	4⅛	3⅜	3 1/16	3 1/16	2⅝	#10	6.8
80-4	DL 80-4	80V C.T. @ 4A	40V C.T. @ 8A	B	5¼	4¼	4⅜	4⅜	2⅞	¼	12.3
80-6‡	DL 80-6	80V C.T. @ 6A	40V C.T. @ 12A	B	5¼	5½	4⅜	4⅜	3⅞	¼	19.0
80-8‡	DL 80-8	80V C.T. @ 8A	40V C.T. @ 16A	B	6⅜	5¼	5 5/16	5 5/16	3¼	¼	20.5
80-12‡	DL 80-12	80V C.T. @ 12A	40V C.T. @ 24A	B	6⅜	6	5 5/16	5 5/16	4⅛	¼	29.0
——	80-25△	80V C.T. @ 25A	40V C.T. @ 50A	B	7½	6½	6¼	6¾	3⅞	¼	40.3

△Available with dual primary only. Therefore, prefix "DL" is not required.
‡ Nominal 115V primary has added taps, I.E., 105/115/125V, Dual (DL) version is 115/230V only.

Items shown in shaded area are not normally in stock. They are standard designs generally available in 3-4 weeks.

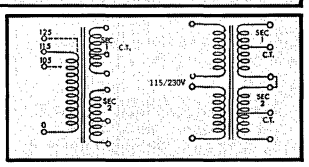
All transformers are designed conservatively and are rated for 50/60 Hz. Only prime raw materials are used. Units are thoroughly impregnated and baked with Signal's own high gloss varnish. The transformers and chokes are rugged in construction, well insulated, and have a consistently uniform appearance. All ratings are at full load current continuous operation. Hipot rating of 1500V RMS is standard.

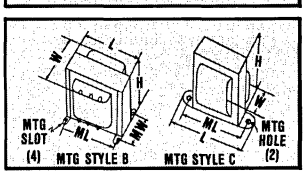
Electrical ratings have been chosen to cover a wide range of applications. All transformers have two center-tapped secondary windings, which may be series or parallel connected as indicated in rating chart.

*The secondary currents shown in the tables are RMS ratings. Depending upon rectifier circuit configurations, the RMS secondary current is different than the DC output current. This is indicated in the chart below:

Rectifier Type	Filter Type	RMS Secondary Current Is
Full Wave Center-Tap	Choke Input	= 0.7 x DC Amps
Full Wave Center-Tap	Capacitor Input	= 1 to 1.2 x DC Amps
Full Wave Bridge	Choke Input	= DC Amps
Full Wave Bridge	Capacitor Input	= 1.6 to 1.8 x DC Amps

For example, in a F.W. Bridge circuit with a capacitive filter, if the load is 1 Amp DC, the RMS Secondary current is 1.6 to 1.8 Amp RMS.





"See page 1•2631 for prices"

Dept. EM, 500 Bayview Ave., Inwood, N.Y. 11696 • Telephone: (516) 239-4510

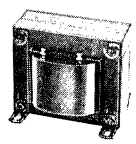
signal TRANSFORMER

filter chokes

1.0 TO 200 AMPS

Signal's line of filter chokes is the most extensive available. It is designed to complement the selection of Rectifier Power Transformers so that a set may be specified for power supplies using inductive filters.

The inductance ratings given are minimum values guaranteed at full DC current. All resistance ratings are maximum values. Special variations or intermediate values of inductance, current, or resistance can be supplied promptly and accurately.

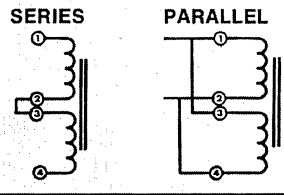


FOR MECHANICAL DIMENSIONS REFER TO TRANSFORMER OUTLINES ON PREVIOUS PAGE

Part No.	Inductance (MHY)	Current (Amps)	Resistance (Ohms)	Mtg. Style	L	W	H	ML	MW	Mtg. Screw	Approx. Lbs.
CH-1	100	1	1.5	B	3	2½	2½	2½	2	#8	2.3
CH-2	70	2	0.9	B	3⅜	2¾	2⅞	2 13/16	2⅛	#8	3.2
CH-4	70	4	0.6	B	3¾	3⅛	3¼	3⅛	2½	#8	5.3
CH-6	40	6	0.4	B	3¾	3⅝	3¼	3⅛	3	#8	6.5
CH-8	30	8	0.3	B	4⅛	3⅝	3½	3 7/16	3	#10	8
CH-12	15	12	0.1	B	5¼	4	4 1/16	4⅜	3⅛	#10	13.7
CH-16	15	16	0.08	B	5¼	4⅝	4 1/16	4⅜	3⅝	#10	17.5
CH-20	7	20	0.05	B	5¼	4	4 1/16	4⅜	3⅛	#10	13.3
CH-25	5	25	0.025	B	5¼	4¾	4 1/16	4⅜	3⅞	#10	17.8
CH-30	4	30	0.01	B	6⅜	5	5⅜	5 5/16	3⅜	¼	24.4
CH-50	1.4	50	0.01	B	6⅜	5¼	5⅜	5 5/16	3¾	¼	26.7
CH-100	0.5	100	0.005	B	6⅜	6¼	5⅜	5 5/16	4⅛	¼	31.4
CH-200	0.3	200	0.001	B	7½	7½	6¼	6¾	4⅛	¼	48.0

dual chokes

FOR LOWER INDUCTANCE APPLICATIONS

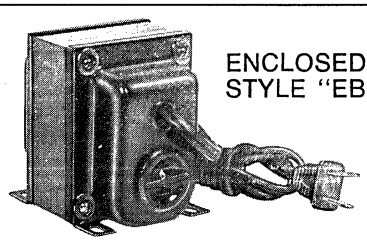


Part No.	Series Connected Ind. (MHY)	Curr. (Amps)	Res. Ω	Parallel Connected Ind. (MHY)	Curr. (Amps)	Res. Ω	Mtg. Style	Dimensions L	W	H	ML	MW	Mtg. Screw	Appr. Lbs.
CL-1-2	72	1	1.4	18	2	0.35	C	2⅞	1¾	2 5/16	2⅜	—	#8	0.9
CL-2-4	40	2	0.7	10	4	0.18	C	3⅛	2⅛	2¾	2 13/16	—	#8	1.5
CL-4-8	20	4	0.3	5	8	0.075	B	3	2⅞	2½	2½	2½	#8	3.0
CL-6-12	12	6	0.15	3	12	0.038	B	3⅜	3 1/16	2 13/16	2 13/16	2½	#8	4.0
CL-12-24	4.8	12	0.052	1.2	24	0.013	B	3⅜	3 1/16	2 13/16	2 13/16	3	#8	5.3
CL-25-50	1.2	25	0.012	0.3	50	0.003	B	3¾	3⅜	3⅜	3⅛	2¾	#8	6.0
CL-50-100	0.5	50	0.0043	0.12	100	0.0011	B	4½	3¾	3¾	3¾	2½	#8	8.0

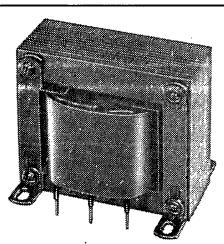
Signal's Dual Chokes are supplied with 2 windings which may be series or parallel connected with rating shown on chart. This line is basically designed for application requiring lower inductance value at high currents, such as low voltage, DC supplies or SCR filters.

step down auto transformers

50/60 Hz 100-2000 VA — 230/115V



ENCLOSED STYLE "EB"



OPEN FRAME STYLE "OF"

(May be used step-up or step-down)

UL APPROVED 2 PRONG LINE CORD RECEPTACLE — LOW REGULATION
BLACK ENAMEL FINISH

VA	Cat. No.	Width	Depth	Height	Mtg. Centers	Lbs.
100	110	1⅞	2⅜	2½	1½ x 1 1/16	1.5
120	112	2⅞	2⅛	3½	2¼ x 1¾	3.0
150	115	2⅞	3⅜	3½	2¼ x 2	3.5
200	120	2⅞	3½	3½	2¼ x 2⅛	4.0
250	125	2⅞	3⅞	3½	2¼ x 2½	4.8
300	130	3¼	3⅞	3⅞	2½ x 2 7/16	5.5
500	150	3¼	4⅞	3⅞	2½ x 3 1/16	8
750	175	3¼	5⅞	3⅞	2½ x 4¼	11
1000	1100	4½	5⅛	5½	3½ x 3½	14
1500	1150	4½	6⅛	5½	3½ x 4½	20
2000	1200	4½	7⅛	5½	3½ x 5½	26

BLACK ENAMEL FINISH. 8" LEADS
INEXPENSIVE VERSION FOR USE IN EQUIPMENT

VA	Cat. No.	Width	Depth	Height	Mtg. Centers	Lbs.
100	110-OF	2¼	2	1 15/16	2 13/16*	1.3
120	112-OF	3⅜	2½	2⅞	2 13/16 x 1⅞	2.5
150	115-OF	3⅜	2¾	2⅞	2 13/16 x 2⅛	3.0
200	120-OF	3⅜	2⅞	2⅞	2 13/16 x 2¼	3.5
250	125-OF	3⅜	3¼	2⅞	2 13/16 x 2⅝	4.2
300	130-OF	3¾	3¼	3⅛	3⅛ x 2½	5.0
500	150-OF	3¾	4¼	3⅛	3⅛ x 3½	8.0
750	175-OF	3¾	5¼	3⅛	3⅛ x 4½	11
1000	1100-OF	5¼	4½	4⅜	4⅜ x 3⅛	14
1500	1150-OF	5¼	5½	4⅜	4⅜ x 4⅛	19
2000	1200-OF	5¼	6½	4⅜	4⅜ x 5⅛	25

* Part 110-OF is mounted by means of a channel with 2 mtg. tabs.

Always in Stock —"THE PRONTO CHALLENGE":—We ship your order (up to 4 pieces) in 48 hours and that's a promise we intend to keep."

"See page 1•2631 for prices"

signal TRANSFORMER
Dept. EM, 500 Bayview Ave., Inwood, NY 11696
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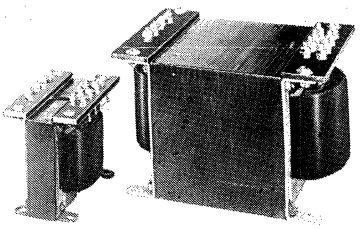
power isolation transformers

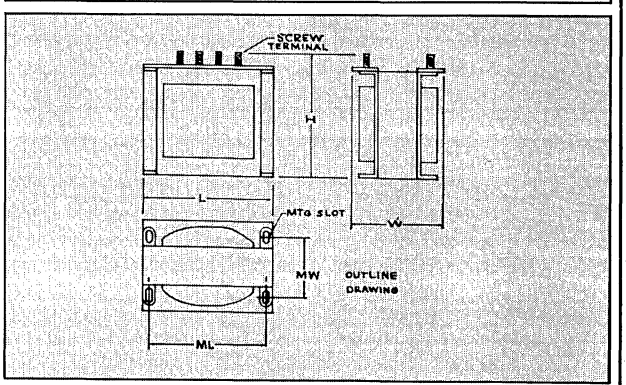
INDUSTRIAL GRADE/STEP-UP OR STEP-DOWN. MANY POSSIBLE VOLTAGE RATINGS.



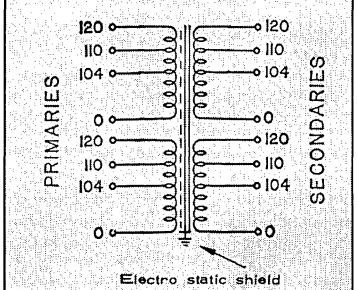
AVAILABLE FROM STOCK FOR IMMEDIATE SHIPMENT

The "DU" and "SU" lines are designed for a maximum of 55°C rise above ambient for use on standard power lines from 50 to 500 Cps. Only prime raw materials are used. Units are thoroughly impregnated and baked with Signal's own high gloss black baking varnish. The transformers are rugged in construction, well-insulated and have a consistently uniform appearance. All ratings are at full load current, continuous operation. 2500V. RMS Hipot is standard.

Heavy ¼ inch phenolic terminal boards are provided with plated brass screws and flat washers (10-32 on ¼ and ½ KVA, ¼-20 on larger sizes). Connections can be easily made with a nut driver. It is also simple to alter the interconnections to change transformer ratings. **Electro static shields are provided grounded to the core.** The connection is made with a lug to ground and may be opened if an ungrounded shield is desired.



DU SERIES 110/220 Dual Primary to 110/220V. Dual Sec. (Primary & Secondary may be reversed)

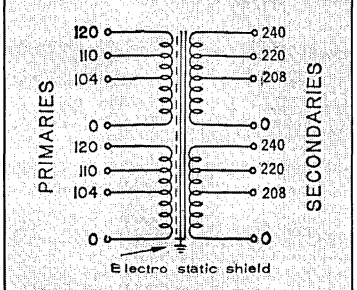


As shown on the schematic diagram the "DU" line is designed with dual primaries and secondaries. All four windings are identically rated at 0/104/110/120 volts. This permits series or parallel connections on either primary or secondary. Therefore, a nominal 110 to 110 volt, 220 to 220 volt, 110 to 220 volt, or 220 to 110 volt transformer can be set up. The winding taps permit intermediate series ratings such as 208, 214, or 230 volts. It is also possible to make auto-transformer connections by connecting a primary group in series with a secondary group. Such nominal ratings as 440 to 220 volts or 220 to 440 volts can be set-up, in addition to the standard ratings described above. A further advantage to auto-transformer connection is the fact that the KVA rating of a particular type is doubled.

Part No.	KVA	Series Secondaries Volts	Series Secondaries Max. Amps	Parallel Secondaries Volts	Parallel Secondaries Max. Amps	Mechanical Dimensions L *	W *	H *	ML †	MW ‡	Mtg. & Term. Screw	Appr. Lbs.
DU-¼	¼	0/208/220/240	1.1	0/104/110/120	2.2	5 5/16	4¼	5¼	4⅜	2½	#10	12
DU-½	½	0/208/220/240	2.3	0/104/110/120	4.6	5 5/16	5 5/16	5¼	4⅜	3⅝	#10	18
DU-1	1	0/208/220/240	4.5	0/104/110/120	9	7 5/16	6¼	7¼	6¾	4⅛	¼	33
DU-2	2	0/208/220/240	9	0/104/110/120	18	7 5/16	8¼	7¼	6¾	6	¼	56
DU-3	3	0/208/220/240	14	0/104/110/120	28	7 5/16	9¼	7¼	6¾	7	¼	70
DU-5	5	0/208/220/240	23	0/104/110/120	46	7 5/16	10¾	7¼	6¾	8½	¼	89
DU-7.5	7.5	0/208/220/240	31	0/104/110/120	62	9	10¾	8	7½	6½	¼	105
DU-10	10	0/208/220/240	41	0/104/110/120	83	9	13	8	7½	9	¼	150

* Maximum. † ±1/32. ‡ ±1/16.

SU SERIES 110/220 Dual Primary to 220/440V. Dual Sec. (Primary & Secondary may be reversed)



"SU" transformers are similar to "DU" types except that a 220/240V secondary is provided.

Part No.	KVA	Series Secondaries Volts	Series Secondaries Max. Amps	Parallel Secondaries Volts	Parallel Secondaries Max. Amps	Mechanical Dimensions L *	W *	H *	ML †	MW ‡	Mtg. & Term. Screw	Appr. Lbs.
SU-¼	¼	0/416/440/480	0.55	0/208/220/240	1.1	5 5/16	4¼	5¼	4⅜	2½	#10	12
SU-½	½	0/416/440/480	1.15	0/208/220/240	2.3	5 5/16	5 5/16	5¼	4⅜	3⅝	#10	18
SU-1	1	0/416/440/480	2.25	0/208/220/240	4.5	7 5/16	6¼	7¼	6¾	4⅛	¼	33
SU-2	2	0/416/440/480	4.5	0/208/220/240	9	7 5/16	8¼	7¼	6¾	6	¼	56
SU-3	3	0/416/440/480	7	0/208/220/240	14	7 5/16	9¼	7¼	6¾	7	¼	70
SU-5	5	0/416/440/480	11.5	0/208/220/240	23	7 5/16	10¾	7¼	6¾	8½	¼	89
SU-7.5	7.5	0/416/440/480	15.5	0/208/220/240	31	9	10¾	8	7½	6½	¼	105
SU-10	10	0/416/440/480	20.5	0/208/220/240	41	9	13	8	7½	9	¼	150

* Maximum. † ±1/32. ‡ ±1/16.

Always in Stock —"THE PRONTO CHALLENGE":—We ship your order (up to 4 pieces) in 48 hours and that's a promise we intend to keep."

"See page 1•2631 for prices"

signal TRANSFORMER

Dept. EM, 500 Bayview Ave., Inwood, NY 11696
Telephone: (516) 239-4510

price list

JANUARY 1, 1983

RECTIFIER POWER

Part No.	Net
10-1	$16.60
10-2	19.20
10-4	21.70
10-6	28.10
10-8	36.30
10-12	40.50
10-25	57.00
10-50	90.00
10-100	142.00
12.8-1	17.70
12.8-2	22.90
12.8-4	27.00
12.8-6	31.00
12.8-8	36.50
12.8-12	45.50
12.8-25	62.40
12.8-50	99.00
12.8-100	150.00
16-1	17.90
16-2	19.80
16-4	28.00
16-6	32.90
16-8	42.70
16-12	45.00
16-25	78.00
16-50	144.00
16-100	198.00
24-1	22.20
24-2	25.40
24-4	31.90
24-6	39.00
24-8	44.00
24-12	63.00
24-20	84.00
24-25	99.00
24-50	136.00
24-100	256.00
36-1	23.40
36-2	28.70
36-4	39.10
36-6	46.90
36-8	59.00
36-12	77.00
36-20	114.00
36-25	124.00
36-30	145.00
36-50	188.00
56-1	27.00
56-2	32.40
56-4	41.80
56-6	59.00
56-8	84.00
56-12	99.00
56-25	170.00
56-50	330.00
68-1	27.90
68-2	36.40
68-4	54.00
68-6	68.50
68-8	88.00
68-12	127.00
68-25	200.00
80-1	30.00
80-2	39.10
80-4	62.50
80-6	94.50
80-8	106.00
80-12	130.00
80-25	208.00
DL-10-1	17.43
DL-10-2	20.16
DL-10-4	22.79
DL-10-6	29.51
DL-10-8	38.12
DL-10-12	42.53
DL-10-25	59.83
DL-10-50	94.50
DL-10-100	149.10
DL-12.8-1	18.59
DL-12.8-2	24.05
DL-12.8-4	28.35
DL-12.8-6	32.55
DL-12.8-8	38.50
DL-12.8-12	47.78
DL-12.8-25	65.52
DL-12.8-50	$103.95
DL-12.8-100	157.50
DL-16-1	18.80
DL-16-2	20.79
DL-16-4	29.40
DL-16-6	34.55
DL-16-8	44.84
DL-16-12	47.00
DL-16-25	81.90
DL-16-50	151.20
DL-16-100	202.00
DL-24-1	23.31
DL-24-2	26.67
DL-24-4	33.50
DL-24-6	40.95
DL-24-8	46.00
DL-24-12	66.15
DL-24-20	87.00
DL-24-25	103.95
DL-24-50	142.80
DL-36-1	24.57
DL-36-2	30.14
DL-36-4	41.06
DL-36-6	49.25
DL-36-8	61.95
DL-36-12	80.85
DL-36-20	119.70
DL-36-25	127.00
DL-36-30	152.25
DL-56-1	28.35
DL-56-2	34.02
DL-56-4	43.89
DL-56-6	61.95
DL-56-8	88.20
DL-56-12	103.95
DL-56-25	178.50
DL-68-1	29.30
DL-68-2	38.22
DL-68-4	56.70
DL-68-6	71.93
DL-68-8	92.40
DL-68-12	133.35
DL-80-1	31.50
DL-80-2	41.00
DL-80-4	65.63
DL-80-6	99.23
DL-80-8	111.50
DL-80-12	136.50

CHOKES

CH-1	17.80
CH-2	22.70
CH-4	37.40
CH-6	40.00
CH-8	43.70
CH-12	60.20
CH-16	84.00
CH-20	68.10
CH-25	79.20
CH-30	99.00
CH-50	108.00
CH-100	124.00
CH-200	182.00

DUAL CHOKES

CL-1-2	15.80
CL-2-4	18.00
CL-4-8	32.50
CL-6-12	36.00
CL-12-24	40.00
CL-25-50	49.00
CL-50-100	66.00

POWER ISOLATION TRANSFORMERS

DU-¼	90.00
DU-½	114.00
DU-1	190.00
DU-2	260.00
DU-3	$350.00
DU-5	440.00
DU-7.5	580.00
DU-10	790.00
SU-¼	90.00
SU-½	114.00
SU-1	190.00
SU-2	260.00
SU-3	350.00
SU-5	440.00
SU-7.5	580.00
SU-10	790.00

AUTO TRANSFORMERS

110	30.00
112	34.00
115	35.50
120	37.00
125	39.00
130	42.00
150	49.00
175	60.00
1100	77.00
1150	99.00
1200	120.00
110-OF	19.00
112-OF	23.00
115-OF	25.00
120-OF	26.50
125-OF	28.80
130-OF	32.00
150-OF	40.80
175-OF	53.50
1100-OF	61.40
1150-OF	94.00
1200-OF	112.00

PC POWER

PC-10-90	8.65
PC-10-120	6.34
PC-10-440	7.42
PC-10-1000	8.65
PC-10-2400	11.45
PC-12-70	8.65
PC-12-100	6.34
PC-12-350	7.42
PC-12-800	8.65
PC-12-2000	11.45
PC-16-55	8.65
PC-16-75	6.34
PC-16-260	7.42
PC-16-640	8.65
PC-16-1500	11.45
PC-20-45	8.65
PC-20-60	6.34
PC-20-220	7.42
PC-20-500	8.65
PC-20-1200	11.45
PC-24-35	8.65
PC-24-50	6.34
PC-24-180	7.42
PC-24-450	8.65
PC-24-1000	$11.45
PC-28-30	8.65
PC-28-40	6.34
PC-28-160	7.42
PC-28-360	8.65
PC-28-800	11.45
PC-34-25	8.65
PC-34-35	6.34
PC-34-125	7.42
PC-34-300	8.65
PC-34-700	11.45
PC-40-20	8.65
PC-40-30	6.34
PC-40-110	7.42
PC-40-250	8.65
PC-40-600	11.45
PC-56-15	8.65
PC-56-20	6.34
PC-58-80	7.42
PC-56-180	8.65
PC-58-420	11.45
PC-120-8	8.65
PC-120-10	6.34
PC-120-35	7.42
PC-120-85	8.65
PC-120-200	11.45
DPC-10-90	10.00
DPC-10-120	7.40
DPC-10-440	8.62
DPC-10-1000	10.10
DPC-10-2400	12.66
DPC-12-70	10.00
DPC-12-100	7.40
DPC-12-350	8.62
DPC-12-800	10.10
DPC-12-2000	12.66
DPC-16-55	10.00
DPC-16-75	7.40
DPC-16-260	8.62
DPC-16-640	10.10
DPC-16-1500	12.66
DPC-20-45	10.00
DPC-20-60	7.40
DPC-20-220	8.62
DPC-20-500	10.10
DPC-20-1200	12.66
DPC-24-35	10.00
DPC-24-50	7.40
DPC-24-180	8.62
DPC-24-450	10.10
DPC-24-1000	12.66
DPC-28-30	10.00
DPC-28-40	7.40
DPC-28-160	8.62
DPC-28-360	10.10
DPC-28-800	12.66
DPC-34-25	10.00
DPC-34-35	7.40
DPC-34-125	8.62
DPC-34-300	10.10
DPC-34-700	12.66
DPC-40-20	10.00
DPC-40-30	7.40
DPC-40-110	8.62
DPC-40-250	10.10
DPC-40-600	12.66
DPC-56-15	10.00
DPC-56-20	7.40
DPC-56-80	8.62
DPC-56-180	10.10
DPC-56-420	12.66
DPC-120-8	10.00
DPC-120-10	7.40
DPC-120-35	8.62
DPC-120-85	10.10
DPC-120-200	12.66
10-BR	.60
24-BR	.60

FLAT-HEAD PC TYPES

LP-10-250	9.00
LP-10-600	9.92
LP-10-1200	11.96
LP-12-200	9.00
LP-12-450	9.92
LP-12-900	11.96
LP-16-150	9.00
LP-16-350	$ 9.92
LP-16-700	11.96
LP-20-125	9.00
LP-20-300	9.92
LP-20-600	11.96
LP-24-100	9.00
LP-24-250	9.92
LP-24-500	11.96
LP-30-85	9.00
LP-30-200	9.92
LP-30-400	11.96
LP-34-75	9.00
LP-34-170	9.92
LP-34-340	11.96
LP-40-60	9.00
LP-40-150	9.92
LP-40-300	11.96
LP-56-45	9.00
LP-56-100	9.92
LP-56-200	11.96
LP-88-28	9.00
LP-88-65	9.92
LP-88-130	11.96
LP-120-20	9.00
LP-120-50	9.92
LP-120-100	11.96
LP-230-10	9.00
LP-230-25	9.92
LP-230-50	11.96

MICRO-PROCESSOR PC TYPES

MPC-X-12	10.40
MPC-X-15	10.40
MPC-Y-12	13.20
MPC-Y-15	13.20
DMPC-X-12	11.85
DMPC-X-15	11.85
DMPC-Y-12	14.40
DMPC-Y-15	14.40
MPL-6-12	12.40
MPL-6-15	12.40
MPL-12-12	14.20
MPL-12-15	14.20

MICRO-PROCESSOR 2-4-1 TYPES

MT-6-12	13.50
MT-6-15	13.50
MT-7-12	17.65
MT-7-15	17.65
MT-8-12	22.76
MT-8-15	22.76
DMT-6-12	15.00
DMT-6-15	15.00
DMT-7-12	18.12
DMT-7-15	18.12
DMT-8-12	23.80
DMT-8-15	23.80

2-4-1

241-3-(ANY)	6.88
241-4-(ANY)	7.54
241-5-(ANY)	8.42
241-6-(ANY)	11.28
241-7-(ANY)	15.26
241-8-(ANY)	20.16
DP-241-4-(ANY)	9.20
DP-241-5-(ANY)	10.00
DP-241-6-(ANY)	12.80
DP-241-7-(ANY)	15.70
DP-241-8-(ANY)	21.20

SPLIT/TRAN

ST-2-(ANY)	6.75
ST-3-(ANY)	6.88
ST-4-(ANY)	7.88
ST-5-(ANY)	8.70
ST-6-(ANY)	10.48
ST-7-(ANY)	11.70
DST-2-(ANY)	7.85
DST-3-(ANY)	8.10
DST-4-(ANY)	8.70
DST-5-(ANY)	9.70
DST-6-(ANY)	11.90
DST-7-(ANY)	13.10
ST-MS	9.00/C
ST-MN	9.00/C

DISCOUNT SCHEDULE*

Quantity	Discount
1-9	Net
10-24	25%
25-49	35%
50-99	43%
100-249	50%
250 Over	Quote

* Different part numbers may not be aggregated to obtain quantity discount.
Terms: Net 30 days on approved credit. FOB Factory, Inwood, N.Y.
Prices subject to change without notice!

All items on this price schedule are stocked with the exception of those in shaded areas. Normal lead time for these parts is 3 to 4 weeks and orders require a $35.00 set-up charge per item.

signal TRANSFORMER

500 Bayview Ave., Inwood, NY 11696 • Telephone: (516) 239-4510
Telex: 96-8112 — TWX 510-225-8440

STACO ENERGY PRODUCTS CO. variable

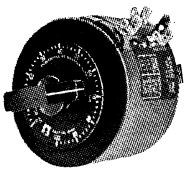


FIG. A

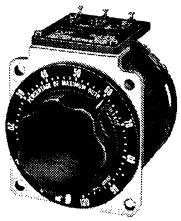


FIG. B

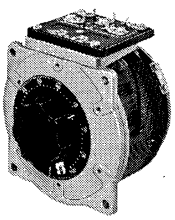


FIG. C

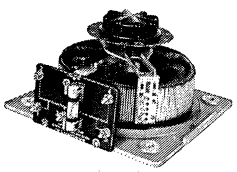


FIG. D

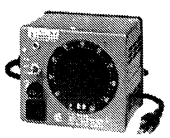


FIG. E

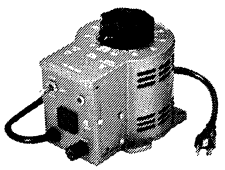


FIG. F

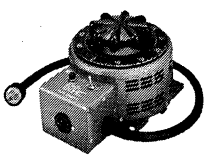


FIG. G

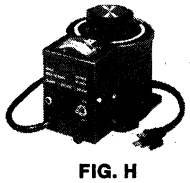


FIG. H

Staco variable transformers offer versatility and reliability unmatched by solid state voltage controls. Staco controls are used worldwide for industrial and laboratory applications to control voltage, current, power, heat, speed, light and electro-mechanical force. Staco variable transformers provide continuously adjustable output voltage from AC power sources without wave form distortions or SCR generated noise. Outstanding features include gold-plated commutators, precise regulation, high efficiency, conservative ratings and rugged construction.

You can select from panel mounted types, cord and plug types, ganged and/or motor driven types, metered types, and fully portable power supplies with or without meters, and ratings from 0.8 amps to 540 amps, 40 volts to 560 volts for single or three phase applications.

Staco has a nationwide network of distributors qualified to offer technical assistance whenever you need it. Additionally, the Staco Engineering Staff is available to help you with special or non-standard applications. Staco's Variable Voltage Controls handbook will be sent to you upon request ... it's loaded with illustrations, engineering data, specifications and ordering information on standard voltage controls. Prices shown are list prices at press time and are subject to change.

PANEL OR BENCH MOUNTING MODELS *120 VOLT INPUT SINGLE PHASE*

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
171	A	*0-120/132	1.75	0.23	2 3/16 x 1 7/8	3.0	$ 20.00
201	A	*0-120/132	2.0	0.26	2 3/16 x 1 7/8	3.0	20.50
221	A	*0-120/132	2.25	0.30	2 3/16 x 2 1/8	3.2	21.00
251	A	*0-120/132	2.5	0.33	2 3/16 x 2 5/16	3.5	25.00
291	A	*0-120/132	3.0	0.40	2 3/16 x 2 5/16	3.5	27.00
501	B	0-120/140	5.0	0.70	3 3/4 x 3 3/4 x 3 5/16	6.0	37.00
1010	B	0-120/140	10.0	1.4	5 5/16 x 5 x 4 3/16	12.0	48.00
1010CT	J	0-120/140	10.0	1.4	6 7/8 x 5 x 4 7/16	12.0	75.00
SQ1010	B	0-120/140	10.0	1.4	5 3/16 x 4 1/4 x 4 5/32	12.0	50.00
1210	B	**0-120	12.0	1.44	5 5/16 x 5 x 4 3/16	12.0	54.00
1210CT	J	**0-120	12.0	1.44	6 7/8 x 5 x 4 7/16	12.0	74.00
SQ1210	B	**0-120	12.0	1.44	5 3/16 x 4 1/4 x 4 5/32	12.0	60.00
1510	C	0-120/140	15.0	2.1	6 1/8 x 6 5/8 x 4 3/8	20.0	98.00
1510CT	C	0-120/140	15.0	2.1	8 31/32 x 6 3/16 x 4 1/2	20.0	131.00
2510	C	0-120/140	25.0	3.5	8 3/16 x 7 5/8 x 4 1/8	23.0	142.00
2510CT	K	0-120/140	25.0	3.5	9 5/8 x 7 5/8 x 4 1/8	26.0	176.00
5010	D	0-140	50.0	7.0	15 3/8 x 13 7/8 x 5 1/4	60.0	336.00
5010CT	D	0-140	50.0	7.0	17 15/16 x 14 x 7 1/8	66.0	381.00
6010	D	0-120/140	60.0	8.4	15 3/8 x 13 7/8 x 5 1/4	67.0	403.00
6010C	D	0-120/140	60.0	8.4	15 3/8 x 13 7/8 x 7 1/8	67.0	419.00
6010CT	D	0-120/140	60.0	8.4	17 15/16 x 14 x 7 1/8	67.0	457.00

PANEL OR BENCH MOUNTING MODELS *240 VOLT INPUT SINGLE PHASE*

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
252	A	0-240/264	0.8	0.21	2 3/16 x 2 7/16	3.5	$ 33.00
1020	B	0-240/280	3.5	0.98	5 5/16 x 5 x 4 3/16	12.0	64.00
1020CT	J	0-240/280	3.5	0.98	6 7/8 x 5 x 4 7/16	12.0	81.00
SQ1020	B	0-240/280	3.5	0.98	5 3/16 x 4 1/4 x 4 5/32	12.0	64.00
1220	B	**0-240	5.0	1.2	5 5/16 x 5 x 4 3/16	12.0	67.00
1220CT	J	**0-240	5.0	1.2	6 7/8 x 5 x 4 7/16	12.0	84.00
SQ1220	B	**0-240	5.0	1.2	5 3/16 x 4 1/4 x 4 5/32	12.0	67.00
1520	C	0-240/280	9.5	2.66	6 1/8 x 6 5/8 x 4 13/16	20.0	98.00
1520CT	K	0-240/280	9.5	2.66	6 3/8 x 9 1/8 x 5	23.0	124.00
2520	C	0-240/280	10.0	2.8	8 3/16 x 7 5/8 x 4 1/8	23.0	142.00
2520CT	K	0-240/280	10.0	2.8	9 5/8 x 7 5/8 x 4 1/8	26.0	176.00
5020	D	0-240/280	28.0	7.8	15 3/8 x 13 7/8 x 5 1/4	60.0	330.00
5020CT	D	0-240/280	28.0	7.8	17 15/16 x 14 x 7 1/8	66.0	381.00
6020	D	0-240/280	35.0	9.8	15 3/8 x 13 7/8 x 5 1/4	63.0	413.00
6020C	D	0-240/280	35.0	9.8	15 3/8 x 13 7/8 x 7 1/8	63.0	436.00
6020CT	D	0-240/280	35.0	9.8	17 15/16 x 14 x 7 1/8	63.0	476.00

PORTABLE MODELS *120 VOLT INPUT SINGLE PHASE*

Cord, matching receptacle, switch, pilot light, fuse, connected for clockwise knob rotation. Available with 2 conductor line cord and receptacle (2PF) or a 3-conductor grounded line cord and receptacle (3PN).

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
2PF171	E	**0-132	1.75	0.23	3 15/16 x 3 15/16 x 3 1/2	3.5	$ 56.00
3PN171	E	**0-132	1.75	0.23	3 15/16 x 3 15/16 x 3 1/2	3.5	58.00
2PF501	E	0-120/140	5.0	0.70	5 3/8 x 6 1/16 x 5 5/8	9.0	69.00
3PN501	E	0-120/140	5.0	0.70	5 3/8 x 6 1/16 x 5 5/8	9.0	71.00
2PF1010	F	0-120/140	10.0	1.4	5 x 6 7/8 x 5 5/8	12.0	71.00
3PN1010	F	0-120/140	10.0	1.4	5 x 6 7/8 x 5 5/8	12.0	74.00
3PN1210†	F	**0-120	12.0	1.44	5 x 6 7/8 x 5 5/8	12.0	91.00
3PN1510†	G	0-120/140	15.0	2.1	5 7/8 x 6 3/8 x 9	21.0	146.00
3PN2210†	G	0-140	22.0	3.08	5 5/8 x 7 5/8 x 10 3/4	24.0	211.00

PORTABLE MODELS *240 VOLT INPUT SINGLE PHASE*

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
2PF1020	F	0-240/280	3.5	0.98	5 x 6 7/8 x 5 5/8	12.0	$ 86.00
3PN1020	F	0-240/280	3.5	0.98	5 x 6 7/8 x 5 5/8	12.0	93.00
3PN1220†	F	**0-240	5.0	1.2	5 x 6 7/8 x 5 5/8	12.0	103.00
3PN1520†	G	0-240/280	9.5	2.66	5 7/8 x 6 3/8 x 9	21.0	150.00
3PN2520†	G	0-280	10.0	2.8	5 5/8 x 7 5/8 x 10 3/4	24.0	211.00

CT refers to enclosed coil and terminals *60 HZ Only on Overvoltage Connection
**60 HZ operation only C refers to enclosed coil only

†2PF Model available at same price

transformers

FIG. J

METERED PORTABLE MODELS *120V & 240V SINGLE PHASE*

As above with an accurate, high quality pivot and jewel meter conveniently located atop the enclosure for easy, accurate readout. 120V models have 0-150V meter, 240V models have 0-300V meter.

MFG. TYPE No.	FIG.	INPUT VOLTS	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
2PF1010V	H	120	0-140	10.0	1.4	5 x 6⅞ x 5⅝	12.0	$117.00
3PN1010V	H	120	0-140	10.0	1.4	5 x 6⅞ x 5⅝	12.0	119.00
3PF1510V	—	120	0-140	15.0	2.1	5⅞ x 6⅜ x 9	21.0	184.00
2PF1020V	H	240	0-280	3.5	9.8	5 x 6⅞ x 5⅝	12.0	133.00
3PN1020V	H	240	0-280	3.5	9.8	5 x 6⅞ x 5⅝	12.0	135.00
3PN1520V	—	240	0-280	9.5	2.66	5⅞ x 6⅜ x 9	21.0	189.00

Ammeter equipped models available. Change suffix V to A.

FIG. K

VARIABLE ISOLATION TRANSFORMERS *120 VOLT INPUT SINGLE PHASE*

An exclusive by STACO, for use where the safety of isolation is required. The output voltage is completely isolated from the power line (input voltage). On uncased models, when proper external connections are made between windings, it is possible to increase the voltage or current output or input through non-isolated, voltage doubler, or series connection.

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
J201	B	0-140	2.0	0.28	5 5/16 x 5 x 4¾	13.0	$102.00
J401	B	0-140	4.0	0.56	6⅛ x 6⅝ x 4 7/16	20.0	156.00
J901	C	0-140	9.0	1.26	8 3/16 x 7⅝ x 4¾	32.0	272.00

FIG. L

ISOLATED PORTABLE MODELS *120 VOLT INPUT SINGLE PHASE*

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	METER	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
3PNJ201	F	0-140	2.0	0.28	NO	5 x 6⅞ x 5⅝	11.0	$120.00
3PNJ201V	H	0-140	2.0	0.28	0-150	5 x 6⅞ x 5⅝	11.0	161.00
3PNJ401	G	0-140	4.0	0.56	NO	5⅞ x 6⅜ x 9	20.0	191.00
3PNJ401V	—	0-140	4.0	0.56	0-150	5⅞ x 6⅜ x 9	20.0	235.00

Ammeter equipped 3PNJ201A and 3PNJ401A available.

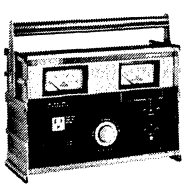


FIG. M

AC POWER SUPPLIES *120 VOLT SINGLE PHASE*

Portable AC Power Supplies are ideal for labs or test bench use. Housed in a ventilated steel and aluminum enclosure with carrying handle, each model is complete with a three-conductor line cord, plug & matching receptacle, pilot light, switch and circuit breaker. Metered models are available with Voltmeter, Ammeter or a Wattmeter (or a combination of meters).

MFG. TYPE NO.	FIG.	INPUT VOLTS	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
L221	L	**120	0-132	1.75	0.23	6 3/32 x 5 x 4¼	5.0	$ 67.00
L501	L	120	0-140	4.5	0.63	7 23/32 x 5⅜ x 5⅞	12.0	86.00
L1010	L	120	0-140	10.0	1.4	9 13/32 x 6½ x 6¼	20.0	102.00
E501V	N	120	0-120/140	5.0	0.7	6⅛ x 17⅝ x 5⅞	20.0	215.00
E501VA	M	120	0-120/140	5.0	0.7	10 x 15 1/16 x 5⅞	25.0	357.00
E501VAW	M	120	0-120/140	5.0	0.7	10 x 15 1/16 x 5⅞	28.0	555.00
E1010V	N	120	0-120/140	10.0	1.4	6 3/16 x 17⅝ x 5⅞	27.0	208.00
E1010VA	M	120	0-120/140	10.0	1.4	10 x 15 1/16 x 5⅞	33.0	422.00
E1010VAW	M	120	0-120/140	10.0	1.4	10 x 15 1/16 x 5⅞	35.0	624.00

E Series Models E171, E501 and E1010, without meters are also available.

FIG. N

ISOLATED AC/DC POWER SUPPLIES *120 VOLT SINGLE PHASE*

As above plus a 0-150V direct rating output voltmeter. 0-140V AC and 0-120V DC isolated outputs at full rated current available from banana jacks located on front panel.

MFG. TYPE NO.	FIG.	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
EJ201V	N	0-140	2.0	0.28	6 3/16 x 17⅝ x 5⅞	20.0	$237.00
EJ401V	N	0-140	4.0	0.56	10 x 15 1/32 x 5⅞	30.0	303.00
EJ901V	N	0-140	9.0	1.26	10 x 16 5/32 x 7½	43.0	428.00

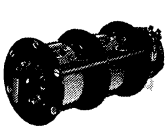


FIG. O

THREE PHASE MODELS *240 VOLTS OR 480 VOLTS INPUT*

Three phase types are three individual units driven by a common shaft and electrically connected in three-phase wye configuration.

MFG. TYPE NO.	FIG.	INPUT VOLTS	INPUT FREQ. HZ	OUTPUT VOLTS	OUTPUT AMPS	KVA	SIZE (INCHES) H x W x D	SH. WT. LBS.	PRICE EACH
221-3	O	240	60	0-240	2.25	0.94	3⅞ x 3⅞ x 8⅛	9	$ 121.00
1010-3	P	240	50/60*	0-240/280	10.0	4.85	6⅛ x 5 x 14 17/32	36	200.00
1510-3	P	240	50/60*	0-240/280	15.0	7.26	7 1/16 x 6⅛ x 14 3/16	56	361.00
2510-3	P	240	50/60*	0-240/280	25.0	12.10	8⅝ x 7⅝ x 14⅝	72	517.00
5010-3Y	Q	240	60	0-280	50.0	24.2	15 7/16 x 13⅞ x 19⅝	225	1199.00
6010-3Y	Q	240	60	0-240/280	60.0	29.1	15 5/16 x 13⅞ x 19⅝	242	1439.00
252-3	O	480	56/60*	0-480/528	0.8	0.73	3⅞ x 3⅞ x 8⅛	9	150.00
1020-3	P	480	50/60*	0-480/560	3.5	3.40	6⅛ x 5 x 14 17/32	36	237.00
1520-3	P	480	50/60*	0-480/560	9.5	9.20	7 1/16 x 6⅛ x 15 1/16	56	356.00
2520-3	P	480	56/60*	0-480/560	10.0	9.70	8⅝ x 7⅝ x 14⅝	72	536.00
5020-3Y	Q	480	50/60*	0-480/560	28.0	27.2	15 7/16 x 13⅞ x 19⅝	225	1205.00
6020-3Y	Q	480	50/60	0-480/560	35.0	33.9	15 5/16 x 13⅞ x 19⅝	240	1506.00

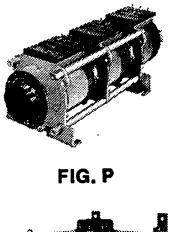


FIG. P

V = Voltmeter VA = Voltmeter-Ammeter VAW = Voltmeter, Ammeter, Wattmeter **60 HZ operation only

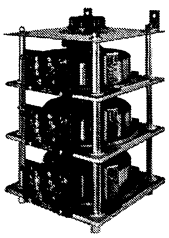


FIG. Q

STACO ENERGY PRODUCTS CO.
301 Gaddis Blvd • Dayton, Ohio 45403
(513) 253-1191 • TWX:810/459-1798 • TELEX:288-032

EEM PRODUCT SELECTION GUIDES

Use the EEM Product Selection Guides.
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume
to locate the Product Selection Guides
that pertain to your needs.

STERLING TRANSFORMER

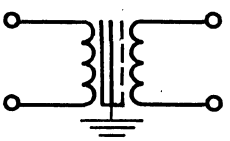
step-up/step-down ISOLATION – AUTO *transformers*

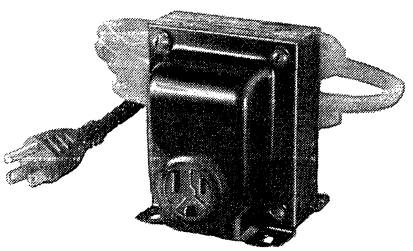
STEP-DOWN ISOLATION TRANSFORMERS

PRIMARY: 240 Volts • 50/60 HZ • Line Cord and Plug*
SECONDARY: 120 Volts • Standard Female Receptacle • Electrostatic Shield • UL Approved Cord and Plug.

Cat No.	VA Watts	Style	DIMENSIONS L	W	H	Mounting Centers M1	M2	Appr. Wt.
S2-50	50	A	2 29/32	3 7/16	3 1/2	2 1/4	1 13/16	3
S2-100	100	A	3 7/32	3 7/8	3 7/8	2 1/2	2 3/16	5
S2-150	150	A	3 17/32	4 3/8	4 1/4	2 3/4	2 13/16	7
S2-220	220	A	3 27/32	4 5/8	4 5/8	3	3 1/16	9.5
S2-330	330	A	4 17/32	5 1/4	5 7/16	3 1/2	3 1/4	14.5
S2-500	500	A	4 17/32	6 1/4	5 7/16	3 1/2	4 1/4	21
S2-700	700	A	5 1/2	5 15/16	6 9/16	4 1/4	3 1/2	25
S2-1000	1000	A	5 1/2	6 15/16	6 9/16	4 1/4	4 1/2	35
S2-1500	1500	B	9	7 3/4	6 5/16	8 1/4	4 3/8	42
S2-2200	2200	B	9	9 3/8	6 5/16	8 1/4	6	65
S2-3300	3300	B	9	11 5/8	6 5/16	8 1/4	8 1/4	95

**Style A Only; Style B — Knockouts for Conduit Connectors.*





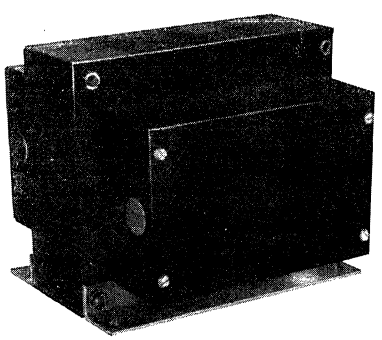
Style A

ISOLATION TRANSFORMERS

PRIMARY: 120 Volts • 50/60 HZ • Line Cord and Plug*
SECONDARY: 120 Volts • Standard Female Receptacle • Electrostatic Shield • UL Approved Cord and Plug.

Cat No.	VA Watts	Style	DIMENSIONS L	W	H	Mounting Centers M1	M2	Appr. Wt.
S1-50	50	A	2 29/32	3 7/16	3 1/2	2 1/4	1 13/16	3
S1-100	100	A	3 7/32	3 7/8	3 7/8	2 1/2	2 3/16	5
S1-150	150	A	3 17/32	4 3/8	4 1/4	2 3/4	2 13/16	7
S1-220	220	A	3 27/32	4 5/8	4 5/8	3	3 1/16	9.5
S1-330	330	A	4 17/32	5 1/4	5 7/16	3 1/2	3 1/4	14.5
S1-500	500	A	4 17/32	6 1/4	5 7/16	3 1/2	4 1/4	21
S1-700	700	A	5 1/2	5 15/16	6 9/16	4 1/4	3 1/2	25
S1-1000	1000	A	5 1/2	6 15/16	6 9/16	4 1/4	4 1/2	35
S1-1500	1500	B	9	7 3/4	6 5/16	6 3/4	4 3/8	42
S1-2200	2200	B	9	9 3/8	6 5/16	6 3/4	6	65
S1-3300	3300	B	9	11 5/8	6 5/16	6 3/4	8 1/4	95

**Style A Only; Style B — Knockouts for Conduit Connectors.*



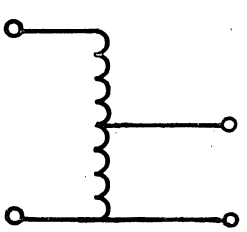
Style B

STEP-DOWN AUTO TRANSFORMERS

PRIMARY: 240 Volts • 50/60 HZ • Line Cord and Plug*
SECONDARY: 120 Volts • Standard Female Receptacle • UL Approved Cord and Plug.

Cat No.	VA Watts	Style	DIMENSIONS L	W	H	Mounting Centers M1	M2	Appr. Wt.
SA-100	100	A	2 29/32	3 7/16	3 1/2	2 1/4	1 13/16	3
SA-150	150	A	2 29/32	3 3/4	3 1/2	2 1/4	2 1/8	4
SA-200	200	A	3 7/32	3 7/8	3 7/8	2 1/4	2 3/16	5
SA-300	300	A	3 17/32	4 3/8	4 1/4	2 3/4	2 13/16	7
SA-450	450	A	3 27/32	4 5/8	4 5/8	3	3 1/6	9 1/2
SA-650	650	A	4 17/32	5 1/4	5 7/16	3 1/2	3 1/4	14 1/2
SA-1000	1000	A	4 17/32	6 1/4	5 7/16	3 1/2	4 1/4	21
SA-1500	1500	A	5 1/2	5 15/16	6 9/16	4 1/4	3 1/2	25
SA-2000	2000	A	5 1/2	6 15/16	6 9/16	4 1/4	4 1/2	35
SA-3000	3000	B	9	7 3/4	6 5/16	6 3/4	4 3/8	42
SA-4500	4500	B	9	9 3/8	6 5/16	6 3/4	6	65
SA-6500	6500	B	9	11 5/8	6 5/16	6 3/4	8 1/4	95
SA-8000**	8000	B	10 5/8	9 5/8	8 1/4	7 1/2	6 1/8	90
SAB-5300†	5300	A	5 3/4	8 5/16	4	3 3/4	6 1/2	17.5

**Style A Only **60 HZ Only Style B — Knockouts for Conduit Connector*
†Step-up/down Auto Transformer. Connections for 208/230 V or 230/208 V, 23 Amp 50/60 HZ



STERLING TRANSFORMER CORPORATION
DEPT. EM, 510 DRIGGS AVENUE • BROOKLYN, NEW YORK 11211 • TELEPHONE: (212) 782-4200

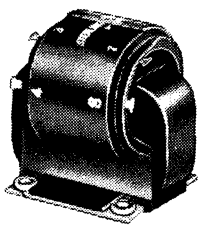
STERLING TRANSFORMER

ENCAPSULATED 400 cps transformers

CLIPPER SERIES

Fig.	Cat. No.	Sec. Volts	Sec. Amp	Insul. Volts (RMS)	Pri. Volts	Mold Size
19	4C1	6.3 CT	0.8	1500	115	SM3
19	4C2	6.3 CT	1.2	1500	115	SM2
19	4C3	6.3 CT	6.8	1500	110/115/120	2
20	4C4	6.3 6.3	4.9 2.7	1500	115	3
19	4C5	6.3 CT	7.2	1500	115	35
21	4C6	6.3 6.3 6.3	7 7 1.5	1500 1500 1500	120	35
22	4C7	6.3 CT 6.3 CT	7 7	1500 1500	120	4
21	4C8	6.3 6.3 6.3	13.7 2.9 0.3	1500 1500 1500	115	4
19	4C9	6.3 CT	12.3	1500	115	5
21	4C11	6.3 6.3 6.3	2.4 2.5 2.7	1500	115	3
19	4C26	6.3 CT	2	1500	115	SM1
19	4C27	6.3 CT	3	1500	115	1A
19	4C28	6.3 CT	5	1500	115	2
19	4C29	5 CT	3	2500	115	SM1
19	4C30	5 CT	6	2500	115	2
19	4C31	8.5 CT	12	1500	115	5
19	4C32	8.5 CT	23	1500	115	7
19	4C33	8.5 CT	35	1500	115	8
19	4C34	8.5 CT	45	1500	115	9
18	4C12	14.1	3	1500	115	3
19	4C35	21 CT	4.5	1500	115	5
19	4C13	21 CT	9	1500	115	7
19	4C36	21 CT	18	1500	115	9
19	4C10	20 CT	0.6	1500	115	SM1

FREQUENCY
380-1000 cps



FOR MINIMUM SIZE & MINIMUM WEIGHT
- CONTOUR MOLDED
- HIPERSIL CORES

MIL-T27C Specifications

MIL Type TF5S03ZZ
85°C Max. Ambient
130°C Max. Oper. Temp.

HIGH SHOCK EXTREME ENVIRONMENT CONDITIONS
LIGHTWEIGHT FOR AIRBORNE USE
10,000 HOUR PLUS-LIFE SERVO APPLICATIONS
ISOLATIONS
POWER SUPPLIES
AIRBORNE CONTROL CIRCUITS
MISSILE CIRCUITS

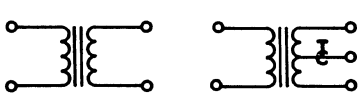


FIG. 18

FIG. 19

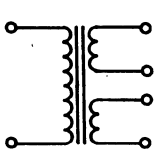


FIG. 20

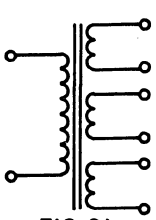


FIG. 21

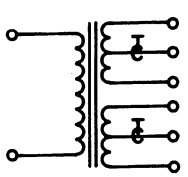


FIG. 22

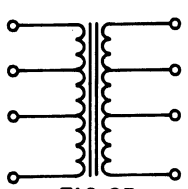


FIG. 23

STERLING TRANSFORMER CORPORATION
DEPT. EM. 510 DRIGGS AVENUE • BROOKLYN, NEW YORK 11211 • TELEPHONE: (212) 782-4200

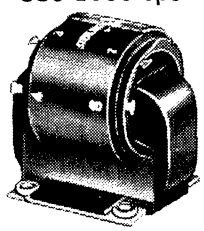
STERLING TRANSFORMER

ENCAPSULATED 400 cps transformers

CLIPPER SERIES

Fig.	Cat. No.	Sec. Volts	Sec. Amp.	Insul. Volts (RMS)	Pri. Volts	Mold Size
19	4C37	21 CT	24	1500	115	10
19	4C38	24 CT	4	1500	115	5
19	4C39	24 CT	8	1500	115	7
19	4C40	24 CT	16	1500	115	9
19	4C41	24 CT	21	1500	115	10
18	4C14	26	0.5	1500	115	SM1
19	4C15	26 CT	1.5	1500	115	3
19	4C23	26 CT	3	1500	115	4
19	4C24	26 CT	5	1500	115	6
22	4C16	28 CT 6.3 CT	0.8 7	1500	115	3
19	4C42	41 CT	2.3	1500	115	5
19	4C43	41 CT	4.5	1500	115	7
19	4C44	41 CT	9	1500	115	9
19	4C45	41 CT	12	1500	115	10
19	4C46	48 CT	2	1500	115	5
19	4C47	48 CT	4	1500	115	7
19	4C48	48 CT	8	1500	115	9
19	4C49	48 CT	10	1500	115	10
19	4C25	52 CT	2	1500	115	5
19	4C17	52 CT	0.2	1500	115	SM1
19	4C18	90 CT	4.5	1500	115	9
18	4C19	115	.05	1500	115	SM2
18	4C21	115	2.8	1500	115	8
23	4C20	105/115/125	0.4	1500	105/115/125	2
23	4C50	105/115/125	1	1500	105/115/125	6
23	4C51	105/115/125	2.4	1500	105/115/125	8
23	4C52	105/115/125	3.2	1500	105/115/125	9
23	4C53	105/115/125	4	1500	105/115/125	10
18	4C22	334	025	1500	115	SM1

FREQUENCY
380-1000 cps



FOR MINIMUM SIZE & MINIMUM WEIGHT
- CONTOUR MOLDED
- HIPERSIL CORES

MIL-T27C Specifications

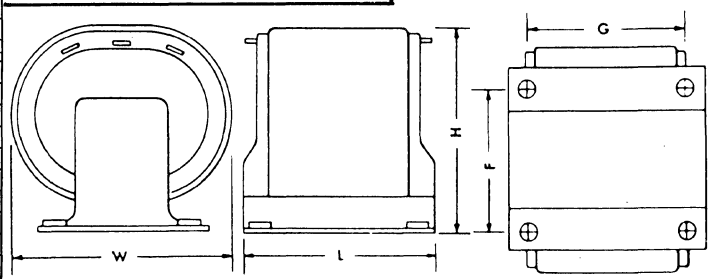
MIL Type TF5S03ZZ
85°C Max. Ambient
130°C Max. Oper. Temp.

HIGH SHOCK EXTREME ENVIRONMENT CONDITIONS
LIGHTWEIGHT FOR AIRBORNE USE
10,000 HOUR PLUS-LIFE SERVO APPLICATIONS
ISOLATIONS
POWER SUPPLIES
AIRBORNE CONTROL CIRCUITS
MISSILE CIRCUITS

Mold No.	Overall Dimen. L	W	H	Mtg. Dimen. F	G	App. Wt. (Lbs.)	Mtg. Meth.
SM3	1 1/32	1 5/16	1 1/4	1	Note 1	0.06	Note 1
SM2	1 1/2	1 1/4	1 11/16	1	Note 1	0.10	Note 1
SM1	1 1/2	1 1/2	1 11/16	1 1/8	Note 1	0.16	Note 1
1	1 13/16	1 7/8	1 13/16	1 1/4	1 7/16	0.25	Note 2
1A	1 11/16	1 17/32	1 13/16	1 5/32	1 1/8	0.25	Note 2
2	2	1 13/16	2 1/8	1 5/32	1 1/4	0.40	Note 2
3	2 5/16	1 13/16	2 1/8	1 5/32	1 7/16	0.45	Note 2
35	2 1/16	2 3/8	2 3/16	1 17/32	1 11/16	0.70	Note 2
4	2 5/16	2 3/8	2 5/16	1 17/32	1 11/16	0.90	Note 2
5	2 3/4	2 3/8	2 7/8	1 17/32	2 3/16	1.20	Note 2
6	2 3/4	2 5/8	3 1/8	1 17/32	2 3/16	1.50	Note 2
7	3	2 7/8	3 3/8	1 25/32	2 1/2	2.00	Note 2
8	3 3/8	2 7/8	3 3/8	1 25/32	2 1/2	2.50	Note 2
83	3 3/4	3 1/4	3 3/8	2 1/4	3	3.25	Note 3
86	3 3/4	3 3/4	3 3/8	2 3/4	3 1/8	4.25	Note 3
9	4 1/16	3 3/8	3 7/8	2 3/16	3 1/2	5.00	Note 3
10	4 1/2	3 15/16	3 15/16	2 3/4	3 1/8	6.00	Note 3

Note 1 — SM Series are two hole mounting with holes on center line. #4-40 Pem nuts are fastened to the bracket.
Note 2 — #6-32 Pem nuts on bracket are standard.
Note 3 — #8-32 Pem nuts on bracket are standard.

- All primaries 380-1000 cps
- Dielectric test voltages:
  PRIMARIES 1500 Volts RMS
  SECONDARIES 1500 Volts RMS
- Epoxy resin used as encapsulant
- Prices subject to change without notice



STERLING TRANSFORMER CORPORATION
DEPT. EM, 510 DRIGGS AVENUE • BROOKLYN, NEW YORK 11211 • TELEPHONE: (212) 782-4200

transistor transformers

STERLING TRANSFORMER

MINISPEC TRANSISTOR TRANSFORMERS — 300 SERIES

Part No.	Application	Primary Impedance	Secondary Impedance	Pri. D.C. Unbal. Ma.	Oper. Lev. DBM	Freq. Response ±2 db.
300	Line to Base	600	600	10	23	200–15,000
301	Coll. to P.P. Base	100	10 C.T./40 C.T.	100	27	200–20,000
302	Coll. to Base or line	50,000	600	3	20	300–15,000
303	Collector to speaker	50,000	6	3	20	300–15,000
304	Coll. to P.P. Base	100,000	1,200 C.T.	1.4	17	200–15,000
305	Coll. to P.P. Base	25,000	1,200 C.T.	3	22	200–15,000
306	P.P. Coll. to P.P. Base	50,000 C.T.	1,200 C.T.	3	20	300–15,000
307	Line to P.P. Base	600 C.T.	1,200 C.T.	4	23	200–15,000
308	Collector to Base	25,000	600	3	22	200–15,000
309	P.P. Coll. to P.P. Base	4,000 C.T.	600 C.T.	3	32	200–15,000
310	Output Coll. to speaker	2,000	3.4	10	32	200–15,000
311	P.P. Coll. to speaker	4,000 C.T.	3.4	3	32	200–15,000
312	Coll. to Speaker	400	10	50	25	200–20,000
313	P.P. Servo Output	500 C.T.	210	30	27	300–20,000
314	P.P. Coll. to P.P. Base	25,000 C.T.	1,200 C.T.	6	22	200–15,000
315	P.P. Coll. to P.P. Base	50,000 C.T.	1200/300 Split	3	20	300–15,000
316	P.P. Coll. to P.P. Base	4,000 C.T.	600/150 Split	3	32	200–15,000
317	Line to P.P. Base	600/150 Split	1,200 C.T.	4	23	200–15,000
318	P.P. Coll. to Servo	250 C.T.	1,000	10	30	200–15,000
319	Coll. to P.P. Base	2,500	600 C.T.	10	32	200–15,000
320	P.P. Coll. to P.P. Base	7,500 C.T.	600 C.T.	8	32	200–15,000
321	Line to P.P. Base	600 C.T.	600 C.T.	20	23	200–15,000
322	P.P. Coll. to Servo	1,600 C.T.	450	15	30	200–15,000
323	P.P. Coll. to Servo	250 C.T.	500	10	30	200–15,000

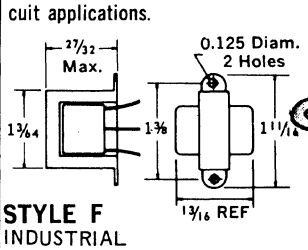
MINISPEC AUDIO TRANSFORMERS — 300 SERIES

Part No.	Application	Primary Impedance	Secondary Impedance	Pri. D.C. Unbal. Ma.	Oper. Lev. DBM	Freq. Response ±2 db.
375	Mike or line to 1 grid	50/250/600 C.T.	50,000	0	5	20–20,000
376	Mike or line to 2 grids	50/250/600 C.T.	50,000 C.T.	0	5	20–20,000
377	Dynamic mike to 1 grid	7.5/30	50,000	0	5	20–20,000
378	Single plate to 1 grid	15,000	60,000	0	6	20–15,000
379	Single plate to 1 grid	15,000	60,000	4	14	200–20,000
380	Single plate to 2 grids	15,000	95,000 C.T.	0	5	20–15,000
381	Single plate to 2 grids	15,000	95,000 C.T.	4	11	200–20,000
382	Single plate to line	15,000	50/250/600 C.T.	0	8	20–20,000
383	Single plate to line	15,000	50/250/600 C.T.	4	21	150–20,000
384	Push pull plates to line	30,000 C.T.	50/250/600 C.T.	0	8	30–50,000
385	Crystal mike to line	50,000	50/250/600 C.T.	0	5	20–20,000
386	Mixing and matching	50/250 C.T.	50/250/600 C.T.	0	8	20–20,000
387	Reactor	300 hy. 0 d.c.	50 hy. @ 3 ma.			DCR 6,000
388	50:1 mike to grid	200	½ Megohm	0	9	80–3,000
389	10:1 plate to grid	10,000	1 Megohm	0	11	100–2,500

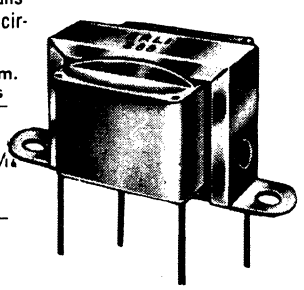
MINISPEC 300 SERIES

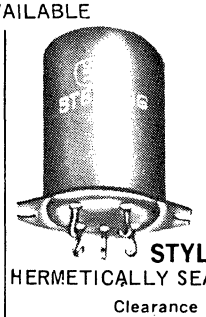
Highest efficiency miniature transformer for transistor and audio circuit applications.

MILITARY STYLE ENCAPSULATED VERSIONS ARE AVAILABLE

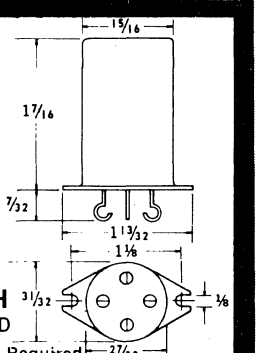


STYLE F
INDUSTRIAL





STYLE H
HERMETICALLY SEALED



STERLING TRANSFORMER CORPORATION
DEPT. EM, 510 DRIGGS AVENUE • BROOKLYN, NEW YORK 11211 • TELEPHONE: (212) 782-4200

STERLING TRANSFORMER

transistor transformers

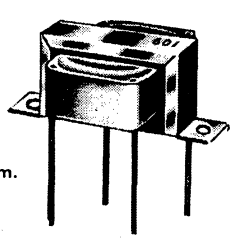
MICROSPEC TRANSISTOR TRANSFORMERS — 600 SERIES

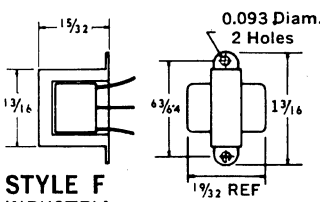
Part No.	Application	Primary Impedance	Secondary Impedance	Pri. D.C. Unbal. Ma.	Oper. Lev. DBM	Freq. Response ±2 db.
601	Line to Base	600	600	8	22	200–15,000
602	Coll. to Base or line	50,000	600	0.7	20	200–15,000
603	P.P. coll. to P.P. Base	50,000 C.T.	600 C.T.	1.4	20	200–15,000
604	Collector to speaker	50,000	6	1	20	200–15,000
605	Coll. to P.P. Base	25,000	1,200 C.T.	1	20	200–15,000
606	P.P. coll. to P.P. Base	50,000 C.T.	1,200 C.T.	1.4	20	200–15,000
607	Line to P.P. Base	600 C.T.	1,200 C.T.	16	22	200–15,000
608	Collector to Base	25,000	600	1	20	200–15,000
609	P.P. coll. to P.P. Base or line	4,000 C.T.	600 C.T.	5	28	200–15,000
610	Coll. to Spkr.	2,000	3.4	5	28	200–15,000
611	Output P.P. coll. to spkr.	4,000 C.T.	3.4	5	28	200–15,000
612	Coll. to P.P. Base	10,000	1,500 C.T.	1	20	200–15,000
613	P.P. Coll. to P.P. Base	10,000 C.T.	200 C.T.	6	20	200–15,000
614	P.P. Coll. to P.P. Base	25,000 C.T.	1,200 C.T.	2	20	200–15,000
615	Coll. to P.P. Base	2,500	2,500 C.T.	2	23	200–15,000
616	P.P. Coll. to P.P. Base	4,000 C.T.	600/150 split	5	28	200–15,000
617	P.P. Coll. to P.P. Base	7,500 C.T.	600 C.T.	4	22,	200–15,000
618	Line to Base	600 C.T.	600 C.T.	16	22	200–15,000
619	P.P. Coll. to P.P. Base	25,000 C.T.	600 C.T.	2	20	200–15,000
620	P.P. Coll. to P.P. Base	10,000 C.T.	1,500 C.T.	2	20	200–15,000
621	Driver/Isolation	10,000 C.T.	10,000 C.T.	2	20	200–15,000
622	P.P. Coll. to P.P. Base	7,500 C.T.	1,200 C.T.	4	22	200–15,000
623	P.P. Coll. to P.P. Base	2,000 C.T.	500 C.T.	10	28	200–15,000
624	Line to P.P. Base	600 C.T.	1200/300 split	16	22	200–15,000

MICROSPEC AUDIO TRANSFORMERS — 600 SERIES

Part No.	Application	Primary Impedance	Secondary Impedance	Pri. D.C. Unbal. Ma.	Oper. Lev. DBM	Freq. Response ±2 db.
675	Input	200/50	250,000/62,500	0	4	200–10,000
676	Interstage 3:1	10,000	90,000	0	4	150–10,000
677	Plate to line	10,000	200	3	20	150–10,000
678	Output	30,000	50	1	20	150–10,000
679	Reactor 50 HY at 1 madc				4700	ohms DCR
680	Output	100,000	60	0.5	20	250–10,000
681	Output	30,000	1,200	0.5	20	200–10,000

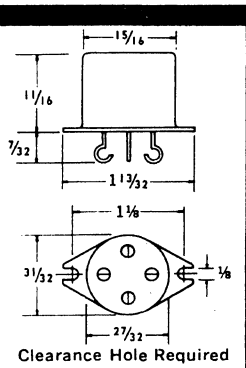
MICROSPEC 600 SERIES
Subminiature transformers
for high efficiency circuits.





STYLE F
INDUSTRIAL

MILITARY STYLE ENCAPSULATED
VERSIONS ARE AVAILABLE



Clearance Hole Required

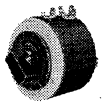
STYLE H
HERMETICALLY SEALED

STERLING TRANSFORMER CORPORATION
DEPT. EM, 510 DRIGGS AVENUE • BROOKLYN, NEW YORK 11211 • TELEPHONE: (212) 782-4200

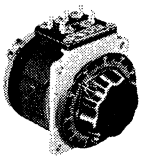
POWERSTAT® *Variable Transformers now*

New epoxy-coated POWERKOTE Coils make the POWERSTAT line the most outstanding value in variable transformers today. *Without increase in price, size or weight,* only POWERSTAT Variable Transformers give an average of 20% higher current ratings, 10:1 greater overload capability, longer life, greater resistance to fungus, salt spray and other contaminating atmospheres. POWERKOTE Coil commutator bars are embedded in place preventing steady-state operating temperature and severe overloads from distorting the commutator.

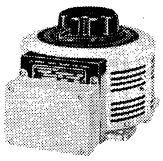
POWERSTAT Variable Transformers are designed to deliver continuously adjustable voltage from a-c power lines. They introduce no waveform distortion and feature rugged construction, precious metal plated commutators, excellent regulation, high efficiency and conservative ratings. All manually operated types listed in the charts except the 10B-12, EN116B-EN216B and EN117B-EN217B Series are available with motor drives if desired. Motor-driven speeds are 5, 15, 30 or 60 seconds for full range travel on all except types having -4, -5, or -6 suffixes which do not offer the 5-second speed. Single types in the 116B-216B, 117B-217B, 126-226 and 136B-236B Series are also offered with 2- or 3-wire cord-plug sets. 1156D-1256D Series types are available in ratings to 244 kva.



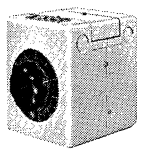
TYPE 10B



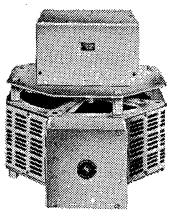
TYPE 21



TYPE 136BT



TYPE EN216B



TYPE 5MB1156DT

RATINGS AND SPECIFICATIONS

INPUT Volts	INPUT Hertz	OUTPUT Volts	Const. Current Load Max. Amp.	Const. Current Load Max. KVA	Const. Impedance Load Max. Amp.	Const. Impedance Load Max. KVA	TYPE	Ship. Wt. Lbs.
10B-12 SERIES								
Single Phase								
120	50/60	0-120	2.25*	0.27	3‡	0.36	✓ 10B	2½
120	60	0-132	2.25*	0.30	—	—		
240	50/60	0-240	0.7*	0.17	0.9‡	0.22	✓ 12	2½
240	50/60	0-264	0.5**	0.13	—	—		
240	50/60	0-240	2.25*	0.54	3‡	0.72	10B-2	6
240	60	0-264	2.25*	0.59	—	—		
480	50/60	0-480	0.7*	0.34	0.9‡	0.43	12-2	6
480	50/60	0-525	0.5**	0.26	—	—		
Three Phase								
120	50/60	0-120	2.25*	0.47	3‡	0.62	10B-2	6
120	60	0-132	2.25*	0.51	—	—		
240	50/60	0-240	0.7*	0.29	0.9‡	0.37	12-2	6
240	50/60	0-264	0.5**	0.23	—	—		
240	60	0-240	2.25*	0.94	3‡	1.2	10B-3	8½
480	50/60	0-480	0.7*	0.58	0.9‡	0.75	12-3	8½
480	60	0-528	0.5**	0.46	—	—		
21-22 SERIES								
Single Phase								
120	50/60	0-120	4.5	0.54	6.5	0.78	✓ 21	6
120	50/60	0-140	4.5	0.63	—	—		
240	50/60	0-240	2.25	0.54	3.25	0.78	✓ 22	6
240	50/60	0-280	2.25	0.63	—	—		
240	50/60	0-240	4.5	1.1	6.5	1.6	✓ 21-2	13½
240	50/60	0-280	4.5	1.3	—	—		
480	50/60	0-480	2.25	1.1	3.25	1.6	22-2	13½
480	50/60	0-560	2.25	1.3	—	—		
Three Phase								
120	50/60	0-120	4.5	0.94	6.5	1.4	21-2	13½
120	50/60	0-140	4.5	1.1	—	—		
240	50/60	0-240	2.25	0.94	3.25	1.4	22-2	13½
240	50/60	0-280	2.25	1.1	—	—		
240	50/60	0-240	4.5	1.9	6.5	2.7	21-3	19
240	60	0-280	4.5	2.2	—	—		
480	50/60	0-480	2.25	1.9	3.25	2.7	✓ 22-3	19
480	60	0-560	2.25	2.2	—	—		

INPUT Volts	INPUT Hertz	OUTPUT Volts	Const. Current Load Max. Amp.	Const. Current Load Max. KVA	Const. Impedance Load Max. Amp.	Const. Impedance Load Max. KVA	TYPE	Ship. Wt. Lbs.
116B-216B and 117B-217B SERIES†								
Single Phase								
120	50/60	0-120	10	1.2	13	1.6	✓ 116B	12
120	50/60	0-140	10	1.4	—	—		
120	60	0-120	12	1.4	15	1.8	✓ 117BT	12
240	50/60	0-240	3.5	0.84	5	1.2	✓ 216B	12
240	50/60	0-280	3.5	0.98	—	—		
240	60	0-240	5	1.2	7	1.7	✓ 217BT	12
240	50/60	0-240	10	2.4	13	3.1	✓ 116BT-2	24
240	50/60	0-280	10	2.8	—	—		
240	60	0-240	12	2.9	15	3.6	117BT-2	24
480	50/60	0-480	3.5	1.7	5	2.4	216BT-2	24
480	50/60	0-560	3.5	2.0	—	—		
480	60	0-480	5	2.4	7	3.4	217BT-2	24
Three Phase								
120	50/60	0-120	10	2.1	13	2.7	✓ 116BT-2	24
120	50/60	0-140	10	2.4	—	—		
120	60	0-120	12	2.5	15	3.1	117BT-2	24
240	50/60	0-240	3.5	1.5	5	2.1	216BT-2	24
240	50/60	0-280	3.5	1.7	—	—		
240	60	0-240	5	2.1	7	2.9	217BT-2	24
240	50/60	0-240	10	4.2	13	5.4	✓ 116BT-3	36
240	60	0-280	10	4.8	—	—		
240	60	0-240	12	5.0	15	6.2	117BT-3	36
480	50/60	0-480	3.5	2.9	5	4.2	✓ 216BU-3	36
480	60	0-560	3.5	3.4	—	—		
480	60	0-480	5	4.2	7	5.8	✓ 217BU-3	36
EN116B-EN216B and EN117B-EN217B SERIES								
Single Phase								
120	50 60	0-120	8	0.96	13	1.6	✓ EN116B	15
120	50 60	0-140	8	1.1	—	—		
120	60	0-120	10	1.2	14.5	1.7	✓ EN117B	15
Three Phase								
480	50 60	0-480	3	2.5	4.5	3.7	✓ EN216B-3	39
480	60	0-560	3	2.9	—	—		
40-VOLT SERIES								
Single Phase								
40	60	0-40	7	0.28	9	0.36	✓ 10B-40	3½
			18	0.72	22	0.88	✓ 21-40	6

LW136B SERIES

INPUT Volts	INPUT Hertz	OUTPUT‡‡ Volts	Max. Amps.	Max. KVA	TYPE	Ship. Wt. Lbs.
Single Phase						
120 240	50 60	15-0-15	35	0.52	✓ LW136B	25
120 240	50 60	0-30	25	0.75		

‡‡LW136B Series ratings are for use as low voltage isolated output transformer.

*Rating when mounted on metal panel. On bracket or nonmetallic panel, derate 10B Series to 1.75 amp., 12 Series to 0.5 amp.

‡Rating when mounted on metal panel. On bracket or nonmetallic panel, derate 10B Series to 2.5 amp., 12 Series to 0.75 amp.

**0.7 amp. maximum in range from 0 to line voltage when mounted on metal panel.

†Also available with open construction. Suffix U when ordering.

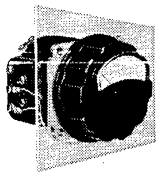
THE SUPERIOR ELECTRIC COMPANY

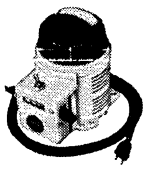
1000 MIDDLE STREET, BRISTOL, CONN. 06010
PHONE: (203) 582-9561

✓ AVAILABLE OFF-THE-SHELF FROM DISTRIBUTOR STOCK

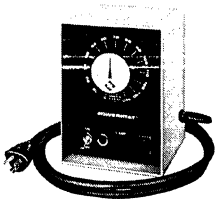
with POWERKOTE® COILS

STATIONARY METERED KNOB TYPES

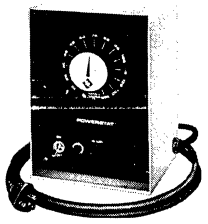




ENCLOSED TYPES



TYPE L10B



TYPE L116B

Single units (those listed in charts without -2 or -3 suffixes) in the 116B-216B, 117B-217B, 126-226, 136B-236B and 146-246 series are also available with metered knobs. Stationary voltmeter does not turn with knob. Voltmeter accurate within ±3% of full scale and insensitive to stray magnetic fields. When ordering, add VS prefix to type number. *Back-of-panel* mounted types in the 21-22 through 146-246 series can be combined with Metered Knob Assemblies. Existing models can be retrofitted also. Assembly type VS150 has a 0-150 volt scale and type VS300 has 0-300. Types VS116B, VS3PN116B and VS3PN136B are available off-the-shelf from distributor stock.

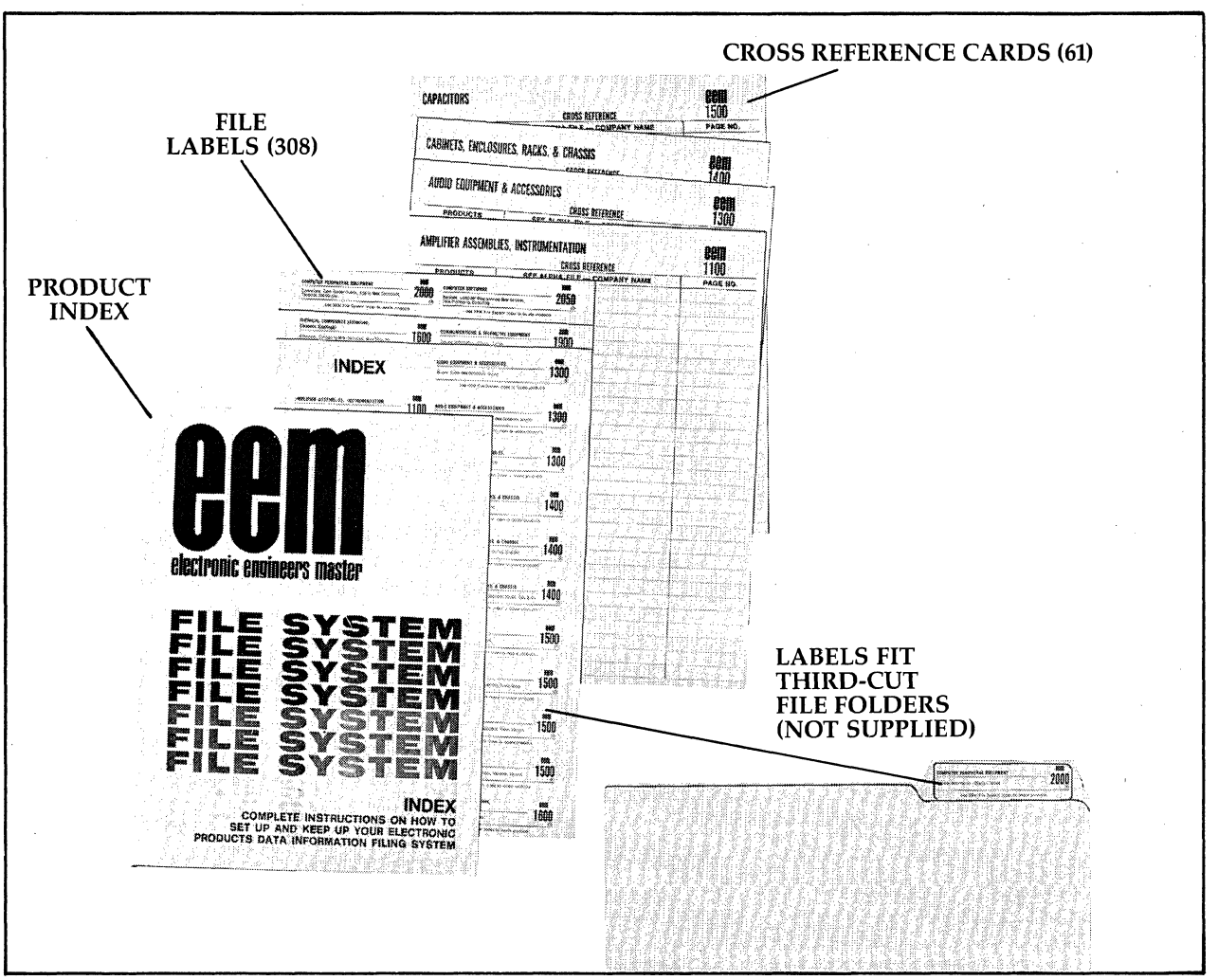
Designed to meet OSHA requirements. Portable 120 volt, single-phase units have grounded NEMA cord-plug assembly, on-off switch, grounded output receptacle, pilot light and fuse. Panel controls are recessed for protection from accidental bumping. Slots at rear for wall hanger brackets. Type L10B rated 0-132 volts, 1.75 amp; type L21 rated 0-140 volts, 4.5 amp; type L116B rated 0-140 volts, 10 amp. All available off-the-shelf from distributor stock.

INPUT		OUTPUT						
			Const. Current Load		Const. Impedance Load			
Volts	Hertz	Volts	Max. Amp.	Max. KVA	Max. Amp.	Max. KVA	TYPE	Ship. Wt. Lbs.
126-226 SERIES†								
Single Phase								
120	50/60	0-120	15	1.8	20	2.4	✓ 126	17
120	50/60	0-140	15	2.1	—	—		
240	50/60	0-240	7.5	1.8	10	2.4	✓ 226	17
240	50/60	0-280	7.5	2.1	—	—		
240	50/60	0-240	15	3.6	20	4.8	126-2	32
240	50/60	0-280	15	4.2	—	—		
480	50/60	0-480	7.5	3.6	10	4.8	✓ 226U-2	32
480	50/60	0-560	7.5	4.2	—	—		
Three Phase								
120	50/60	0-120	15	3.1	20	4.2	126-2	32
120	50/60	0-140	15	3.6	—	—		
240	50/60	0-240	7.5	3.1	10	4.2	✓ 226U-2	32
240	50/60	0-280	7.5	3.6	—	—		
240	50/60	0-240	15	6.2	20	8.3	126-3	49
240	60	0-280	15	7.3	—	—		
480	50/60	0-480	7.5	6.2	10	8.3	✓ 226T-3	49
480	60	0-560	7.5	7.3	—	—		
136B-236B SERIES†								
Single Phase								
120	50/60	0-120	22	2.6	28	3.4	✓ 136B	25
120	50/60	0-140	22	3.1	—	—		
120	50/60	0-120	44	5.3	56	6.7	136B-2 §	52
120	50/60	0-140	44	6.2	—	—		
240	50/60	0-240	10	2.4	13	3.1	✓ 236B	25
240	50/60	0-280	10	2.8	—	—		
240	50/60	0-240	22	5.3	28	6.7	✓ 136B-2	52
240	50/60	0-280	22	6.2	—	—		
480	50/60	0-480	20	4.8	26	6.2	✓ 236B-2	52
480	50/60	0-560	20	5.6	—	—		
Three Phase								
120	50/60	0-120	22	4.6	28	5.8	✓ 136B-2	52
120	50/60	0-140	22	5.3	—	—		
240	50/60	0-240	10	4.2	13	5.4	✓ 236B-2	52
240	50/60	0-280	10	4.8	—	—		
240	50/60	0-240	22	9.1	28	11.6	✓ 136B-3	76
240	60	0-280	22	10.7	—	—		
480	50/60	0-480	10	8.3	13	10.8	✓ 236B-3	76
480	60	0-560	10	9.7	—	—		
146-246 SERIES†								
Single Phase								
120	50/60	0-120	30	3.6	35	4.2	✓ 146	38
120	50/60	0-140	30	4.2	—	—		
120	50/60	0-120	60	7.2	70	8.4	146-2 §§	83
120	50/60	0-140	60	8.4	—	—		
240	50/60	0-240	15	3.6	19	4.6	✓ 246	38
240	50/60	0-280	15	4.2	—	—		
240	50/60	0-240	30	7.2	35	8.4	146-2	83
240	50/60	0-280	30	8.4	—	—		
480	50/60	0-480	15	7.2	19	9.1	246-2	83
480	50/60	0-560	15	8.4	—	—		

INPUT		OUTPUT						
			Const. Current Load		Const. Impedance Load			
Volts	Hertz	Volts	Max. Amps.	Max. KVA	Max. Amps.	Max. KVA	TYPE	Ship. Wt. Lbs.
146-246 SERIES† (contd.)								
Three Phase								
120	50/60	0-120	30	6.2	35	7.3	146-2	83
120	50/60	0-140	30	7.3	—	—		
240	50/60	0-240	15	6.2	19	7.9	246-2	83
240	50/60	0-280	15	7.3	—	—		
240	50/60	0-240	30	12.5	35	14.5	146-3	125
240	60	0-280	30	14.5	—	—		
480	50/60	0-480	15	12.5	19	15.8	246-3	125
480	60	0-560	15	14.5	—	—		
1156D-1256D SERIES†								
Single Phase								
120	50/60	0-120	50	6.0	55	6.6	✓ 1156D	82
120	50/60	0-140	50	7.0	—	—		
120	50/60	0-120	100	12.0	110	13.2	1156D-2P	169
120	50/60	0-140	100	14.0	—	—		
120	50/60	0-120	150	18.0	165	19.8	1156D-3P	272
120	50/60	0-140	150	21.0	—	—		
240	50/60	0-240	28	6.7	28	6.7	✓ 1256D	82
240	50/60	0-280	28	7.8	—	—		
240	50/60	0-240	50	12.0	55	13.2	1156D-2S	156
240	50/60	0-280	50	14.0	—	—		
240	50/60	0-240	56	13.4	56	13.4	✓ 1256D-2P	169
240	50/60	0-280	56	15.7	—	—		
240	50/60	0-240	84	20.2	84	20.2	1256D-3P	272
240	50/60	0-280	84	23.5	—	—		
240	50/60	0-240	100	24.0	110	26.4	1156D-4PS	361
240	50/60	0-280	100	28.0	—	—		
480	50/60	0-480	28	13.4	28	13.4	✓ 1256D-2S	156
480	50/60	0-560	28	15.7	—	—		
480	50/60	0-480	56	26.9	56	26.9	1256D-4PS	361
480	50/60	0-560	56	31.4	—	—		
Three Phase								
120	50/60	0-120	50	10.4	55	11.4	1156D-2D	155
120	50/60	0-140	50	12.1	—	—		
240	50/60	0-240	28	11.6	28	11.6	✓ 1256D-2D	155
240	50/60	0-280	28	13.6	—	—		
240	50/60	0-240	50	20.8	55	22.9	✓ 1156D-3Y	230
240	60	0-280	50	24.2	—	—		
240	50/60	0-240	100	41.6	110	45.7	1156D-6Y	507
240	50/60	0-280	100	48.5	—	—		
480	50/60	0-480	28	23.3	28	23.3	✓ 1256D-3Y	235
480	60	0-560	28	27.2	—	—		
480	50/60	0-480	56	46.6	56	46.6	1256D-6Y	507
480	60	0-560	56	54.3	—	—		

†Also available with open construction. Suffix U when ordering.
§Requires also one paralleling choke type T5000.
§§Requires also one paralleling choke type T6053.

✓ AVAILABLE OFF-THE-SHELF FROM DISTRIBUTOR STOCK



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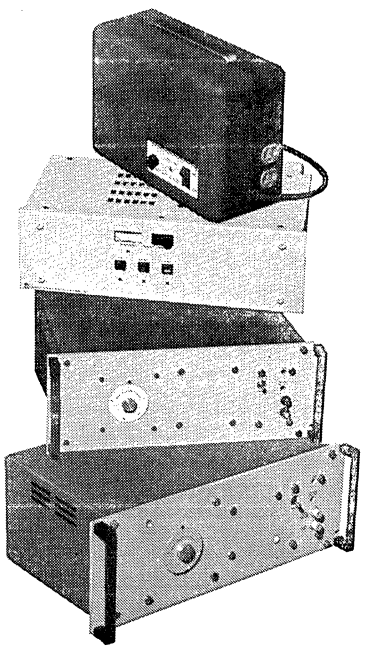
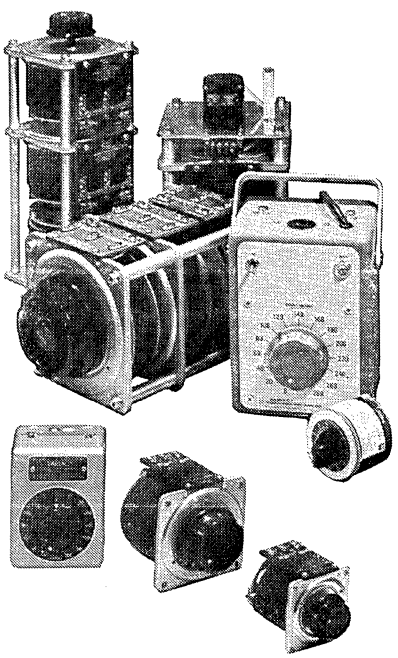
Variac® now by Technipower





Variac® Autotransformers and Voltage Regulators, an industry synonym for prestigious power control products, has joined the Technipower family as part of an ongoing program for supplying an increasingly wider range of high quality equipment.

Voltage Regulators

Here is a select group of Automatic Voltage Regulators which will control large industrial loads while protecting sensitive equipment and encouraging peak component performance. Add to this, extremely fast response with virtually no waveform distortion, fast correction and smooth control of voltage. Also assured is freedom from voltage jumps that can be introduced by switching controls. These Automatic Voltage Regulators utilize an auxiliary unit that will multiply the variable transformer power rating while a solid state device senses and controls. Choose from among 5 basic models with 100 variations of same, in addition to custom built units. Variac by Technipower — your prime source for quality power control products. Send for catalog.

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The industry standard and an outstanding value. Variac Autotransformers are available in 120, 208, 240 and 480 Volts and in single and 3 phase models, both manual and motor driven types. Efficient, cool running and overloadable 1000% (short term) load, Variac Autotransformers will generate output voltages from 0 to line or above line voltage, with outstanding efficiency and regulation. They function independent of load size or power factor, are quiet, reliable and easy to install. More than 700 standard Variac Autotransformers are offered in this category with as many as 1000 possible product variations manufactured to custom order. Technipower produces all Variac Autotransformers and Voltage Regulators at its plant in Connecticut.

Backed by a One Year Warranty.

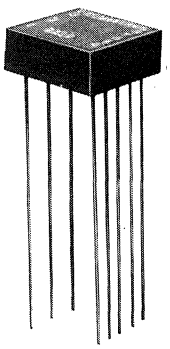
High Reliability Power Conversion
See EEM page 3•1721 for complete description of Technipower's "Mil-Qual" Encapsulated and Open Frame Modular Power Supplies.

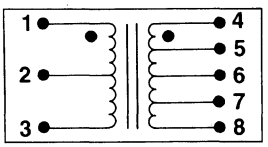
TECHNIPOWER
A Penril COMPANY
P. O. Box 222 Commerce Park, Danbury, Conn. 06810
Tel: (203) 748-7001 TWX: 710-456-9280

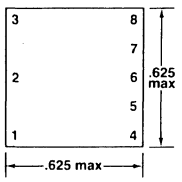
Technitrol, Inc.

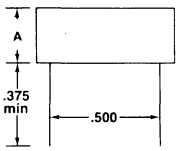
TRANSFORMERS INTERFACE MIL-STD-1553

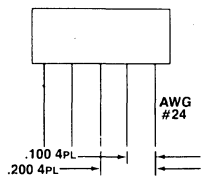
The following units have been designed to meet the requirements of MIL-T-21038 Grade 5 or 7, Class S for Low Power Pulse Transformers. They are designed specifically to meet specification for interface transformers as described by MIL-STD-1553.





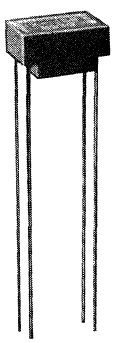


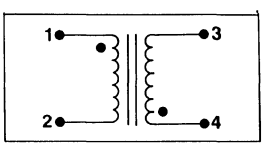


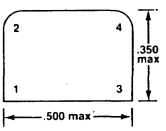


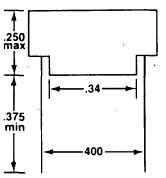
HIPOT = 100V$_{RMS}$
IR ≥ 10K$_{MEG}$ Ω @ 250 $_{VDC}$

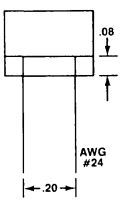
PART NO.	TURNS RATIO	PRIMARY	SECOND-ARY	% DROOP	CMR (Typical)	"A" (Max.)
T1553-1	1CT : 1CT ±3% 1CT : .707CT ±3%	1-3 1-3	4-8 5-7	4	51dB	.300
T1553-2	1.4CT : 1CT ±3% 2CT : 1CT ±3%	1-3 1-3	4-8 5-7	4	49dB	.250
T1553-3	1.25CT : 1CT ±3% 1.66CT : 1CT ±3%	1-3 1-3	4-8 5-7	8	48dB	.250
T1553-4	2.3CT : 1CT ±3% 3.2CT : 1CT ±3%	4-8 5-7	1-3 1-3	12	50dB	.300





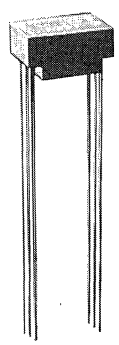


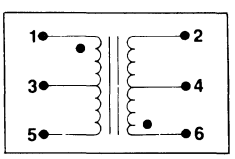


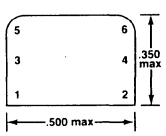


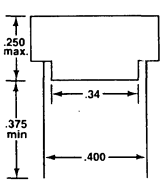
HIPOT = 100V$_{RMS}$
IR ≥ 10K$_{MEG}$ Ω @ 250 $_{VDC}$

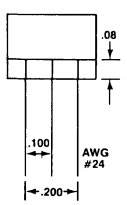
PART NO.	TURNS RATIO	PRIMARY	SECONDARY	% DROOP	CMR (Typical)
T1553-20	1 : 1.41 ±3%	1-2	3-4	10	50dB











HIPOT = 100V$_{RMS}$
IR ≥ 10K$_{MEG}$ Ω @ 250 $_{VDC}$

PART NO.	TURNS RATIO	PRIMARY	SECONDARY	% DROOP	CMR (Typical)
T1553-21	1CT : 1CT ±3%	1-5	2-6	10	50dB
T1553-22	1CT : 1.41CT ±3%	1-5	2-6	6	50dB
T1553-23	1CT : 1.66CT ±3%	1-5	2-6	12	52dB
T1553-24	1CT : 2CT ±3%	1-5	2-6	12	50dB

NOTE: 1. Leads-½ hard copper, electro tin-plated per MIL-T-10727.
2. Sinusoidal or trapezoidal wave forms are accurately processed in accordance with MIL-STD 1553A and B, MAC AIR A3818, A5690, A5232, A4905.

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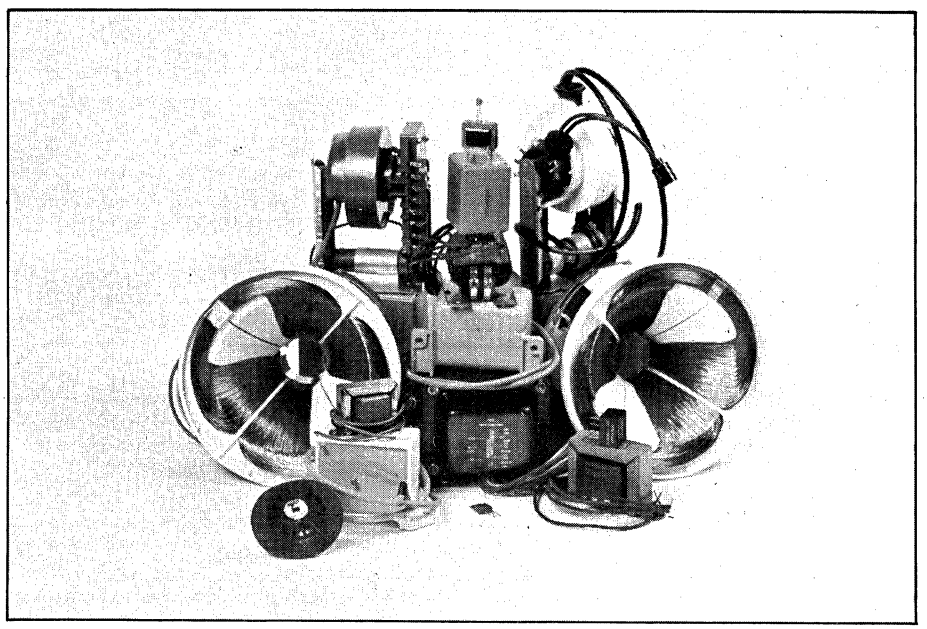

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Mil-E-5400	Mil-I-45208	UL-544
Mil-T-21038	Mil-STD-45662	UL-697
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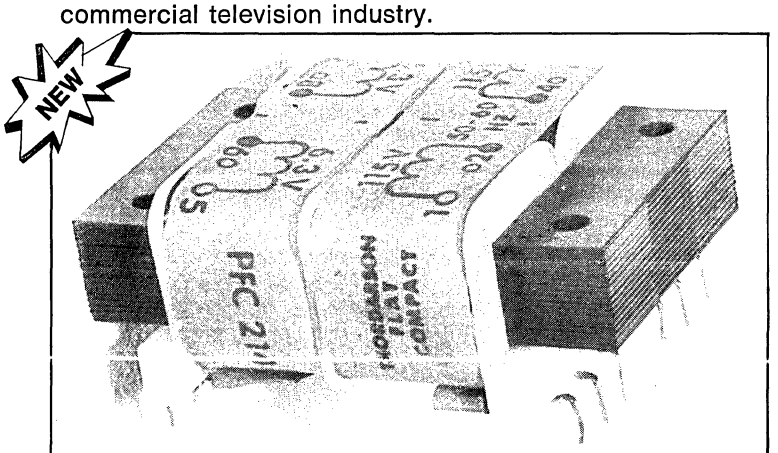

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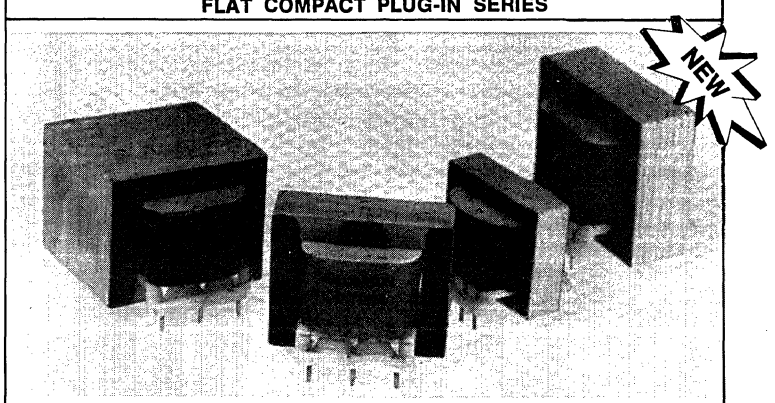

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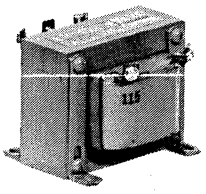

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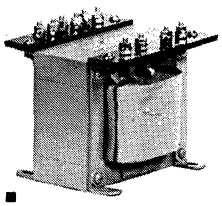
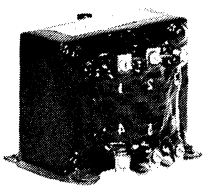
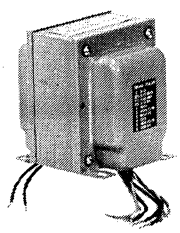


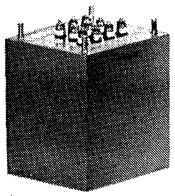
■ STYLE B (OVER 700 VA)



STYLE BE



STYLE V



STYLE CM

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SECONDARY VOLTS TAP VOLTS	PART NO.	PRIMARY VOLTS 50-500 Hz	RATING VA	SECONDARY AMPS (RMS) SERIES HOOKUP	SECONDARY AMPS (RMS) PARALLEL HOOKUP
10 VOLTS Series 2.5 - 5 - 7.5 - 10 Parallel 2.5 - 5	10 02	115	20	2	4
	10 05	115	50	5	10
	10 10	115	100	10	20
	10 20	115	200	20	40
12.6 VOLTS Series 3.1 - 6.3 - 9.4 - 12.6 Parallel 3.1 - 6.3	12 02	115	24	2	4
	12 05	115	60	5	10
	12 10	115	120	10	20
	12 20	115	240	20	40
24 VOLTS Series 6 - 12 - 18 - 24 Parallel 6 - 12	24 01	115	24	1	2
	24 02	115	48	2	4
	24 04	115	96	4	8
	24 06	115	144	6	12
	24 08	115	192	8	16
	24 12	105, 115, 125	288	12	24
	24 20	105, 115, 125	480	20	40
	24 25	105, 115, 125	600	25	50
	24 30	105, 115, 125	720	30	60
	24 50	105, 115, 125	1200	50	100
	24 100	115, 230	2400	100	200
36 VOLTS Series 9 - 18 - 27 - 36 Parallel 9 - 18	36 00	115	18	0.5	1
	36 01	115	36	1	2
	36 02	115	72	2	4
	36 04	115	144	4	8
	36 06	115	216	6	12
	36 08	105, 115, 125	288	8	16
	36 12	105, 115, 125	432	12	24
	36 20	105, 115, 125	720	20	40
	36 25	105, 115, 125	900	25	50
	36 30	105, 115, 125	1080	30	60
	36 50	115, 230	1800	50	100
	36 100	115, 230	3600	100	200
56 VOLTS Series 14 - 28 - 42 - 56 Parallel 14 - 28	56 00	115	28	0.5	1
	56 01	115	56	1	2
	56 02	115	112	2	4
	56 04	115	224	4	8
	56 06	115	336	6	12
	56 08	105, 115, 125	448	8	16
	56 12	105, 115, 125	672	12	24
	56 25	105, 115, 125	1400	25	50
	56 50	115, 230	2800	50	100
	56 100	115, 230	5600	100	200
64 VOLTS Series 16 - 32 - 48 - 64 Parallel 16 - 32	64 00	115	32	0.5	1
	64 01	115	64	1	2
	64 02	115	128	2	4
	64 04	115	256	4	8
	64 06	115	384	6	12
	64 08	105, 115, 125	512	8	16
	64 12	105, 115, 125	768	12	24
	64 25	105, 115, 125	1600	25	50
	64 50	115, 230	3200	50	100
80 VOLTS Series 20 - 40 - 60 - 80 Parallel 20 - 40	80 00	115	40	0.5	1
	80 01	115	80	1	2
	80 02	115	160	2	4
	80 05	115	400	5	10
	80 10	105, 115, 125	800	10	20
	80 25	115, 230	2000	25	50
	80 50	115, 230	4000	50	100
120 VOLTS Series 30 - 60 - 90 - 120 Parallel 30 - 60	120 00	115	60	0.5	1
	120 01	115	120	1	2
	120 02	115	240	2	4
	120 04	115	480	4	8
	120 08	105, 115, 125	960	8	16
	120 12	105, 115, 125	1400	12	24
	120 20	105, 115, 125	2400	20	40
180 VOLTS Series 45 - 90 - 135 - 180 Parallel 45 - 90	180 00	115	90	0.5	1
	180 01	115	180	1	2
	180 02	115	360	2	4
	180 05	115	640	5	10
	180 10	105, 115, 125	1800	10	20
230 VOLTS Series 57.5 - 115 - 172.5 - 230 Parallel 57.5 - 115	230 00	115	115	0.5	1
	230 01	115	230	1	2
	230 02	115	460	2	4
	230 05	105, 115, 125	1150	5	10
	230 08	115, 230	1840	8	16
300 VOLTS Series 75 - 150 - 225 - 300 Parallel 175 - 150	300 00	115	150	0.5	1
	300 01	115	300	1	2
	300 02	115	600	2	4
	300 05	105, 115, 125	1500	5	10

DC TO RMS CONVERSION CHART

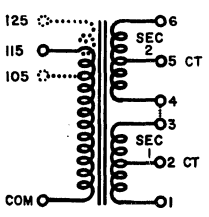
SECONDARY RMS CURRENT = DC CURRENT × FACTOR BELOW

	Choke Input Filter or Inductive Load	Resistive Load	Capacitor Input Filter or Capacitive Load
FULL WAVE BRIDGE	1.0	1.0	1.8
FULL WAVE C.T.	.7	1.0	1.15

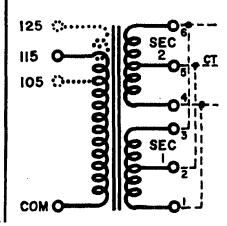
CERTIFIED DATA AVAILABLE

CUSTOM VARIATIONS QUOTED PROMPTLY

SERIES HOOKUP



PARALLEL HOOKUP



TODD SYSTEMS "HIGH CURRENT TRANSFORMERS & CHOKES" are designed for use in high power rectifier circuits, and high current A.C. applications. "TODD ENGINEERED" designs feature a nominal temperature rise of 45°C., at full load, thus providing outstanding overload capacity. All designs utilize extremely low regulation, varying from 10% in the smallest to 1% in the larger units. Four styles . . . select the type best suited for your lab, test rigs, OEM or production equipment

DATA SUBJECT TO CHANGE WITHOUT NOTICE

CONTACT FACTORY FOR PRICES

QUALITY ENGINEERED — PRECISION BUILT

TODD SYSTEMS INC.

50 ASH STREET, DEPT. EM — YONKERS, NY, U.S.A. 10701 — (914) 963-3400

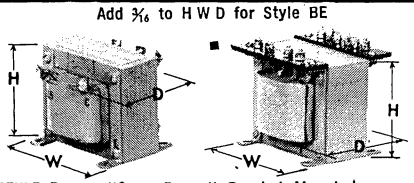
TODD ENGINEERED

HIGH CURRENT TRANSFORMERS

MECHANICAL SPECIFICATIONS · · · · · · · · · · · · SPECIFY STYLE REQUIRED

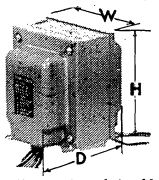
PART NO.	• BRACKET MTD. (STYLE B) • ENCAPSULATED (STYLE BE) H	W	D	MW	MD	WGT.	• FULLY MTD. SHELLS (STYLE V) H	W	D	MW	MD	WGT.	• HERMETIC SEALED MIL-T (STYLE CM) H	W	D	MW	MD	WGT.	PART NO.
10 02	2½	3	2⅛	2½	1½	1¼	3	2½	2¼	2	1¼	1¼	3 13/16	3½	3	2⅝	2⅛	2⅛	10 02
10 05	2½	3	2⅝	2½	2⅛	2½	3	2½	2⅞	2	1⅞	2½	3 13/16	3½	3	2⅝	2⅛	3½	10 05
10 10	3⅛	3¾	3¼	3⅛	2⅜	4¼	3⅞	3¼	3⅝	2½	2⅜	4¾	4 7/16	4½	3⅝	3 5/16	2 11/16	6½	10 10
10 20	3¾	4½	3⅞	3¾	2⅝	8¼	4½	3¾	4⅛	3	3	8¾	5 7/16	5	4¼	4 1/16	3 5/16	12	10 20
12 02	2½	3	2⅛	2½	1⅝	1½	3⅛	2½	2⅜	2	1¼	1¾	3 13/16	3½	3	2⅝	2⅛	2¾	12 02
12 05	2½	3	3	2½	2⅜	3	3⅛	2½	3⅛	2	2	3¼	3 13/16	3½	3	2⅝	2⅛	4¾	12 05
12 10	3¼	3¾	3⅝	3⅛	2⅛	5¼	3⅞	3¼	3⅝	2½	2½	5¼	4 7/16	4¼	3⅝	3 5/16	2 11/16	7½	12 10
12 20	3¾	4½	4⅛	3¾	2¾	9	4½	3¾	4¼	3	3⅛	9½	6¼	5¾	4⅞	4⅜	3½	12½	12 20
24 01	2½	3	2⅛	2½	1¾	1¾	3⅛	2½	2⅝	2	1½	2¼	3 13/16	3½	3	2⅝	2⅛	3⅜	24 01
24 02	2½	3	2½	2½	2	2¼	3⅛	2½	2⅞	2	1¾	2½	3 13/16	3½	3	2⅝	2⅛	3¾	24 02
24 04	3⅛	3¾	3⅜	3⅛	2⅛	4¼	3¾	3⅛	3⅜	2½	2⅛	4¼	4 7/16	4¼	3⅝	3 5/16	2 11/16	6¼	24 04
24 06	3½	4⅛	3⅜	3 7/16	2 5/16	6¼	4⅛	3½	3⅝	2¾	2½	6¾	4⅞	4⅝	3 15/16	3 11/16	3	9½	24 06
24 08	3½	4⅛	4	3 7/16	3	9	4¼	3½	4⅜	2¾	3⅜	8½	4⅞	4⅝	3 15/16	3 11/16	3	11½	24 08
24 12	3¾	4½	4⅞	3¾	3⅜	12	4½	3¾	5	3	3¾	12½	5 7/16	5	4¼	4 1/16	3 5/16	16	24 12
24 20	4⅜	5¼	5	4⅜	3½	16½	5¼	4⅜	5½	3½	3⅞	17	6¼	5¾	4⅞	4⅜	3½	22	24 20
24 25	4⅜	5¼	5⅝	4⅜	3⅞	19½	5¼	4⅜	6	3½	4⅜	20	6¼	5¾	4⅞	4⅜	3½	24½	24 25
24 30	■ 4⅜	5¼	6	4⅜	4⅜	21¼	5¼	4⅜	6⅜	3½	4¾	22	7½	6⅞	5 13/16	5 5/16	4¼	27½	24 30
24 50	■ 5⅜	6⅜	6⅜	5 5/16	5⅜	39	6½	5½	7⅜	4¼	5 5/16	43	7½	6⅞	5 13/16	5 5/16	4¼	52	24 50
24 100	■ 6⅛	7 1/16	8	5⅞	6½	64							8¾	8	6¾	6¾	5½	74	24 100
36 00	2 3/16	2⅝	1⅜	2 3/16	1½	1	2¾	2¼	2¼	1¾	1½	1¼	3 13/16	3½	3	2⅝	2⅛	2	36 00
36 01	2½	3	2⅛	2½	1⅞	1⅞	3⅛	2½	2¾	2	1 5/8	2	3 13/16	3½	3	2⅝	2⅛	3	36 01
36 02	2⅞	3⅜	2¾	2 11/16	2¼	3¼	3½	2⅞	3¼	2¼	2 3/16	3⅝	4¼	3⅞	3 5/16	3	2 7/16	5¼	36 02
36 04	3½	4⅛	3½	3 7/16	2½	6¾	4¼	3½	4	2¾	2⅞	6¾	4⅞	4⅝	3 15/16	3 11/16	3	9½	36 04
36 06	3¾	4½	4¼	3¾	2⅝	8¼	4⅝	3⅞	4⅛	3	2⅞	9¼	5 7/16	5	4¼	4 1/16	3 5/16	13	36 06
36 08	3¾	4½	5⅛	3¾	3½	12½	4⅝	3⅞	5	3	3⅞	12¼	5 7/16	5	4¼	4 1/16	3 5/16	17	36 08
36 12	4 1/16	5¼	5¼	4⅜	3⅝	16¾	5½	4½	5¾	3½	4 1/16	17¼	6¼	5¾	4⅞	4⅜	3½	22	36 12
36 20	■ 5⅜	6⅜	4⅝	5 5/16	3¾	24	6½	5½	5¾	4¼	3¾	25	7½	6⅞	5 13/16	5 5/16	4¼	31	36 20
36 25	■ 5⅜	6⅜	5½	5 5/16	4	30	6½	5½	6	4¼	4	28	7½	6⅞	5 13/16	5 5/16	4¼	34	36 25
36 30	■ 5 5/16	6⅜	6	5 5/16	4¾	33	6½	5½	6¾	4¼	4¾	36	7½	6⅞	5 13/16	5 5/16	4¼	43	36 30
36 50	■ 6¼	7 1/16	7½	5⅞	6⅛	55							8¼	7 5/16	6⅝	5 13/16	4¾	61	36 50
36 100	■ 7½	9	9	7½	7	105													36 100
56 00	2 13/16	2⅝	1½	2 13/16	1 5/8	1¼	2¾	2¼	2⅜	1¾	1¾	1 5/8	3 13/16	3½	3	2⅝	2⅛	2¾	56 00
56 01	2½	3	2⅞	2½	2¼	2⅞	3	2⅝	2⅞	2	2	3¼	3 13/16	3½	3	2⅝	2⅛	4	56 01
56 02	3⅛	3¾	3¼	3⅛	2⅜	4¼	3⅞	3¼	3½	2½	2 5/16	4¾	4 7/16	4¼	3⅝	3 5/16	2 11/16	7½	56 02
56 04	3½	4⅛	4	3 7/16	3	9	4¼	3½	4½	2¾	3⅜	8½	4⅞	4⅝	3 15/16	3 11/16	3	12½	56 04
56 06	4⅜	5¼	4½	4⅜	2⅞	12	5 7/16	4½	4¾	3½	3⅛	12½	6¼	5¾	4⅞	4⅜	3½	16	56 06
56 08	4⅜	5¼	5	4⅜	3⅝	16¾	5 7/16	4½	5⅝	3½	4	18	6¼	5¾	4⅞	4⅜	3½	22½	56 08
56 12	■ 5 5/16	6⅜	4⅝	5 5/16	3 7/16	24	6½	5½	5½	4¼	3½	25	7½	6⅞	5 13/16	5 5/16	4¼	31	56 12
56 25	■ 5 5/16	6⅜	6⅜	5 5/16	5 5/16	39	6½	5½	7¼	4¼	5¼	39	7½	6⅞	5 13/16	5 5/16	4¼	45	56 25
56 50	■ 6¼	7 1/16	8½	5⅞	7¼	78							8¾	8	6¾	6¾	5½	85	56 50
56 100	■ 7½	9	11	7½	9	140													56 100
64 00	2½	3	2¼	2½	1⅞	2	3	2½	2⅝	2	1¾	2	3 13/16	3½	3	2⅝	2⅛	3¼	64 00
64 01	2½	3	2¾	2½	2⅜	3	3⅛	2⅝	3⅛	2	2⅛	2⅛	4 7/16	4¼	3⅝	3 5/16	2 11/16	3¾	64 01
64 02	3⅛	3¾	3¼	3⅛	2⅜	5	3⅞	3⅛	3⅝	2½	2⅜	4¾	5 13/16	4⅝	3 15/16	3 11/16	4⅞	7¼	64 02
64 04	3¾	4½	4⅜	3¾	3⅛	10	4⅝	3¾	4½	3	3⅜	11	5 7/16	5	4¼	4 1/16	3 5/16	15½	64 04
64 06	3¾	4½	5½	3¾	4⅜	15	4⅝	3¾	4⅞	3	3 5/8	16	6¼	5¾	4⅞	4⅜	3½	22	64 06
64 08	4⅜	5¼	5⅛	4⅜	3¾	18	5½	4½	5⅞	3½	4¼	19¼	6¼	5¾	4⅞	4⅜	3½	25	64 08
64 12	■ 5½	6⅜	4⅞	5 5/16	3¾	27	6½	5½	5¾	4¼	3¾	27	7½	6⅞	5 13/16	5 5/16	4¼	32½	64 12
64 25	■ 6¼	7 1/16	7¼	5 13/16	5⅜	50							7½	6⅞	5 13/16	5 5/16	4¼	57	64 25
64 50	■ 7⅝	9	8¼	7½	6⅜	95							10 3/8	8	6¾	6¾	5½	103	64 50
80 00	2½	3	2⅝	2½	2⅛	2½	3	2½	2⅞	2	2	2½	3 13/16	3½	3	2⅝	2⅛	3¾	80 00
80 01	2 13/16	3⅜	2⅞	2 13/16	2¼	3½	3½	2⅞	3¼	2¼	2¼	3⅝	4¼	3⅞	3 5/16	3	2 7/16	5¼	80 01
80 02	3 5/16	4⅛	3¼	3 5/16	2½	6½	4¼	3½	4	2¾	2⅞	6¾	4⅞	4⅝	3 15/16	3 11/16	3	9	80 02
80 05	4⅜	5¼	5	4⅜	3½	17	5 7/16	4½	5½	3½	3¾	17½	4 7/16	4¼	3⅝	3 5/16	2 11/16	21½	80 05
80 10	■ 5½	6⅜	5	5⅜	3⅞	30	6½	5½	6	4¼	4	31	7½	6⅞	5 13/16	5 5/16	4¼	36½	80 10
80 25	■ 6¼	7⅛	5⅞	5 13/16	4½	44							8¼	7 5/16	6⅝	5 13/16	4¾	48½	80 25
80 50	■ 7⅝	9	9¼	7½	7⅜	115													80 50
120 00	2 13/16	3⅜	2⅝	2 13/16	2⅛	3	3 1/16	2⅞	3⅛	2¼	2	3	4¼	3⅞	3 5/16	3	2 7/16	4¾	120 00
120 01	3⅛	3¾	3⅜	3⅛	2⅜	5	3⅞	3¼	3½	2½	2¼	4⅞	4 7/16	4¼	3⅝	3 5/16	2 11/16	6¾	120 01
120 02	3¾	4½	4⅝	3¾	3⅜	11	4⅝	3⅞	4⅝	3	3⅜	10½	5 7/16	5	4¼	4 1/16	3 5/16	14	120 02
120 04	4⅜	5¼	4⅞	4⅜	3½	16	5½	4½	5½	3 7/16	4	17	6¼	5⅜	4⅞	4⅜	3½	21¼	120 04
120 08	■ 5⅜	6⅜	6½	5 5/16	4½	35	6⅜	5 7/16	6⅜	4¼	4½	34	7½	6⅞	5 13/16	5 5/16	4¼	40½	120 08
120 12	■ 5⅜	6⅜	6⅞	5 5/16	5¾	45	6⅜	5 7/16	7⅝	4¼	5¾	47	7½	6⅞	5 13/16	5 5/16	4¼	51½	120 12
120 20	■ 6¼	7⅛	8¼	5 13/16	6⅜	64							8¼	7 5/16	6⅝	5 13/16	4¾	70½	120 20
180 00	3⅛	3¾	3⅜	3⅛	2⅛	4¼	3⅞	3 1/16	3½	2½	2¼	4¾	4 7/16	4¼	3⅝	3 5/16	2 11/16	6⅝	180 00
180 01	3 7/16	4⅛	3⅜	3 7/16	2½	5¾	4¼	3½	3⅞	2¾	2⅞	6½	4⅞	4⅝	3 15/16	3 11/16	3	8¾	180 01
180 02	4⅜	5¼	4¾	4⅜	3¼	15	5 7/16	4½	5⅜	3½	3⅛	15¾	6¼	5¾	4⅞	4⅜	3½	19½	180 02
180 05	■ 5 5/16	6⅜	5¾	5 5/16	4⅜	34	6⅜	5 7/16	6⅜	4¼	4⅜	32	7½	6⅞	5 13/16	5 5/16	4¼	39¼	180 05
180 10	■ 6¼	7⅛	7½	5⅞	6⅛	54							7½	6⅞	5 13/16	5 5/16	4¼	57½	180 10
230 00	3⅛	3¾	3⅜	3⅛	2½	5	3⅞	3⅛	3⅝	2½	2½	5¼	4 7/16	4¼	3⅝	3 5/16	2 11/16	7½	230 00
230 01	3½	4⅛	4	3 7/16	3⅛	9½	4¼	3½	4⅝	2¾	3½	8½	4⅞	4⅝	3 15/16	3 11/16	3	11¼	230 01
230 02	4⅜	5¼	5¼	4⅜	4	18	5 7/16	4½	5⅞	3½	3⅝	18	6¼	5¾	4⅞	4⅜	3½	21¾	230 02
230 05	■ 5⅜	6⅜	6	5 5/16	4¾	36	6⅜	5 7/16	6⅞	4¼	4⅞	36	7½	6⅞	5 13/16	5 5/16	4¼	41	230 05
230 08	■ 6¼	7⅛	7½	5⅞	6⅛	54							8¼	7 5/16	6½	5 13/16	4¾	59¼	230 08
300 00	3¾	4½	3½	3¾	2¼	6	4½	3¾	3¾	3	2 5/8	6½	4⅞	4⅝	3 15/16	3 11/16	3	9	300 00
300 01	4⅜	5¼	4	4⅜	3⅛	12½	5½	4½	5	3½	3⅜	13½	6¼	5¾	4⅞	4⅜	3½	16¾	300 01
300 02	4⅜	5¼	5⅝	4 5/16	4¾	23	5½	4½	6⅝	3½	5	24	6¼	5¾	4⅞	4⅜	3½	27½	300 02
300 05	■ 5 5/16	6⅜	7⅛	5 5/16	6¼	49	6½	5½	8	4¼	6	48	7½	6⅞	5 13/16	5 5/16	4¼	52½	300 05

Add 3/16 to H W D for Style BE

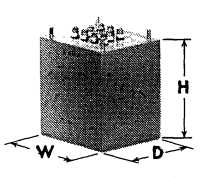


STYLE B: • "Open Frame" Bracket Mounted • Double Vacuum Varnish Impregnated

STYLE BE: • Conforms to MIL-T-27B • Epoxy Encapsulation added to Style B



STYLE V: • Fully Enclosed in Metal Shells • Ease of "Wiring with Leads" • Attractive Appearance • Dbl Vacuum Varnish Impregnated



STYLE CM: • Hermetically Sealed to MIL-T-27B • Environment Proof • Attractive Gray Finish • Permanent Name Plate

CONTACT FACTORY FOR PRICES

QUALITY ENGINEERED PRECISION BUILT

TODD SYSTEMS INC.

50 ASH STREET, DEPT. EM YONKERS, NY, U.S.A. 10701 (914) 963-3400

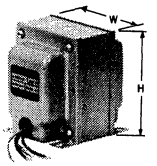
TODD ENGINEERED — LINE ISOLATION ..... HIGH CURRENT CHOKES

LINE ISOLATION — OUTPUT 115 VOLTS — 50/60 HERTZ, UL COMPONENTS

STRAIGHT ISOLATION — ELECTROSTATIC SHIELD CONNECTED TO CORE — TWO STYLES

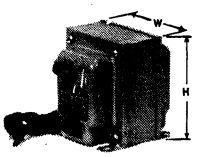
CATALOG NUMBER	WATTS (VA)	INPUT VOLTS	HIPOT TEST VOLTS	DIMENSIONS H	W	D	MW	MD	WGT.
LI-25	25	115	1500	3 1/8	2 5/8	2 1/2	2	1 1/2	1 5/8
LI-50	50	115	1500	3 1/2	2 7/8	3	2 1/4	1 7/8	3
LI-100	100	115	1500	3 1/2	2 7/8	3 1/2	2 1/4	2 1/4	4
LI-175	175	115	1500	4 5/8	3 7/8	3 7/8	3	2 3/4	7
LI-250	250	115	1500	4 5/8	3 7/8	4 3/8	3	3 1/4	10
LI-350	350	115	1500	4 5/8	3 7/8	5 1/4	3	4 1/8	14
LI-500	500	115	1500	6	4 3/8	5 1/8	3 7/16	3 3/8	17 1/2
LI-750	750	115	1500	6	4 3/8	6 3/8	3 7/16	4 1/2	24
LI-1000	1000	115	1500	6	4 3/8	7 1/4	3 7/16	5 1/2	30
LI-1500	1500	115	1500	6 1/2	5 1/2	7 1/2	4 1/4	5 3/8	42
LI-2000	2000	115	1500	6 1/2	5 1/2	9	4 1/4	6 7/8	58
LI-100-1	100	230	2000	3 1/2	2 7/8	3 1/2	2 1/4	2 1/4	4
LI-250-1	250	230	2000	4 5/8	3 7/8	4 3/8	3	3 1/4	10
LI-500-1	500	230	2000	6	4 3/8	5 1/8	3 7/16	3 3/8	17 1/2
LI-1000-1	1000	230	2000	6	4 3/8	7 1/4	3 7/16	5 1/2	30
LI-1500-1	1500	230	2000	6 1/2	5 1/2	7 1/2	4 1/4	5 3/8	42
LI-2000-1	2000	230	2000	6 1/2	5 1/2	9	4 1/4	6 7/8	58

STYLE LO



LEAD WIRE TERMINALS

STYLE LRG

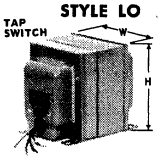


LINE CORD RECEPTACLE (W/GROUND)

ADJUSTABLE ISOLATION — ELECTROSTATIC SHIELD CONNECTED TO CORE — • PRIMARY TAPPED • TWO STYLES

CATALOG NUMBER	WATTS (VA)	INPUT VOLTS	HIPOT TEST VOLTS	DIMENSIONS H	W	D	MW	MD	WGT.
LI-50-2	50	105/115/125	1500	3 1/2	2 7/8	3 7/8	2 1/4	2 1/2	3
LI-100-2	100	105/115/125	1500	3 1/2	2 7/8	4 3/8	2 1/4	3	4 1/2
LI-250-2	250	105/115/125	1500	4 5/8	3 7/8	5 1/8	3	4	11 1/2
LI-500-2	500	105/115/125	1500	6	4 3/8	5 7/8	3 7/16	4 1/8	19
LI-1000-2	1000	105/115/125	1500	6	4 3/8	8 1/8	3 7/16	6 3/8	34
LI-50-3	50	210/230/250	2000	3 1/2	2 7/8	3 7/8	2 1/4	2 1/2	3
LI-100-3	100	210/230/250	2000	3 1/2	2 7/8	4 3/8	2 1/4	3	4 1/2
LI-250-3	250	210/230/250	2000	4 5/8	3 7/8	5 1/8	3	4	11 1/2
LI-500-3	500	210/230/250	2000	6	4 3/8	5 7/8	3 7/16	4 1/8	19
LI-1000-3	1000	210/230/250	2000	6	4 3/8	8 1/8	3 7/16	6 3/8	34

STYLE LO



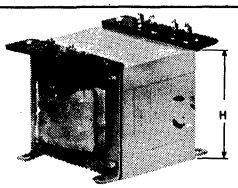
LEAD WIRE TERMINALS

STYLE LRG

LINE CORD RECEPTACLE (W/GROUND)

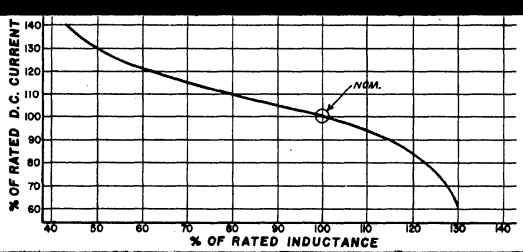
HI-POWER ISOLATION — ELECTROSTATIC SHIELD CONNECTED TO CORE — BRACKET MOUNTED

CATALOG NUMBER	WATTS (VA)	INPUT VOLTS	HIPOT TEST VOLTS	DIMENSIONS H	W	D	MW	MD	WGT.
LI-2500-4	2500	115/230	2000	6 1/8	7 1/8	8 3/4	5 7/8	7	60
LI-3000-4	3000	115/230	2000	7 1/2	9	7 7/8	7 1/2	6 1/2	95
LI-4000-4	4000	115/230	2000	7 1/2	9	9	7 1/2	7 5/8	113
LI-5000-4	5000	115/230	2000	7 1/2	9	10 1/4	7 1/2	8 7/8	135
LI-6000-4	6000	115/230	2000	7 1/2	9	11 3/4	7 1/2	10 1/4	168
LI-2500-5	2500	230/460	2500	6 1/8	7 1/8	8 3/4	5 7/8	7	60
LI-3000-5	3000	230/460	2500	7 1/2	9	7 7/8	7 1/2	6 1/2	95
LI-4000-5	4000	230/460	2500	7 1/2	9	9	7 1/2	7 5/8	113
LI-5000-5	5000	230/460	2500	7 1/2	9	10 1/4	7 1/2	8 7/8	135
LI-6000-5	6000	230/460	2500	7 1/2	9	11 3/4	7 1/2	10 1/4	168



SCREW TERMINALS

HIGH CURRENT CHOKES — 50/500 HERTZ — DIMENSIONS REFER TO HIGH CURRENT XFMR SKETCHES



- **Matching styles complement high current transformers**
- **Wide variety of compatible current ratings**

INDUCTANCE VARIATION

Graph indicates typical variation of inductance (%) when used at D.C. currents (%) other than the rated values.

Chokes operated at D. C. currents higher than rated value must be run on an intermittent basis to avoid overheating.

CATALOG NUMBER	INDUCTANCE (mh)	D.C. CURRENT (AMPS)	RESISTANCE (OHMS)	• BRACKET MTD. (STYLE B) • ENCAPSULATED (STYLE BE) H	W	D	MW	MD	WGT.	• FULLY MTD. SHELLS (STYLE V) H	W	D	MW	MD	WGT.	• HERMETICALLY SEALED MIL-T (STYLE CM) H	W	D	MW	MD	WGT.
CH-00	200	.5	3.00	2 1/4	2 5/8	2	2	1 3/4	1 1/2	2 5/8	2 1/4	2 1/4	1 3/4	1 5/8	1 3/4	3 1/8	3	2 1/16	2 5/16	1 7/8	2 1/8
CH-01	100	1	1.50	2 1/2	2	2 1/8	2 1/2	2	2 1/4	3 1/8	2 1/2	2 5/8	2	1 3/4	2 1/4	3 1 3/16	3 1/2	3	2 5/8	2 1/8	3 1/4
CH-02	80	2	1.30	2 1/2	3	2 1/2	2 1/2	2	2 1/2	3 1/8	2 1/2	2 1/2	2	1 3/4	2 1/2	3 1 3/16	3 1/2	3	2 5/8	2 1/8	3 1/2
CH-04	60	4	.60	3 1/8	3 3/4	3 1/4	3 1/8	2 1/2	5 1/4	3 7/8	3 3/16	3 3/4	2 1/2	2 1/4	6	4 1/16	4 1/4	3 5/8	3 5/16	2 11/16	7 1/4
CH-05	50	5	.50	3 1/8	3 3/4	3 3/8	3 1/8	2 3/4	5 3/4	3 7/8	3 3/16	4	2 1/2	3	6 1/2	4 1/16	4 1/4	3 5/8	3 5/16	2 11/16	8
CH-06	40	6	.35	3 1/8	3 3/4	3 3/8	3 1/8	2 3/4	6	3 7/8	3 3/16	4	2 1/2	3	6 1/2	4 1/16	4 1/4	3 5/8	3 5/16	2 11/16	8 5/8
CH-08	30	8	.25	3 1/2	4 1/8	3 7/8	3 3/8	3	8	4 1/8	3 1/2	4 3/8	2 3/4	3 3/8	8 1/2	4 7/8	4 5/8	4	3 11/16	3	11 1/8
CH-12	20	12	.12	3 3/4	4 1/2	4 7/8	3 3/8	3 1/2	15 1/2	4 5/8	3 7/8	4 7/8	3	3 3/4	14	5 5/16	5	4 1/4	4 1/16	3 5/16	20
CH-16	15	16	.08	4 7/16	5 1/4	4 5/8	4 3/8	3 3/8	14 1/4	5 7/16	4 1/2	5 1/4	3 1/2	3 3/4	15	6 1/4	5 3/4	4 7/8	4 3/8	3 1/2	22 1/2
CH-20	10	20	.05	4 7/16	5 1/4	4 1/2	4 3/8	3 1/2	15 1/2	5 7/16	4 1/2	5 3/8	3 1/2	3 7/8	16	6 1/4	5 3/4	4 7/8	4 3/8	3 1/2	24
CH-25	6.5	25	.028	4 7/16	5 1/4	5	4 3/8	4	18 1/2	5 7/16	4 1/2	5 7/8	3 1/2	4 3/8	19 1/2	6 1/4	5 3/4	4 7/8	4 3/8	3 1/2	26 1/2
CH-30	5.5	30	.022	5 3/8	6 3/8	4 1/2	5 1/4	3 1/4	21	6 1/2	5 7/16	5 1/2	4 1/4	3 1/4	24	7 1/2	6 7/8	5 13/16	5 5/16	4 1/4	29 1/2
CH-40	4.0	40	.014	5 3/8	6 3/8	4 5/8	5 1/4	3 1/2	23	6 1/2	5 7/16	5 3/4	4 1/4	3 1/2	25	7 1/2	6 7/8	5 13/16	5 5/16	4 1/4	32 1/2
CH-50	3.0	50	.010	5 3/8	6 3/8	5 1/2	5 1/4	4 1/8	29	6 1/2	5 7/16	6 3/8	4 1/2	4 1/8	30	7 1/2	6 7/8	5 13/16	5 5/16	4 1/4	37
CH-100	.8	100	.003	5 3/8	6 3/8	5 3/4	5 1/4	4 5/8	35	6 1/2	5 7/16	6 7/8	4 1/4	4 5/8	36	7 1/2	6 7/8	5 13/16	5 5/16	4 1/4	45
CH-200	.35	200	.001	6 1/8	7 1/8	6 3/4	5 7/8	5 1/2	43												

CONTACT FACTORY FOR PRICES

QUALITY ENGINEERED — PRECISION BUILT

TODD SYSTEMS INC.

50 ASH STREET, DEPT. EM — YONKERS, NY, U.S.A. 10701 — (914) 963-3400

TODD ENGINEERED

STEPDOWN AUTOTRANSFORMERS

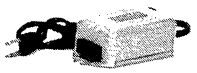
CONVERT DOMESTIC APPLIANCES FOR USE ON FOREIGN VOLTAGES

COND. CAT.-SD-81

50/60 HERTZ—*UL* COMPONENTS • ALSO AVAILABLE WIRED FOR STEPUP

PORTABLE MODEL — 220/240 INPUT 110/120 OUTPUT

CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-35	20	7/8	1 1/2	2	2 5/8
SD-36	40	1 1/4	1 7/16	2 1/8	3 1/2
SD-37	60	1 5/16	1 7/16	2 1/8	3 1/2
SD-41	80	1 7/16	1 7/16	2 1/8	3 1/2



LINE CORD • RECEPTACLE

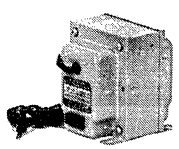
NORMAL DUTY MODEL — 220/240 INPUT 110/120 OUTPUT

CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-24	50	1 5/8	2 1/4	2 3/4	2 1/4
SD-21	65	1 5/8	2 1/4	2 3/4	2 1/4
SD-25	80	1 3/4	2 1/4	2 3/4	2 3/8
SD-23	100	1 3/4	2 1/4	2 3/4	2 3/8
SD-26	125	2 3/8	2 5/8	3 1/16	2 1/2
SD-27	150	2 3/8	2 5/8	3 1/16	2 1/2

LINE CORD • PIGTAIL

HEAVY DUTY MODEL — 220/240 INPUT 110/120 OUTPUT

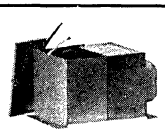
CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-16	100	2 1/4	3 1/8	2 5/8	3 1/4
SD-17	150	3 1/2	3 1/8	2 5/8	3 7/8
SD-38	200	3 3/4	3 1/8	2 5/8	4
SD-12	250	5 1/2	4 5/8	3 7/8	3 3/8
SD-18	350	6 1/2	4 5/8	3 7/8	3 5/8
SD-11	500	9 3/4	4 5/8	3 7/8	4 1/4
SD-19	750	12	4 5/8	3 7/8	5
SD-13	1000	13 3/4	4 5/8	3 7/8	5 1/4
SD-14	1500	19	4 5/8	3 7/8	6 5/8
SD-20	2000	24 1/2	6	4 3/8	6 3/8
SD-39	2500	35 1/2	6 1/2	5 1/2	6 5/8



LINE CORD • RECEPTACLE

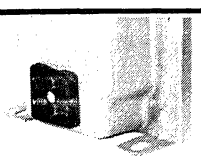
INDUSTRIAL MODEL — 220/240 INPUT 110/120 OUTPUT

CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-28	3000	47	6 1/8	7 1/16	10 1/4
SD-29	4000	54	6 1/8	7 1/16	12
SD-22	5000	59	6 1/8	7 1/16	11 1/4
SD-30	6000	70	6 1/8	7 1/16	12 1/4

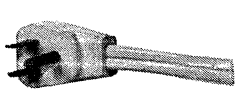


JUNCTION BOX
LEAD TERMINALS

ACCESSORIES — AVAILABLE FOR USE WHERE APPLICABLE

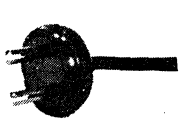


3 WIRE RECEPTACLE



3 WIRE LINE CORD

PLUG ADAPTERS



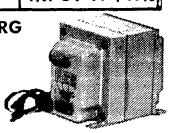
FOREIGN PLUGS

3 TAP REFRIGERATION — 188/210 210/236 236/260 → 105V-50Hz (115V - 60Hz. INPUT V. +10%)

CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-31LRG	350	6 1/2	4 5/8	3 7/8	4 3/8
SD-32LRG	550	9 1/4	4 5/8	3 7/8	5
SD-33LRG	750	12	4 5/8	3 7/8	5 3/4
SD-42LRG	850	14 1/2	4 5/8	3 7/8	6 5/8
SD-34LRG	1000	16 1/4	4 5/8	3 7/8	7
SD-40LRG	1500	23	4 5/8	3 7/8	8 1/2

CATALOG NUMBER	RATING WATTS	WEIGHT LBS.	DIMENSIONS H	W	D
SD-31LO	350	6 1/4	4 5/8	3 7/8	4 1/2
SD-32LO	550	9	4 5/8	3 7/8	5 1/8
SD-33LO	750	12	4 5/8	3 7/8	5 1/2
SD-42LO	850	14	4 5/8	3 7/8	6
SD-34LO	1000	16	4 5/8	3 7/8	6 1/2
SD-40LO	1500	22	4 5/8	3 7/8	8

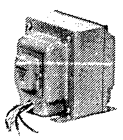
STYLE LRG



TAP SWITCH

3 WIRE LINE CORD & RECEPTACLE (WITH GROUND)

STYLE LO



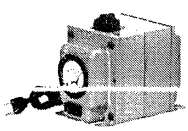
JUNCTION BOX

LEAD WIRE TERMINALS

MULTI-TAPPED VOLTAGE REGULATOR — METER • SWITCH

TYPE	PRIMARY VOLTS (SELECTOR SWITCH TAPS)	OUTPUT VOLTS
11	84 92 100 108 115 122 130 138	115
12	84 92 100 108 115 122 130 138	208, 230
21	170 185 200 215 230 245 260 275	115
22	170 185 200 215 230 245 260 275	208, 230

CATALOG NUMBER	TYPE	RATING WATTS	WGT. LBS.	DIMENSIONS H	W	D
MVR-17	11 or 22	150	4 5/8	4 5/8	3 7/8	5
MVR-18	11 or 22	350	6 1/2	4 5/8	3 7/8	5 1/2
MVR-11	11 or 22	500	8	4 5/8	3 7/8	5 3/4
MVR-19	11 or 22	750	11	4 5/8	3 7/8	6 5/8
MVR-13	11 or 22	1000	13 1/4	4 5/8	3 7/8	7 1/8
MVR-14	11 or 22	1500	17	6	4 3/8	7 3/8
MVR-20	11 or 22	2000	22	6	4 3/8	8 1/4
MVR-17	12 or 21	150	6	4 5/8	3 7/8	5 1/8
MVR-18	12 or 21	350	9	4 5/8	3 7/8	5 7/8
MVR-11	12 or 21	500	12 1/2	4 5/8	3 7/8	6 3/4
MVR-19	12 or 21	750	15	4 5/8	3 7/8	7 1/4
MVR-13	12 or 21	1000	18 3/4	6	4 3/8	7 1/2
MVR-14	12 or 21	1500	24	6	4 3/8	8 1/2
MVR-20	12 or 21	2000	30 1/2	6	4 3/8	9 1/4

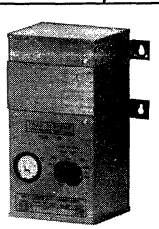


3 WIRE LINE CORD & RECEPTACLE (WITH GROUND)

PANEL MOUNTED VOLTAGE REGULATOR — METER • SWITCH JUNCTION BOX

TYPE	PRIMARY VOLTS (SELECTOR SWITCH TAPS)	OUTPUT VOLTS
11	84 92 100 108 115 122 130 138	115
12	84 92 100 108 115 122 130 138	208, 230
21	170 185 200 215 230 245 260 275	115
22	170 185 200 215 230 245 260 275	208, 230

CATALOG NUMBER	TYPE	RATING WATTS	WGT. LBS.	DIMENSIONS H	W	D
PVR-20	11 or 22	2000	29	5 3/8	6 3/8	11 1/4
PVR-28	11 or 22	3000	40	5 3/8	6 3/8	12 1/4
PVR-29	11 or 22	4000	49	5 3/8	6 3/8	13 3/8
PVR-22	11 or 22	5000	57	5 3/8	6 3/8	14 5/8
PVR-30	11 or 22	6000	63	6 1/8	7 1/8	13 3/4
PVR-20	12 or 21	2000	44	6 1/8	7 1/8	13
PVR-28	12 or 21	3000	58	6 1/8	7 1/8	14
PVR-29	12 or 21	4000	78	6 1/8	7 1/8	15 1/2
PVR-22	12 or 21	5000	91	6 1/8	7 1/8	16 1/2
PVR-30	12 or 21	6000	105	6 1/8	7 1/8	18



- JUNCTION BOX
- LEAD TERMINALS

CONTACT FACTORY FOR PRICES

QUALITY ENGINEERED — PRECISION BUILT

TODD SYSTEMS INC.

50 ASH STREET. YONKERS, NY, U.S.A. 10701 (914) 963-3400

50/60 Hz TOROIDAL POWER TRANSFORMERS CUSTOM MADE OR STANDARD

LOW WEIGHT	Typically less than half the weight of stacked core transformers.
SMALL DIMENSIONS	Low height allows slim compact design of electronic equipment.
EASY MOUNTING	Washer mounting requires only one single bolt to the chassis.
LOW HUM	Continuously rolled core has no airgap. No loose parts to rattle.
LOW STRAYFIELD	Primary and secondary windings are distributed evenly along the core, which has no airgap.
SMALL NO-LOAD LOSSES	Typically less than ¼ of the no-load losses of ordinary stacked core transformers.
MEETS ALL SAFETY REQUIREMENTS	TOROID transformers are made to meet all major safety regulations such as US (UL 1411), Scandinavian (SEMKO 115, etc.), West German (VDE 550) and Swiss (SEV). 4000V RMS insulation is standard.
CUSTOM DESIGN	Our application engineers will help you to select the best transformer for your application, and will also custom design a rectifier transformer from DC data. Prototypes can be delivered 2 to 3 weeks after order.

STANDARD OFF-THE-SHELF TRANSFORMERS FOR 117V - 60 Hz PRIMARY VOLTAGE

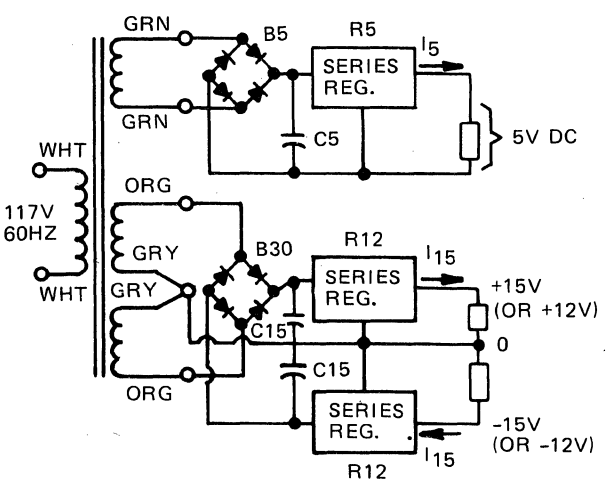
Nominal Power	Size OD × H Weight	Secondaries* Nominal Volt/ Current	No-Load Volt	Stock Number
20VA	2.4″ × 1.2″ .7 lbs	2×8.5V/1.18A	2×10.4V	102.082
		2×12V/.83A	2×14.9V	102.122
		2×15V/.67A	2×18.0V	102.152
		2×18V/.56A	2×21.2V	102.182
		2×24V/.42A	2×29.8V	102.242
40VA	2.8″ × 1.3″ 1.1 lbs	2×8.5V/2.35A	2×10.4V	104.082
		2×12V/1.67A	2×14.6V	104.122
		2×15V/1.33A	2×18.3V	104.152
		2×18V/1.10A	2×22.1V	104.182
		2×24V/.83A	2×29.3V	104.242
70VA	3.2″ × 1.4″ 1.5 lbs	24V/2.9A	28.2V	107.241
		220V/.31A	261V	107.220
		2×8.5V/4.1A	2×10.0V	107.082
		2×12V/2.9A	2×14.1V	107.122
		2×15V/2.3A	2×17.6V	107.152
		2×18V/1.9A	2×21.0V	107.182
100VA	3.7″ × 1.4″ 2.2 lbs	24V/4.15A	27.8V	110.241
		2×8.5V/5.8A	2×9.8V	110.082
		2×12V/4.15A	2×13.9V	110.122
		2×15V/3.3A	2×17.4V	110.152
		2×18V/2.8A	2×20.7V	110.182
150VA	3.7″ × 1.8″ 2.9 lbs	24V/6.2A	26.8V	115.241
		220V/.67A	246.5V	115.220
		2×8.5V/8.6A	2×9.5V	115.082
		2×12V/6.2A	2×13.4V	115.122
		2×15V/5.0A	2×16.8V	115.152
		2×18V/4.1A	2×20.2V	115.182
340VA	4.5″ × 2.3″ 5.3 lbs	220V/1.55A	235V	134.220
		2×24V/7.08A	2×25.7V	134.242
		2×30V/5.67A	2×32.1V	134.302
		2×33V/5.15A	2×35.3V	134.332
600VA	5.5″ × 2.4″ 8.2 lbs	220V/2.73A	2×232V	160.220
		2×24V/12.5V	2×25.4V	160.242
		2×30V/10.0A	2×31.7V	160.302
		2×33V/9.1A	2×34.9V	160.332
		2×38V/7.9A	2×40.1V	160.382

*Dual secondaries can be used separately, in parallel or in series. Series connection forms centertap.

+5V/±15V RECTIFIER TRANSFORMERS FOR 105V-130V 60 Hz PRIMARY SUPPLY.

Transformer Size-Wt. OD x H	Maximum DC Currents	Diode Bridge Required RMS	Regulator Max. Load Volts/Power	Capacitor Data (min) μF/Volts	Transformer Stock Number
20VA- .7 lbs 2.4″x1.2″	I_5 = .75A I_{15} = .20A	B5: 1.3A/15V B30: .35A/50V	R5: 10V/4.5W R12: 19V/2.5W	C5: 6000/16V C12: 1,500/30V	102.530
40VA-1.1 lbs 2.8″x1.3″	I_5 = 1.9A I_{15} = .24A	B5: 3.2A/15V B30: .4A/50V	R5: 10V/12W R12: 19V/3W	C5: 14,000/16V C12: 1,800/30V	104.530
70VA-1.5 lbs 3.2″x1.4″	I_5 = 3.2A I_{15} = .37A	B5: 5.5A/15V B30: .64A/50V	R5: 9V/18W R12: 17V/4W	C5: 24,000/16V C12: 2,600/30V	107.530
100VA-2.2 lbs 3.7″x1.4″	I_5 = 5.6A I_{15} = .37A	B5: 9.4A/15V B30: .64A/50V	R5: 9V/33W R12: 17V/4.5W	C5: 40,000/16V C12: 2,600/30V	110.530

Transformer to be used with user-provided components per schematic below. Specs for diode bridges, capacitors and series regulators must meet or exceed data per table above.



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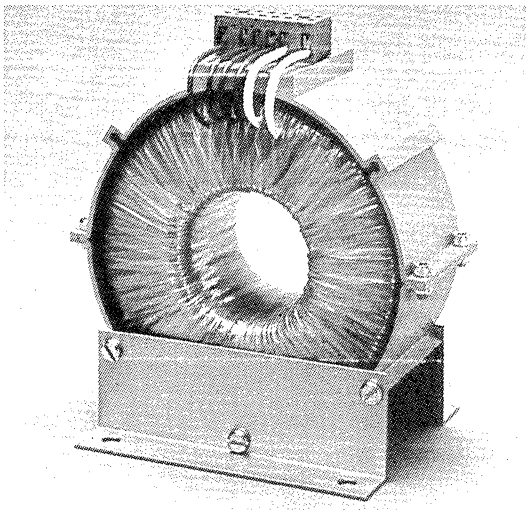
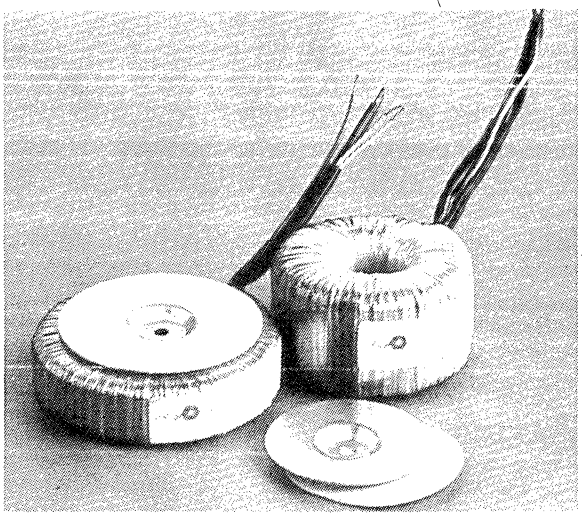
50/60 Hz TOROIDAL POWER TRANSFORMERS CUSTOM MADE OR STANDARD



Belt mounted (800VA-3,000VA)



Washer mounted (15VA-1,400VA)

BASIC DATA FOR TOROID TRANSFORMERS ON STANDARD CORE SIZES

Max. Power		No Load	Max. Copper	Size and Weight (Unmounted transformer)	
60Hz VA	50Hz VA	Loss W	Loss W	OD × H inches	Weight lbs
20	15	.20	3.3	2.4×1.2	.7
40	30	.25	6.4	2.8×1.3	1.1
70	50	.42	12	3.2×1.4	1.5
100	80	.50	15	3.7×1.4	2.2
150	120	.75	18	3.7×1.8	2.9
180	150	.9	21	4.5×1.6	3.3
275	225	1.5	23	4.5×1.9	4.4
340	285	1.8	25	4.5×2.3	5.3
430	360	1.8	31	5.5×2.0	5.7
600	500	2.4	35	5.5×2.4	8.2
720	600	2.9	38	5.5×2.8	9.7
1,000	800	3.5	47	6.3×2.4	12.1
1,200	1,000	4.4	50	6.3×2.8	14.6
1,400	1,150	5.3	48	6.3×3.3	17.9
1,750	1,450	5.4	61	7.9×2.6	20.6
2,100	1,750	6.7	64	7.9×3.0	25.1
2,400	2,000	8.1	67	7.9×3.3	27.3
2,750	2,300	7.7	82	8.7×3.2	29.0
3,300	2,700	9.2	84	8.7×3.5	34.6

Complete Data and Application Notes available on request.

GENERAL INFORMATION

Both standard and custom made transformers are made on standard core sizes (see table on left). Non-standard core sizes can be made for large volume users to meet special size requirements. Cores are tape-wound from grain-oriented silicon steel and heat-treated for optimum performance.

Both ends of windings are normally taken out as 8" leads with colored PVC tube insulation. Taps can be formed by external interconnection of leads.

Temperature rise.
TOROID transformers are normally designed for a temperature rise of 60-70°C (140-158°F). The steady-state temperature in a transformer depends on the mounting environment.

Inrush current.
Due to absence of air gap and good magnetic properties of the core material, the inrush current at power-on is higher than in stacked core transformers. Slow fuses should be chosen for primary circuit protection, especially for transformers over 300 VA.

Static shielding.
A static shield to minimize capacitive coupling between primary and secondary is available as an option. The shield occupies space and thus reduces the effective output power of the transformer.

Magnetic strayfield.
The strayfield from a well made toroidal power transformer is very insignificant compared to the strayfield from a conventional stacked-core transformer. The small residual strayfield from a TOROID transformer can, if required, be further reduced by means of a thin ring of magnetic material fitted as a belt around the toroid.

3-phase transformers.
A 3-phase toroidal transformer consists of three separate units that can be mounted individually or stacked upon each other, depending on available space.

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet

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TRANSFORMERS

SUBMINIATURE AUDIO TRANSFORMERS

LT & LS SERIES
LU SERIES

The LS Series is electrically and mechanically the same as the LT Series except for phase relationships between terminals.

LS, LT, and LU Series transformers have successfully passed the rigid requirements of MIL-T-27, Class S, Grade 5.

Subminiature in size, weighing less than 0.1 ounce, these transformers have tenth inch grid spacing between terminals and are ideally suited for transistor circuit applications which utilize printed circuit board design. All three series have risers on mountng surfaces to facilitate inspection and board cleaning and also to prevent moisture traps.

A wide range of standard designs are available which meet the requirements of most common applications and allow for rapid delivery of prototype quantities. Special designs are also available in all three types.

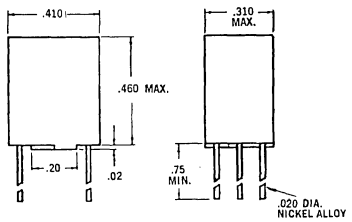
The new LU Series exhibits the same electrical characteristics as the LS and LT Series but has been packaged in a "thin line" configuration to allow for closer board spacing for "card cage" applications or where height dimensions are critical.

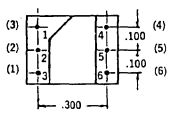
MAGNETIC SHIELDING

LS, LT and LU Series transformers are available with magnetic shields.

To order transformers with shields installed, add 500 to dash numbers shown in the table below. For example: to order an LS-22 with shield, specify LS-522.

LS/LT SERIES

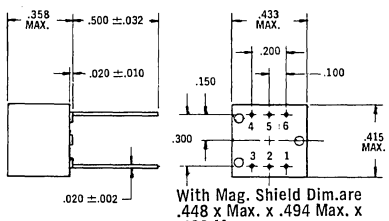




WT. 0.1oz

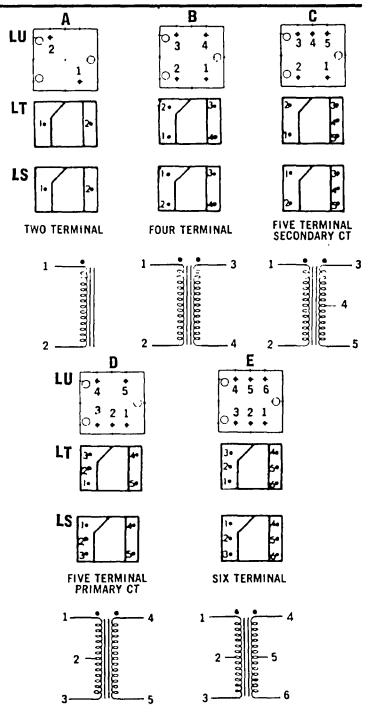
With Mag. Shield Dimensions are .356 Max. x .465 Max. x .531 Max.

LU SERIES



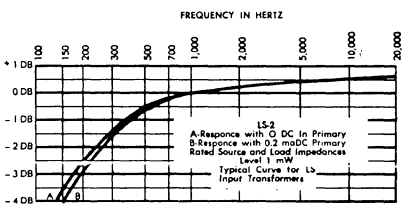
With Mag. Shield Dim.are .448 x Max. x .494 Max. x .400 Max.

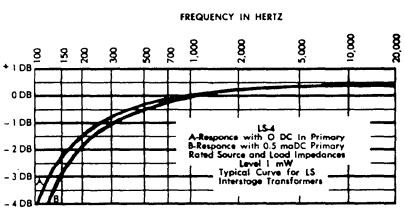
Mech. Tol. = ±.010 unless indicated.

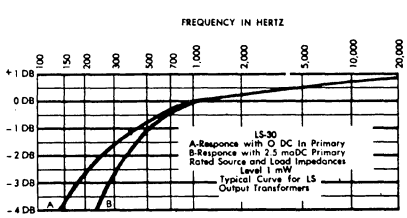


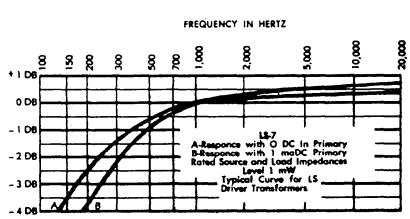
LS, LT or LU No.	Type	MIL-T-27 Designation	Primary Impedance	DCR Pri. Ohms	DC ma Pri.	Secondary Impedance	Max. Power mW	Terminal Layout
2	Input	TF5S21ZZ	50000 CT	3800	0.2	1000CT	25	E
4	Interstage	TF5S21ZZ	20,000/30,000	1700	0.5	800/1200	40	B
5	Interstage	TF5S21ZZ	20,000/30,000CT	1700	0.5	800/1200CT	40	E
6	Interstage	TF5S21ZZ	10,000/12,000CT	1050	1	1500/1800CT	50	E
7	Driver	TF5S21ZZ	10,000/12,000CT	1050	1	1200/1500CT	50	E
8	Driver	TF5S21ZZ	10,000/12,000CT	1050	1	2000/2500CT	50	E
9	Driver	TF5S21ZZ	10,000/12,000CT	1050	1	500/600CT	50	E
10	Output	TF5S21ZZ	500/600	60	3	50/60	50	B
11	Output	TF5S21ZZ	1000/1200	145	3	50/60	50	B
12	Output	TF5S21ZZ	600	70	3	3.2	50	B
13	Output	TF5S21ZZ	1200	120	2	3.2	50	B
14	Output	TF5S21ZZ	10,000	1160	1	3.2	50	B
15	Output	TF5S21ZZ	150/200CT	18	10	12/16	50	D
16	Output	TF5S21ZZ	300/400CT	38	7	12/16	50	D
17	Output	TF5S21ZZ	600/800CT	75	4.5	12/16	50	D
18	Output	TF5S21ZZ	1000/1330CT	120	3.5	12/16	50	D
19	Output	TF5S21ZZ	1500/2000CT	180	3	12/16	50	D
20	Output	TF5S21ZZ	7500/10,000CT	820	1	12/16	50	D
21	Output	TF5S21ZZ	300CT	37	7	600	50	D
22	Output	TF5S21ZZ	500CT	60	3	600	50	D
23	Output	TF5S21ZZ	900CT	100	4	600	50	D
24	Output	TF5S21ZZ	1500CT	170	3	600	50	D
25	Output	TF5S21ZZ	120/150CT	15	10	3.2/4	50	D
26	Output	TF5S21ZZ	320/400CT	40	6	3.2/4	50	D
27	Output	TF5S21ZZ	600/750CT	70	4.5	3.2/4	50	D
28	Output	TF5S21ZZ	800/1000CT	100	4	3.2/4	50	D
29	Output	TF5S21ZZ	1200/1500CT	125	3	3.2/4	50	D
30	Output	TF5S21ZZ	1600/2000CT	190	2.5	3.2/4	50	D
31	Output	TF5S21ZZ	8000/10,000CT	820	1	3.2/4	50	D
32	Output	TF5S21ZZ	10,000CT	1000	1	10,000CT	50	E
33	Driver	TF5S21ZZ	10,000/12,000	1050	1	500/600CT	50	C
34	Driver	TF5S21ZZ	20000	1700	0.3	1000	50	B
35	Output	TF5S21ZZ	1000	135	3	50	50	B
36	Output	TF5S21ZZ	400CT	40	3	11	50	D
37	Driver	TF5S21ZZ	10,000/12,000	1050	1	2000/2500CT	50	C
38	Output	TF5S21ZZ	600CT	72	3	600CT	50	E
39	Output	TF5S21ZZ	10,000	1000	1	10,000 split	50	*
40	Output	TF5S21ZZ	600	72	3	600 split	50	*
41	Input	TF5S21ZZ	25,000CT	4300	0.6	1000CT	30	E
42	Isolation	TF5S21ZZ	600CT	90	4	600CT	30	E
101	Choke	TF5S20ZZ	6 H @ 2 ma DC	1700				A
102	Choke	TF5S20ZZ	1.25 H @ 2 ma DC	180				A
103	Choke	TF5S20ZZ	3.5 M @ 2 ma DC	1100				A
104	Choke	TF5S20ZZ	.3 H @ 4 ma DC	42				A

* Primary terminals 1-2, secondary 3-4 & 5-6.









The above are typical response curves up to 20 kHz however many items in this series have useful frequency ranges up to 100 kHz and beyond.

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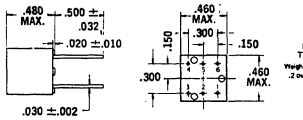
TRANSFORMERS

SUBMINIATURE AUDIO TRANSFORMERS

Torotel LA and LB series transformers are manufacturered to MIL-T-27, Grade 5, Class S specification. These series have 0.1 grid spaced terminals for printed circuit application. Both types have risers on mounting surfaces to prevent the formation of moisture traps and to facilitate cleaning of board assemblies.

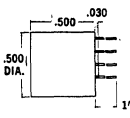
The LA Series is electrically the same as the LB Series, but is packaged in a .460 inch cube with smaller outline dimensions for application where this configuration is more suitable.

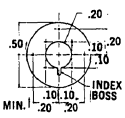
Leads are made of 20 AWG tinned copper. Units utilizing Dumet wire are available on special request.



LA TYPE Weight less than .2 ounces (6g)

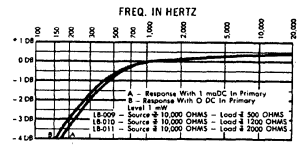
LB TYPE Weight less than .2 ounces (6g)

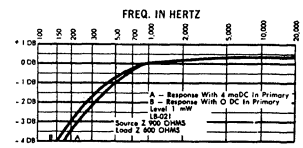


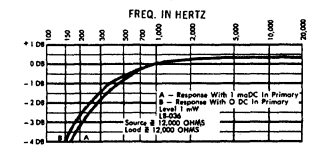


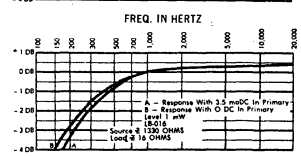
† LB DIMENSIONS WITH SHIELD O.D. .580 MAX. HT. .580 MAX.

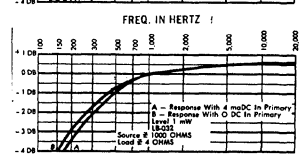
MOUNTING TEMPLATE AND LB PIN LAYOUT

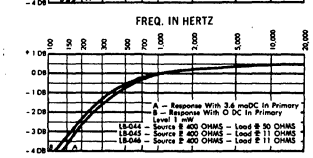


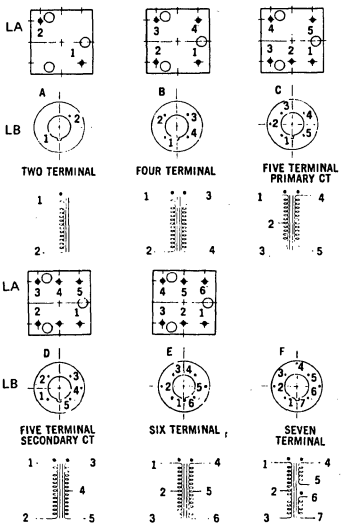












LA or LB No.	MIL Type	Application	Pri. Imp.	DC ma in Pri.	Sec. Imp.	Nom. Pri. DCR	mW Level @ 1 KHz	Term. Layout
001	TF5S21ZZ	Interstage	20,000 30,000	.5 .5	800 1200	850	50	B
002	TF5S21ZZ	Output	500 600	3 3	50 60	60	100	B
003	TF5S21ZZ	Output	1000 1200	3 3	50 60	115	100	B
004	TF5S21ZZ	Output	600	3	3.2	60	100	B
005	TF5S21ZZ	Output	1200	2	3.2	115	100	B
006	TF5S21ZZ	Output	10,000	1	3.2	790	100	B
007	TF5S21ZZ	Input	200,000	0	1000	8500	25	B
		Other Application	500	0	100,000			
008	TF5S20ZZ	Reactor 3.5 H @ 2 maDC, 1 H @ 5 maDC				630		A
009	TF5S21ZZ	Output or Driver	10,000 12,000	1 1	500CT 600CT	800	100	D
010	TF5S21ZZ	Driver	10,000 12,000	1 1	1200CT 1500CT	800	100	D
011	TF5S21ZZ	Driver	10,000 12,000	1 1	2000CT 2500CT	800	100	D
012	TF5S21ZZ	Single or PP Output	150CT 200CT	10 10	12 16	11	500	C
013	TF5S21ZZ	Single or PP Output	300CT 400CT	7 7	12 16	20	500	C
014	TF5S21ZZ	Single or PP Output	600CT 800CT	5 5	12 16	43	500	C
015	TF5S21ZZ	Single or PP Output	800CT 1070CT	4 4	12 16	51	500	C
016	TF5S21ZZ	Single or PP Output	1000CT 1330CT	3.5 3.5	12 16	71	500	C
017	TF5S21ZZ	Single or PP Output	1500CT 2000CT	3 3	12 16	108	500	C
018	TF5S21ZZ	Single or PP Output	7500CT 10,000CT	1 1	12 16	505	500	C
019	TF5S21ZZ	Output to Line	300CT	7	600	19	500	C
020	TF5S21ZZ	Output or Line to Line or Mixing	500CT	5.5	600	31	500	C
021	TF5S21ZZ	Output to Line	900CT	4	600	53	500	C
022	TF5S21ZZ	Output to Line	1500CT	3	600	86	500	C
023	TF5S21ZZ	Interstage	20,000CT 30,000CT	0.5 0.5	800CT 1200CT	850	100	E
024	TF5S21ZZ	Input	200,000CT	0	1000CT	8500	25	E
		Other Application	500CT	0	100,000CT			
025	TF5S21ZZ	Interstage	10,000CT 12,000CT	1 1	1500CT 1800CT	800	100	E
026	TF5S20ZZ	Reactor 6 H @ 2 maDC, 1.5 H @ 5 maDC				2100		A
027	TF5S20ZZ	Reactor 1.2 H @ 2 maDC, 0.5 H @ 1 maDC				100		A
028	TF5S20ZZ	Reactor 0.3 H @ 4 maDC, 0.15 H @ 20 maDC				31		A
029	TF5S21ZZ	Single or PP Output	120CT 150CT	10 10	3.2 4	10	500	C
030	TF5S21ZZ	Single or PP Output	320CT 400CT	7 7	3.2 4	20	500	C

* These LA types have no primary center tap .

LA or LB No.	MIL Type	Application	Pri. Imp.	DC ma in Pri.	Sec. Imp.	Nom. Pri. DCR	mW Level @ 1 KHz	Term. Layout
031	TF5S21ZZ	Single or PP Output	640CT 800CT	5 5	3.2 4	43	500	C
032	TF5S21ZZ	Single or PP Output	800CT 1000CT	4 4	3.2 4	51	500	C
033	TF5S21ZZ	Single or PP Output	1060CT 1330CT	3.5 3.5	3.2 4	71	500	C
034	TF5S21ZZ	Single or PP Output	1600CT 2000CT	3 3	3.2 4	109	500	C
035	TF5S21ZZ	Single or PP Output	8000CT 10,000CT	1 1	3.2 4	505	100	C
036	TF5S21ZZ	Isolation or Interstage	10,000CT 12,000CT	1 1	10,000CT 12,000CT	950	100	E
037	TF5S21ZZ	Driver	10,000CT 12,000CT	1 1	1200CT 1500CT	800	100	E
038	TF5S21ZZ	Driver	10,000CT 12,000CT	1 1	2000CT 2500CT	800	100	E
039	TF5S21ZZ	Driver	10,000CT 12,000CT	1 1	500CT 600CT	800	100	E
040	TF5S21ZZ	Input	100,000	0	1000	1700	70	B
041	TF5S21ZZ	Driver	20,000	0.5	1000	1000	100	B
042	TF5S21ZZ	Driver	20,000	0.5	1200CT	1000	100	D
043	TF5S21ZZ	Output	1000	3	50	60	100	B
044	TF5S21ZZ	Output	400	3	50	30	100	B
045	TF5S21ZZ	Output	400	3	11	30	100	B
046	TF5S21ZZ	Single or PP Output	400CT	3	11	30	500	C
047	TF5S20ZZ	Reactor 10 H @ 0 maDC, 8 H @ 5 maDC				650		A
*048	TF5S21ZZ	Isolation or Interstage Ratio 1:1:1	2000CT 2500CT	3 3	8000 split 10,000 split	195	100	F
*049	TF5S21ZZ	Interstage	10,000CT 12,000CT	1 1	2000 split 2400 split	560	100	F
*050	TF5S21ZZ	Interstage	20,000CT 30,000CT	0.5 0.5	1000 split 1500 split	800	100	F
*051	TF5S21ZZ	Interstage	40,000CT 50,000CT	0.25 0.25	400 split 500 split	1700	50	F
*052	TF5S21ZZ	Interstage or Output	400CT 500CT	8 6	400 split 500 split	46	500	F
*053	TF5S21ZZ	Interstage	400CT 500CT	8 6	120 split 150 split	46	500	F
*054	TF5S21ZZ	Interstage	400CT 500CT	8 6	40 split 50 split	46	500	F
*055	TF5S21ZZ	Interstage	80CT 100CT	12 10	32 split 40 split	9.8	500	F
056	TF5S21ZZ	Input	50,000CT	0.3	1000CT	1900	50	E
057	TF5S21ZZ	Output	600CT 750CT	4.5	3.2 4	40	500	C
058	TF5S21ZZ	Output	1200CT 1500CT	3	3.2 4	100	500	C
059	TF5S21ZZ	Input	100,000CT	0	1000CT	3300	50	E
060	TF5S21ZZ	Driver	10,000CT	1	600CT	1100	100	E
061	TF5S21ZZ	Driver	4000CT	1.5	10,000CT	440	100	E
062	TF5S21ZZ	Output	1000CT	3	600CT	110	100	E
063	TF5S21ZZ	Output	600CT	4	25,000CT	65	100	E
064	TF5S21ZZ	Output	600CT	4	600CT	67	100	E
065	TF5S21ZZ	Output	600CT	4	60CT	65	100	E
066	TF5S21ZZ	Output	600CT	4	4	65	100	C
† 500		Magnetic Shielding Case						

† The LB-Mag. Shield may be supplied for all LB Types. Add 500 to dash no. (I.E. LB-001 with Shield, order LB-501)

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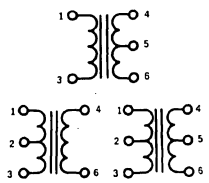
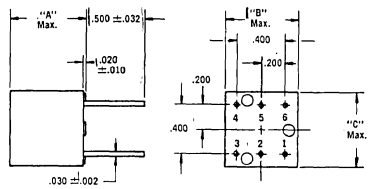
TRANSFORMERS

AUDIO TRANSFORMERS

LL & LR SERIES



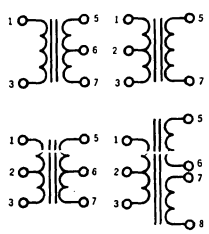


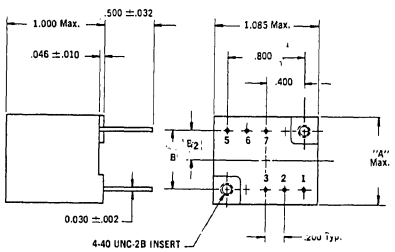
Series	A	B	C
LL	.600	.590	.590
LR	.925	.800	.710

These tiny, versatile "LL" transformers are provided with .020 risers and 0.1 grid spacing for printed circuit board applications and are manufactured to MIL-T-27, Grade 5, Class S specifications.
Response: ±1 db 200 to 50,000 Hz
Distortion: 10% max. at rated power, 200 to 50,000 Hz
Weight: 0.4 oz.

These miniaturized "LR" transformers are manufactured to MIL-T-27, Grade 5, Class S specifications and are ideally suited for a wide range of printed circuit applications.
Response: ±1 db 200 to 20,000 Hz
Distortion: 10% max. at rated power, 200 to 20,000 Hz
Weight: 1.0 oz.

LW & LY SERIES



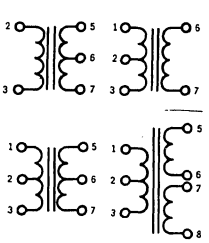


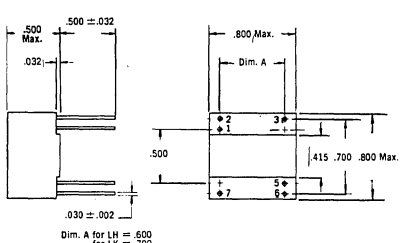
Series	A	B	B_2
LW	.900	.600	.300
LY	1.125	.800	.400

"LW" Series transformers are manufactured to MIL-T-27, Grade 5, Class S specifications. Riser areas and 0.1 grid spacing make these units ideal for printed circuit board applications.
Response: ±1 db 100 to 10,000 Hz
Distortion: 1.5% max. at 60 mW, 200 to 10,000 Hz
Weight: 2.0 oz.

"LY" Series transformers are highly compact, efficient units with power output ratings to 7.5 watts. These transformers are manufactured to MIL-T-27, Grade 5, Class S specifications.
Response: ±1 db 60 to 10,000 Hz
Distortion: 1% max. at 250 mW, 200 to 10,000 Hz — 10% max. at rated power, 200 to 10,000 Hz
Weight: 2.5 oz.

LH & LK SERIES





Series	A
LK	.700
LH	.600

"LH & LK" Series transformers are the ultimate in compactness. Designed to meet MIL-T-27, Grade 5, Class S.
Response: ±1 db 200 to 10,000 Hz
Distortion: 10% max. at rated power, 200 to 10,000 Hz
Weight: .75 oz.

LL Series

No.	MIL-T-27 Designation	Application	Impedance Ohms Pri.	Impedance Ohms Sec.	DC Resistance Ohms Pri.	DC Resistance Ohms Sec.	Max. Pri. DC (ma)	Max. 200 Hz Power† (mW)
001	TF5S21ZZ	Input	100,000CT	1000CT	6000	60	0	150
002	TF5S21ZZ	Interstage	25,000CT	1000CT	2800	120	0	150
003	TF5S21ZZ	Interstage	10,000CT	10,000CT	1100	1200	1	150
004	TF5S21ZZ	Driver	10,000CT	1500CT	1100	200	1	150
005	TF5S21ZZ	Output to Line	10,000CT	600CT	1100	75	1	150
006	TF5S21ZZ	Interstage	4000CT	10,000CT	440	1200	1.5	150
007	TF5S21ZZ	Output to Line	1000CT	600CT	100	60	3	150
008	TF5S21ZZ	Output	1000CT	4	100	0.4	3	150
009	TF5S21ZZ	Input	600CT	25,000CT	65	3500	4	150
010	TF5S21ZZ	Isolation	600CT	600CT	65	75	4	150
011	TF5S21ZZ	Output	600CT	60	65	7	4	150
012	TF5S21ZZ	Output	600CT	4	65	0.5	4	150
013	TF5S21ZZ	Driver	10,000CT	2000CT	1100	240	1	150
014	TF5S21ZZ	Driver	10,000CT	500CT	1100	65	1	150
015	TF5S21ZZ	Line to Line	500CT	600CT	55	75	4.5	150
016	TF5S21ZZ	Output to Line	300CT	600CT	33	75	5.5	150

LR Series

No.	MIL-T-27 Designation	Application	Impedance Ohms Pri.	Impedance Ohms Sec.	DC Resistance Ohms Pri.	DC Resistance Ohms Sec.	Max. Pri. DC (ma)	Max. 200 Hz Power† (mW)
001	TF5S21ZZ	Interstage	25,000CT	1000CT	2600	110	0.5	750
002	TF5S21ZZ	Interstage	10,000CT	10,000CT	1000	1100	1	750
003	TF5S21ZZ	Driver	10,000CT	1500CT	1000	165	1	750
004	TF5S21ZZ	Output to Line	10,000CT	600CT	1000	70	1	750
005	TF5S21ZZ	Output	10,000CT	4	1000	0.5	1	750
006	TF5S21ZZ	Interstage	4000CT	10,000CT	400	1100	1.5	750
007	TF5S21ZZ	Output	1500CT	15	150	2	2.5	750
008	TF5S21ZZ	Output to Line	1000CT	600CT	100	70	3	750
009	TF5S21ZZ	Output	1000CT	4	100	0.5	3	750
010	TF5S21ZZ	Input	600CT	25,000CT	60	2900	4	750
011	TF5S21ZZ	Isolation	600CT	600CT	60	70	4	750
012	TF5S21ZZ	Output	600CT	60	60	6.5	4	750
013	TF5S21ZZ	Output	600CT	15	60	2	4	750
014	TF5S21ZZ	Output	600CT	4	60	0.5	4	750
015	TF5S21ZZ	Output to Line	250	600CT	25	70	7	750
016	TF5S21ZZ	Driver	10,000CT	2000CT	1000	110	1	750
017	TF5S21ZZ	Driver	10,000CT	500CT	1000	110	1	750
018	TF5S21ZZ	Line to Line	500CT	600CT	50	70	4.5	750
019	TF5S21ZZ	Output to Line	300CT	600CT	30	70	5.5	750

LW Series

No.	MIL-T-27 Designation	Application	Impedance Ohms Pri.	Impedance Ohms Sec.	DC Resistance Ohms Pri.	DC Resistance Ohms Sec.	Max. Pri. DC (ma)	Max. 200 Hz Power† (watts)
001	TF5S21ZZ	Interstage	10,000CT	10,000CT	800	1050	1	3.5
002	TF5S21ZZ	Output to Line	10,000CT	600CT	800	60	1	3.5
003	TF5S21ZZ	Output	10,000CT	4	800	0.5	1	3.5
004	TF5S21ZZ	Output	1500CT	15	110	1.5	2.5	3.5
005	TF5S21ZZ	Output to Line	1000CT	600CT	75	60	3	3.5
006	TF5S21ZZ	Output	1000CT	4	75	0.5	3	3.5
007	TF5S21ZZ	Input	600CT	25,000CT	45	2700	4	2.5
008	TF5S21ZZ	Isolation	600CT	600CT	45	60	4	3.5
009	TF5S21ZZ	Output	600CT	60	45	6.5	4	3.5
010	TF5S21ZZ	Output	600CT	15	45	1.5	4	3.5
011	TF5S21ZZ	Output	600CT	4	45	0.5	4	3.5
012	TF5S21ZZ	Output to Line	250	600CT	20	60	7	3.5
013	TF5S21ZZ	Interstage	25,000CT	1000CT	2500	85	0.5	2.5
014	TF5S21ZZ	Driver	10,000CT	2000CT	800	170	1	3.5
015	TF5S21ZZ	Driver	10,000CT	500CT	800	50	1	3.5
016	TF5S21ZZ	Line to Line	500CT	600CT	50	60	4.5	3.5
017	TF5S21ZZ	Output to Line	300CT	600CT	30	60	5.5	3.5
018	TF5S21ZZ	Interstage	2500CT	10K split	200	900	1.5	3.5

LY Series

No.	MIL-T-27 Designation	Application	Impedance Ohms Pri.	Impedance Ohms Sec.	DC Resistance Ohms Pri.	DC Resistance Ohms Sec.	Max. Pri. DC (ma)	Max. 200 Hz Power† (mW)
001	TF5S21ZZ	Interstage	10,000CT	10,000CT	700	900	1	6
002	TF5S21ZZ	Output to Line	10,000CT	600CT	700	55	1	6
003	TF5S21ZZ	Output	10,000CT	4	700	0.4	1	6
004	TF5S21ZZ	Output	1500CT	15	100	1.5	2.5	7.5
005	TF5S21ZZ	Output to Line	1000CT	600CT	65	55	3	7.5
006	TF5S21ZZ	Output	1000CT	4	65	0.4	3	7.5
007	TF5S21ZZ	Isolation	600CT	600CT	40	55	4	7.5
008	TF5S21ZZ	Output	600CT	60	40	6	4	7.5
009	TF5S21ZZ	Output	600CT	15	40	1.5	4	7.5
010	TF5S21ZZ	Output	600CT	4	40	0.4	4	7.5
011	TF5S21ZZ	Output to Line	250	600CT	16	55	7	7.5
012	TF5S21ZZ	Driver	10,000CT	2000CT	700	150	1	6
013	TF5S21ZZ	Driver	10,000CT	500CT	700	45	1	6
014	TF5S21ZZ	Line to Line	500CT	600CT	45	55	4.5	7.5
015	TF5S21ZZ	Output to Line	300CT	600CT	27	55	5.5	7.5
016	TF5S21ZZ	Interstage	2500CT	10K split	170	800	1.5	7.5

LH & LK No.	Application	Impedance Ohms Pri.	Impedance Ohms Sec.	DC Resistance Ohms Pri.	DC Resistance Ohms Sec.	Max. Pri. DC (ma)	Max. 200 Hz Power† (mW)
001	Interstage	25,000CT	1000CT	1325	53	0.5	300
002	Interstage	10,000CT	10,000CT	510	525	1	325
003	Driver	10,000CT	1500CT	510	80	1	325
004	Output to Line	10,000CT	600CT	510	31	1	325
005	Output	10,000CT	4	510	0.3	1	325
006	Interstage	4000CT	10,000CT	200	525	1.5	325
007	Output	1500CT	15	75	1	2.5	325
008	Output to Line	1000CT	600CT	50	31	3	325
009	Output	1000CT	4	50	0.3	3	325
010	Input	600CT	25,000CT	30	1500	4	300
011	Isolation	600CT	600CT	30	31	4	325
012	Output	600CT	60	30	3	4	325
013	Output	600CT	15	30	1	4	325
014	Output	600CT	4	30	0.3	4	325
015	Output to Line	250	600CT	13	31	7	325
016	Driver	10,000CT	2000CT	510	106	1	325
017	Driver	10,000CT	500CT	510	26	1	325
018	Line to Line	500CT	600CT	25	31	4.5	325
019	Output to Line	300CT	600CT	15	31	5.5	325
020	Isolation-Ratio 1:1:1	2000CT	8K split	100	425	2	300
021	Isolation	10,000CT	2K split	510	106	1	300

† These power ratings are based upon lowest frequency operation. Much higher ratings are possible at higher operating frequencies.

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TRANSFORMERS

400 Hz MINIATURE POWER TRANSFORMERS

Reference for all Industrial and Military Standard 400 Hz Miniature Power Transformers

These 400 Hz Miniature Power Transformers are selected for use in all Military and Industrial applications requiring high performance in the smallest possible package size. They conform to all of the requirements of MIL-T-27, Class S (−55°C to +130°C). The minimum continuous operating life expectancy is 10,000 hours. This series is available having power ratings of 0.5 VA through 25 VA. The primaries are 115 Vrms with secondary voltages ranging from 5 Vrms through 300 Vrms.

It is recommended that these transformers be specified for all applications where space, weight, and cost effectiveness are prime considerations.

PART NUMBER EXAMPLE

0.5 S T 26

0.5 — V.A. Rating (See Table I)
S — Package Style
T — Schematic (See Table I)
26 — Secondary Voltage (See Table II)

TABLE I

VA Rating	Package Style	Schematic	Size	Max. Height (Inches)	Regulation (%)		Available Secondary Voltages (VRMS)		Exciting Current (ma)	Efficiency (%)		Temperature Rise (°C) — MIL-T-27 No Heat Sink		Weight (Oz.)	
					Nom.	Max.	Min.	Max.	Max.	Min.	Nom.	Nom.	Max.	Nom.	Max.
0.5	S	T, X	—	—	15	18	5	300	1	65	70	10	15	0.38	0.4
0.5	S	S, Y	—	—	17	21	5	300	1	65	70	12	17	0.38	0.4
1.5	E, P	T, X	A	0.47	20	23	5	300	1.5	70	76	13	17	0.76	0.85
1.5	E, P	S, Y	A	0.59	15	18	5	300	3	70	76	13	17	0.97	1.1
2	E, P	T, X	A	0.78	3	3.7	5	300	6	72	87	10	15	1.5	1.65
2.4	E, P	S, Y	A	1.03	3	3.8	5	300	9	73	88	11	16	1.9	2.2
3	E, P	T, X	A	0.59	15	18	5	300	3	75	84	15	20	0.97	1.1
3	E, P	S, Y	A	0.78	10	12	5	300	6	75	84	15	20	1.5	1.65
3.6	E, P	T, X	A	1.03	3	3.8	5	300	9	76	87	10	15	1.9	2.2
6	E, P	T, X	A	0.78	10	12	5	300	6	81	88	18	25	1.5	1.65
6	E, P	S, Y	A	1.03	8	10	5	300	9	80	88	18	25	1.9	2.2
7.3	E, P	S, T, X, Y	B	0.97	3	3.5	5	300	16	84	92	15	23	3.2	3.4
9	E, P	T, X	A	1.03	8	10	5	300	9	83	89	23	30	1.9	2.2
13	E, P	S, T, X, Y	B	1.20	3	3.6	5	300	25	87	93	21	28	4.2	4.4
16	E, P	S, T, X, Y	B	0.97	7	8	5	300	16	87	92	25	32	3.2	3.4
25	E, P	S, T, X, Y	B	1.20	6	7	5	300	25	88	93	36	45	4.2	4.4

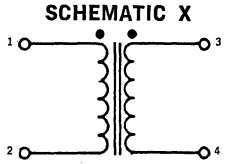
TABLE II INDUSTRY STANDARD SECONDARY VOLTAGES

Secondary Voltage	5	5.5	6	6.3	7	7.5	8	9	10	11	12	12.6	13	15	16	18	20	22	24	26	28	30	33
Maximum Working Voltage	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325

Secondary Voltage	36	39	43	47	51	56	62	68	75	82	91	100	110	115	120	130	150	180	200	220	240	270	300
Maximum Working Voltage	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	440	440	440	580	580

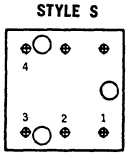
SCHEMATIC AND TERMINAL CONFIGURATIONS

SCHEMATIC X



TERMINAL LAYOUTS

STYLE S



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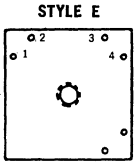

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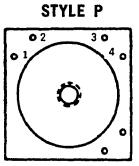

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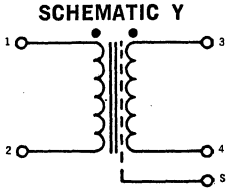

TERMINAL LAYOUTS

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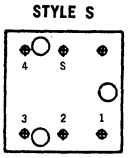

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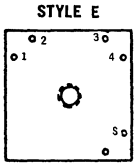

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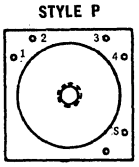
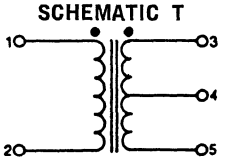


SCHEMATIC T



TERMINAL LAYOUTS

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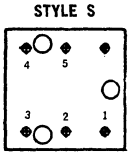

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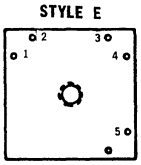

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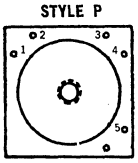

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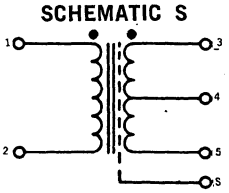

TERMINAL LAYOUTS

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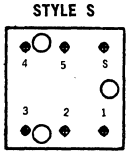

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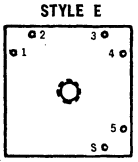

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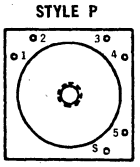

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TRANSFORMERS

400 Hz MINIATURE POWER TRANSFORMERS

Reference for all Industrial and Military Standard 400 Hz Miniature Power Transformers

PHYSICAL SPECIFICATIONS

Size: Sizes for Standard VA Types are given in Table I, and Outline Drawings.

Construction: MIL-T-27, Grade 5; Black Epoxy Encapsulated.

Terminals: Printed circuit pins — tinned brass.

Terminal Strength (Method 211 of MIL-STD-202, Test Condition A): 2.0 pounds.

Marking: Includes MIL-T-27 Type Designation, winding ratings, maximum working voltage, schematc, Torotel name, and part number.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature Range: −55°C to +130°C (ambient plus temperature rise).

Altitude: 70,000 feet, maximum.

Vibration: MIL-STD-202, Method 204, Test Condition D.

Life Expectancy: 10,000 hours minimum.

Other Environmental Specifications: In accordance with MIL-T-27, Grade 5 Class S, Family 03.

ELECTRICAL SPECIFICATIONS

Primary Voltage: 115 volts rms ±10%.

Frequency: 400 Hz ±5%.

Secondary Voltage: See Table II.

Secondary Voltage Tolerance: ±3% at full load and 115 volts, 400 Hz applied to primary.

Electrostatic Shielding (Schematics S and Y): 5 to 1 minimum voltage ratio at 20 KHz.

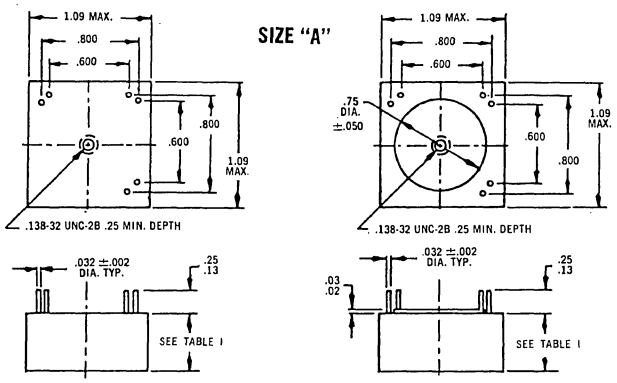
Phase Shift: 1.0 electrical degree between primary and secondary voltage at rated load, maximum.

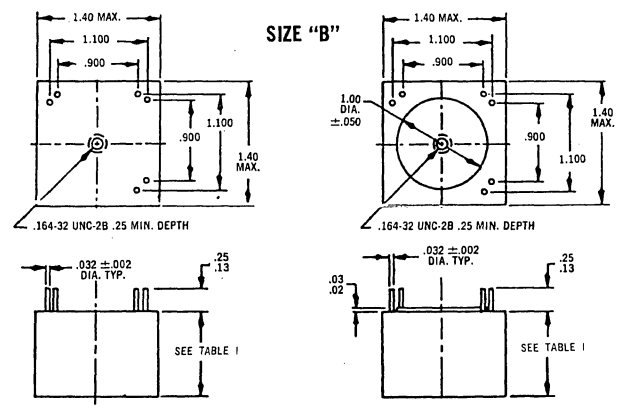
Insulation Resistance: 10,000 megohms minimum at 500 VDC.

Dielectric Strength: At sea level—2.8 times the maximum working voltage. At reduced barometric pressure—1.25 times the maximum working voltage.

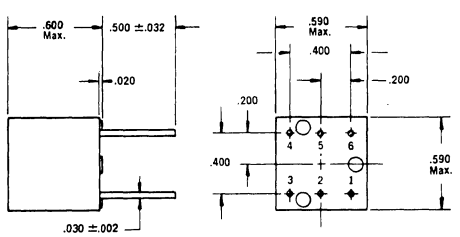
Mech. Tol. = ±.005 unless indicated.

PACKAGE STYLE E **PACKAGE STYLE P**





PACKAGE STYLE S



MECH. TOL. FOR STYLE "S" = ±.010 UNLESS INDICATED.

TOROTEL PRODUCTS INC.
13402 South 71 Highway/Grandview, MO 64030/(816) 761-6314 TWX 910-777-7037

TRANSFORMERS

PC MOUNT POWER TRANSFORMERS

Torotel standard PC mount transformers are designed for 115 Vrms 60 Hz input and are generally usable to above 400 Hz. Voltages listed in table are standard values but transformers can be furnished with other voltage and current ratings. Transformers are available with Channel Frame mounting, either tab style, (Type C) twist prong (Type B) or without Frame (Style A).

Also custom designed power transformers and audio transformers are available in these and other types and sizes upon special request.

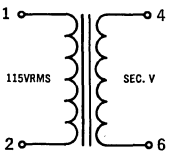
PART NUMBER EXAMPLE

T1 — 230 — A — B

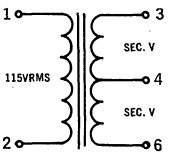
- T1 — VA Size
- 230 — Secondary Voltage
- A — Schematic
- B — Frame Style

Prefix	VA Size
T1	.50
T2	1.50
T3	4.50
T4	7.50

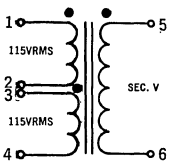
SCHEMATIC "A"



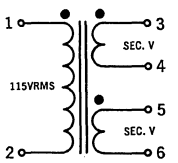
SCHEMATIC "B"



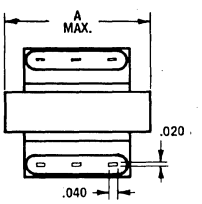
SCHEMATIC "C"



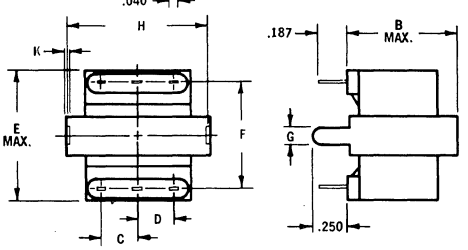
SCHEMATIC "D"



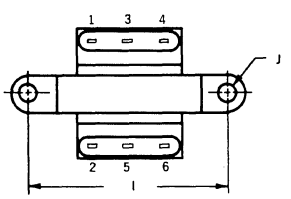
FRAME STYLE "A" NO FRAME



FRAME STYLE "B" P.C. MOUNT



FRAME STYLE "C" TAB MOUNT



SECONDARY VOLTAGE TABLE

Standard Secondary Voltages	
4	30
5	34
6.3	40
7.5	44
8	54
10	56
12	60
12.6	76
15	88
16	90
17	115
20	120
24	180
27	230
28	

DIMENSION TABLE

Size	A	B	C	D	E	F	G	H	I	J	K
T1	1.125	.870	.250	.250	.930	.720	.125	1.040	1.375	.125	.018
T2	1.500	1.250	.310	.310	1.156	1.000	.125	1.420	1.750	.187	.032
T3	1.750	1.450	.400	.400	1.275	1.100	.125	1.680	2.000	.187	.032
T4	1.970	1.690	.400	.400	1.468	1.300	.187	1.940	2.375	.187	.032

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THE MOST RESPECTED NAME IN MAGNETIC COMPONENTS

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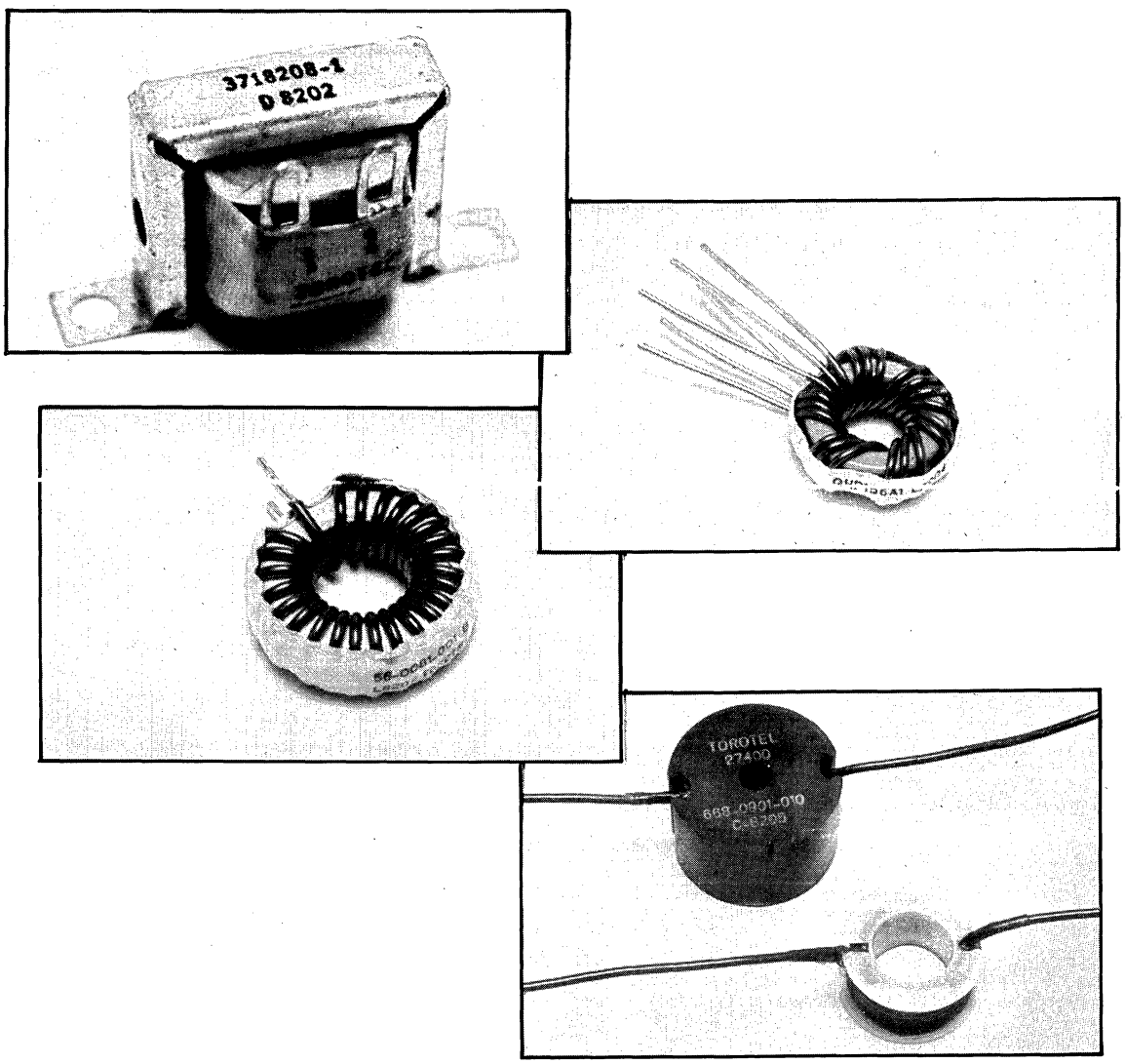

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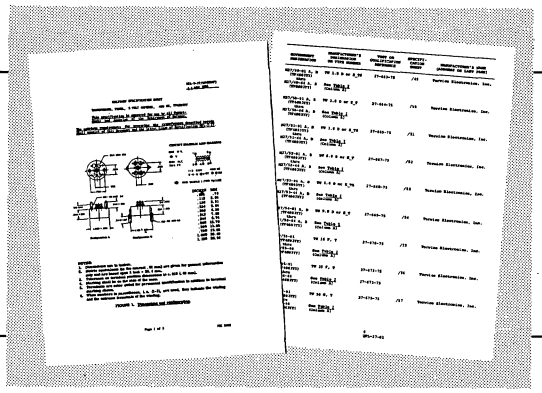
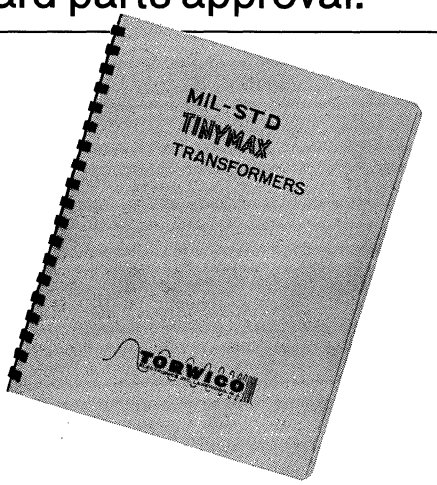
TORWICO ELECTRONICS INC

LEADER IN MAGNETIC COMPONENTS

TINYMAX® Transformers have QPL Status on Qualified Product List 27.



Now you can specify Military Standard Transformers without the need for Qualification Testing or requests for non-standard parts approval.



These miniature transformers are of toroidal construction and offer a size and weight reduction when compared to conventional laminated and "C" core designs. Yet, the prices on these custom engineered transformers are competitive with off-the-shelf stock items.

So, when you need a 115V, 400 Hz transformer having a specific secondary voltage don't settle for an off-the-shelf item that may only approximate your requirement. Torwico has over 2,000 MIL/STD units and an almost infinite selection of STD TINYMAX.

What's more, Torwico offers fast delivery and competitive pricing. Selection, delivery and price--Torwico has it all.

STD TINYMAX -- MIL-T-27, Grade 4 and Grade 5, Class S, 115 volt, 400 Hz transformers available in power ratings ranging from 1.5 VA through 250 VA, with an almost infinite combination of secondary voltages of 6V through 300V.

MIL-STD TINYMAX -- Grade 4 and Grade 5, Class S, 115 Volt, 400 Hz transformers. Reference M27/37 through M27/66. Over 2,000 choices of secondary voltages.

EXTENSION OF APPROVAL -- Any design selected directly from, or based, on our MIL/STD TINYMAX transformer may be qualified to MIL-T-27 by similarity.

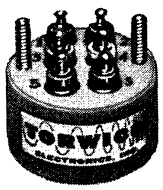
PROCUREMENT NOTE -- Catalog information and cross referenced sheets may be obtained from the factory or for MIL-STD units, refer directly to specification sheets M27/37 through M27/66.

PROTOTYPE DELIVERIES -- A large assortment of TINYMAX transformers is always maintained in stock for immediate delivery. Others can be shipped within 10 days.

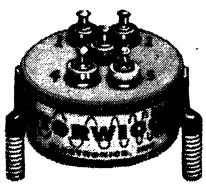
For a copy of Towico's MIL-STD TINYMAX catalog, contact your local Torwico representative. He'll show you why Torwico is the easy way to deal with military standards.

TORWICO ELECTRONICS INC. LEADER IN MAGNETIC COMPONENTS

TINYMAX® 400 HZ Power Transformers



This Case style available in 1.5 through 250 VA



This Case style available in 1.5 through 9 VA

TINYMAX®

CONDENSED PERFORMANCE DATA FOR "STANDARD" GRADE 4 TINYMAX 400 HZ TRANSFORMERS MIL-T-27 DESIGNATION TF4S03YY

VA RATING	SELECTED FULL LOAD SEC. V (RMS) ± 3% (from range shown with 115V PRI.	O.D ± .031"	HT. ± .031"	WEIGHT MAX.	REGULATION MAX.	TEMP. RISE MAX.
1.5	6.0 to 300	1.000	.469	1.00 oz.	23%	17°C
1.5 (With Electrostatic Shield)	6.0 to 300	1.000	.594	1.25 oz.	18%	17°C
3	6.0 to 300	1.000	.594	1.25 oz.	18%	20°C
3 (With Electrostatic Shield)	6.0 to 300	1.000	.812	1.70 oz.	12%	20°C
6	6.0 to 300	1.000	.812	1.70 oz.	12%	25°C
6 (With Electrostatic Shield)	6.0 to 300	1.000	1.062	2.30 oz.	10%	25°C
9	6.0 to 300	1.000	1.062	2.30 oz.	10%	30°C
9 (With Electrostatic Shield)	6.0 to 300	1.375	1.125	3.80 oz.	8%	32°C
16	6.0 to 300	1.375	1.125	3.80 oz.	8%	32°C
25	6.0 to 300	1.375	1.375	4.95 oz.	7%	45°C
50	6.0 to 300	2.000	1.500	11.00 oz.	3%	35°C
75	10 to 300	2.000	1.750	13.50 oz.	3%	40°C
100	12 to 300	2.250	2.000	18.70 oz.	2.5%	43°C
250	26 to 300	2.875	2.000	30.00 oz.	2%	55°C

WITH OR WITHOUT ELECTROSTATIC SHIELD

TINYMAX®

CONDENSED PERFORMANCE DATA FOR "STANDARD" GRADE 5 TINYMAX 400 HZ TRANSFORMERS MIL-T-27 DESIGNATION TF5S03ZZ

VA RATING	SELECTED FULL LOAD SEC. V (RMS) ± 3% (from range shown with 115V PRI.	SIZE MAX- INCHES	WEIGHT MAX.	REGULATION MAX.	TEMP. RISE MAX.
1.5	6.0 to 300	1.09 Sq. X .47 ht.	.85 oz.	23%	17°C
1.5 (With Electrostatic Shield)	6.0 to 300	1.09 Sq. X .59 ht.	1.10 oz.	18%	17°C
3	6.0 to 300	1.09 Sq. X .59 ht.	1.10 oz.	18%	20°C
3 (With Electrostatic Shield)	6.0 to 300	1.09 Sq. X .78 ht.	1.65 oz.	12%	20°C
6	6.0 to 300	1.09 Sq. X .78 ht.	1.65 oz.	12%	25°C
6 (With Electrostatic Shield)	6.0 to 300	1.09 Sq. X 1.03 ht.	2.20 oz.	10%	25°C
9	6.0 to 300	1.09 Sq. X 1.03 ht.	2.20 oz.	10%	30°C
9 (With Electrostatic Shield)	6.0 to 300	1.40 Sq. X .97 ht.	3.40 oz.	8%	32°C
16	6.0 to 300	1.40 Sq. X .97 ht.	3.40 oz.	8%	32°C
25	6.0 to 300	1.40 Sq. X 1.20 ht.	4.40 oz.	7%	45°C

WITH OR WITHOUT ELECTROSTATIC SHIELD

TORWICO ELECTRONICS INC.
NEW HAMPSHIRE AVENUE & ROUTE 70, LAKEWOOD, N.J. 08701 201•364-1800

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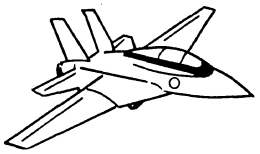
There are 33 Guides in this edition of EEM.
See page 2 (1•2, 2•2, 3•2) of each volume to locate the Product Selection Guides that pertain to your needs.



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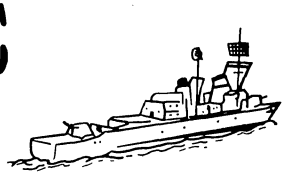

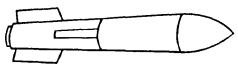

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Trans American Transformer provides custom signal transformers with high accuracies over the full military temperature/environmental range. Our speciality is High Performance and Consistency in the smallest size. Your design or our design to your specifications.

These transformers are fully encapsulated P-C mount toroidal/laminated units. They are manufactured in accordance with Mil-T27D Grades 4 and 5. They have high input impedance and low output impedance combined with high transformation accuracy and minimum quadrature. These characteristics make these units particularly useful in solid state synchro to digital and digital to synchro converter applications.

Send for catalog T-101A

HIGH FREQUENCY SWITCHING POWER SUPPLY MAGNETICS

Switching power supply magnetics designed and manufactured to meet all high reliability military requirements. Typical circuit designs include push pull, forward converter and flyback. Power requirements from milliwatts to approximately 1 kilowatt. Units available in Grade 4, 5, 6 and temperature Class S through U.

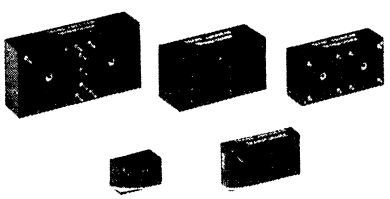
Send for catalog T-202A

POWER TRANSFORMERS 60-400 Hz

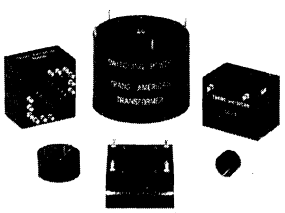
Designed and built to meet the specifications of Mil-T-27D, high reliability and long life are major features of these units. All designs available in Grades 4, 5, 6 and temperature Class S through U. Low profile and PC mount toroidal and laminated units provide the absolute smallest size/volume for any system requirement.

Send for catalog T-303A

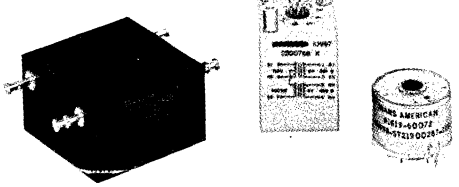
SCOTT "T"



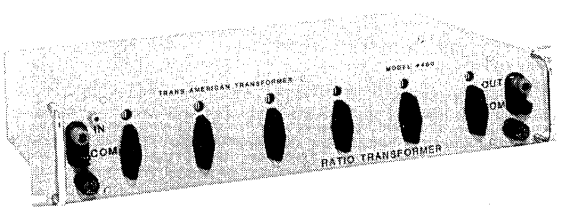
HIGH FREQUENCY



POWER TRANSFORMER



TRANS AMERICAN TRANSFORMER PRECISION DIGITAL RATIO TRANSFORMERS



QUALITY — RELIABILITY

Trans American Transformer engineers will custom design all magnetics to meet any high reliability requirement.

Qualification Testing — Environmental Testing
Mil-T-27D/Mil-STD-202/Mil-STD/810/
Mil-Q-9858/Mil-I-45208/Mil-C-45662

Quality is built-in and confirmed by testing.

THERMAL TOOLS

1. Wire stripper
2. Resistive tweezer
3. Conductive tweezer

Options: Temperature control/Multiple units/
Temperature monitoring

RATIO INFORMATION — DECADE RATIO TRANSFORMER

Model	Ratio Range	Accuracy 10V to Max Input	Frequency Range	Input Impedance	Max Input Voltage	Nom. Out. Res.	Resolution	Size	Approx. Wt.
M450	0.000000 to 1.111110	1 part per million at 50 to 3000 Hz	50 to 10,000 Hz	200K @ 400Hz	.35 x f (f in Hz) not to exceed 350V	4 ohm	Continuous	3½″ H x 19″ W x 10″ D	7¾ lbs.
M460	0.000000 to 1.111110	1 part per million at 30 to 400 Hz	30 to 1,000 Hz	250K @ 60Hz	2.5 x f (f in Hz) not to exceed 350V	8 ohm	Continuous	3½″ H x 19″ W x 10″ D	9 lbs.

Trans American Transformer, Inc.

142 PECONIC AVENUE, MEDFORD, NY 11763 • PHONE (516) 654-1880

Litton Standard Products
TRIAD-UTRAD
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750 • Phone: (219) 356-6500 • TWX: 810-333-1532

POWER TRANSFORMERS

FOR POWER SUPPLY, CONTROL AND FILAMENT CIRCUITS

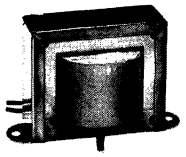
115V PRIMARY—SINGLE SECONDARY/50-60 Hz UNLESS NOTED (‡)

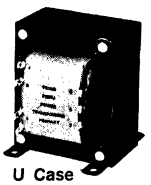
LISTED IN ORDER OF INCREASING SECONDARY VOLTAGES

Triad Part No.	Secondary Volts	Secondary Amps	RMS Test Voltage	Case Type	Connections or Lead Holes Used	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD	Mounting Hole Size	Max. Unit Wt. Lbs.
F-1X‡+	2.5 CT	3	1500	X	Leads	1 5/8	2 13/16	1 5/8	2 3/8	—	3/16	.68
F-72Z‡	2.5 CT	5	Sec. 7500	Z	Sec.-Lugs	2 23/32	3 1/8	2 1/8	2 13/16	—	3/16	1.7
F-6X‡+	2.5 CT	6	Sec. 2500	X	Leads	1 15/16	3 5/16	1 3/4	2 13/16	—	3/16	1
F-3X‡	2.5 CT	10	Sec. 3000	X	Leads	2 9/32	3 3/4	2 1/8	3 1/8	—	3/16	1.7
F-5U	2.5 CT	10	Sec. 7500	U	Leads	3 1/16	2 1/2	2 7/16	2	1 7/8	5/16 x 3/16	2.2
F-7X	5.0 CT	3	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-8X	5.0 CT	6	1500	X	Leads	2 9/32	3 3/4	2 1/8	3 1/8	—	3/16	1.7
F-12X	5.0 CT	8	2500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.5
F-10U‡	5.0 CT	14	Sec.10,000	U	Leads	3 13/16	3 3/16	3 1/4	2 1/2	2 9/16	5/16 x 3/16	4.75
F-15U‡	5.0 CT	15	Sec. 3000	U	Lugs	3 1/2	2 7/8	2 11/16	2 1/4	2 3/16	5/16 x 3/16	3.25
F-9U	5.2 CT	13	1500	U	Leads	3 7/16	2 13/16	3 1/4	2 1/4	2 3/8	5/16 x 3/16	4
F-11U	5.2 CT	24	1500	U	Leads	3 13/16	3 3/16	3 7/8	2 1/2	3 1/16	5/16 x 3/16	6.75
F-13X+	6.3	.6	1500	X	Leads	1 3/8	2 3/8	1 3/8	2	—	3/16	.37
R-84K	6.3§	.6	Sec. 3500	K	2-Leads	2 3/4	2 1/4	2 11/16	1 1/2	2 3/8	3/16	1.5
F-14X‡+	6.3 CT	1.2	Sec. 2500	X	Leads	1 5/8	2 13/16	1 5/8	2 3/8	—	3/16	.7
F-14Z‡	6.3 CT	1.2	Sec. 2500	Z	Leads	1 15/16	2 3/8	1 5/8	2	—	3/16	.7
F-52X	6.3§	1.2	Sec. 5000	X	Leads	1 15/16	3 5/16	1 3/4	2 13/16	—	3/16	1
F-51X‡	6.3§	2	Sec. 5000	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.25
F-16X+	6.3 CT	3	Sec. 2500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-53X	6.3	4	Sec. 5000	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.1
F-43X‡	6.3	4	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.25
F-18A	6.3 CT	6	1500	A	1-Leads	3 3/16	2 21/32	2 5/8	2	1 11/16	3/8 x 3/16	2.5
F-18X+	6.3 CT	6	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.3
F-69X	6.3 CT	8	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	—	3/16	2.3
F-21A	6.3 CT	10	1500	A	1-Leads	3 19/32	2 31/32	3 1/8	2 1/4	2	3/8 x 3/16	3.8
F-20U†	6.3 CT-6 CT	11	Sec. 3000	U	Leads	3 1/2	2 7/8	3	2 1/4	2 7/16	5/16 x 3/16	4
F-17U‡	6.3 CT	15	Sec.10,000	U	Pri. Leads	4 1/4	3 1/2	3 3/4	2 3/4	2 13/16	5/16 x 3/16	7.5
F-22A	6.3 CT	20	2000	A	2-Leads	3 7/8	3 9/32	4 1/8	2 1/2	3	3/8 x 3/16	7
F-24U†	7.5 CT-6.3 CT	8	Sec. 3000	U	2-Leads	3 1/2	2 7/8	2 13/16	2 1/4	2 5/16	5/16 x 3/16	3.65
F-28U†	7.5 CT-6.3 CT	25	Sec. 3000	U	Leads/Lugs	4 5/8	3 13/16	3 5/8	3	3 1/16	5/16 x 3/16	7.5
F-180X	10.0 CT	1	1500	X	Leads	1 15/16	3 5/16	1 3/4	2 13/16	—	3/16	.9
F-31X	10.0 CT	3	2000	X	Leads	2 9/32	3 3/4	2 1/8	3 1/8	—	3/16	1.7
F-95X	10.0 CT	4	1500	X	Leads	2 5/8	4	2 1/8	3 9/16	—	3/16	2.1
F-33U	10.0 CT	5	2000	U	Leads	3	2 1/2	2 5/8	2	2 1/16	3/16 x 3/8	2.5
F-96U	10.0 CT	6	1500	U	Leads	3	2 1/2	2 3/4	2	2 5/16	3/8 x 3/16	2.1
F-23U	10.0 CT	7	1500	U	Leads	3 1/2	2 7/8	2 15/16	2 1/4	2 7/16	5/16 x 3/16	3.9
F-97U	10.0 CT	8	1500	U	Leads	3 7/16	2 13/16	3	2 1/4	2 1/2	3/8 x 3/16	4.0
F-35U	10.0 CT	10	2000	U	Leads	4 1/8	4 1/2	3 1/4	2 3/4	2 7/16	3/16 x 3/8	9.1
F-113X	12.0	0.15	1500	X	Leads	1 3/8	2 3/8	1 3/8	—	2	3/16	.4
F-216X‡	12.0	.35	1500	X	Leads	1 3/8	2 3/8	1 3/8	2	—	3/16	.37
F-114X	12.0	0.7	1500	X	Leads	1 5/8	2 13/16	1 5/8	—	2 3/8	3/16	.8
F-217X‡	12.0	1.2	1500	X	Leads	2	3 1/4	1 3/4	2 13/16	—	3/16	1.0
F-218X‡	12.0	2	1500	X	Leads	2	3 1/4	1 7/8	2 7/8	—	3/16	1.13
F-219X‡	12.0	4	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	—	3/16	2.3
F-220U‡	12.0	6	1500	U	Leads	3 7/16	2 13/16	2 1/2	2 1/4	2 1/8	3/8 x 3/16	3.5
F-221U‡	12.0	8	1500	U	Leads	3 13/16	3 1/8	2 3/8	2 1/2	2 1/8	3/8 x 3/16	4.0
F-29U†	12 CT-11 CT 10.0 CT	11	Sec. 3000	U	Leads	4 3/8	3 1/2	3 3/8	2 3/4	2 5/16	5/16 x 3/16	6.5
F-70X	12.6 CT	1.0	1500	X	Leads	1 15/16	3 5/16	1 3/4	2 13/16	—	3/16	1.3
F-25X +	12.6 CT	1.5	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-44X‡+	12.6 CT	2	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.25
F-26X‡+	12.6 CT	2.5	1500	X	Leads	2 9/32	3 11/16	2	3 1/8	—	3/16	1.55
F-224X‡	12.6	3	1500	X	Leads	2 1/4	3 3/4	2 1/8	3 1/8	—	3/16	1.6
F-225X‡	12.6	4	1500	X	Leads	2 5/8	4	2 1/16	3 9/16	—	3/16	2.3
F-181U+	12.6 CT	4	1500	U	Leads	3 1/16	2 9/16	2 3/16	2	2	3/16	2.3
F-182U	12.6 CT	6	1500	U	Leads	3 3/8	2 13/16	2 7/16	2 1/4	2 3/8	5/16 x 3/16	3.8

§ Static shield. † Tapped primary to produce lower voltages. ‡ 60 cycle operation. + Available 115/230 PRI.

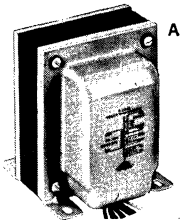
X Case



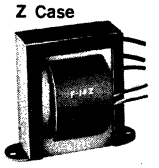


U Case

A Case



Z Case



POWER TRANSFORMERS

Litton TRIAD-UTRAD Standard Products
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750 • Phone: (219) 356-6500 • TWX: 810-333-1532

115V PRIMARY—SINGLE SECONDARY/50-60 Hz UNLESS NOTED (‡) CONTINUED

Triad Part No.	Secondary Volts	Secondary Amps	RMS Test Voltage	Case Type	Connections or Lead Holes Used	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD	Mounting Hole Size	Max. Unit Wt. Lbs.
F-183U	12.6 CT	8	1500	U	Leads	3 13/16	3 3/16	2 15/16	2 1/2	2 1/4	5/16 x 3/16	5
F-112X+	14.0 CT	0.25	1500	X	Leads	1 3/8	2 3/8	1 3/8	2	—	3/16	.4
F-250X	14.0 CT	1	1500	X	Leads	1 15/16	3 1/4	1 3/4	2 13/16	—	3/16	1.2
F-251X	14.0 CT	2	1500	X	Leads	2 1/4	3 11/16	1 15/16	3 1/8	3/16	—	1.5
F-252U	14.0 CT	4	1500	U	Leads	3	2 1/2	2 7/16	2	2 1/4	5/16 x 3/16	3
F-253U	14.0 CT	6	1500	U	Leads	3 3/8	2 13/16	2 7/8	2 1/4	2 3/8	5/16 x 3/16	4
F-410X	18.0 CT	.75	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-411X	18.0 CT	1	1500	X	Leads	1 15/16	3 5/16	2 1/8	2 13/16	—	3/16	1.45
F-412X	18.0 CT	1.5	1500	X	Leads	2 3/32	3 3/4	2 1/8	3 1/8	—	3/16	1.7
F-413X	18.0 CT	2	1500	X	Leads	2 3/32	3 3/4	2 1/4	3 1/8	—	3/16	1.95
F-254X	20.0 CT	1	1500	X	Leads	2 1/4	3 11/16	1 15/16	3 1/8	—	3/16	1.5
F-255X	20.0 CT	2	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	—	3/16	2.5
F-256U	20.0 CT	4	1500	U	Leads	3 3/8	2 13/16	2 7/8	2 1/4	2 3/8	5/16 x 3/16	4
F-257U	20.0 CT	6	1500	U	Leads	3 3/4	3 1/8	3 1/8	2 1/2	2 5/8	5/16 x 3/16	5.7
F-258U	20.0 CT	8	1500	U	Leads	3 3/4	3 1/8	3 1/2	2 1/2	2 7/8	5/16 x 3/16	6.4
F-259U	20.0 CT	10	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4
F-115X+	24.0 CT	0.085	1500	X	Leads	1 3/16	2 1/16	1 1/4	1 3/4	—	3/16	3
F-116X+	24.0 CT	0.2	1500	X	Leads	1 3/8	2 3/8	1 1/2	2	—	3/16	.45
F-117X+	24.0 CT	0.4	1500	X	Leads	1 5/8	2 13/16	1 5/8	2 3/8	—	3/16	.8
F-118X+	24.0 CT	0.7	1500	X	Leads	1 15/16	3 1/4	2	2 13/16	—	3/16	1.3
F-45X‡+	24.0 CT	1	1500	X	Leads	1 15/16	3 5/16	2	3 1/8	—	3/16	1.3
F-46X‡+	24.0	1	1500	X	Leads	1 15/16	3 11/16	2 1/8	3 1/8	—	3/16	1.4
F-192X	24.0 CT	2	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.3
F-229X‡	24.0	2	1500	X	Leads	2 9/16	4	1 7/8	3 9/16	—	3/16	2.3
F-193U	24.0 CT	4	1500	U	Leads	3 13/16	3 1/8	2 13/16	2 1/2	2 1/8	5/16 x 3/16	4
F-260U	24.0 CT	6	1500	U	Leads	3 3/4	3 1/8	3 1/2	2 1/2	2 7/8	5/16 x 3/16	6.4
F-261U	24.0 CT	8	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4
F-401U	24.0 CT	10	1500	U	Leads	4 1/8	3 7/16	3 3/4	2 3/4	3	3/8 x 3/16	8.0
F-226U	24.0 CT	12	1500	U	Leads	4 9/16	3 3/4	4 1/8	3	3 1/4	3/8 x 3/16	10.4
F-57X†	25.2 CT	1	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.5
F-41X‡+	25.2 CT	2	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.2
F-56X	25.2 CT	2.8	1500	X	Leads	2 21/32	4	2 1/4	3 9/16	—	3/16	2.5
F-119X	26.8 CT	0.15	1500	X	Leads	1 3/8	2 3/8	1 1/2	2	—	3/16	.45
F-120X	26.8 CT	0.5	1500	X	Leads	1 15/16	3 1/4	2	2 13/16	—	3/16	1.3
F-40X‡+	26.8 CT	1	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-55X+	26.8 CT	1.7	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.3
F-121X	28.0 CT	.085	1500	X	Leads	1 3/16	2 1/16	1 3/8	1 3/4	—	3/16	.25
F-122X	28.0 CT	.175	1500	X	Leads	1 3/8	2 3/8	1 1/2	2	—	3/16	.35
F-123X	28.0 CT	.300	1500	X	Leads	1 5/8	2 13/16	1 5/8	2 3/8	—	3/16	.6
F-124X	28.0 CT	.800	1500	X	Leads	1 15/16	3 1/4	2	2 13/16	—	3/16	1
F-184X	28.0 CT	1	1500	X	Leads	2 3/32	3 3/4	2 1/8	2 13/16	—	3/16	1.4
F-185U+	28.0 CT	2	1500	U	Leads	3 1/16	2 1/2	2 7/16	2	2 1/4	3/16 x 3/8	2.9
F-187U	28.0 CT	4	1500	U	Leads	3 1/2	2 7/8	3 1/4	2 1/4	2 3/4	5/16 x 3/16	5.3
F-262X	30.0 CT	1	1500	X	Leads	2 1/4	3 11/16	1 15/16	3 1/8	—	3/16	1.5
F-210X	30.0 CT	1.7	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	1.55
F-263U	30.0 CT	2	1500	U	Leads	3	2 1/2	2 9/16	2	2 3/8	5/16 x 3/16	3.2
F-264U	30.0 CT	4	1500	U	Leads	3 3/4	3 1/8	3 1/8	2 1/2	2 5/8	5/16 x 3/16	5.7
F-265U	30.0 CT	6	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4
F-266U‡	30.0 CT	8	1500	U	Leads	4 1/2	3 3/4	4	3	3	5/16 x 3/16	10
F-227X‡	35.0 CT	.065	1500	X	Leads	1 3/16	2 1/16	1 5/16	1 3/4	—	3/16	.3
F-188X	35.0 CT	.1	1500	X	Leads	1 5/8	2 13/16	1 7/16	2 3/8	—	3/16	.35
F-228X‡	35.0 CT	.3	1500	X	Leads	1 5/8	2 13/16	1 5/8	2 3/8	—	3/16	.6
F-189X	35.0 CT	.5	1500	X	Leads	2 5/16	3 11/16	1 15/16	3 1/8	—	3/16	1
F-54X+	35.0 CT	1.5	1500	X	Leads	2 19/32	4	2 1/4	3 9/16	—	3/16	2.2
F-190U	35.0 CT	2	1500	U	Leads	3 3/8	2 13/16	2 3/4	2 1/4	2 3/8	5/16 x 3/16	3.5
F-191U	35.0 CT	4	1500	U	Leads	3 13/16	3 3/16	3 3/16	2 3/4	2 1/2	5/16 x 3/16	6
F-267U	35.0 CT	6	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4
F-268U	35.0 CT	8	1500	U	Leads	4 1/2	3 3/4	4 1/4	3	3 1/4	5/16 x 3/16	11
F-269U	35.0 CT	10	1500	U	Leads	5 1/4	4 3/8	4 1/8	3 1/2	2 3/4	5/16 x 3/16	12
F-270X	40.0 CT	1	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	—	3/16	2.6
F-271U	40.0 CT	2	1500	U	Leads	3 3/8	2 13/16	2 7/8	2 1/4	2 3/8	5/16 x 3/16	4
F-272U	40.0 CT	4	1500	U	Leads	3 3/4	3 1/8	3 1/2	2 1/2	2 7/8	5/16 x 3/16	6.4
F-273U	40.0 CT	6	1500	U	Leads	4 1/2	3 3/4	4	3	3	5/16 x 3/16	10
F-274U	40.0 CT	8	1500	U	Leads	4 1/2	3 3/4	4 1/4	3	3 5/8	5/16 x 3/16	10.5
F-275U	40.0 CT	10	1500	U	Leads	5 1/4	4 3/8	4 1/2	3 1/2	3 1/4	5/16 x 3/16	14.5
F-276X	50.0 CT	1	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	—	3/16	2.4
F-277U	50.0 CT	2	1500	U	Leads	3 3/4	3 1/8	2 7/8	2 1/2	2 3/8	5/16 x 3/16	4.7
F-278U	50.0 CT	4	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4
F-58A	50.0 CT	5	1500	A	Leads	4 5/8	3 15/16	4 1/2	3	3 3/8	3/8 x 3/16	10
F-59X	60.0 CT	.4	1500	X	Leads	1 15/16	3 5/16	2	2 13/16	—	3/16	1.3
F-279U	60.0 CT	1	1500	U	Leads	3	2 1/2	2 5/8	2	2 3/8	5/16 x 3/16	3.4
F-280U	60.0 CT	2	1500	U	Leads	3 3/4	3 1/8	3 1/8	2 1/2	2 5/8	5/16 x 3/16	5.6
F-281U	60.0 CT	4	1500	U	Leads	4 1/2	3 3/4	4	3	3	5/16 x 3/16	10
F-282U	60.0 CT	6	1500	U	Leads	5 1/4	4 3/8	4 1/8	3 1/2	2 7/8	5/16 x 3/16	12.5
F-283U	70.0 CT	1	1500	U	Leads	3 3/8	2 13/16	2 5/8	2 1/4	2 1/4	5/16 x 3/16	4
F-284U	70.0 CT	2	1500	U	Leads	3 3/4	3 1/8	3 1/2	2 1/2	2 7/8	5/16 x 3/16	6

§ Static shield. † Tapped primary to produce lower voltages. ‡ 60 cycle operation. + Available 115/230 PRI.

TRIAD-UTRAD
Litton Standard Products
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750 • Phone: (219) 356-6500 • TWX: 810-333-1532

POWER TRANSFORMERS

MICROPROCESSOR POWER TRANSFORMERS

DUAL C.T. SECONDARIES, 115V PRIMARY/50/60 Hz

F234Z-F245U HAVE 2 ISOLATED WINDINGS

Triad Part No.	Secondary Volts	Secondary Amps	RMS Test Voltage	Case Type	Connections or Lead Holes Used	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD	Mounting Hole Size	Max. Unit Wt. Lbs.
F-234Z‡	12.0 CT	.1	1500	Z	Lugs	1 3/8	2	1 5/16	1 3/4	—	3/16	.3
F-235Z‡	12.0 CT	.25	1500	Z	Lugs	2	2 3/8	1 7/16	2	—	3/16	.6
F-236Z‡	12.0 CT	.5	1500	Z	Lugs	2 5/16	2 7/8	1 5/8	2 3/8	—	3/16	.9
F-237Z‡	12.0 CT	1	1500	Z	Lugs	2 3/8	2 13/16	2 1/16	2 3/8	—	3/16	1.1
F-238U‡	12.0 CT	2	1500	U	Lugs	2 1/2	3	2 3/16	2 1/2	2	3/8 x 3/16	2.2
F-239U‡	12.0 CT	4	1500	U	Lugs	3 1/8	3 3/4	2 3/4	3 1/8	2 1/4	3/8 x 3/16	4.3
F-240U‡	12.0 CT	6	1500	U	Lugs	3 1/2	4 1/8	3 1/16	2 1/2	2 1/4	3/8 x 3/16	5.4
F-241U‡	18.0 CT	1	1500	U	Lugs	2 1/2	3	2 1/2	2 1/8	2	3/8 x 3/16	2.2
F-242U‡	18.0 CT	2	1500	U	Lugs	3 1/8	3 3/4	3 1/8	3 7/16	2	3/8 x 3/16	4.0
F-243U‡	18.0 CT	4	1500	U	Lugs	3 1/2	4 1/8	3 1/4	3 3/4	2 1/4	3/8 x 3/16	5.2
F-244U‡	18.0 CT	8	1500	U	Lugs	3 3/4	4 1/2	4	3 3/4	2 3/4	3/8 x 3/16	8.3
F-245U‡	18.0 CT	12	1500	U	Lugs	4 3/8	5 3/16	4 1/4	4 1/2	2 3/4	3/8 x 3/16	11.9
F-194X	32.0 CT 15.5 CT	.050 .200	1500	X	Leads	1 5/8	2 7/8	1 3/8	2 3/8	—	3/16	.45
F-195X	32.0 CT 15.5 CT	.250 .750	1500	X	Leads	2 1/4	3 3/4	1 7/8	3 1/8	—	3/16	1.3
F-196U	32.0 CT 15.0 CT	1 2	1500	U	Leads	3 3/8	2 13/16	2 5/8	2 1/4	2 1/4	5/16 x 3/16	4
F-197U	32.0 CT 15.0 CT	1 4	1500	U	Leads	3 3/4	3 1/8	2 15/16	2 1/2	2 1/4	5/16 x 3/16	4.7
F-198U	32.0 CT 15.0 CT	1 6	1500	U	Leads	3 3/4	3 1/8	3 3/16	2 1/2	2 3/4	5/16 x 3/16	6.2
F-199U	32.0 CT 15.0 CT	1 10	1500	U	Leads	4 1/8	3 7/16	3 1/2	2 3/4	2 3/4	5/16 x 3/16	7.4

* Windings may be connected in series to obtain their combined voltage when properly phased. Current will be equal to the current of the lowest winding. Example: Two 6.3V windings @ 2A in series would be 12.6V @ 2A. Windings may also be connected in parallel to obtain combined current. Example: Two 6.3V windings @ 2A in parallel would be 6.3V @ 4A. ¶ Tapped primary 105-115-125. ‡ 60 cycle operation.

DUAL C.T. SECONDARIES/PRIMARY 230V, 50/60 Hz

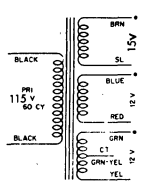
Triad Part No.	Secondary Volts	Secondary Amps	RMS Test Voltage	Case Type	Connections or Lead Holes Used	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD	Mounting Hole Size	Max. Unit Wt. Lbs.
F-395X	32.0 CT 15.0 CT	.250 .750	1500	X	Leads	2 1/4	3 3/4	1 7/8	3 1/8	—	3/16	1.3
F-396U	32.0 CT 15.0 CT	1 2	1500	U	Leads	3 3/8	2 13/16	2 5/8	2 1/4	2 1/4	5/16 x 3/16	4
F-397U	32.0 CT 15.0 CT	1 4	1500	U	Leads	3 3/4	3 1/8	2 15/16	2 1/2	2 1/4	5/16 x 3/16	4.7

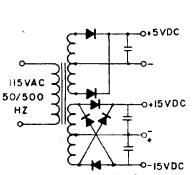
TRIPLE SECONDARIES, 115V PRIMARY, 60 Hz ONLY (3 ISOLATED WINDINGS)

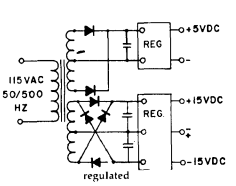
Type No.	Secondary Volts	Secondary Amps	RMS Test Voltage	Case Type	Connections	Case Dimensions H	Case Dimensions W	Case Dimensions D	Case Dimensions MW	Mtg. Hole Size	Max. Unit Wt. Lbs.
F-295Z	12VCT-12V 15V	.1	1500	Z	Leads	1 3/4	2	1 1/2	1 3/4	3/16	.4
F-296Z		.15	1500	Z	Leads	1 15/16	2 3/8	1 1/2	2	3/16	.6
F-297Z		.25	1500	Z	Leads	1 15/16	2 7/16	1 5/8	2	3/16	.7
F-298Z		.5	1500	Z	Leads	2 1/4	3 3/4	1 7/8	3	3/16	1.3
F-299X		1.5	1500	X	Leads	2 9/16	4	2 1/4	3 9/16	3/16	2.3

TRIPLE SECONDARIES, 115-230V PRIMARY, 50-60 Hz (3 ISOLATED WINDINGS)

F-3295Z	12VCT-12V 15V	.1	1500	Z	Leads	1 3/4	2	1 1/2	1 3/4	3/16	.41
F-3297Z		.25	1500	Z	Leads	2 3/8	2 7/8	1 5/8	2 3/8	3/16	.8
F-3298Z		.5	1500	Z	Leads	2 3/8	2 13/16	2	2 3/8	3/16	1.25







TRANSFORMERS

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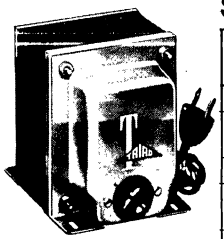
STEPDOWN AUTOFORMERS/50-60 Hz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Triad Part No.	Output Watts (VA)	Primary Volts	Secondary Volts ±5%	Secondary RMS Amps	RMS Test Voltage	Case Type	Connections	Mounting Dimension MW	Mounting Dimension MD
N-1X	50	230	115	.435	1500	X	Leads	3⅛	—
N-3M	85	230	115	.74	1500	M	6′ Cord & Plug & Socket	2¼	1⅝
N-2X	100	230	115	.87	1500	X	Leads	3⅝	—
N-4M	150	230	115	1.3	1500	M	6′ Cord & Plug & Socket	2¼	2⅜
N-6U	200	230	115	1.7	1500	U	Leads	2¼	2¼
N-5M	250	230	115	2.17	1500	M	6′ Cord & Plug & Socket	2½	3
N-7M	600	230	115	5.22	1500	M	6′ Cord & Plug & Socket	3	3⅞
N-39X	50	0-100-115-127-135	115	.43	1500	X	Lugs	2 13/16	—
N-40X	100	0-100-115-127-135	115	.87	1500	X	Lugs	2 13/16	—
N-100MG	100	115	230	.65	1500	MG	6′ 3 Wire, Cord Plug & Socket	2¼	2 31/32
N-250MG	250	115	230	1.1	1500	MG	6′ 3 Wire, Cord Plug & Socket	2½	3¼
N-500MG	500	115	230	2.2	1500	MG	6′ 3 Wire, Cord Plug & Socket	3	3⅝
N-1000MG	1000	115	230	4.35	1500	MG	6′ 3 Wire, Cord Plug & Socket	3½	4⅛

LOW VOLTAGE RECTIFIER/TRANSISTOR DRIVE VOLTAGE, 50-60 Hz

Triad Part No.	Primary Volts	Secondary AC Volts	Secondary AC Amps	DC Volts Half Wave	DC Volts Bridge	RMS Test Voltage	Case Type	Connections	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD
F-94X	115†	10-20 CT—40 CT	.035	15	30	1500	X	Leads	1⅜	2⅜	1⅜	2	—
F-90X	115†	10-20 CT—40 CT	.1	15	30	1500	X	Leads	1⅝	2 13/16	1⅝	2⅜	—
F-91X	115†	10-20 CT—40 CT	.3	15	30	1500	X	Leads	2 9/32	3 11/16	2	3⅛	—
F-93X	115†	10-20 CT—40 CT	.75	15	30	1500	X	Leads	2 19/32	4	2¼	3 9/16	—
F-92A	115†	10-20 CT—40 CT	1.0	15	30	1500	A	Leads (2 Holes)	3 3/16	2 21/32	3	2	2 1/16
F-394X	230	10-20 CT—40 CT	.035	15	30	1500	X	Leads	1⅜	2⅜	1⅜	2	—
F-390X	230	10-20 CT—40 CT	.1	15	30	1500	X	Leads	1⅝	2 13/16	1⅝	2⅜	—
F-391X	230	10-20 CT—40 CT	.3	15	30	1500	X	Leads	2¼	3 11/16	2	3⅛	—
F-393X	230	10-20 CT—40 CT	.75	15	30	1500	X	Leads	2 19/32	4	2¼	3 9/16	—
F-392A	230	10-20 CT—40 CT	1.0	15	30	1500	A	Leads	3 3/16	2 21/32	3	2	2 1/16

UNIVERSAL RECTIFIER POWER/PRIMARY 117V, 50-60 Hz

Triad Part No.	Secondary No. 1 AC Volts	Secondary DC Amps Full Wave CT	Secondary DC Amps Bridge	Secondary No. 2 AC Volts	Secondary No. 2 DC Amps	RMS Test Volts	Case Type	Connections	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD
F-202U	11.0 to 29.5	2.0	1.25	—	—	1000	U	Lugs	3	2½	3	2	2⅛
F-203U	12.0 to 30.0	4.0	2.0	—	—	1000	U	Lugs	3⅜	2 13/16	3¼	2¼	2⅜
F-204U	11.5 to 29.0	8.0	4.0	—	—	1000	U	Lugs	3¾	3⅛	4⅛	2½	2⅞
F-205U	12.0 to 29.5	12.0	6.0	—	—	1000	U	Lugs	4⅛	3 7/16	5⅛	2¾	3¼

Triad Part No.	Primary Volts	Secondary AC Volts	Secondary AC Amps	DC Volts Half Wave	DC Volts Bridge	RMS Test Voltage	Case Type	Connections	Case Dimension H	Case Dimension W	Case Dimension D	Mounting Dimension MW	Mounting Dimension MD
F-47U F-347U	115 115/230	0-17-18	3	6-7	13-14	1500	U	Leads	3	2½	2¾	1⅝	2⅜
F-48U	115	0-17-18	6	6-7	13-14	1500	U	Leads	3 13/16	3 3/16	3 3/16	2½	2 11/16
F-49U	115	36* 36*	3 3	13 13	26 26	1500	U	Leads	4⅝	3 13/16	3¾	3	3 1/16
F-60U	115	0-6.5-13-19.5-26	3	9	18	1500	U	Leads	3⅜	2 13/16	2⅝	2¼	2 3/16
F-360U	115/230	—	—	—	—	—	—	—	—	—	—	—	—
F-61U	115	0-24-27-30-33-36	3	13	26	1500	U	Leads	3¾	3⅛	3¼	2½	2⅝
F-361U	115/230	—	—	—	—	—	—	—	—	—	—	—	—
F-67U‡	110-120	0-24-27-30-33-36	8	13	26	1500	U	Leads	4⅝	3 13/16	4⅜	3	3 5/16
F-64U	115	0-7-8-9	7	—	5-6-7	1500	U	Leads	3⅜	2 13/16	2¾	2¼	2 3/16

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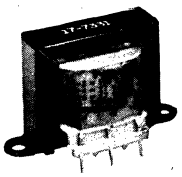
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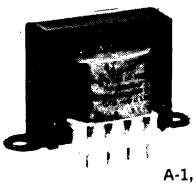
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LOW-VOLTAGE, LOW-CURRENT PLUG-IN PRINTED CIRCUIT POWER

115V, 50-60 Hz PRIMARY/DUAL SECONDARIES*

Cat. No.	Fig.	Output Watts	Secondary		Dimensions						Mtg. Dim.	Wt. Oz.
			Series Connection	Parallel Connection	H	W	D	L	A	B		
F-131P	B	1½	8V CT @ .188A	4V @ .376A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-139P	B	1½	12.6V CT @ .12A	6.3V @ .24A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-132P	B	1½	15V CT @ .100A	7.5V @ .200A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-150P	B	1½	17V CT @ .085A	8.5V @ .170A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-138P	B	1½	25.2V CT @ .06A	12.6V @ .12A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-133P	B	1½	30V CT @ .050A	15V @ .100A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-160P	B	1½	34V CT @ .045A	17V @ .090A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-135P	B	1½	76V CT @ .020A	38V @ .040A	1⅛	1 25/64	1 5/32	1 25/64	5/16	1	—	3.5
F-149XP	A	4½	12.6V CT @ .35A	6.3V @ .70A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-142XP	A	4½	15V CT @ .300A	7.5V @ .600A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-161XP	A	4½	17V CT @ .264A	8.5V @ .528A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-148XP	A	4½	25.2V CT @ .178A	12.6V @ .356A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-143XP	A	4½	30V CT @ .150A	15V @ .300A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-162XP	A	4½	34V CT @ .132A	17V @ .264A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-147XP	A	4½	40V CT @ .112A	20V @ .224A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-144XP	A	4½	54V CT @ .084A	27V @ .168A	1 25/64	2 3/8	1 1/4	1 45/64	13/32	1 3/32	2	7.5
F-159XP	A	7½	12.6V CT @ .60A	6.3V @ 1.2A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-152XP	A	7½	15V CT @ .500A	7.5V @ 1.000A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-163XP	A	7½	17V CT @ .441A	8.5V @ .882A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-158XP	A	7½	25.2V CT @ .30A	12.6V @ .60A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-153XP	A	7½	30V CT @ .250A	15V @ .500A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-164XP	A	7½	34V CT @ .220A	17V @ .440A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5
F-154XP	A	7½	54V CT @ .140A	27V @ .280A	1 41/64	2 13/16	1 15/32	1 61/64	13/32	1 5/16	2 3/8	10.5

115-230V, 50-60 Hz DUAL PRIMARY*/DUAL SECONDARIES*

F-3132P	B-1	1½	15V CT @ .1A	7.5V @ .200A	1⅛	1 3/8	1 1/8	1 3/8	13/64	1	1 3/8	4.0
F-3142XP	A-1	4½	15V CT @ .3A	7.5V @ .600A	1 3/8	2 3/8	1 1/4	1 5/8	1/4	1 7/64	2	6.5
F-3152XP	A-1	7½	15V CT @ .5A	7.5V @ .100A	1 5/8	2 13/16	1 61/64	1 7/16	1/4	1 15/16	2 3/8	11.0
F-3143XP	A-1	4½	30V CT @ .150A	15V @ .300A	1 3/8	2 3/8	1 1/4	1 5/8	1/4	1 7/64	2	6.5
F-3153XP	A-1	7½	30V CT @ .250A	15V @ .500A	1 5/8	2 13/16	1 61/64	1 7/16	1/4	1 15/16	2 3/8	11.0
F-333P	B-1	1½	30V CT @ .050A	15V @ .100A	1⅛	—	1 1/8	1 3/8	13/64	1	—	4.0
F-349XP	A-1	4½	16V CT @ .280A	8V @ .560A	1 3/8	2 3/8	1 1/4	1 5/8	1/4	1 7/64	2	6.5
F-359XP	A-2	10	24V CT @ .450A	12V @ .900A	1 5/8	2 13/16	1 7/16	1 7/8	1/4	1 5/16	2 3/8	11.0
F-362XP	A-2	10	20V CT @ .500A	10V @ 1.0A	1 5/8	2 13/16	1 7/16	1 7/8	1/4	1 5/16	2 3/8	11.0

PLUG-IN PRINTED CIRCUIT POWER TRANSFORMERS/

115V, 50-60 Hz PRIMARY/TRIPLE OUTPUT SECONDARIES FOR ±15V AND ±5V DC

Cat. No.	Fig.	Output Watts	Secondary		Dimensions						Mtg. Dim.	Wt. Oz.
			Series Connection	Parallel Connection	H	W	D	L	A	B		
F-165P	B	1½	24V CT @ .025A	9V CT @ .100A	1⅛	1 25/64	1 5/32	1 25/64	13/64	1	—	3.5
F-167P	B	1½	32V CT @ .020A	15V CT @ .060A	1⅛	1 25/64	1 5/32	1 25/64	13/64	1	—	3.5
F-168XP	A	4½	32V CT @ .050A	15V CT @ .195A	1 25/64	2 3/8	1 1/4	1 45/64	1/4	1 3/32	2	7.5
F-166XP	A	7½	24V CT @ .125A	9V CT @ .500A	1 41/64	2 13/16	1 15/32	1 61/64	1/4	1 5/16	2 3/8	10.5
F-169XP	A	7½	32V CT @ .100A	15V CT @ .287A	1 41/64	2 13/16	1 15/32	1 61/64	1/4	1 5/16	2 3/8	10.5

PLUG-IN PRINTED CIRCUIT AUDIO TRANSFORMERS

Cat. No.	Fig.	Output M.W.	Primary Impedance	Secondary Impedance	Primary D.C. Unbalance	Dimensions			Pin Dimension		Wt. Oz.
						H	W	D			
TY-141P	B	100	10,000 CT	10,000 CT	4 ma.	5/8	13/16	19/32	3/16	.042	1
TY-142P	B	100	10,000 CT	2,000 CT	4 ma.	5/8	13/16	19/32	3/16	.042	1
TY-147P	B	100	150 CT	600 CT	15 ma.	5/8	13/16	19/32	3/16	.042	5

* Two isolated windings.

TRANSFORMERS

TRIAD-UTRAD
Litton Standard Products
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750
Phone: (219) 356-6500 • TWX: 810-333-1532

ISOLATION/50-60 Hz ALL ISOLATION UNITS HAVE STATIC SHIELDS

Type No.	Output Watts (VA)	Primary Volts	Secondary AC Volts ±5%	Secondary AC Amps	RMS Test Voltage	Case Type	Connections	Lead Holes Used	Case Dimensions H	Case Dimensions W	Case Dimensions D	Mounting Dimensions MW	Mounting Dimensions MD
N-48X	15	115	115	.13	1500	X	Leads	—	1 15/16	3 5/16	2	2 13/16	—
N-51X‡	35	115	115	.3	1500	X	Leads	—	2 9/32	3 11/16	2 1/8	3 1/8	—
N-68X	50	115-230§	115	.435	1500	X	Leads	—	2 9/32	3 11/16	2 1/8	3 1/8	—
N-53M	85	115	115	.74	1500	M	6' Cord, Plug & Socket	—	3 19/32	2 31/32	3 5/8	2 1/4	2 3/8
N-54M	150	115	115	1.3	1500	M	6' Cord, Plug & Socket	—	3 7/8	3 9/32	4 1/4	2 1/2	3
N-73A	150	115	115-230§	.65	1500	A	Leads	1	3 7/8	3 9/32	3 7/8	2 1/2	2 3/4
N-67A	150	115-230§	115	1.3	1500	A	Leads	2	3 7/8	3 9/32	4 1/8	2 1/2	3
N-55M	250	115	115	2.17	1500	M	6' Cord, Plug & Socket	—	4 5/8	3 15/16	5	3	3 7/8
N-55MG†	—	115	—	—	—	—	—	—	—	—	—	—	—
N-66A	250	115-230§	115	2.17	1500	A	Leads	2	4 5/8	3 15/16	4 5/8	3	3 5/8
N-469A‡	50	220-440§	115	.435	1500	A	Leads	1	3 3/16	2 21/32	2 1/2	2	1 9/16
N-471A‡	300	220-440§	115	2.6	2000	A	Leads	1	4 5/8	3 15/16	4 3/8	3	3 3/8

CONTROL TRANSFORMERS/6V, 12V, 24V SECONDARIES

Triad Part No.	Primary	Secondary Parallel	Secondary Series	VA Rating	Case Type	Connections	Height Overall	Base Area	Mounting Dimension	Shpg. Wt. in lbs.
F-105Z		6V @ 2A	12V @ 1A	12	Z	Lugs	3 3/8	2 7/8 x 1 3/4	2 3/8	1
F-106Z		6V @ 4A	12V @ 2A	24	Z	Lugs	2 3/4	3 1/8 x 2	2 13/16	1 1/2
F-107Z		12V @ 4A	24V @ 2A	48	Z	Lugs	3 1/8	3 5/8 x 2 3/8	3 1/8	2 1/2
F-398U		12V @ 6A	24V @ 3A	72	U	Lugs	3 1/2	2 13/16 x 2 13/16	2 1/4 x 2 1/4	4 1/4
F-108U		12V @ 8A	24V @ 4A	96	U	Lugs	3 1/2	2 7/8 x 3	2 1/4 x 2 1/4	4 1/4
F-399U	115V/230V	12V @ 12A	24V @ 6A	144	U	Lugs	3 3/4	3 1/8 x 3 1/2	2 1/2 x 2 7/8	5.9
F-109U	50/60 CPS	12V @ 16A	24V @ 8A	192	U	Lugs	4 1/8	3 3/4 x 3 1/2	3 x 2 3/4	8
F-211Z	on all	24V @ .5A	48V @ .25A	12	Z	Lugs	2 5/16	2 13/16 x 1 1/2	2 3/8	.678
F-212Z		24V @ 1A	48V @ .50A	24	Z	Lugs	2 3/4	3 1/8 x 2 1/4	2 13/16	1.05
F-213Z		24V @ 2A	48V @ 1A	48	Z	Lugs	3 1/16	3 5/8 x 2 3/8	3 1/8	1.55
F-214U		24V @ 4A	48V @ 2A	96	U	Lugs	3 31/32	3 3/16 x 2 3/16	2 1/4 x 2 5/8	3.24
F-400U		24V @ 6A	48V @ 3A	144	U	Lugs	3 3/4	3 1/8 x 3 1/2	2 1/2 x 2 7/8	5.9
F-215U		24V @ 8A	48V @ 4A	192	U	Lugs	4 5/32	3 3/4 x 3 7/16	2 3/4 x 3	6.06

MINIATURE AUDIO TRANSFORMERS

Type No.	Power Output	Application	Matching Impedance Primary	Matching Impedance Secondary	DC Resistance Primary	DC Resistance Secondary	Overall Turns Ratio	Frequency Response ±3DB	RMS Test Volts	Case Type	Case Dimension H	Case Dimension W	Case Dimension D	Mtg. Dimen. MW
T-1X‡	1MW	Line or Mike to Grid	600/250/50	50,000	80	3200	1:9.16	60-15,000	500	X	5/8	1 1/32	3/4	1
T-31X‡	10MW	Line to Line	600/250/50	600/250/50	55	80	1:1	50-15,000	500	X	5/8	1 1/32	3/4	1
T-34X	20MW	Transistor or Line to Transistor or Line	500 CT 2 MA. D.C.	500 CT/ 125§	45	55	1:1.03	50-20,000	500	X	5/8	1 9/32	11/16	1 1/16
T-35X	10MW	Transistor or Line to Transistor	600 CT 1 MA. D.C.	2000 CT/ 500§	68	200	1:1.7	50-20,000	500	X	5/8	1 1/32	3/4	1

TELEPHONE COUPLING TRANSFORMERS

Cat. No.	Fig. No.	Application	Primary Impedance	Secondary Impedance	Dimensions A	B	C	D	E	F	G	H	I	J	Wt. Oz.
TY-300P	B	Hybrid*	600	600/600†	.63	.75	.55	.421	.187	.375	.25	.203	.020	.041	3.2
TY-301P	B	Coupling	600	900	.63	.75	.55	.421		.375	.25	.203	.020	.041	3.2
TY-302P	B	Hybrid*	600	600/600	.75	1.00	.94	.781	.200	.400	.26	.203	.020	.041	3.2
TY-303P	B	Bridging	4000	600	.63	.75	.55	.421		.375	.25	.203	.020	.041	3.2
TY-304P	B	Coupling	600 CT	600 CT	.63	.75	.55	.421	.187	.375	.25	.188	.018	.041	4.8
TY-350P	B	Holding Coil	2.0 hy @ 60 ma. 1.3 hy @ 100 maDC, 180 ohms DCR		1.19	1.44	.98	1.00		.63	.25		.020	.040	4.8

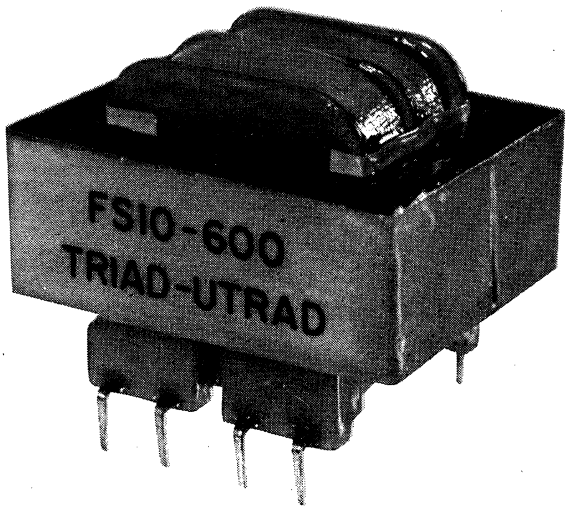
* Two required for hybrid operation. † Split winding; one wide band, one narrow band.

TRIAD-UTRAD
Litton Standard Products
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750 • Phone: 219-356-6500 • TWX: 810-333-1532

SPLIT PACK

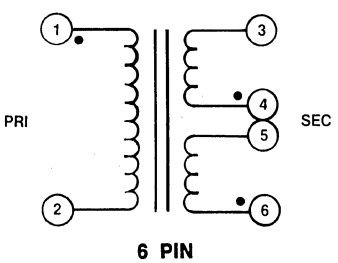
Split Bobbin Transformer

Triad-Utrad's new Split Pack split bobbin transformer increases the depth and versatility of Triad's already extensive line of PC board mounted transformers. Like Triad's recent Flat Pack series, the Split Pack transformers are nonconcentrically wound—with primary and secondaries wound side by side, unlike the secondary-on-top-of-primary windings of standard PC board transformers. Split bobbin winding and low capacitive coupling eliminate costly electrostatic shielding. The Split Pack's unique construction makes possible higher HiPot testing—2,500V rather than 1,500V.

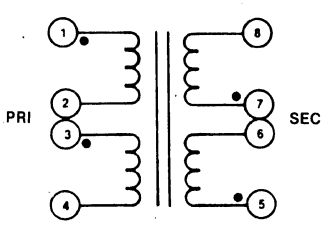


Triad Split Pack

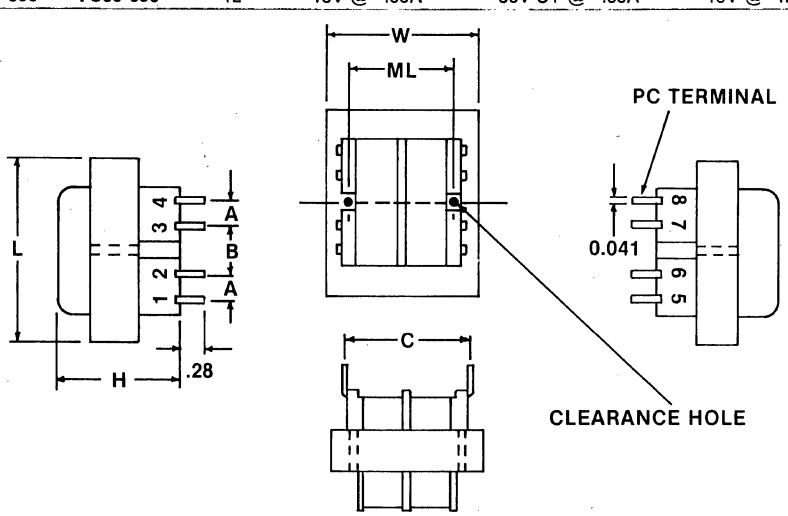
PRIMARY 115V 6 PIN	PRIMARY 115/230V 8 PIN	VA	SECONDARY RATINGS (RMS) INDIVIDUAL	SERIES	PARALLEL
F10-250	FS10-250	2.5	5V @ .25A	10V CT @ .25A	5V @ .5A
F10-600	FS10-600	6	5V @ .6A	10V CT @ .6A	5V @ 1.2A
F10-1200	FS10-1200	12	5V @ 1.2A	10V CT @ 1.2A	5V @ 2.4A
F12-200	FS12-200	2.5	6.3V @ .2A	12.6V CT @ .2A	6.3V @ .4A
F12-500	FS12-500	6	6.3V @ .5A	12.6V CT @ .5A	6.3V @ 1.0A
F12-1000	FS12-1000	12	6.3V @ 1.0A	12.6V CT @ 1.0A	6.3V @ 2.0A
F16-150	FS16-150	2.5	8V @ .15A	16V CT @ .15A	8V @ .3A
F16-400	FS16-400	6	8V @ .4A	16V CT @ .4A	8V @ .8A
F16-800	FS16-800	12	8V @ .8A	16V CT @ .8A	8V @ 1.6A
F20-120	FS20-120	2.5	10V @ .12A	20V CT @ .12A	10V @ .24A
F20-300	FS20-300	6	10V @ .3A	20V CT @ .3A	10V @ .6A
F20-600	FS20-600	12	10V @ .6A	20V CT @ .6A	10V @ 1.2A
F24-100	FS24-100	2.5	12V @ .1A	24V CT @ .1A	12V @ .2A
F24-250	FS24-250	6	12V @ .25A	24V CT @ .25A	12V @ .5A
F24-500	FS24-500	12	12V @ .5A	24V CT @ .5A	12V @ 1.0A
F28-85	FS28-85	2.5	14V @ .085A	28V CT @ .085A	14V @ .17A
F28-200	FS28-200	6	14V @ .2A	28V CT @ .2A	14V @ .4A
F28-420	FS28-420	12	14V @ .42A	28V CT @ .42A	14V @ .84A
F36-65	FS36-65	2.5	18V @ .065A	36V CT @ .065A	18V @ .13A
F36-170	FS36-170	6	18V @ .17A	36V CT @ .17A	18V @ .34A
F36-350	FS36-350	12	18V @ .35A	36V CT @ .35A	18V @ .7A



6 PIN



8 PIN



VA	H	W	L	ML	A	B	C	WT
2.5	1-3/16	1-1/8	1-3/8	—	.250	.250	1.20	.25
6	1-5/16	1-5/16	1-5/8	1-1/16	.250	.350	1.280	.44
12	1-7/16	1-9/16	1-7/8	1-1/4	.300	.400	1.410	.70

Specifications:

Dual Primaries—115/230V, 50/400 Hz

Split Bobbin—side by side windings reduce interwinding capacitance and eliminate the need for a static shield.

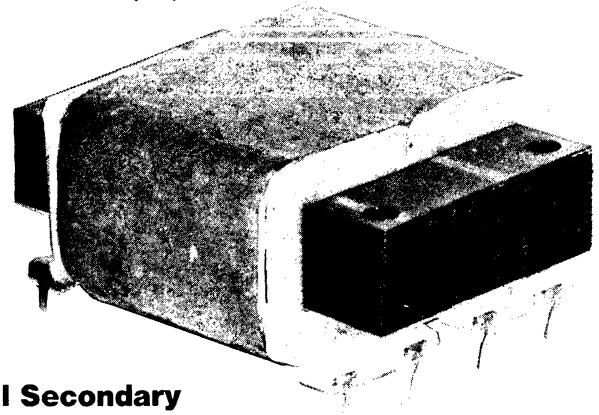
Hi-Pot—2,500V RMS is standard.

Terminals—are precision spaced.

FLAT PACK POWER

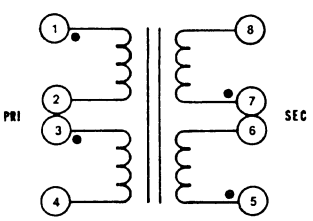
TRIAD-UTRAD
Litton Standard Products
Dept. EM, 1124 East Franklin Street, Huntington, IN 46750
Phone: (219) 356-6500 • TWX: 810-333-1532

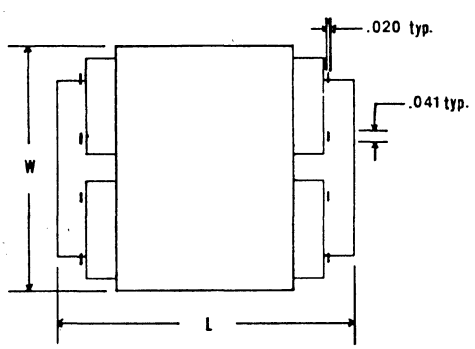
Triad-Utrad's Flat Pack power transformer is designed to meet the needs of low clearance printed circuit board and solid state power designs. These new units can also be used for control and instrumentation applications. Voltages and currents were chosen for widely used power applications and could be used in single or dual output supplies. The Triad-Utrad Flat Pack has a unique construction feature allowing them to pass a 2000V HiPot test.

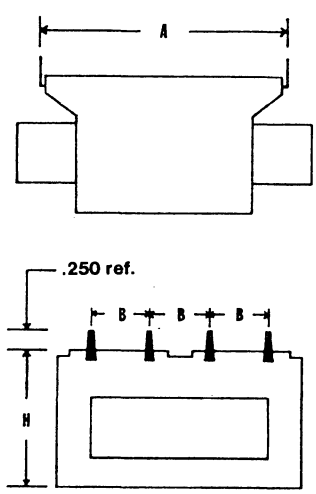


115-230 volts, 50-60 Hz, Dual Primary, Dual Secondary

TYPE NO.	OUTPUT WATTS	INDIVIDUAL	SERIES	SECONDARY PARALLEL
FP10-600	6	5V @ .6A	10V CT @ .6A	5V @ 1.2A
FP10-1200	12	5V @ 1.2A	10V CT @ 1.2A	5V @ 2.4A
FP12-475	6	6.3V @ .475A	12.6V CT @ .475A	6.3V @ .95A
FP12-950	12	6.3V @ .95A	12.6V CT @ .95A	6.3V @ 1.9A
FP16-375	6	8V @ .375A	16V CT @ .375A	8V @ .75A
FP16-750	12	8V @ .75A	16V CT @ .75A	8V @ 1.5A
FP20-300	6	10V @ .3A	20V CT @ .3A	10V @ .6A
FP20-600	12	10V @ .6A	20V CT @ .6A	10V @ 1.2A
FP24-250	6	12V @ .25A	24V CT @ .25A	12V @ .5A
FP24-500	12	12V @ .5A	24V CT @ .5A	12V @ 1.0A
FP30-200	6	15V @ .2A	30V CT @ .2A	15V @ .4A
FP30-400	12	15V @ .4A	30V CT @ .4A	15V @ .8A
FP34-170	6	17V @ .17A	34V CT @ .17A	17V @ .34A
FP34-340	12	17V @ .34A	34V CT @ .34A	17V @ .68A
FP40-150	6	20V @ .15A	40V CT @ .15A	20V @ .3A
FP40-300	12	20V @ .3A	40V CT @ .3A	20V @ .6A
FP56-100	6	28V @ .1A	56V CT @ .1A	28V @ .2A
FP56-200	12	28V @ .2A	56V CT @ .2A	28V @ .4A
FP88-65	6	44V @ .065A	88V CT @ .065A	44V @ .13A
FP88-130	12	44V @ .13A	88V CT @ .13A	44V @ .26A
FP120-50	6	60V @ .05A	120V CT @ .05A	60V @ .1A
FP120-100	12	60V @ .1A	120V CT @ .1A	60V @ .2A
FP230-25	6	115V @ .025A	230V CT @ .025A	115V @ .05A
FP230-50	12	115V @ .05A	230V CT @ .05A	115V @ .1A







OUTPUT WATTS	H	W	L	A	B
6	.875	1.562	1.875	1.600	.375
12	1.062	2.000	2.500	2.000	.500

Specifications:
Flat Pack = allows 1" card spacing for 6VA units or 1-1/4" for 12VA units
Dual Primaries = 115/230V, 50/60HZ
Split Bobbin = side by side windings reduce interwinding capacitance and eliminates the need for a static shield
Semi-Toroidal Construction reduces radiated magnetic fields and results in balanced windings
Hi-Pot = 2000V RMS is standard
Terminals are precision spaced

Selection Guide for TRW Transformers

STANDARD AUDIO TRANSFORMERS AND INDUCTORS

Product Series	Description	Frequency Range	Max. Power
Military Types: Grade 5, Metal Encased			
BIT-250	Ribbon style Kovar leads; compatible with transistor and IC flat pack styles. Transformers and inductors.	300 Hz to 250 kHz	80 mW @ 1 kHz
DO-T	Flexible 1½" Dumet leads. Ultraminiature transformers and inductors for transistor circuitry.	300 Hz to 20 kHz	500 mW @ 1 kHz
DO-T200	Plug-in — TO-5 pattern. Ultraminiature transformers and inductors for transistor style circuitry.	300 Hz to 20 kHz	100 mW @ 1 kHz
DI-T	Flexible 1½" Dumet leads. Ultraminiature transformers and inductors for transistor circuitry.	400 Hz to 100 kHz	500 mW @ 1 kHz
DI-T200	Plug-in — TO-5 pattern. Ultraminiature transformers and inductors for transistor circuitry.	400 Hz to 100 kHz	500 mW @ 1 kHz
TOP-1000	Plug-in, .50 D by .35 High	300 Hz to 75 kHz	.6 W @ 1 kHz
TOP-2000	Plug-in, .50 D by .5 High	150 Hz to 75 kHz	1 W @ 1 kHz
TOP-3000	Plug-in, .750 D by .52 High	50 Hz to 30 kHz	2 W @ 1 kHz
Military Types: Grade 4, Metal Encased			
H	**Transformers** — Full line of input, interstage and output types for transistor and tube use. Chopper type transformers. **Inductors** — Range from .4 mHys to 450 Hys.	30 Hz to 20 kHz	1 mW to 10 mW
FHA	Low profile audio unit, straight 1" pin terminals for plug-in mounting.	300 Hz to 20 kHz	100 mW @ 300 Hz
W (Mil Std)	Qualified to Mil Stds. print No.'s M27/3-01A to M27/11-01A. Inputs, interstage and output types.	300 Hz to 10 kHz	2W @ 300 Hz
Military Types: Grade 5, Molded			
SSO-P	Transistor and tube type transformers. Input, interstage, output and inductors.	300 Hz to 20 kHz	100 mW @ 300 Hz
SO-P	Transistor and tube type transformers. Input, interstage, output and inductors.	200 Hz to 20 kHz	250 mW @ 200 Hz
MTC	Plug-in, MIL-T-27, transformers for telephone interconnect and hybrid action.	300 Hz to 4 kHz	10 mW
Industrial Types: Cased, Non-Hermetic			
I-DI-T	Industrial versions of standard DI-T types.	400 Hz to 100 kHz	500 mW
I-DO-T	Industrial versions of standard DO-T types.	300 Hz to 20 kHz	500 mW
O	Excellent quality compact audio transformers and inductors, full range of transistor and tube applications	300 Hz to 20 kHz	1 Watt
A	Ultra compact wideband transistor and tube type transformers and inductors, hybrids and choppers.	10 kHz 50 kHz	5 Watt
LS	Linear standard transformers. Hi-fidelity, highest quality. Tube and transistor types. Includes low dist. high efficiency, shielded types, hybrid transformers. Broadcast quality.	7 Hz to 50 kHz	Low level to 50W
Industrial Types: Open Frame, Non-Hermetic			
SSO	Flexible lead type transformers and inductors for tube and transistor application. Channel frame available.	300 Hz to 20 kHz	100 mW
SO	Small, broadband type, flexible lead type. Transistor and tube types. Channel frame available.	200 Hz to 20 kHz	250 mW
PC	Plug-in types for mounting on PC boards. Same electrical characteristics as standard ouncer, sub-ouncer and sub-sub-ouncer lines.	100 Hz to 20 kHz 200 Hz to 20 kHz 300 Hz to 20 kHz	1W 250 mW 100 mW
TC	Plug-in and lead type transformers and inductors for telephone interconnect	100 Hz to 10 kHz	1 mW to 10 mW

STANDARD PULSE TRANSFORMERS

Type No.	Ratio	Pulse Width Micro-seconds	Rise Time Micro-seconds	Droop in %	Hi-Pot Volt-age RMS	MIL Type Designation	Service
BIT-P	4:4:1	.05-100	.01-40	0-30	200	TP6RX4410CZ	Coupling and Blocking Oscillator
PIP	4:4:1 & 5:3:1	.05-10	.01-.40	0-15	100	TP6RX4410CZ TP6RX5310CZ	Coupling and Blocking Oscillator
H-60 to H-68	4:4:1 & 5:3:1	.05-10	.012-.40	0-25	100	TP7SX4410AZ	Coupling and Blocking Oscillator
H-45 to H-57	1:1:1 & 5:3:1	.05-25	.01-2	0-30	1250	TP7SX1110	Coupling and Blocking Oscillator Higher Voltage, Tube, SCR, etc.

STANDARD POWER TRANSFORMERS AND INDUCTORS

Product Series	Description	Frequency	Power Range
Military Types			
DO-T400	Flexible lead ultraminiature power transformer. Hermetically sealed to MIL-T-27D Grade 5, Metal Clad.	380 Hz to 2400 Hz	400 mW
FP	MIL-T-27, Grade 5, low profile power transformers. 115V pri; secs deliver 2 to 30V.	400 Hz	10W to 30W
LL	MIL-T-27 Inductors Grade 5. Axially leaded units. .365 D x .49 L.	.25 Amps to 3 Amps	30 μHys to 5000 μHys
H	Inductors. Hermetically sealed inductor to MIL-T-27D Grades 4 & 5.	.017A to 30A*	0.4 mHy to 450 Hyst
H	Hermetically sealed to MIL-T-27D. Grades 4 & 5. Transistor, filament, inverter and plate type. Metal clad & molded.	50 Hz to 2500 Hz	1.2 VA to 5.0 KVA
HIT	Ultra-shielded power line isolation transformers. Hermetically sealed to MIL-T-27D. Grade 4. 0.1 mfd or less, effective coupling.	50 Hz to 400 Hz	50W to 1200W
MET	Hermetically sealed metal clad to MIL-T-27D Grade 4. For 400 Hz application to give min. size. Transistor, filament, universal types.	380 Hz to 2400 Hz	1.4W to 240W
N	Mil. St'd. filament & plate transformers per MIL-T-27D. Grade 4 (ruggedized) construction.	50 Hz to 400 Hz	7.5W to 400W
NV	Inverter transformer, miniature. Hermetically sealed to MIL-27D, Grade 4, Class V. Multiple outputs.	10 kHz, 20 kHz, 50 kHz	32.5 VA to 89 VA
PH/PV	MIL-T-27 3-phase transformers; Grades 4 & 5. Electrostatically shielded isolation and multi-output transformers.	50/60 Hz	25W-360W
SRC-10	Transformer, hermetically sealed to MIL-T-27D, Grade 4. Precision Scott-T reference.	60 Hz to 400 Hz	6 VA
SRA	Low inductance, high current miniature molded inductors.	up to 100 kHz up to 15A*	8 μHys to 1250 μHyst
SRB	Low inductance, high current miniature molded inductors.	up to 100 kHz up to 15A*	20 μHys to 3000 μHyst
SRC	Low inductance, high current miniature molded inductors.	up to 100 kHz up to 13.6A*	60 μHys to 10,000 μHyst
Industrial Types			
CG	High quality. Plate Transformers. Designed to AIEE. Rugged drawn steel cases. Vacuum impregnated & compound filled.	50/60 Hz	100 VA to 4950 VA
FT	Channel frame, filament/transistor transformers. For 2.5 VCT to 48 VCT. From .04A to 10A.	50/60 Hz	7.5 VA to 48 VA
PF	For photoflash and similar applications. Line and transistor inputs. Power, inverter & trigger types.	Trigger DC Inverter 4½ VDC 50/60 Hz	6 KV pulse to 15 KV pulse 40 Watt-Sec
R	(Inductors). Replacement types, channel frame construction. Vacuum sealed to prevent corrosion.	30 mA to 5A*	2 mHys to 5 Hyst
R	Replacement type line adjusting and isolation transformers. High reliability. Vacuum sealed to prevent corrosion. Housed in protective shells.	50/60 Hz	50 VA to 2500 VA

IN ADDITION TO THE NEEDS met by TRW stock audio and power components listed on this page, there are many unique applications that can be met with special units.

Our catalog audio line, for example, represents close to 500 commercial and MIL grade components covering a frequency band from 5 Hz to 250 kHz, at levels of mWs to 250 W and ranging in weight from 1/20 oz. to 16 lb. Our custom designs — which often can be MIL qualified by similarity — cover an even broader range of frequencies and power ratings.

Custom power designs range from milliwatts to 100 kVA capacity. They comprise temperature ranges from Class R (105°C) to Class U (higher than 170°C.) All types of mechanical and electrical configurations are available, and special engineering emphasis is placed on individual requirements.

Our engineering and laboratory facilities are uniquely equipped to handle customer problems in tough design areas such as shielding, corona, reliability, high voltage or miniaturization. Facilities are also available to produce sample orders.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

The BIT-250™ Line—An Advanced Development in Transformer Technology

PACKAGING

Size reduction without loss of performance is achieved by major reduction of air gaps in the magnetic circuit. Core permeability closely approaches the theoretical maximum for material and structure.

Materials, dimensions, and surface finish are identical with IC Flat Pack standards. Removable support protects terminal alignment prior to final assembly. This insulated support allows testing in conventional jigs.

RELIABILITY

Cylindrical bobbin-winding techniques eliminate corner stress normally found in fine-wire windings of conventional rectangular structures.

Lead arrangements and terminations have been designed to maximum reliability under thermal shock and temperature cycling.

FLEXIBILITY

The stock units shown on facing page are designed to afford maximum flexibility of application.

Transformers are 7-terminal types, with center-tapped primaries and split secondaries. When connected in parallel, split-winding secondaries provide ¼ the impedance and twice the DC current capability as series connections.

Inductors in the stock line include both single-winding and split-winding types.

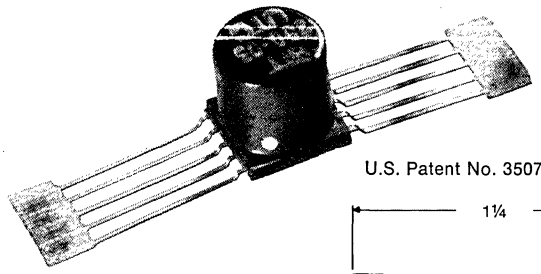
SPECIALS

BIT-250's not found in the stock line will be designed to customer's requirements.

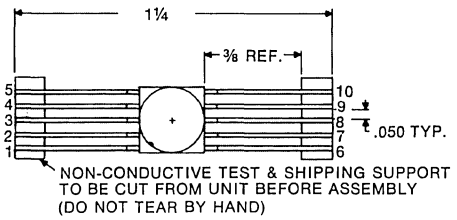
- Special electrical parameters
- 10 or more leads
- Operation to 130°C per MIL Class S.

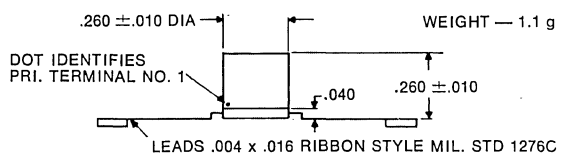
NOTES

- **FREQUENCY RESPONSE** ±2 db, 300 Hz — 250,000 Hz, @ 1 MW Ref. level.
- **DIELECTRIC STRENGTH** tested @ 200 V RMS.
- **MIL SPECS** To complete MIL-T-27D Specs. Metal encased, ruggedized, Grade 5, Class R.
- **SHIELDING** All units electromagnetically self-shielded.
- **LEAD MATERIAL** Tinned ribbon-style, solderable and weldable — MIL-STD-1276C.



U.S. Patent No. 3507039





TRANSFORMERS

BIT-250 Type No.	MIL Part No.	Pri Imp Ω (CT)	Sec Imp Ω (Split Wdg) Series/Par	Power Level mW for 5% Max Dist @ 1 KHz	Pri DCR Ω	(Series Conn.) Sec DCRΩ	Turns Ratio Pri/ Sec/ Sec	Turns Ratio Pri./ Overall Sec	Typical Application
BIT-250-14	M27/173-03	150	12/3	80	16	1.85	7.1:1:1	3.54:1	Output
BIT-250-18	M27/173-04	300	600/150	80	30	65	1.4:1:1	1:1.4	Output or Matching
BIT-250-20	M27/173-05	400	400/100	80	45	45	2:1:1	1:1	Matching or Interstage
BIT-250-26	M27/173-06	500	50/12.5	80	58	5.5	6.32:1:1	3.16:1:1	Output
BIT-250-30	M27/173-07	600	600/150	80	65	65	2:1:1	1:1	Isolation or Matching
BIT-250-36	M27/173-08	1000	1000/250	80	110	100	2:1:1	1:1	Output or Matching
BIT-250-40	M27/173-02	1500	600/150	75	150	65	3.16:1:1	1.58:1	Output
BIT-250-48	M27/173-09	2000	8000/2000	75	177	745	1:1:1	1:2	Isolation or Interstage
BIT-250-56	M27/173-10	10K	500/125	75	900	45	8.92:1:1	4.46:1	Output or Driver
BIT-250-60	M27/173-11	10K	1200/300	75	900	100	5.78:1:1	2.89:1	Driver
BIT-250-64	M27/173-12	10K	2000/500	75	900	160	4.48:1:1	2.24:1	Interstage
BIT-250-70	M27/173-13	10K	10K/2500	75	900	750	2:1:1	1:1	Isolation or Interstage
BIT-250-90	M27/173-01	25K	1000/250	40	2400	78	10:1:1	5:1	Interstage

INDUCTORS

BIT-250 Type No.	MIL-Type	Connections	Inductance Hys Min @ 1 KHz 5 V	@ ma DC	DC Res Ω	Ratio of Wdgs.
BIT-250-03 (2 Wdgs)	TF5R20ZZ	Series	8.6 2.5	0 2	2260	1:1
		Parallel	2.4 .63	0 4	565	
BIT-250-05 (1 Wdg)	TF5R20ZZ		5.5 1.5	0 2	1000	
BIT-250-06 (1 Wdg)	TF5R20ZZ		.80 .25	1 6	250	
BIT-250-09 (2 Wdgs)	TF5R20ZZ	Series	.60 .15	0 5	146	1:1
		Parallel	.15 .038	0 10	37	

DO-T® Transistor Transformers and Inductors

PACKAGING

Hermetically sealed. A TRW Inductive Products pioneered structure. The bobbin is completely rigid eliminating stress and wire movement. The turns are circular in shape rather than square, eliminating turn corner stress and effecting uniform wire lay. No tapes are employed in connecting coil wire and external leads. They are rigidly anchored in secure terminal board fashion providing strain relief.

The leads used on the stock DO-T transformers are insulated solid .016 diameter Dumet leads. For plug-in type see page 9.

MIL SPECS To complete MIL-T-27D Specs. Units are fully ruggedized, hermetically sealed, **metal cased** to MIL Grade 5, Class R.

ALTITUDE 150,000 ft. max.

PERFORMANCE

The radically designed TRW/UTC DO-T Family (see pages 6-11) transistor transformers provide unprecedented power handling capacity and reliability, coupled with small size. Electrical parameters and areas of application exceed conventional transformer capabilities.

Curves on this page and on pages 8 & 9 indicate their performance compared to that of similar size units now on the market. These curves show representative performance of all DO-T's and DI-T's except 200,000 ohm units. Higher performance is obtained when used in push-pull with balanced DC. Other manufacturers' comparative performance is shown on these curves to put unjustified claims in perspective. For example, the TRW/UTC DO-T10 delivers 100 mW @ 5% distortion @ 300 Hz. **Identical measurements** were made on contemporary manufacturers' equivalent, rated at 50 mW @ 300 Hz. Actual delivered power was under **1 mW @ 7½% distortion @ 300 Hz.**

FREQUENCY RESPONSE ±3 db, 300 Hz to 20 kHz at 1 mw.

WORKING VOLTAGE 50 volts peak.

APPLICATION

Units can be used for different impedances from those shown, keeping in mind that impedance ratio is constant. Lower source impedance will improve low frequency response and level ratings . . . higher source will reduce them. Units may be used reversed, input to secondary. The frequency response curve on this page is shown to 20 kHz. This descriptive curve is not meant to be restrictive. Units can be used at frequencies well above 20 kHz. Satisfactory applications for frequencies up to and above 250 kHz have been developed.

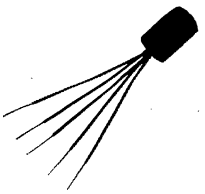
PULSE APPLICATION In pulse coupling impedance matching applications, (when measured with a 30 microsecond input pulse voltage wave), typical values for these transformers are: 5% or less droop, zero overshoot and less than 10% backswing.

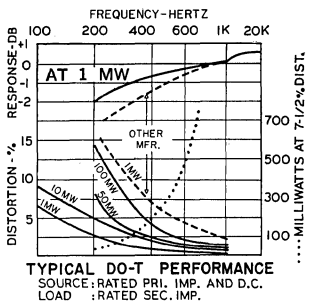
RELIABILITY The exceptional reliability of DO-T family units, inherent in their unique structure, has been dynamically proven in the field.

SHIELDING Hipermalloy electromagnetic shield available from stock for all DO-T family units. Order TRW P/N DOT-SH, or DIT-SH.

DILESIL HIGH TECHNOLOGY DO-T FAMILY TRANSFORMER

- A High Reliability version of the DO-T and DI-T line is available on special order. This alternate construction is designated DILESIL.
- DILESIL construction is intended for fine wire DO-T, DI-T transformers which are used in environments that produce prolonged thermal stress, far exceeding the thermal cycling specification requirements of MIL-T-27.
- DILESIL DO-T's have been approved and qualified by the Defense Electronic Supply Command and have appeared on QPL-27 for MIL-T-27C. DILESIL DO-T's are presently being requalified to MIL-T-27D.
- DILESIL construction is recommended for applications requiring extreme reliability under thermal stress. Thousands of these parts have been used in Hi-Rel Military and NASA applications for the past fifteen years.
- DILESIL DO-T and DI-T transformers are electrically identical to standard DO-T and DI-T parts. However, DILESIL parts are slightly larger than equivalent DO-T and DI-T parts.
- Contact the TRW Inductive Products engineering department for more detailed information.





TYPICAL DO-T PERFORMANCE
SOURCE: RATED PRI. IMP. AND D.C. LOAD : RATED SEC. IMP.

SPECIALS

For indication of possibilities of DO-T Family units custom built to your special requirements, contact the TRW Inductive Products engineering department.

The stock DO-T Family are Grade 5, Class R units, for a maximum operating temperature of 105°C in accordance with MIL-T-27D Specs. On special order they can be designed to Class S requirements of MIL-T-27D (130°C maximum operating temperature). No additional life expectancy is gained by ordering Class S insulation systems for applications in the vicinity of Class R temperatures. Where the operating temperatures are above 105°C, the use of Class S insulations will afford greater life expectancy.

Special units with electrical modifications of changed lead lengths, modified impedance ratios, and additions of electrostatic shields, etc., are available for all DO-T Family units.

Stock units cover general purpose applications. For specific applications cost reductions may be effected.

INDUCTOR DO-T™ LISTING

Type No.	MIL Type		
DO-T50 (2 Wdgs)	TF5R20ZZ	Series connection: .075 Hy @ 10 ma DC, .06 Hy @ 30 ma DC, DCR 10.5 ohms Parallel connection: .018 Hy @ 20 ma DC, .015 Hy @ 60 ma DC, DCR 2.6 ohms	
DO-T28	TF5R20ZZ	.3 Hy @ 4 ma DC, .15 Hy @ 20 ma DC	DCR 25 ohms
DO-T27	TF5R20ZZ	1.25 Hys @ 2 ma DC, .5 Hy @ 11 ma DC	DCR 100 ohms
DO-T8	TF5R20ZZ	3.5 Hys @ 2 ma DC, 1 Hy @ 5 ma DC	DCR 560 ohms
DO-T26	TF5R20ZZ	6 Hys @ 2 ma DC, 1.5 Hys @ 5 ma DC	DCR 2100 ohms
DO-T49 (2 Wdgs)	TF5R20ZZ	Series connection: 20 Hys @ 1 ma DC, 8 Hys @ 3 ma DC, DCR 5100 ohms Parallel connection: 5 Hys @ 2 ma DC, 2 Hys @ 6 ma DC, DCR 1275 ohms	

For Power DO-T Transformers (DO-T400 Series) See Catalog page 29.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

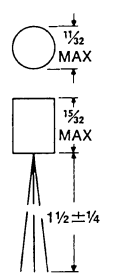
DO-T® Transistor Transformers and Inductors

TRANSFORMER DO-T™ LISTING

Locating Line	Type No.	MIL Part No.	Pri. Imp. Ω	DC ma‡ in Pri.	Sec. Imp. Ω	P. Max in mW @ 1 kHz 5% Dist.	DCR ±25% Pri.	DCR ±25% Sec. Ser. Conn.	Turns Ratio ±3% Pri.	Turns Ratio ±3% Sec. Ser. Conn.
1	DO-T44	M27/172-01	80 CT 100 CT	12 10	32 split 40 split	500	9.8	6	1.58	1
2	DO-T29	M27/172-02	120 CT 150 CT	10 10	3.2 4	500	10	.46	6.12	1
3	DO-T12	M27/172-03	150 CT 200 CT	10 10	12 16	500	11	1.5	3.54	1
4	DO-T13	M27/172-04	300 CT 400 CT	7 7	12 16	500	20	1.63	5	1
5	DO-T19	M27/172-05	300 CT	7	600	500	19	89	1	1.41
6	DO-T30	M27/172-06	320 CT 400 CT	7 7	3.2 4	500	20	.46	10	1
7	DO-T43	M27/172-07	400 CT 500 CT	8 6	40 split 50 split	500	46	8	3.16	1
8	DOT-42	M27/172-08	400 CT 500 CT	8 6	120 split 150 split	500	46	26	1.82	1
9	DO-T41	M27/172-09	400 CT 500 CT	8 6	400 split 500 split	500	46	74	1	1
10	DO-T53	M27/172-10	400 CT 500 CT	8 6	4000 CT 5000 CT	500	46	550	1	3.33
11	DO-T2	M27/172-11	500 600	3 3	50 60	100	60	8	3.16	1
12	DO-T20	M27/172-12	500 CT	5.5	600	500	31	90	1	1.1
13	DO-T4	M27/172-13	600	3	3.2	100	60	.58	13.7	1
14	DO-T55	TF5R21ZZ	600 CT	4	600 CT	500	47	47	1	1
15	DO-T14	M27/172-14	600 CT 800 CT	5 5	12 16	500	43	1.5	7.07	1
16	DO-T31	M27/172-15	640 CT 800 CT	5 5	3.2 4	500	43	.46	14.1	1
17	DO-T32	M27/172-16	800 CT 1000 CT	4 4	3.2 4	500	51	.46	15.8	1
18	DO-T15	M27/172-17	800 CT 1070 CT	4 4	12 16	500	51	1.5	8.15	1
19	DO-T21	M27/172-18	900 CT	4	600	500	53	89	1.22	1
20	DO-T3	M27/172-19	1000 1200	3 3	50 60	100	115	8	4.46	1
21	DO-T45	M27/172-20	1000 CT 1250 CT	3.5 3.5	16,000 split 20,000 split	100	120	940	1	4
22	DO-T16	M27/172-21	1000 CT 1330 CT	3.5 3.5	12 16	500	71	1.5	9.15	1
23	DO-T33	M27/172-22	1060 CT 1330 CT	3.5 3.5	3.2 4	500	71	.46	18.2	1
24	DO-T5	M27/172-23	1200	2	3.2	100	105	.58	19.35	1
25	DO-T17	M27/172-24	1500 CT 2000 CT	3 3	12 16	500	108	1.5	11.2	1
26	DO-T22	M27/172-25	1500 CT	3	600	500	86	89	1.58	1
27	DO-T34	M27/172-26	1600 CT 2000 CT	3 3	3.2 4	500	109	.46	22.4	1
28	DO-T51	M27/172-27	2000 CT 2500 CT	3 3	2000 split 2500 split	100	195	125	1	1
29	DO-T37	M27/172-28	2000 CT 2500 CT	3 3	8000 split 10,000 split	100	195	455	1	2
30	DO-T52*	TF5R21ZZ	4000 CT 5000 CT	2 2	8000 CT 10,000 CT	100	320	590	1	1.41
31	DO-T18	M27/172-29	7500 CT 10,000 CT	1 1	12 16	100	505	1.6	25	1
32	DO-T35	M27/172-30	8000 CT 10,000 CT	1 1	3.2 4	100	505	.46	50	1
33	DO-T48*	TF5R21ZZ	8000 CT 10,000 CT	1 1	1200 CT 1500 CT	100	640	110	2.58	1
34	DO-T47*	TF5R21ZZ	9000 CT 10,000 CT	1 1	9000 CT 10,000 CT	100	850	1080	1	1
35	DO-T6	M27/172-31	10,000	1	3.2	100	790	.68	55.7	1
36	DO-T9	M27/172-32	10,000 12,000	1 1	500 CT 600 CT	100	780	50	4.48	1
37	DO-T10	M27/172-33	10,000 12,500	1 1	1200 CT 1500 CT	100	780	115	2.89	1
38	DO-T25	M27/172-34	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	100	780	126	2.58	1
39	DO-T38	M27/172-35	10,000 CT 12,000 CT	1 1	2000 split 2400 split	100	560	230	2.24	1
40	DO-T11	M27/172-36	10,000 12,500	1 1	2000 CT 2500 CT	100	780	190	2.24	1
41	DO-T36	M27/172-37	10,000 CT 12,000 CT	1 1	10,000 CT 12,000 CT	100	975	1175	1	1
42	DO-T1	M27/172-38	20,000 30,000	.5 .5	800 1200	50	830	115	5	1
43	DO-T23	M27/172-39	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	50	830	115	5	1
44	DO-T39	M27/172-40	20,000 CT 30,000 CT	.5 .5	1000 split 1500 split	50	800	113	4.47	1
45	DO-T40	M27/172-41	40,000 CT 50,000 CT	.25 .25	400 split 500 split	50	1700	60	10	1
46	DO-T54	M27/172-42	40,000 CT 50,000 CT	.25 .25	4000 CT 5000 CT	50	1700	450	3.33	1
47	DO-T46*	TF5R21ZZ	100,000 CT	0	500 CT	25	7900	85	14.14	1
48	DO-T7	M27/172-43	200,000	0	1000	25	8500	100	14.14	1
49	DO-T24	M27/172-44	200,000 CT	0	1000 CT	25	8500	100	14.14	1
	DO-TSH	Drawn Hipermalloy shield and cover for DO-T's provides 20 to 30 db shielding. .55″ h x .36″ dia. ⅛″ hole in cover.								
	DO-TSH-2†	Drawn Hipermalloy shield and cover for DO-T's provides 20 to 30 db shielding. .64″ h x .383″ dia. ⅜″ hole in cover.								

Unit Locating Key

Type No.	Located on Line
DO-T1	42
DO-T2	11
DO-T3	20
DO-T4	13
DO-T5	24
DO-T6	35
DO-T7	48
DO-T8	Pg. 6
DO-T9	36
DO-T10	37
DO-T11	40
DO-T12	3
DO-T13	4
DO-T14	15
DO-T15	18
DO-T16	22
DO-T17	25
DO-T18	31
DO-T19	5
DO-T20	12
DO-T21	19
DO-T22	26
DO-T23	43
DO-T24	49
DO-T25	38
DO-T26	Pg. 6
DO-T27	Pg. 6
DO-T28	Pg. 6
DO-T29	2
DO-T30	6
DO-T31	16
DO-T32	17
DO-T33	23
DO-T34	27
DO-T35	32
DO-T36	41
DO-T37	29
DO-T38	39
DO-T39	44
DO-T40	45
DO-T41	9
DO-T42	8
DO-T43	7
DO-T44	1
DO-T45	21
DO-T46	47
DO-T47	34
DO-T48	33
DO-T49	Pg. 6
DO-T50	Pg. 6
DO-T51	28
DO-T52	30
DO-T53	10
DO-T54	46
DO-T55	14

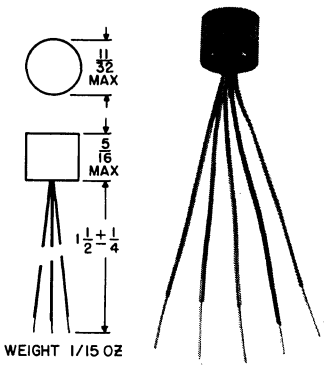


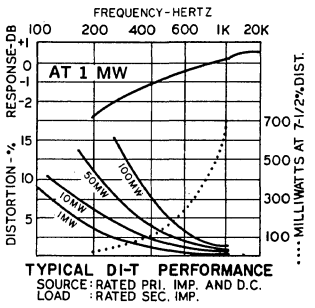
WEIGHT 1/10 OZ.

See Catalog page 29 for TRW/UTC's line of 400 cycle DO-T Transformers

‡ maDC shown is for single ended usage. For push-pull, maDC can be any balanced value taken by .5W transistors.
Where windings are listed as split, ¼ of the listed impedance is available by paralleling the winding.
* Includes electrostatic shield.
† DO-TSH2 fits over DO-TSH.

DI-T® Transistor Transformers and Inductors





TYPICAL DI-T PERFORMANCE
SOURCE: RATED PRI. IMP. AND D.C. LOAD : RATED SEC. IMP.

FREQUENCY RESPONSE ±3 db, 400 Hz to 100 kHz at 1 mW.

UNIT LOCATION KEY

Type No.	Located on Line	Type No.	Located on Line
DI-T1	23	DI-T26	28
DI-T2	7	DI-T27	26
DI-T3	11	DI-T28	25
DI-T5	12	DI-T36	22
DI-T8	27	DI-T37	15
DI-T9	17	DI-T38	20
DI-T10	18	DI-T41	5
DI-T11	21	DI-T43	4
DI-T19	3	DI-T44	1
DI-T20	8	DI-T51	14
DI-T21	10	DI-T52	16
DI-T22	13	DI-T53	6
DI-T23	24	DI-T55	9
DI-T25	19	DI-T56	2

PACKAGING DO-T family; see Cat. p. 6.

MIL SPECS To complete MIL-T-27D Specs. Grade 5. Class R.

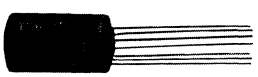
Locating Line	Type No.	MIL Type	Pri. Imp. Ω	ma D.C.‡ In Pri.	Sec. Imp. Ω	Pri. DCR Ω	mw Level*	Application
1	DI-T44	TF5R21ZZ	80 CT 100 CT	12 10	32 split 40 split	11.5	500	Interstage
2	DI-T56	TF5R21ZZ	150 CT	10	150 CT	14	500	Coupling
3	DI-T19	TF5R21ZZ	300 CT	7	600	20	500	Output to line
4	DI-T43	TF5R21ZZ	400 CT 500 CT	8 6	40 split 50 split	50	500	Interstage
5	DI-T41	TF5R21ZZ	400 CT 500 CT	8 6	400 split 500 split	50	500	Interstage or output (Ratio 2:1:1) also wide pulse application
6	DI-T53	TF5R21ZZ	400 CT 500 CT	8 6	4000 CT 5000 CT	33	500	Input or driver to low noise transistor
7	DI-T2	TF5R21ZZ	500 600	3 3	50 60	65	100	Output
8	DI-T20	TF5R21ZZ	500 CT	5.5	600	32	500	Output or line to line or mixing
9	DI-T55	TF5R21ZZ	600 CT	4	600 CT	47	500	Isolation or Interstage (Ratio 1:1) also wide pulse application
10	DI-T21	TF5R21ZZ	900 CT	4	600	53	500	Output to line
11	DI-T3	TF5R21ZZ	1000 1200	3 3	50 60	110	100	Output
12	DI-T5	TF5R21ZZ	1200	2	3.2	110	100	Output
13	DI-T22	TF5R21ZZ	1500 CT	3	600	87	500	Output to line
14	DI-T51	TF5R21ZZ	2000 CT 2500 CT	3 3	2000 split 2500 split	180	100	Isolation or Interstage (Ratio 2:1:1) also wide pulse application
15	DI-T37	TF5R21ZZ	2000 CT 2500 CT	3 3	8000 split 10,000 split	180	100	Isolation or Interstage (Ratio 1:1:1) also wide pulse application
16	DI-T52	TF5R21ZZ	4000 CT 5000 CT	2 2	8000 CT 10,000 CT	300	100	Interstage Includes electrostatic shield
17	DI-T9	TF5R21ZZ	10,000 12,000	1 1	500 CT 600 CT	870	100	Output or driver
18	DI-T10	TF5R21ZZ	10,000 12,500	1 1	1200 CT 1500 CT	870	100	Driver
19	DI-T25	TF5R21ZZ	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	870	100	Interstage
20	DI-T38	TF5R21ZZ	10,000 CT 12,000 CT	1 1	2000 split 2400 split	620	100	Interstage
21	DI-T11	TF5R21ZZ	10,000 12,500	1 1	2000 CT 2500 CT	870	100	Driver
22	DI-T36	TF5R21ZZ	10,000 CT 12,000 CT	1 1	10,000 CT 12,000 CT	970	100	Isolation or Interstage (Ratio 1:1) also wide pulse application
23	DI-T1	TF5R21ZZ	20,000 30,000	.5 .5	800 1200	815	50	Interstage
24	DI-T23	TF5R21ZZ	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	815	50	Interstage
25	DI-T28	TF5R20ZZ	.1 Hy @ 4 ma DC, .08 Hy @ 10 ma DC			25		Inductor
26	DI-T27	TF5R20ZZ	.9 Hy @ 2 ma DC, .5 Hy @ 6 ma DC			105		Inductor
27	DI-T8	TF5R20ZZ	2.5 Hys @ 2 ma DC, .9 Hy @ 4 ma DC			630		Inductor
28	DI-T26	TF5R20ZZ	4.5 Hys @ 2 ma DC, 1.2 Hys @ 4 ma DC			2300		Inductor
29	DI-TSH	Drawn Hipermalloy shield and cover for DI-T's provides 20 to 30 db shielding .390″ h x .359″ dia. ⅛″ hole in cover.						

* For 5% maximum distortion @ 1 kHz.

‡ ma DC shown is for single ended usage. For push-pull, ma DC can be any balanced value taken by .5W transistors. Where windings are listed as split, ¼ of the listed impedance is available by paralleling the winding.

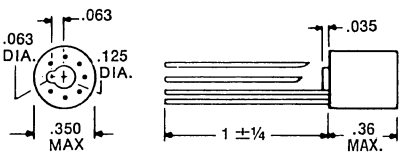
TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

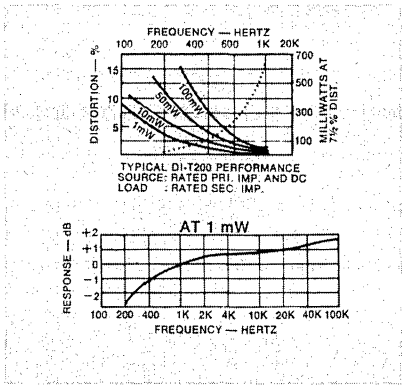
DO-T200 and DI-T200 Series Transformers and Inductors



HEIGHT 9/16 FOR DO-T

Weight: 1/15 OZ. DI-T
1/8 OZ. DO-T





PACKAGING Metal encased. DO-T family unit. See Catalog page 6.

MIL SPECS To complete MIL-T-27D Specs. Ruggedized, metal encased to MIL Grade 5, Class R.

FREQUENCY RESPONSE At 1 mW ±3 db, 300 Hz to 20 kHz, DO Type; ±3 db, 400 Hz to 100 kHz, DI Type.

TERMINALS Leads are .016 Dumet wire, tinned, and may be either welded or soldered. They are uninsulated and are spaced on a .1″ radius circle, conforming to the termination pattern of the "TO-76" cased semiconductors and micrologic elements.

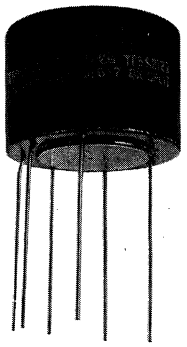
Type No.	MIL Part No.	Pri. Imp.Ω	ma D.C.‡ In Pri.	Sec. Imp. Ω	Pri. DCR Ω	mw Level*	Application
DO-T255	M27/76-07	1000 CT 1200 CT	3 3	50 60	115	100	Output or matching
DO-T275	M27/76-06	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	780	100	Interstage
DO-T277	M27/76-05	10,000 CT 12,000 CT	1 1	2000 split 2400 split	560	100	Interstage
DO-T278	M27/76-04	10,000 12,500	1 1	2000 CT 2500 CT	780	100	Driver
DO-T283	M27/76-03	10,000 CT 12,000 CT	1 1	10,000 CT 12,000 CT	975	100	Isolation or Interstage (Ratio 1:1) also pulse application
DO-T288	M27/76-02	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	830	50	Interstage
DO-T297	M27/76-01	200,000 CT	0	1000 CT	8500	25	Input and Chopper
DO-T200SH	Drawn Hipermalloy shield provides 15 to 20 db shielding through side of case, .578″ h x .375″ dia. no cover.						
DI-T225	M27/103-15	80 CT 100 CT	12 10	32 split 40 split	11.5	500	Interstage
DI-T227	TF5R21ZZ	150 CT	10	150 CT	14	500	Coupling
DI-T230	M27/103-14	300 CT	7	600 CT	20	500	Output or line to line or matching
DI-T235	M27/103-13	400 CT 500 CT	8 6	40 split 50 split	50	500	Interstage
DI-T240	M27/103-12	400 CT 500 CT	8 6	400 split 500 split	50	500	Interstage or output (Ratio 2:1:1) also wide pulse application
DI-T245	M27/103-11	500 CT 600 CT	3 3	50 CT 60 CT	65	500	Output or matching
DI-T250	M27/103-10	500 CT	5.5	600 CT	32	500	Output or line to line or mixing or matching
DI-T255	M27/103-09	1000 CT 1200 CT	3 3	50 CT 60 CT	110	500	Output or matching
DI-T260	M27/103-08	1500 CT	3	600 CT	87	500	Output to line or matching
DI-T265	M27/103-07	2000 CT 2500 CT	3 3	8000 split 10,000 split	180	100	Isolation or Interstage (Ratio 1:1:1) also wide pulse application
DI-T270	M27/103-06	10,000 CT 12,000 CT	1 1	500 CT 600 CT	870	100	Output or driver
DI-T273	M27/103-05	10,000 CT 12,500 CT	1 1	1200 CT 1500 CT	870	100	Output or driver
DI-T276	M27/103-04	10,000 CT 12,000 CT	1 1	2000 CT 2400 CT	870	100	Interstage or driver
DI-T278	M27/103-03	10,000 CT 12,500 CT	1 1	2000 split 2500 split	620	100	Interstage or driver
DI-T283	M27/103-01	10,000 CT 12,000 CT	1 1	10,000 CT 12,000 CT	970	100	Isolation or Interstage (Ratio 1:1) also wide pulse application
DI-T288	M27/103-02	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	815	50	Interstage or driver
DI-T290	M27/103-16	600 CT	4	600 CT	47	500	Isolation or Interstage (Ratio 1:1) also wide pulse application
DI-T204	TF5R20ZZ	Split Inductor (2 wdgs) Series connected: .1 Hy @ 4 ma DC, .08 Hy @ 10 ma DC, DCR 25 ohms Parallel connected: .025 Hy @ 8 ma DC, .02 Hy @ 20 ma DC, DCR 6 ohms					
DI-T208	TF5R20ZZ	Split Inductor (2 wdgs) Series connected: .9 Hy @ 2 ma DC, .5 Hy @ 6 ma DC, DCR 105 ohms Parallel connected: .2 Hy @ 4 ma DC, .1 Hy @ 12 ma DC, DCR 26 ohms					
DI-T212	TF5R20ZZ	Split Inductor (2 wdgs) Series connected: 2.5 Hys @ 2 ma DC, .9 Hy @ 4 ma DC, DCR 630 ohms Parallel connected: .6 Hy @ 4 ma DC, .2 Hy @ 8 ma DC, DCR 157 ohms					
DI-T216	TF5R20ZZ	Split Inductor (2 wdgs) Series connected: 4.5 Hys @ 2 ma DC, 1.2 Hys @ 4 ma DC, DCR 2300 ohms Parallel connected: 1.1 Hys @ 4 ma DC, .3 Hy @ 8 ma DC, DCR 575 ohms					
DI-T200SH	Drawn Hipermalloy shield provides 15 to 20 db shielding through side of case. .421″ h x .375″ dia. no cover.						

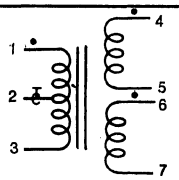
* For 5% maximum distortion @ 1 kHz

‡ ma DC shown is for single ended usage. For push-pull, ma DC can be any balanced value taken by .5W transistors.
Where windings are listed as split, ¼ of the listed impedance is available by paralleling the winding.

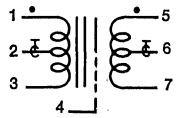
TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

TOP Transistor Transformers

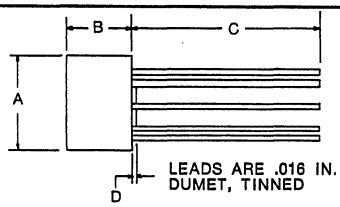




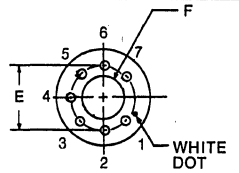
SPLIT SEC. PARTS



C.T. PARTS WITH E.S. SHIELD



LEADS ARE .016 IN. DUMET, TINNED



7 LEADS EQUALLY SPACED AS FOR 8

DIMENSIONS

	A MAX.	B MAX.	C ±.25	D ±.010	E ±.010	F ±.010
TOP-1000 SERIES	.5	.35	1.0	.020	.35	.218
TOP-2000 SERIES	.5	.50	1.0	.020	.35	.218
TOP-3000 SERIES	.75	.52	1.0	.020	.60	.475

TOP-1000 Series (TF5S21ZZ) FREQUENCY RESPONSE ±3 DB 300 Hz-75 KHz at 1 mW

Type No.	Pri. Imp. (Ω)	ma DC in Pri.	Sec. Imp. (Ω)	Power (Watts) at 1 kHz & Higher	Power (Watts) at 400 Hz	Power (Watts) at 300 Hz	DCR Pri./Sec. (±25%)	Turns Ratio Pri./Sec.
TOP-1265	150 CT	11	150 Split	.6	.3	.16	13/18.3	1/1
TOP-1270	150 CT	11	600 Split	.6	.3	.16	13/75	1/2
TOP-1380	600 CT	5.5	600 Split	.6	.3	.16	57/79	1/1
TOP 1385*	600 CT	5.5	600 CT	.6	.3	.16	53/75	1/1
TOP-1387	600 CT	5.5	1200 Split	.6	.3	.16	53/105	1/1.41
TOP-1490*	2000 CT	3	2000 CT	.6	.3	.16	198/218	1/1
TOP-1495	2000 CT	3	8000 Split	.6	.3	.16	198/850	1/2
TOP-1640	10,000 CT	1.4	10,000 Split	.6	.3	.16	865/1215	1/1
TOP-1645*	10,000 CT	1.4	10,000 CT	.6	.3	.16	1060/1215	1/1
TOP-1655	15,000 CT	1	600 Split	.6	.3	.16	1305/72.5	5/1

TOP-1000SH Drawn Hipermalloy Shield — .53 O.D. x .40 H

TOP-2000 Series (TF5S21ZZ) FREQUENCY RESPONSE ±3 DB 150 Hz-75 KHz at 1 mW

Type No.	Pri. Imp. (Ω)	ma DC in Pri.	Sec. Imp. (Ω)	Power (Watts)† at 1 kHz & Higher	Power (Watts)† at 400 Hz	Power (Watts)† at 150 Hz	DCR Pri./Sec. (±25%)	Turns Ratio Pri./Sec.
TOP-2265	150 CT	8	150 Split	1	.75	.075	12/20	1/1
TOP-2270	150 CT	8	600 Split	1	.75	.075	12/82	1/2
TOP-2380	600 CT	4	600 Split	1	.75	.075	60/66	1/1
TOP-2385*	600 CT	4	600 CT	1	.75	.075	60/68	1/1
TOP-2387	600 CT	4	1200 Split	1	.75	.075	60/116	1/1.41
TOP-2490*	2000 CT	2	2000 CT	1	.75	.075	175/240	1/1
TOP-2495	2000 CT	2	8000 Split	1	.75	.075	185/1015	1/2
TOP-2640	10,000 CT	1	10,000 Split	1	.75	.075	780/1075	1/1
TOP-2645*	10,000 CT	1	10,000 CT	1	.75	.075	715/985	1/1
TOP-2655	15,000 CT	.8	600 Split	.66	.66	.075	1165/80	5/1
TOP-2695	20,000 CT	.7	1000 Split	.5	.5	.075	1750/135	4.47/1
TOP-2814	100,000 CT	.3	2000 Split	.1	.1	.075	10,000/248	7.07/1

TOP-2000SH Drawn Hipermalloy Shield — .53 O.D. x .55 H

† For 5% Dist at Rated Frequency.

TOP-3000 Series (TF5S21ZZ) FREQUENCY RESPONSE ±3 DB 50 Hz-30 KHz at 1 mW

Type No.	Pri. Imp. (Ω)	ma DC in Pri.	Sec. Imp. (Ω)	Power (Watts) at 1 kHz & Higher	Power (Watts) at 400 Hz	Power (Watts) at 50 Hz	DCR Pri./Sec. (±25%)	Turns Ratio Pri./Sec.
TOP-3065	150 CT	8	150 Split	2	1.5	.03	12/16.5	1/1
TOP-3070	150 CT	8	600 Split	2	1.5	.03	12/66	1/2
TOP-3180	600 CT	4	600 Split	2	1.5	.03	48/66	1/1
TOP-3185*	600 CT	4	600 CT	2	1.5	.03	48/66	1/1
TOP-3187	600 CT	4	1200 Split	2	1.5	.03	48/132	1/1.41
TOP-3290*	2000 CT	2.2	2000 CT	2	1.5	.03	160/220	1/1
TOP-3295	2000 CT	2.2	8000 Split	2	1.5	.03	160/880	1/2
TOP-3440	10,000 CT	1	10,000 Split	1	1	.03	800/1100	1/1
TOP-3445*	10,000 CT	1	10,000 CT	1	1	.03	800/1100	1/1
TOP-3455	15,000 CT	.8	600 Split	.66	.66	.03	1200/66	5/1
TOP-3495	20,000 CT	.7	1000 Split	.5	.5	.03	1600/110	4.47/1
TOP-3614	100,000 CT	.3	2000 Split	.1	.1	.03	8000/220	7.07/1

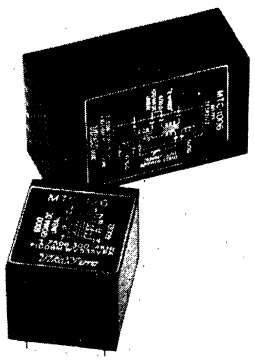
TOP-3000SH Drawn Hipermalloy Shield — .78 O.D. x .57 H

* Includes Electrostatic Shield.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

Telephone Interconnect Transformers

MTC Series



APPLICATIONS MTC (MIL-T-27D) transformers, designed for coupling applications feature unbalanced DC current ratings of up to 120 mA — higher than competitive units — while longitudinal balance per FCC 68.310 specification is greater than 60 dB.

The 2-wire to 4-wire hybrid transformer is noteworthy in that it can carry up to 100 mA unbalanced DC current through its primary, and has greater than 60 dB trans-hybrid loss over the 300-Hz to 4-kHz frequency band.

Dielectric strength exceeds 1500 volts AC.

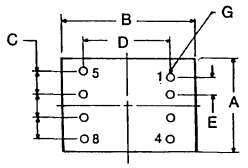


FIGURE 1

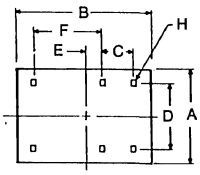


FIGURE 2

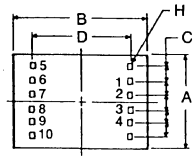
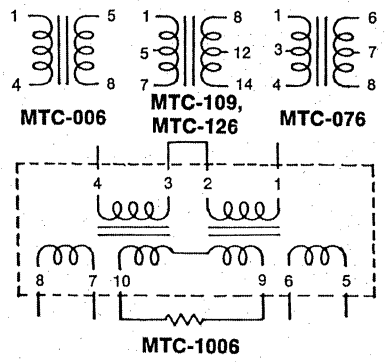


FIGURE 3

SCHEMATICS



Type	A	B	Unit Height	C ±.010	D ±.010	E ±.010	F ±.010	G, Dia. ±.005	H, Sq. ±.005	Pin Ht. ±.030
MTC-006	.875	1.093	.719	.20	.50	.15	—	.025	—	.125
MTC-076	1.562	1.875	.750	.25	1.00	.375	.75	—	.025	.156
MTC-109	1.562	1.875	1.156	.40	1.00	.20	.80	—	.025	.343
MTC-126	1.562	1.875	1.156	.40	1.00	.20	.80	—	.025	.343
MTC-1006	1.625	2.812	1.156	.20	2.30	—	—	—	.025	.125

Type No.	Application	Primary Impedance (Ohms)	DCR	Max Unbalanced DC Current (mA)	Secondary Impedance (Ohms)	DCR	Size
MTC-006	Coupling	600	33	0	600	35	Figure 1
MTC-076	Coupling	600 CT	44	70	600 CT	51	Figure 2
MTC-109	Coupling	900 CT	32	100	600 CT	21	Figure 2
MTC-126	Coupling	600 CT	22	120	600 CT	21	Figure 2
MTC-1006	Hybrid	600 Split		100‡	600/600		Figure 3

Series	Frequency Response	Max. Power Level	Longitudinal Balance	Maximum Distortion	Impedance Matching	Return Loss	Hybrid-trans-Hybrid Loss
MTC-006	±.50 dB, 300 Hz-4 kHz	+7 dBm	60 dB min.	0.5%	—	26 dB min.*	—
MTC-076	±.75 dB, 300 Hz-4 kHz	+10 dBm	60 dB min.	0.5%	—	10 dB min.*	—
MTC-109	±.75 dB, 300 Hz-4 kHz	+10 dBm	60 dB min.	0.5%	—	10 dB min.*	—
MTC-126	±.75 dB, 300 Hz-4 kHz	+10 dBm	60 dB min.	0.5%	—	10 dB min.*	—
MTC-1006	±.50 dB, 300 Hz-4 kHz	+10 dBm	60 dB min.	0.5%	—	11 dB min.*	60 dB min.

* Return loss figures are lowest readings over the frequency range as measured per MIL-STD-188C. For industrial use, return loss is greater than 22 dB. ‡ In 2-wire port.

TC Series

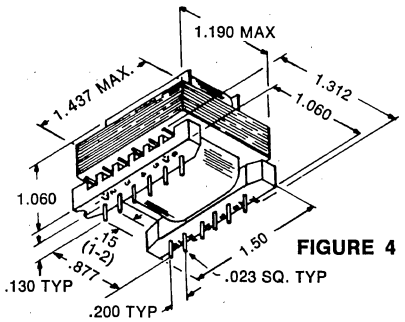


FIGURE 4

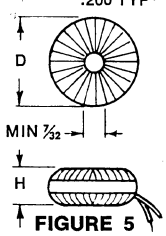


FIGURE 5

SIZE SERIES	D	H	WT. OZ.
TC-L-2	1·	13/32	3/4
TC-L-3	1 1/4	5/8	2

HIGH-Q-TOROID MICROCRYSTALLINE WAX IMPREGNATED SUPPLIED WITH 4″ LEADS

APPLICATIONS The TC Series of plug-in transformers is ideally suited for telephone interconnection applications. These low-profile units meet or exceed all modem and voice transmission impedance-matching requirements. They feature low distortion and wide frequency response, and are specially designed for wave soldering to printed circuit boards.

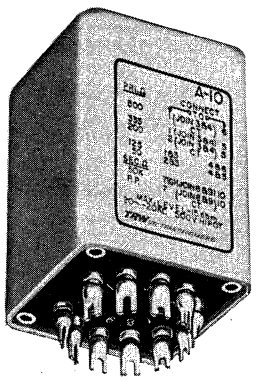
Type No.	Application	Primary Impedance (Ohms)	Max Unbalanced DC Current (mA)	Secondary Impedance (Ohms)	Size
TC-0-30	Coupling	600 Split	—	600 Split	Same as PC-0, Pg. 17
TC-0-20	Coupling	600 Split	—	1500 CT	Same as PC-0, Pg. 17
TC-SO-15	Coupling	600 Split	—	600 Split	Same as PC-SO, Pg. 19
TC-SO-22	Coupling	600 Split	—	1500 CT	Same as PC-SO, Pg. 19
TC-SSO-33	Coupling	600 Split	—	600 Split	Same as PC-SSO, Pg. 22
TC-SSO-20	Coupling	600 Split	—	1500 CT	Same as PC-SSO, Pg. 22
TC-F-1*	Coupling	900/600 Split	60/75	600 CT	Figure 4
TC-0-37	Bridging	4000 Split	—	600 Split	Same as PC-0, Pg. 17
TC-SO-23	Bridging	4000 Split	—	600 Split	Same as PC-SO, Pg. 19
TC-SSO-27	Bridging	4000 Split	—	600 Split	Same as PC-SSO, Pg. 22
TC-0-35†	Hybrid	600	—	600/600	Same as PC-0, Pg. 17
TC-SSO-32†	Hybrid	600	—	600/600	Same as PC-SSO, Pg. 22
TC-D-1†	Hybrid	600	—	600/600 0 dBm level	Same as DO-T Pg. 7
TC-L-1	Holding Coil	2 Hy @ 60 mA DC; 1.3 Hy @ 100 mA DC; 180 ohm			Figure 4
TC-L-2	Holding Coil	1 Hy @ 0 mA DC; .8 Hy @ 25 mA DC; 225 ohm			Figure 5
TC-L-3	Holding Coil	1 Hy @ 0 mA DC; .8 Hy @ 40 mA DC; 113 ohm			Figure 5
PC-0-17	Hipermalloy shield, slip fit over TC-0 units				
PC-SO-SH	Hipermalloy shield, slip fit over TC-SO units				
PC-SSO-SH	Hipermalloy shield, slip fit over TC-SSO units				
DOT-SH	Hipermalloy shield, slip fit over TC-D-1 units				

Series	Frequency Response	Max. Power Level	Longitudinal Balance	Maximum Distortion	Impedance Matching	Return Loss	Hybrid-trans-Hybrid Loss
TC-0	±.50 dB, 100 Hz-10 kHz	+10 dBm	50 dB min.	0.5%	±10%	26 dB min.	50 dB min.
TC-SO	±.50 dB, 200 Hz-10 kHz	+10 dBm	50 dB min.	0.5%	±10%	26 dB min.	50 dB min.
TC-SSO	±.50 dB, 275 Hz-10 kHz	+10 dBm	50 dB min.	0.5%	±10%	26 dB min.	50 dB min.

* Frequency response ±2 dB, 300 Hz to 10 kHz, flat pack design. † Two units required for 2-wire to 4-wire hybrid.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

Ultra-Compact™ Audio Units



TYPE A CASE 1½" x 1½" x 2" h.
Unit Weight: ½ lb. Mounting Holes 1$\frac{3}{32}$" sq.
Screws: 4-40. Cutout: 1⅜" dia.

PACKAGING High quality rugged die cast zinc alloy case with both top and bottom mounting facilities. Asterisked items (see Type No.) have multiple alloy shield.

APPLICATIONS Compact commercial amplifiers and equipments.

APPLICATION NOTE Included in line are filament/transistor supply units.

FOR HERMETIC METAL CASED MIL TYPES See Catalog page 15.

NOTE All units except those carrying DC in primary employ a true humbucking coil structure, which provides electrical balance and effects good inductive shielding.

HIPERMALLOY MAGNETIC SHIELD

APPLICATION Ideal for ultra low level applications such as microphone input, instrumentation, low cross talk multi-channel mixing, and medical.

SHIELDING Provides approximately 20 db of shielding.

INSTALLATION Slips over standard "A"-line case.

SIZE 1$\frac{19}{32}$" sq x 2$\frac{1}{32}$" H

INPUT AND MATCHING TRANSFORMERS

Type No.	Application	Primary Imp. Ohms	Unbal DC	Secondary Imp. Ohms	Response ±2 db (Hz)	Pri. Res. Ohms	Max. Level dbm	Max. Level mw
A-10	Low impedance to grid	50, 125/150, 200/250, 333, 500/600	0	50,000 split	20-20,000	59	+15	30
A-11*	Low impedance to 1 or 2 grids	50, 200, 500	0	50,000 CT	20-20,000	52	+ 5	3
A-12	Low impedance to PP grids	50, 125/150, 200/250, 333, 500/600	0	80,000 split	20-20,000	60	+15	30
A-20†	Mixing, matching	50, 125/150, 200/250, 333, 500/600	0	50, 125/150, 200/250, 333, 500/600	10-50,000	64	+15	30
A-21*†	Mixing, matching	50, 200/250, 500/600	0	50, 200/250, 500/600	30-30,000	28	+15	30
A-27	Xtal/hi. impedance to line	100,000 split	0	50, 125/150, 200/250, 333, 500/600	30-20,000 meas. with res. source	3700	+15	30
A-39*	Line to transistor	600/150 split	0	2000/500 split	20-20,000	70	+10	10
A-43†	Mixing, matching line or transistor to 2 simultaneously loaded lines or transistors	600/150 split	0	2 secondaries each 600/150 split	20-30,000	45	+15	30

* Multiple alloy shield for extremely low hum pickup † High electrostatic shielding

Interstage and Output Transformers

Type No.	Application	Primary Imp. Ohms	Unbal DC	Secondary Imp. Ohms	Response ±2 db (Hz)	Pri Res. Ohms	Max. Level dbm	Max. Level mw
A-15	Transistor Interstage	10,000/2500 split	8 ma	2000/500 split	40-20,000	600	—	1w
A-16	Plate to grid	15,000	0	60,000	20-20,000	800	+15	30
A-18	Single or PP Plates to PP grids	15,000 split	0	80,000 split	20-20,000	1040	+15	30
A-19	Plate to PP grids	15,000	8 ma	80,000 split	40-20,000	2900	+15	30
A-22	Tr. Instg. or output	500 CT	20 ma	500/125 split	40-20,000	36	—	1W
A-23	Tr. Instg. or output	500 CT	20 ma	16/4 split	40-20,000	36	—	1W
A-24	Single or PP plates to line	15,000 split	0	50, 125/150, 200/250, 333, 500/600	20-40,000	1430	+15	30
A-25	Plate to line	15,000	8 ma	50, 125/150, 200/250, 333, 500/600	40-20,000	1580	+15	30
A-26	Single or PP plates to line	30,000 split	0	50, 125/150, 200/250, 333, 500/600	20-40,000	2520	+15	30
A-28	Transistor to V.C.	48 CT	750 ma Bal	16 split, 8, 4	40-20,000	5	—	5W
A-34	Transistor Interstage	25,000/6250 split	3 ma	500/125 split	30-20,000	1620	—	1W
A-35	Transistor Interstage	10,000/2500 split	8 ma	500/125 split	30-20,000	610	—	1W
A-36	Transistor Interstage	500/125 split	20 ma	150/37.5 split	40-20,000	36	—	1W
A-37	Transistor Interstage	500/125 split	20 ma	50/12.5 split	40-20,000	36	—	1W
A-38	Transistor Interstage	100/25 split	40 ma	40/10 split	40-20,000	6.2	—	1W
A-44	Tr. Instg. or output	4K/1K split	12 ma	600/150 split	30-20,000	310	—	1W

Special Application Transformers and Inductor

Type No.	Application	Inductance Characteristics
A-30	Audio inductor	450 Hys @ 0 ma DC; 250 Hys @ 5 ma DC, 600 ohms; 65 Hys @ 10 ma DC, 1500 ohms

Type No.	Application	Pri. Imp. Ohms	Unbal DC	Sec. Imp. Ohms	±2 db from	Pri. Res. Ohms	Max. Level
A-45	Autotransformer, speaker matching	4, 8, 16	0	—	40 Hz - 20 kHz	1.2	1w @ 40 Hz; 4w @ 80 Hz
A-47	Hybrid transformer 3 balanced windings CT	500/600 CT Turns Ratio 1:1:1	0	500/600 CT 500/600 CT	40 Hz - 20 kHz	39	+10 dbm, 10 mw
A-48	"2 wire to 4 wire" hybrid circuit. Two transformers in one case for hybrid circuit use. Includes electromagnetic shielding. Hybrid circuit will provide 60 db minimum circuit isolation. Turns Ratio 1:1:1.	500/600	0	500/600 } 2 Wdgs. 500/600 } plus winding for balance loading.	40 Hz - 20 kHz	—	+10 dbm, 10 mw
A-49	Similar to A-48 except Turns Ratio 1:1.41:1.41						

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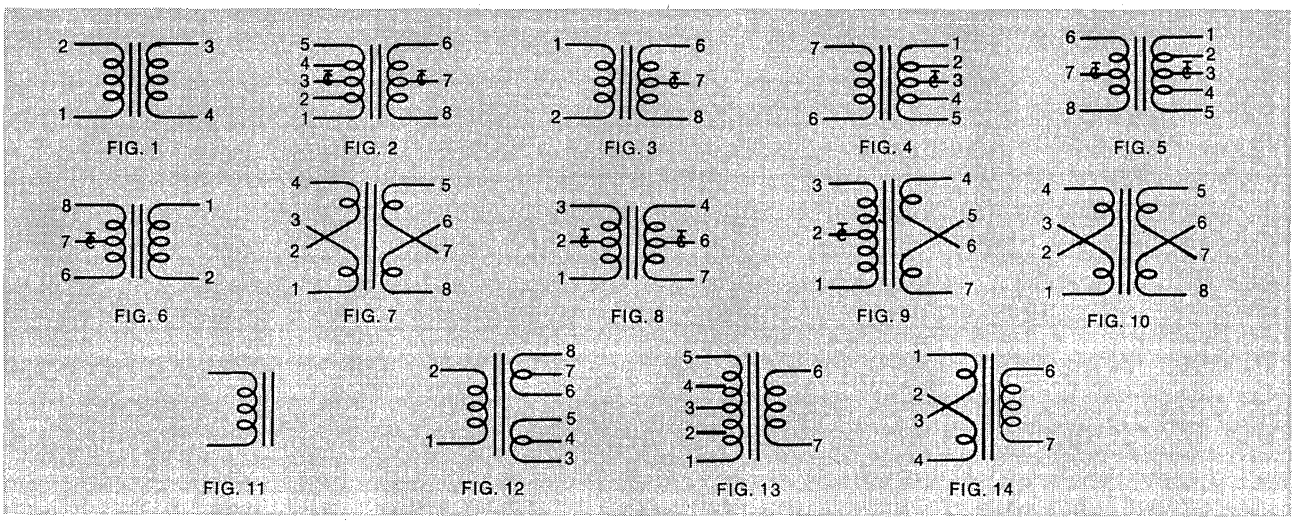
O, PC-O
Performance Characteristics

FREQUENCY RESPONSE: 100 Hz - 40 kHz **WORKING VOLTAGE: 175 V PEAK ALL UNITS**

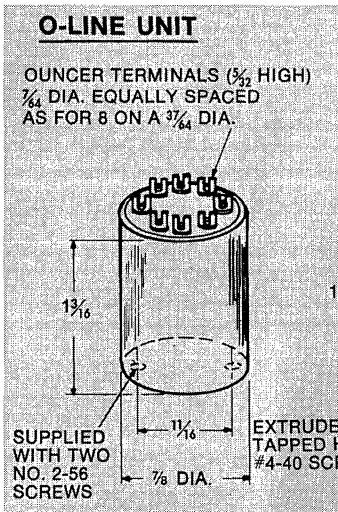
Type No. O-#	Type No. PC-O-#	Application	Pri. Imp. Ω	Unbal. ma DC/Pri.	Sec. Imp. Ω	DCR ±20% Pri.	DCR ±20% Sec. Ser. Conn.	Turns Ratio ±3% Total Pri.	Turns Ratio ±3% Total Sec.	Max. Level dbm	Max. Level mw	Schem. Diag. Fig. No.	±1 db (Hz)	Term. w/Same Polarity
1	1	Low input imp. to grid	50, 200/250, 500/600		50K	52	3900	1	10	+8	6.3	13	30-20K	1,6
2	2	Low input imp. to PP grids	50, 200/250, 500/600		50K CT	52	3900	1	10	+8	6.3	2	30-20K	1,6
3	3	Low input imp. to grid	7.5/30		50K	4.5		1	40.9	+8	6.3	14	30-20K	
4	4	Plate to grid	15K		60K	710	3200	1	2	+8	6.3	1	30-20K	1,3
5	5	Plate to grid	15K	4	60K	710	3200	1	2	+8	6.3	1	200-10K	1,3
6	6	Plate to PP grids	15K		95K CT	690	3900	1	2.5	+8	6.3	3	30-20K	1,6
7	7	Plate to PP grids	15K	4	95K CT	690	3900	1	2.5	+8	6.3	3	200-10K	1,6
8	8	Plate to line	15K		50, 200/250, 500/600	950	48	5.49	1	+8	6.3	4	30-20K	1,6
9	9	Plate to line	15K	4	Same as 0-8	950	48	5.49	1	+8	6.3	4	200-10K	
10	10	PP to line	30K CT		Same as 0-8	1300	52	7.7	1	+8	6.3	5	30-20K	1,8
11	11	Crystal to line or transistor	50K		Same as 0-8	3900	53	10	1	+8	6.3	4	30-20K	1,6
12	12	Mixing matching	50, 200/250		Same as 0-8	12	45	1	1.58	+8	6.3	5	30-20K	1,6
13	13	Inductor	300 Hys @ 0 DC; 50 Hys @ 3 ma DC; 6000 ohms			—	—	—				11		
15	15	10:1 plate to grid	10K		1 Megohm	330	4875	1	10	+8	6.3	1	50-5K	1,3
16*		Low imp. to grid	250 CT		50K	40	1900	1	14	+8	6.3		30-20K	
17		Hipermalloy shield, slip fit over ouncer, 1″ dia. provides 25 db shielding					—	—	—					
	17	Hipermalloy shield, slip fit over PC-O unit, 1 1/16″ max. x 1 1/8″ max. x 25/32″ max. H												
18	18	Transistor interstage	10/2.5K split	4	2K/500 split	800	204	2.24	1	+20	100	7	100-20K	1,2,5,6
19	19	Transistor interstage	10/2.5K split	4	4K/1K split	800	353	1.58	1	+20	100	7	100-20K	1,2,5,6
20	20	Transistor to line	1500 CT	8	500/125 split	100	35	1.73	1	+20	100	9	100-20K	1,4
21	21	Transistor to voice coil	2000/4000 CT	4	8/16	200	.9	15.8	1	+20	100	6	100-20K	6,1
22	22	Transistor to voice coil	400/500 CT	20	3.2/4	35	.45	11	1		1W†	6	100-20K	6,1
24	24	Inductor	1.6 Hys @ 3 ma DC; .8 Hys @ 10 ma DC; 25 ohms			—	—	—				11		
25	25	Transistor input	600/150 split		2K/500 split	70	280	1	1.83	+15	30	7	50-15K	1,2,5,6
26	26	Transistor interstage	10K CT	4	10K CT	700	1000	1	1	+20	100	8	100-20K	1,4
27	27	Transistor interstage	10K CT	4	500/125 split	750	52	4.5	1	+20	100	9	100-20K	1,4,5
28	28	Transistor interstage	50K CT	2	500/125 split	3200	64	10	1	+20	100	9	100-20K	1,4,5
29	29	Transistor interstage or chopper	100K CT	1	500/125 split	3200	35	14	1	+20	100	9	100-20K	1,4,5
30	30	Transistor interstage	500/125 split	20	500/125 split	37	67	1	1		1W†	10	100-20K	1,2,5,6
31	31	Transistor interstage	500/125 split	20	150/37.5 split	35	16	1.8	1		1W†	10	100-20K	1,2,5,6
32	32	Transistor interstage	500/125 split	20	50/12.5 split	37	7	3.16	1		1W†	10	100-20K	1,2,5,6
33	33	Transistor interstage	100/25 split	40	40/10 split	9	5	1.58	1		1W†	7	100-20K	1,2,5,6
35	35	Hybrid	600		600/600 CT	95 ea.	1:1:1 3 equal windings				250	12	100-20K	1,3,6
36	36	Split inductor	Series connection: 1 Hy 20 ma DC; 60 ohms Parallel connection: 25 Hys 40 ma DC; 15 ohms			—	—	—						
37	37	Transistor to line	4K/1K split	4	600/150 split	395	57	2.58	1		1W†	7	100-20K	1,2,5,6

* Uses two heavy gauge hipermalloy shields for very low hum pickup plus orientable mounting.
Primary CT is balanced to 1% can be used for 150, 200, 250, 500 or 600 ohm source . . . 200:1 imped. ratio. 3 oz.
† At 200 Hz, ¼ watt at 100 Hz.

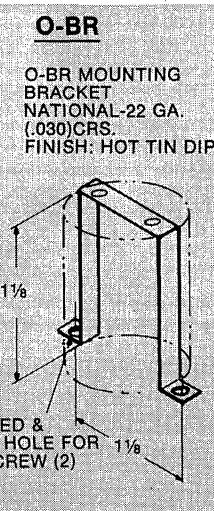
O, PC-O
Performance Characteristics



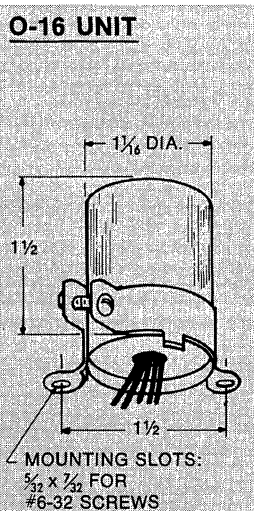
O-LINE UNIT



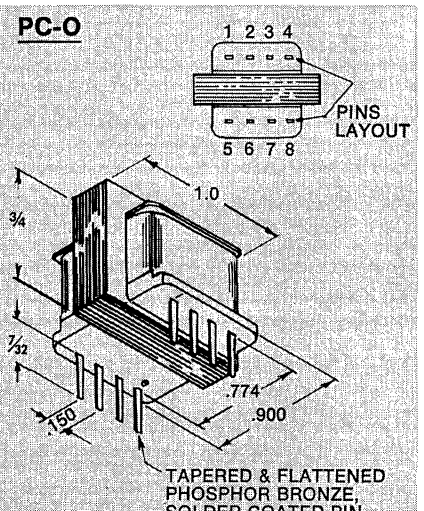
O-BR



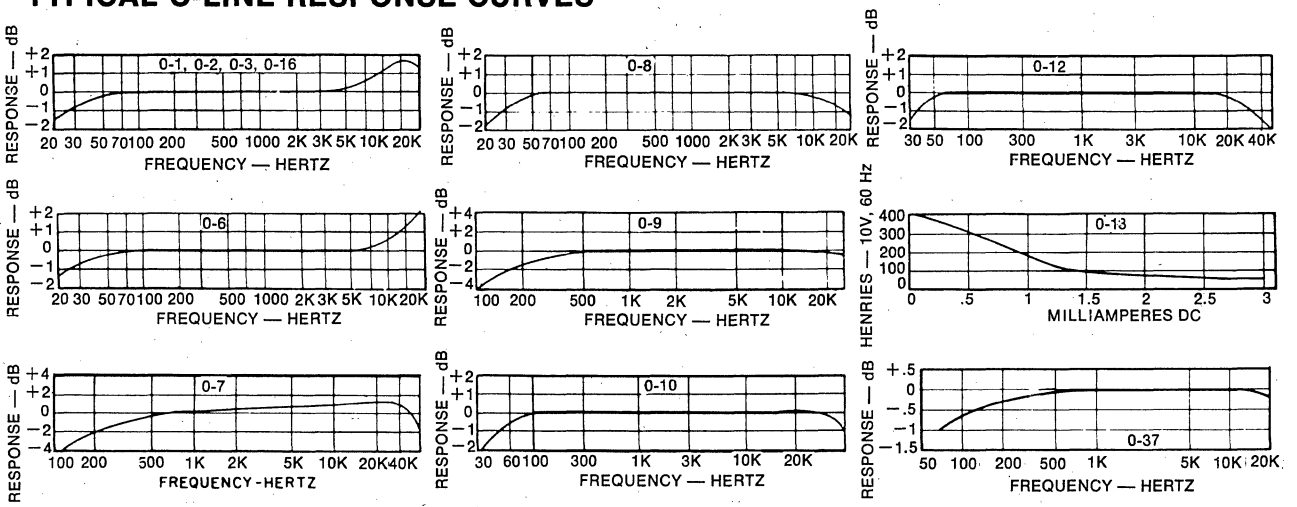
O-16 UNIT



PC-O



TYPICAL O-LINE RESPONSE CURVES



SO, PC-SO, SO-P
Performance Characteristics

Line	Type No. SO	Type No. PC-SO	Type No. SO-P	MIL Part No. for Type SO-P	E. T. Product Millivolt Sec.	Unbal. DC ma in Winding	Input-Matching Impedance Primary (Ohms)	Output-Matching Impedance Secondary (Ohms)	Maximum Level DBM	Maximum Level M.W	Series Connected DCR ±25% Ohms In Pri.	Series Connected DCR ±25% Ohms Out Sec.	Turns Ratio ±3% Pri.	Turns Ratio ±3% Sec.	Schem. PC/P	Pins Arrange PC/P
	Input Winding								Frequency Response 200 Hz - 20 kHz — Working Voltage: 175 Peak							
1	9	9	9	M27/165-06	1.5	0	3.2	500 CT	+24	250	0.35	15	1	12.5	20/9	E/C
3	10	10	10	M27/165-09	4.6	60	8 16	2000 CT 4000 CT	+24	250	2	290	1	15.9	20/9	E/C
4	14	14	14	M27/165-01	5.2	10	32 split 40 split	80 CT 100 CT	+24	250	3.2	4.9	1	1.58	5/11	E/D
5	13	13	13	M27/165-03	5.8	2.5	40 split 50 split	400 CT 500 CT	+24	250	4.5	20	1	3.16	5	E
6	4	4	4	M27/165-16	3.7	24	50	30K	+23	200	3.8	1850	1	24.5	10	E
7	6	6	6	M27/165-18	3.2	20	60	100K	+23	200	3.7	3400	1	40	10	E
8	14	14	14	M27/165-01	8.3	16	80 CT 100 CT	32 split 40 split	+24	250	4.9	3.2	1.58	1	5/11	E/D
9	12	12	12	M27/165-04	10	14	120 split 150 split	400 CT 500 CT	+24	250	12.6	20	1	1.82	5	E
10	1	1	1	M27/165-02	1.2	0	200 50	250K 62.5K	+10	10	16	2500	1	35	10	E
11	3	3	3	M27/165-11	10	21 10	200 500	10K 25K	+23	200	30	1225	1	7.1	10/1	E/A
13	13	13	13	M27/165-03	18	8	400 CT 500 CT	40 split 50 split	+24	250	20	4.5	3.16	1	5	E
14	12	12	12	M27/165-04	18	8	400 CT 500 CT	120 split 150 split	+24	250	20	12.5	1.82	1	5	E
15	11	11	11	M27/165-05	18	8	400 CT 500 CT	400 split 500 split	+24	250	20	45	1	1	5	E
16	9	9	9	M27/165-06	19	0	500 CT	3.2	+24	250	15	.35	12.5	1	20/9	E/C
17	15	15	15	M27/165-07	23	6	600 CT	600 split	+24	250	35	60	1	1	5/11	E/D
18	22	22	22	TF5R21ZZ	28	5	900 split	600 split	+24	250	72	44	1.22	1	7	E
19	20	20	20	M27/165-08	32	4	600 split†	10K CT	+23	200	80	1050	1	4.08	6	E
20	18	18	18	M27/165-17	23	9	600 split	50K CT	+24	250	63	2400	1	9.1	5/11	E/D
21	7	7	7	M27/165-15	9.2	2.5	800 1200	20K 30K	+23	200	32	450	1	5	10/1	E/A
22	22	22	22	TF5R21ZZ	23	6	600 split	900 split	+24	250	44	72	1	1.22	7	E
23	10	10	10	M27/165-09	7.4	4 2	2K CT 4K CT	8 16	+24	250	290	2	15.9	1	20/9	E/C
24	8	8	8	M27/165-12	15	2.2	2K CT	10K	+23	200	40	1000	1	2.23	2/3	E/B
25	16	16	16	M27/165-10	46	4	2500 CT	2500 split	+24	250	140	300	1	1	5	E
26	3	3	3	M27/165-11	74	3 1.5	10K 25K	200 500	+23	200	1225	30	7.1	1	10/1	E/A
27	20	20	20	M27/165-08	133	1	10K CT†	600 split	+23	200	1050	80	4.08	1	6	E
28	8	8	8	M27/165-12	34	1	10K	2000 CT	+23	200	1000	40	2.23	1	2/3	E/B
29	21	21	21	M27/165-13	111	1	10K CT† 12K CT†	10K split 12K split	+23	200	855	1080	1	1	6	E
30	2	2	2	M27/165-14	10	.25	10K	90K	+20	100	215	1850	1	3	10/1	E/A
31	7	7	7	M27/165-15	46	.5	20K 30K	800 1200	+23	200	450	32	5	1	10/1	E/A
32	4	4	4	M27/165-16	91	1	30K	50	+23	200	1850	3.8	24.5	1	10	E
33	18	18	18	M27/165-17	100	1	50K CT	600 split	+24	250	2400	63	9.1	1	5/11	E/D
34	2	2	2	M27/165-14	29	0	90K	10K	+20	100	1850	215	3	1	10/1	E/A
35	6	6	6	M27/165-18	130	.5	100K	60	+23	200	3400	3.7	40	1	10	E
36	1	1	1	M27/165-02	44	0	250K 62.5K	200 50	+10	10	2500	16	35	1	10	E

† Electrostatic Shield.

Key to SO Line

SO-Type	Line Number
1	10-36
2	30-34
3	11-26
4	6-32
5	37-38
6	7-35
7	21-31
8	24-28
9	1-16
10	3-23
11	15
12	9-14
13	5-13
14	4-8
15	17
16	25
18	20-33
20	19-27
21	29
22	18-22

INDUCTORS

37	SO-5	Inductor, 50 Hys @ 1 maDC, 2675 ohms DC res.		
38	SO-5P PC-SO5	Split Inductor — Series: 40 Hys @ 1 maDC, 20 Hys @ 2 maDC, 2675 ohms Parallel: 10 Hys @ 2 maDC, 5 Hys @ 4 maDC, 670 ohms	13/12	E/A

SHIELDS Drawn Hipermalloy Shield provides 20 db Shielding

PC-SO-SH	31/32″ Sq x 5/8″ H
SO-P-SH	1 1/16″ L x 13/16″ W x 47/64″ H

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Subouncer™ Units

TYPES

SO — Open frame type with flexible leads.

PC-SO — Printed circuit board mounting open frame (new item).

SO-P — Hermetically sealed type to complete MIL-T-27D Specs, Grade 5, Class R.

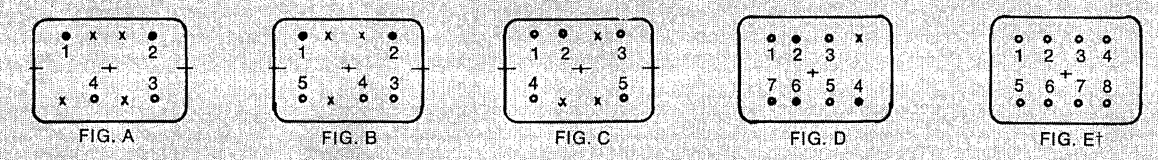
NOTES

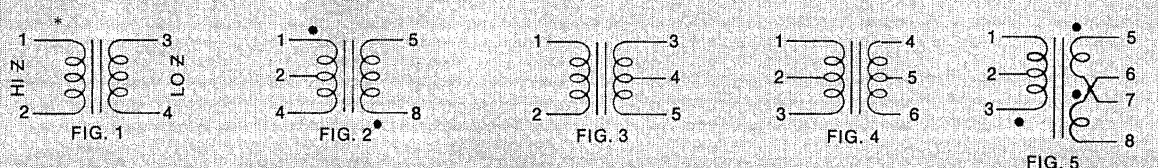
ON PERFORMANCE CHARACTERISTICS

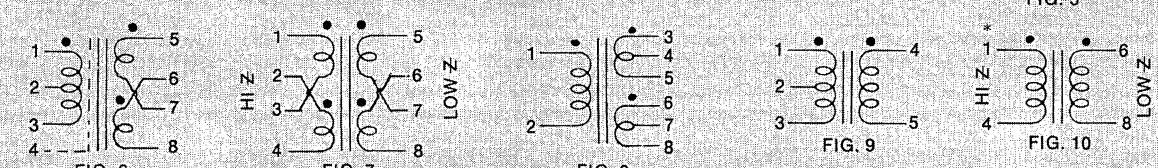
- To present the widest range of application, matching impedance values are listed in order of increasing impedance value without regard to the traditional designation of primary or secondary winding.
- The primary and secondary winding can be used arbitrarily as the input or output.
- Impedance values written one above the other indicate a range of matching impedances over which the parts will give satisfactory performance as long as the impedance ratio is maintained.
- Impedance values separated by a slash indicate the series and parallel connected impedance value of the windings.
- PC-SO Types have terminal arrangements that permit the connection of series or parallel windings by bridging adjacent terminals (see Fig. 14). This eliminates unwanted cross overs on the PC board when split is available.

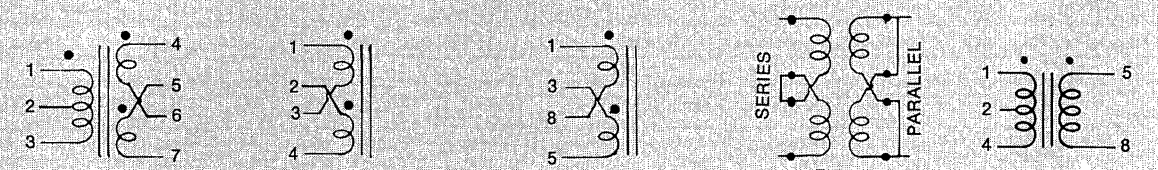
(E.T. is the maximum voltage, time product for a single pulse applied to the winding.)

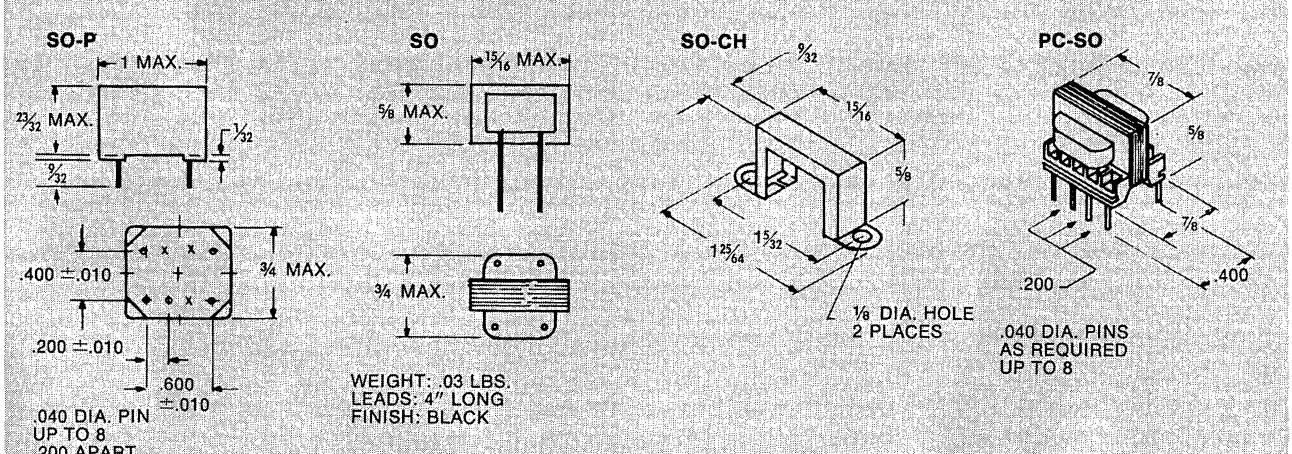
PIN ARRANGEMENT (Pins not used are removed. These are indicated by "x.")











† Pin numbers not shown in schematic will be missing. * On PC-SO-2 and SO-2P, Hi Z and Lo Z are reversed.

SSO, PC-SSO, SSO-P
Performance Characteristics

Line	Type No. SSO	Type No. PC-SSO	Type No. SSO-P	E.T. Product Millivolt Sec.	Unbal. DC ma In Winding	Input-Matching Impedance Primary (Ohms)	Output-Matching Impedance Secondary(Ohms)	Maximum Level DBM	Maximum Level M.W.	Series Connected DCR ±25% Ohms In Pri.	Series Connected DCR ±25% Ohms Out Sec.	Turns Ratio ±3% Pri.	Turns Ratio ±3% Sec.	Schematic Catalog Pg. 22 PC/P	Pins Arrangement Catalog Pg. 22 PC/P
	Input Winding					300 Hz - 20 kHz — Working Volts: 175 Peak									
1	16	16	16	1.2	54	3.2 4.0	1200 1500	+20	100	.45	70	1	18.1	10	F
2	10	10	10	1.5	54	3.2	10K	+20	100	.65	800	1	55.5	10	F
3	29	29	29	2.5	26	12.8/3.2 split* 16.0/4 split*	500/125 split* 600/150 split*	+20	100	1.5	36.2	1	6.11	7	F
4	36	36	36	2.5	26	12.8/3.2 split* 16.0/4 split*	4K/1K split 5K/1.25K split	+20	100	1.5	327	1	17.6	7	F
5	38	38	38	2.5	26	12.8/3.2 split* 16.0/4 split*	8K/2K split 10K/2.5K split	+20	100	1.5	600	1	25	7	F
6	9	9	9	3.3	26	16	10K	+20	100	2.7	800	1	25	10	F
7	11	11	11	2.5	11	50 60	500 600	+20	100	5	50	1	3.16	10	F
8	30	30	30	2.5	11	50/12 split* 60/15 split*	500/125 split* 600/150 split*	+20	100	6.5	36	1	3.16	7	F
9	12	12	12	2.5	11	50 60	1000 1200	+20	100	5.0	90	1	4.45	10	F
10	4	4	4	2.6	11	50	30K	+20	100	4.6	2875	1	24.5	10	F
11	6	6	6	2.0	15	60	100K	+20	100	3.3	3500	1	40	10	F
12	28	28	28	5.5	10	48/12 split* 100/25 split*	48/12 split* 100/25 split*	+20	100	5.9	6.9	1	1	7	F
13	44	44	44	1.2	0	100/25 split*† 200/50 split*†	100K CT 200K CT	+7	5	4.1	3290	1	31.6	6	F
14	34	34	34	10	0	200/50 split* 240/60 split*	1K/250 split* 1200/300 split*	+20	100	19	102	1	2.23	7	F
15	3	3	3	7.7	10 5	200 500	10K 25K	+20	100	34	2500	1	7.1	10/1	F/A
16	14	14	14	4.7	14 7	200 CT 500 CT	10K CT 25K CT	+20	100	22	560	1	7.07	14/4	F/C
17	39	39	39	7.7	10 5	200/50 split 500/125 split	10K/2.5K split 25K/6.25K split	+20	100	34	2500	1	7.1	7	F
18	26	26	26	5.7	12	400/100 split 500/125 split	40K CT 50K CT	+20	100	43	1900	1	10	5	F
19	43	43	43	5.7	12	400/100 split 500/125 split	40K/10K split 50K/12.5K split	+20	100	43	1900	1	10	7	F
20	29	29	29	5.3	8	500/125 split* 600/150 split*	12.8/3.2 split* 16/4 split*	+20	100	36.2	1.5	6.11	1	7	F
21	11	11	11	2.6	3.5	500 600	50 60	+20	100	50	5	3.16	1	10	F
22	30	30	30	2.6	3.5	500/125 split* 600/150 split*	50/12.5 split* 60/15 split*	+20	100	36	6.5	3.16	1	7	F
23	19	19	19	13	10	500 CT	600 CT	+20	100	26	70	1	1.1	14/4	F/C
24	31	31	31	13	10	500/125 split*	600/150 split*	+20	100	30	42	1	1.1	7	F
25	32	32	32	Hybrid, 3 equal windings Center Tapped-Trifilar		500 600	500 CT 500 CT 600 CT 600 CT	+14	25	50	50 50	1:1:1		8	F
26	17	17	17	18	8	500 CT 600 CT	10K 12K	+20	100	95	800	1	4.48	13	F
27	40	40	40	18	8	500/125 split* 600/150 split*	10K/2.5K split 12K/3.0K split	+20	100	98	1200	1	4.48	7	F
28	19	19	19	15	10	600 CT	500 CT	+20	100	70	26	1.1	1	14/4	F/C
29	31	31	31	15	10	600/150 split*	500/125 split*	+20	100	40.3	32.9	1.1	1	7	F
30	33	33	33	13	10	600/150 split*†	600 CT	+20	100	29	42	1	1	6	F
31	46	46	46	15	10	600/150 split*	900/225 split*	+20	100	43	50	1	1.22	7	F
32	20	20	20	15	11	600 CT	1500 CT	+20	100	65	70	1	1.58	14/4	F/C
33	35	35	35	13	5	600/150 split*	2K/500 split*	+20	100	40	113	1.82	1	7	F
34	27	27	27	6.8	11	600/150 split	4K CT	+20	100	47	155	1	2.68	5/11	F/E
35	37	37	37	8.5	3.2	600/150 split*†	8K CT	+10	50	55	484	1	3.65	6	F
36	7	7	7	8.5	2.5	800 1200	20K 30K	+20	100	110	800	1	5	10	F
37	15	15	15	8.5	5	800 CT 1200 CT	20K CT 30K CT	+20	100	110	800	1	5	12/4	F/D
38	42	42	42	8.5	5	800/200 split 1200/300 split	20K/5K split 30K/7.5K split	+17	50	110	800	1	5	7	F
39	46	46	46	18	8	900/225 split*	600/150 split*	+20	100	50	43	1.22	1	7	F
40	12	12	12	11	3	1000 1200	50 60	+20	100	5	90	4.45	1	10	F
41	34	34	34		6	1K/25 split* 1200/300 split*	200/50 split* 240/60 split*	+20	100	102	19	2.23	1	7	F

† Electrostatic Shield * Bifilar

Key	
SSO	Line
2	64, 71
3	15, 55
4	10, 68
5	Pg. 22
6	11, 72
7	36, 65
8	49, 60
9	6, 54
10	2
11	7, 21
12	9, 40
13	42, 74
14	16, 57
15	37, 66
16	1, 45
17	26, 58
19	23, 28
20	32, 46
21	43, 75
22	47, 61
23	Pg. 22
24	Pg. 22
25	62
26	18, 69
27	34, 50
28	12
29	3, 20
30	8, 22
31	24, 29
32	25
33	30
34	14, 41
35	33, 48
36	4, 51
37	35, 53
38	5, 52
39	17, 56
40	27, 59
41	63
42	38, 67
43	19, 70
44	13, 73
45	44, 76
46	31, 39

SHIELDS-DRAWN HIPERMALLOY SHIELD PROVIDES 20 db SHIELDING

PC-SSO-SH	2 7/32" Sq x 1/2" H
SSO-P-SH	1" L x 13/16" W x 19/32" H

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

SSO, PC-SSO, SSO-P
Performance Characteristics

Line	Type No. SSO	Type No. PC-SSO	Type No. SSO-P	E.T. Product Millivolt Sec.	Unbal. DC ma In Winding	Input Winding: Input-Matching Impedance Primary (Ohms)	Input Winding: Output-Matching Impedance Secondary (Ohms)	300 Hz - 20 kHz — Working Volts: 175 Peak: Maximum Level DBM	Maximum Level M.W.	Series Connected DCR ±25% Ohms In Pri.	Series Connected DCR ±25% Ohms Out Sec.	Turns Ratio ±3% Pri.	Turns Ratio ±3% Sec.	Schematic Catalog Pg. 22 PC/P	Pins Arrangement Catalog Pg. 22 PC/P
42	13	13	13	3.2	0	1000	200K	+7	5	190	4000	1	14.4	10	F
43	21	21	21	3.2	0	1000 CT	200K CT	+7	5	200	4000	1	14.4	14/4	F/C
44	45	45	45	3.25	0	1000/250 split†	200K CT	+7	5	200	4000	1	14.4	6	F
45	16	16	16	22	3 1500	1200	3.2 40	+20	100	70	.45	18.1	1	10	F
46	20	20	20	23	7	1.5K CT	600 CT	+20	100	70	65	1.58	1	14/4	F/C
47	22	22	22	32	7	1500 CT 1800 CT	10K CT 12K CT	+20	100	300	800	1	2.58	12/4	F/D
48	35	35	35	25	2.5	2K/500 split*	600/150 split*	+20	100	113	40	1.82	1	7	F
49	8	8	8	10	2.2	2K CT	10K	+20	100	45	1200	1	2.23	13/3	F/B
50	27	27	27	16	2.5	4K CT	600 split	+20	100	155	47	2.58	1	5/11	F/E
51	36	36	36	44	2.6	4K/1K split 5K/125 split	12.8/3.2 split* 16/4 split*	+20	100	327	1.5	17.6	1	7	F
52	38	38	38	63	2	8K/2K split 10/2.5K split	12.8/3.2 split* 16/4 split*	+20	100	600	1.5	25	1	7	F
53	37	37	37	30	.6	8K CT†	600/150 split*	+7	50	484	55	3.65	1	6	F
54	9	9	9	82	2	10K	16	+20	100	800	2.7	25	1	10	F
55	3	3	3	55	3 1.5	10K 25K	200 500	+20	100	2500	34	7.1	1	10/1	F/A
56	39	39	39	55	3 1.5	10K/2.5K split 25K/6.25K split	200/50 split 500/125 split	+20	100	2500	34	7.1	1	7	F
57	14	14	14	33	2 1	10K CT 25K CT	200 CT 300 CT	+20	100	560	22	7.07	1	14/4	F/C
58	17	17	17	82	2	10K 12K	500 CT 600 CT	+20	100	800	95	4.48	1	13	F
59	40	40	40	82	4	10K/2.5 split 12K/3.0K split	500/125 split 600/150 split	+20	100	1200	98	4.48	1	7	F
60	8	8	8	23	1	10K	2K CT	+20	100	1200	45	2.23	1	13/3	F/B
61	22	22	22	82	4	10K CT 12K CT	1500 CT 1800 CT	+20	100	800	300	2.58	1	12/4	F/D
62	25	25	25	60	1	10K CT 12K CT	10K split‡ 12K split‡	+20	100	560	650	1	1	5/11	F/E
63	41	41	41	60	1	10K/2.5K split 12K/3.0K split	10K/2.5K split 12K/3.0K split	+20	100	560	650	1	1	7	F
64	2	2	2	13	.25	10K	90K	+15	30	710	3150	1	3	10	F
65	7	7	7	42	.5	20K 30K	800 1200	+20	100	800	110	5	1	10	F
66	15	15	15	42	1	20K CT 30K CT	800 CT 1200 CT	+20	100	800	110	5	1	12/4	F/D
67	42	42	42	42	1	20K/5K split 30K/7.5K split	800/200 split 1200/300 split	+17	50	800	110	5	1	7	F
68	4	4	4	64	1	30K	50	+20	100	2875	4.6	24.5	1	10	F
69	26	26	26	57	.5	40K CT 50K CT	400/100 split 500/125 split	+20	100	1900	43	10	1	5	F
70	43	43	43	57	.5	40K/10K split 50K/12.5K split	400/100 split 500/125 split	+20	100	1900	43	10	1	7	F
71	2	2	2	38		90K	10K	+15	30	3150	710	3	1	10	F
72	6	6	6	79	.5	100K	60	+20	100	3500	3.3	40	1	10	F
73	44	44	44	40	0	100K CT† 200K CT†	100/25 split 200/50 split	+7	5	3290	4.1	31.6	1	6	F
74	13	13	13	48	0	200K	1000	+7	5	4000	190	1	14.4	10	F
75	21	21	21	48	0	200K CT	1K CT	+7	5	4000	200	14.1	1	14/4	F/C
76	45	45	45	48	0	200K CT†	1K/250 split	+7	5	4000	200	14.4	1	6	F

† Electrostatic Shield * Bifilar ‡ Secondary is not split for SSO-25
Magnetic Shields on Catalog page 20

Key

SSO	Line
2	64, 71
3	15, 55
4	10, 68
5	Pg. 22
6	11, 72
7	36, 65
8	49, 60
9	6, 54
10	2
11	7, 21
12	9, 40
13	42, 74
14	16, 57
15	37, 66
16	1, 45
17	26, 58
19	23, 28
20	32, 46
21	43, 75
22	47, 61
23	Pg. 22
24	Pg. 22
25	62
26	18, 69
27	34, 50
28	12
29	3, 20
30	8, 22
31	24, 29
32	25
33	30
34	14, 41
35	33, 48
36	4, 51
37	35, 53
38	5, 52
39	17, 56
40	27, 59
41	63
42	38, 67
43	19, 70
44	13, 73
45	44, 76
46	31, 39

SSO, PC-SSO, SSO-P
Performance Characteristics

INDUCTORS

		Pri.	Sch.	Pin Diag.
SSO-5	50 Hys at 1 ma DC, 4400 ohms DC res.	Blk Blk		
SSO-23	8 Hys at 2 ma DC, 4 Hys at 5 ma DC, 650 ohms	Rd Gn		
SSO-24	3.5 Hys at 2 ma DC, 1.5 Hys at 5 ma DC, 160 ohms	Rd Blue		
PC-SSO-5 **SSO-5P**	Split Series: 100 Hys @ 0 ma DC, 50 Hys @ 1 ma DC, 4400 ohms Parallel: 25 Hys @ 0 ma DC, 12 Hys @ 2 ma DC, 1100 ohms		16/ /15	F/ /A
PC-SSO-23 **SSO-23P**	Split Series: 8 Hys @ 2 ma DC, 4 Hys @ 5 ma DC, 600 ohms Parallel: 2 Hys @ 4 ma DC, 1 Hy @ 10 ma DC, 150 ohms		16/ /15	F/ /A
PC-SSO-24 **SSO-24P**	Split Series: 3.5 Hys @ 2 ma DC, 1.5 Hys @ 5 ma DC, 160 ohms Parallel: 0.9 Hy @ 4 ma DC, 0.4 Hy @ 10 ma DC, 40 ohms		16/ /15	F/ /A

MIL-PART NUMBER DESIGNATIONS

Type No.	Designation	Type No.	Designation	Type No.	Designation	Type No.	Designation	Type No.	Designation
SSO-1P	M27/167-02	**SSO-10P**	M27/167-20	**SSO-19P**	M27/167-07	**SSO-28P**	M27/167-03	**SSO-37P**	M27/167-12
SSO-2P	M27/167-32	**SSO-11P**	M27/167-05	**SSO-20P**	M27/167-17	**SSO-29P**	M27/167-04	**SSO-38P**	M27/167-21
SSO-3P	M27/167-01	**SSO-12P**	M27/167-14	**SSO-21P**	M27/167-41	**SSO-30P**	M27/167-06	**SSO-39P**	M27/167-24
SSO-4P	M27/167-35	**SSO-13P**	M27/167-40	**SSO-22P**	M27/167-29	**SSO-31P**	M27/167-08	**SSO-40P**	M27/167-27
SSO-5P	TF5R20ZZ	**SSO-14P**	M27/167-25	**SSO-23P**	TF5R20ZZ	**SSO-32P**	M27/167-11	**SSO-41P**	M27/167-31
SSO-6P	M27/167-38	**SSO-15P**	M27/167-34	**SSO-24P**	TF5R20ZZ	**SSO-33P**	M27/167-09	**SSO-42P**	M27/167-13
SSO-7P	M27/167-33	**SSO-16P**	M27/167-16	**SSO-25P**	M27/167-30	**SSO-34P**	M27/167-15	**SSO-43P**	M27/167-37
SSO-8P	M27/167-28	**SSO-17P**	M27/167-26	**SSO-26P**	M27/167-36	**SSO-35P**	M27/167-10	**SSO-44P**	M27/167-39
SSO-9P	M27/167-22	**SSO-18P**	M27/167-23	**SSO-27P**	M27/167-18	**SSO-36P**	M27/167-19	**SSO-45P**	M27/167-42

PIN ARRANGEMENT (Pins not used are removed. These are indicated by "x.")

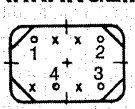


FIG. A

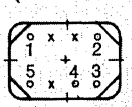


FIG. B

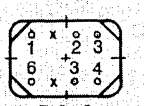


FIG. C

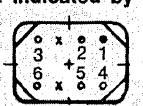


FIG. D

FIG. E

FIG. Ft

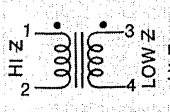


FIG. 1

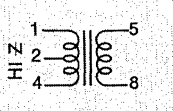


FIG. 2

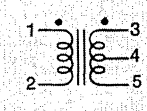


FIG. 3

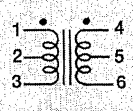


FIG. 4

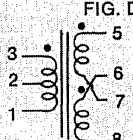


FIG. 5

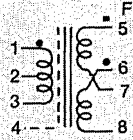


FIG. 6

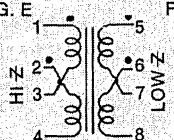


FIG. 7

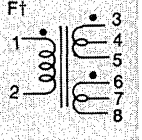


FIG. 8

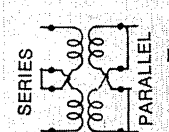


FIG 9

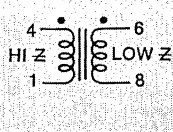


FIG. 10

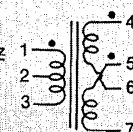


FIG. 11

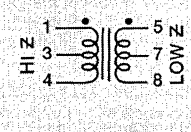


FIG. 12

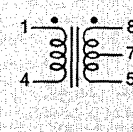


FIG. 13

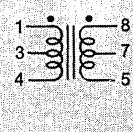


FIG. 14

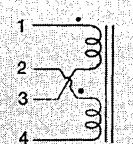


FIG. 15

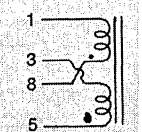
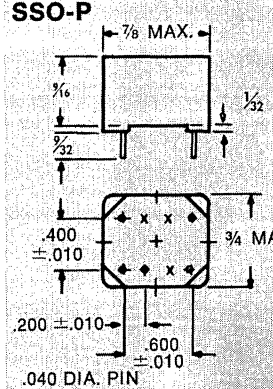


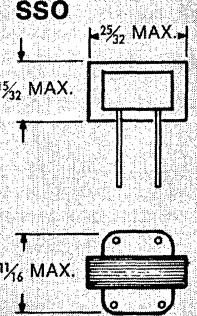
FIG. 16

SSO-P



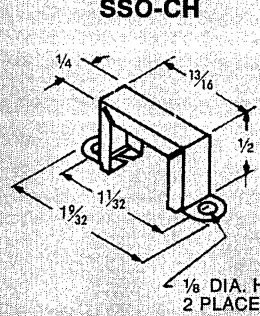
.040 DIA. PIN
UP TO 8
.200 APART (TYP.)

SSO



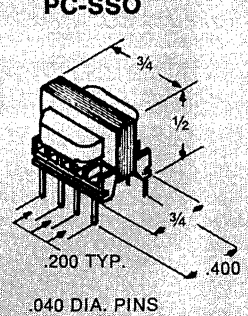
WEIGHT: .02 LBS.
LEADS: 4" LONG
FINISH: BLACK

SSO-CH



⅛ DIA. HOLE
2 PLACES

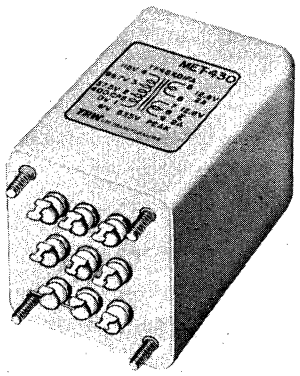
PC-SSO



.040 DIA. PINS
AS REQUIRED
UP TO 8

†Pin numbers not shown in schematic will be missing.

Universal Transistor Supply Transformers



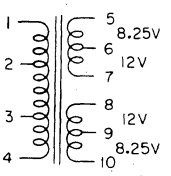
PACKAGING Hermetically sealed. Drawn metal case to MIL Grade 4.

MIL SPECS To complete MIL-T-27D Specs. MIL Type TF4S03 plus two letter case code. H-915 is qualified as M27/184-01. H-935 is qualified as M27/157-01. H-925 is qualified as M27/156-01.

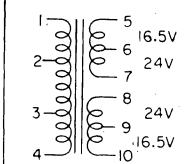
NOTES: Chart below shows the secondary AC voltages available, and the approximate DC voltages resulting, in typical capacitive filter silicon rectifier circuits (at the indicated currents). Since the capacitor following the rectifier affects the DC, voltage values used (in 1000 mfd) are shown in parenthesis ( ) after each current rating.

Primary taps can modify nominal AC voltages by −6%, +6%, and +12%.

UTC TYPE NO.
H-915 MET-465
H-925 MET-475
H-935 MET-445
H- 94 MET-455
H- 95
H- 96



UTC TYPE NO.
H-965 MET-495



PRI 2-4 115V NOM OUTPUT
1-4 115V -6% OUTPUT
1-3 115V +6% OUTPUT
2-3 115V+12% OUTPUT

INCLUDING MET™ SERIES

Primary 115 Volts, 50/60 Hz Nominal Secondary Volts, 8.25 to 40.5

Type No.	MIL DC Range	Industrial DC Range	MIL Case
H-915	6V-.065A to 53V-.02A	6V-.085A to 53V-.025A	AH
H-925	6V-.22A to 53V-.07A	6V-.28A to 53V-.085A	AJ
H-935	6V-1.2A to 53V-.4A	6V-1.52A to 53V-.48A	FA
H-94	6V-3A to 53V-1A	6V-3.8A to 53V-1.2A	HA
H-95	6V-7.5A to 53V-2.5A	6V-9A to 53V-3A	KA
H-96	6V-18A to 53V-6A	6V-23A to 53V-7.5A	OA

Primary 115 Volts, 50/60 Hz Nominal Secondary Volts, 16.5 to 81

H-965	12V-1.5A to 106V-.5A	12V-1.9A to 106V-.6A	HA

Primary 115 Volts, 400 Hz Nominal Secondary Volts, 8.25 to 40.5

Type No.	MIL DC Range	Industrial DC Range	MIL Case
MET-445	6V-.6A to 53V-.2A	6V-.75A to 53V-.25A	AH
MET-455	6V-1.2A to 53V-.4A	6V-1.25A to 53V-.48A	AJ
MET-465	6V-3A to 53V-1A	6V-3.8A to 53V-1.2A	FA
MET-475	6V-7.5A to 53V-2.5A	6V-9A to 53V-3A	HA

Primary 115 Volts, 400 Hz Nominal Secondary Volts, 16.5 to 81

MET-495	12V-.6A to 106V-.2A	12V-.76A to 106V-.24A	AJ

DC Output for 16.5- to 81-Volt Secondaries

Nominal AC Voltage	Approx. DC Voltage	DC Current in Amperes (Capacitance in 1000 mfd in Parentheses) 60-Hz Type H-965	400-Hz Type MET-495
Full Wave Bridge Silicon Rectifier			
16.5	12	1.5 (.5)	0.6 (.06)
24	24	1.25 (.5)	0.5 (.06)
33	36	0.75 (.25)	0.3 (.06)
40.5	48	1.0 (.25)	0.4 (.06)
48	50	0.65 (.125)	0.26 (.04)
57	68	0.60 (.125)	0.24 (.04)
64.5	82	0.55 (.125)	0.22 (0.4)
81	106	0.50 (.125)	0.20 (.04)
Full Wave CT			
33 CT	13	1.15 (.5)	0.46 (.06)
48 CT	24	0.90 (.25)	0.36 (.06)
81 CT	48	0.75 (.25)	0.30 (.06)

DC OUTPUT FOR 8.25- TO 40.5-VOLT SECONDARIES

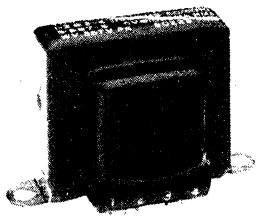
Nominal AC Voltage	Approx. DC Voltage	DC Current in Amperes (Capacitance in 1000 mfd in Parentheses) 60-Hz Types H-915	H-925	H-935	H-94	H-95	H-96	400-Hz Types MET-445	MET-455	MET-465	MET-475
Full Wave Bridge Silicon Rectifier											
8.25	6	.065 (.2)	.22 (.2)	1.2 (2)	3.0 (2)	7.5 (4)	18 (12)	.6 (.5)	1.2 (.5)	3.0 (.5)	7.5 (1)
12	12	.055 (.2)	.18 (.2)	1.0 (2)	2.5 (2)	6.0 (4)	15 (12)	.5 (.5)	1.0 (.5)	2.5 (.5)	6.0 (1)
16.5	18	.035 (.2)	.11 (.2)	.6 (1)	1.5 (1)	3.7 (2)	9 (6)	.3 (.25)	.6 (.25)	1.5 (.25)	3.7 (.5)
20.25	24	.042 (.2)	.14 (.2)	.8 (1)	2.0 (1)	5.0 (2)	12 (6)	.4 (.25)	.8 (.25)	2.0 (.25)	5.0 (.5)
24	25	.027 (.2)	.09 (.1)	.52 (.5)	1.3 (.5)	3.5 (1)	8 (4)	.26 (.15)	.52 (.15)	1.3 (.15)	3.5 (.25)
28.5	34	.025 (.1)	.085 (.1)	.48 (.5)	1.2 (.5)	3.0 (1)	7.5 (4)	.25 (.15)	.48 (.15)	1.2 (.15)	3.0 (.25)
32.25	41	.023 (.1)	.08 (.1)	.44 (.5)	1.1 (.5)	3.0 (1)	7 (4)	.22 (.15)	.44 (.15)	1.1 (.15)	3.0 (.25)
40.5	53	.020 (.1)	.07 (.1)	.40 (.5)	1.0 (.5)	2.5 (1)	6 (4)	.20 (.15)	.40 (.15)	1.0 (.15)	2.5 (.25)
Full Wave CT											
16.5 CT	6.6	.055 (.2)	.17 (.2)	.92 (2)	2.3 (2)	5.5 (4)	13.5 (12)	.46 (.5)	.92 (.5)	2.3 (.5)	5.5 (1)
24 CT	12	.040 (.2)	.13 (.2)	.72 (1)	1.8 (1)	4.5 (2)	11 (6)	.36 (.25)	.72 (.25)	1.8 (.25)	4.5 (.5)
40.5 CT	24	.035 (.2)	.11 (.2)	.60 (1)	1.5 (1)	3.7 (2)	9 (6)	.30 (.25)	.60 (.25)	1.5 (.25)	3.7 (.5)

Industrial Rating — Multiply D.C. Current By Approx. 1.25

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

Plug-In IC Power Transformers

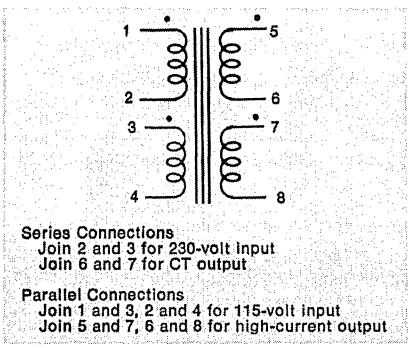
TPC Series



APPLICATIONS The TPC Series of plug-in power transformers is ideally suited for low-voltage, high-current IC feed applications. These units are also recommended for use in full-wave centertap and full-wave bridge rectifier circuits.

MIL SPECS To complete MIL-T-27D Specs, Grade 5, Class S.

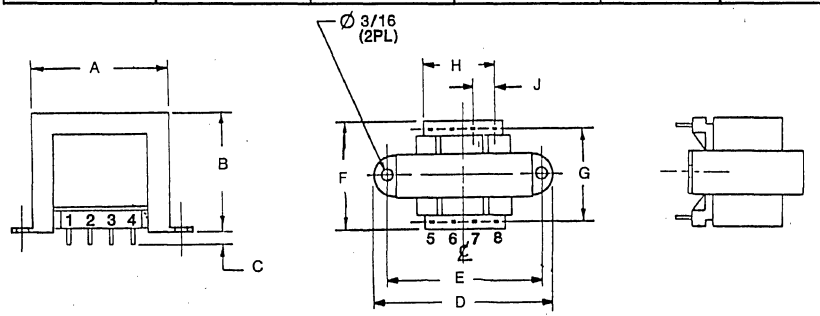
RATINGS Based on approximately 20% regulation from no-load to full-load RMS conditions.



Series Connections
Join 2 and 3 for 230-volt input
Join 6 and 7 for CT output

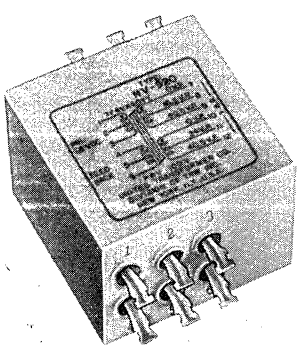
Parallel Connections
Join 1 and 3, 2 and 4 for 115-volt input
Join 5 and 7, 6 and 8 for high-current output

Type No.	Power Rating (VA)	Series Connections Primary Input: 230 volts, 50/60 Hz Secondary Voltage (volts)	Series Connections Primary Input: 230 volts, 50/60 Hz Max. Secondary Current (mA)	Parallel Connections Primary Input: 115 volts, 50/60 Hz Secondary Voltage (volts)	Parallel Connections Primary Input: 115 volts, 50/60 Hz Max. Secondary Current (mA)
TPC-10-170	1.7	10 CT	170	5	340
TPC-12-135	1.7	12 CT	135	6.3	270
TPC-16-110	1.7	16 CT	110	8	220
TPC-24-70	1.7	24 CT	70	12	140
TPC-28-60	1.7	28 CT	60	14	120
TPC-34-50	1.7	34 CT	50	17	100
TPC-40-40	1.7	40 CT	40	20	80
TPC-120-14	1.7	120 CT	14	60	28
TPC-10-530	5.3	10 CT	530	5	1060
TPC-12-420	5.3	12 CT	420	6.3	840
TPC-16-330	5.3	16 CT	330	8	660
TPC-24-220	5.3	24 CT	220	12	440
TPC-28-190	5.3	28 CT	190	14	380
TPC-34-155	5.3	34 CT	155	17	310
TPC-40-130	5.3	40 CT	130	20	260
TPC-120-45	5.3	120 CT	45	60	90
TPC-10-1200	12.0	10 CT	1200	5	2400
TPC-12-950	12.0	12 CT	950	6.3	1900
TPC-16-750	12.0	16 CT	750	8	1500
TPC-24-500	12.0	24 CT	500	12	1000
TPC-28-430	12.0	28 CT	430	14	860
TPC-34-350	12.0	34 CT	350	17	700
TPC-40-300	12.0	40 CT	300	20	600
TPC-120-100	12.0	120 CT	100	60	200



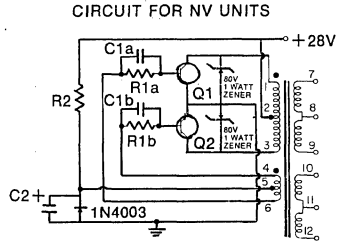
Power Rating	A Max.	B Max.	C ±.020	D Max.	E	F Max.	G ±.032	H ±.010	J Typ.	Weight, lb.
1.7 VA	1.50	1.25	.15	2.125	1.750	1.344	1.00	.60	.20	.20
5.3 VA	1.75	1.50	.15	2.375	2.000	1.469	1.10	.75	.25	.32
12.0 VA	2.00	1.75	.15	2.875	2.375	1.625	1.30	.75	.25	.58

NV™ Series



CIRCUIT

CIRCUIT FOR NV UNITS



R1a, R1b = 10Ω 1 WATT, R2 = 15K= 1 WATT
S1a, C1b = 43pf, C2 = 50 μf 6V
Q1, Q2 = TRW 2N5326

- Hermetically sealed.
- Made to complete MIL-T-27D specs; Grade 4, Class V.
- High efficiency.
- Advanced winding coupling technique.
- Reduced spiking assures transistor reliability.
- Miniaturization due to the use of high efficiency core material.
- Ease of rectifier filtering at high operating frequencies.

DIMENSIONS

NV-520, NV-720: 1 3/16" sq x 1 3/16" high max.
NV-530, NV-730: 1 9/16" sq x 1 3/16" high max.
Approximate weights: 1.5 oz. and 2.5 oz.

0 to Peak Volts		81	64.5	57	FULL WAVE BRIDGE 48	40.5	33	24	16.5	FULL WAVE CT 81 CT	48 CT	33 CT
Type No.	Freq. (kHz)	Current in amperes RMS, at above voltages										
NV-520	10	.4	.45	.5	.55	.8	.6	1.05	1.2	.55	.65	.85
NV-530	10	.8	.9	1	1.1	1.6	1.2	2.1	2.4	1.1	1.3	1.7
NV-720	20	.55	.6	.65	.70	1.1	.8	1.3	1.6	.70	.85	1.05
NV-730	20	1.1	1.2	1.3	1.4	2.2	1.60	2.6	3.2	1.4	1.7	2.1

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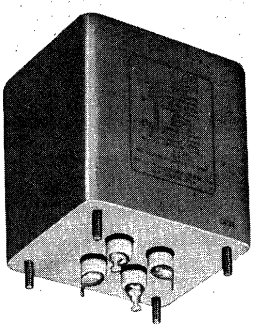
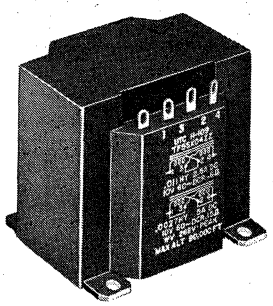
Filter Inductors

METAL CASED



MOLDED



PACKAGING Hermetically sealed. H-70 group — Metal encased. H-105 group — molded.

APPLICATIONS Transistor supply units have two windings for wide flexibility. All are swinging types to enhance power supply regulation.

CONSTRUCTION Grain-oriented core materials impart highest permeabilities, producing exceptionally high inductance for size.

MIL SPECS To complete MIL-T-27D Specs. H-70 group (metal cased) Grade 4, Class S. H-105 group (molded) Grade 5, Class S.

METAL CASED MIL-T-27D RATINGS IN REGULAR TYPE, **INDUSTRIAL RATINGS IN BOLD TYPE**

Type No.	MIL Type	Ind. @ ma Hys.	Ind. @ ma DC	Ind. @ ma Hys.	Ind. @ ma DC	Ind. @ ma Hys.	Ind. @ ma DC	Ind. @ ma Hys.	Ind. @ ma DC	Res. Ohms	Max. DCV Ch. Input	Test V RMS	MIL Case
H-70	TF4S04AH	20	20	18	25	14.5	30	10	35	925	350	1000	AH
H-71	TF4S04FB	20	40	18.5	50	15.5	60	10	70	350	500	2500	FB
H-72	TF4S04GB	13	70	11.5	85	9.5	105	7	125	215	500	2500	GB
H-73	TF4S04HB	11	100	9.5	125	7.5	150	5.5	175	150	700	2500	HB
H-74	TF4S04JB	11	150	10	170	8.5	195	**6.5**	**215**	135	700	2500	JB
H-75	TF4S04KB	11	200	10	230	8.5	250	**6.5**	**300**	90	700	2500	KB
H-76	TF4S04LB	11	200	10	230	8.5	250	**6.5**	**300**	85	1500	4500	LB
H-77	TF4S04MB	10	300	9	350	**8**	**390**	**6.5**	**435**	60	2000	5500	MB
H-78	TF4S04OA	7	400	**6.5**	**430**	**6**	**465**	**5.5**	**500**	48	2500	7000	OA
H-164†	M27/171-01	45‡	35	40‡	75	18‡	350	9‡	750	1.2		500	AG
*	(2 Wdgs.)	11.25‡	70	10‡	150	4.5‡	700	2.25‡	1.5A	.295			
H-166†	TF4S04AH	125‡	50	80‡	100	20‡	500	12‡	1 A	1.2		500	AH
*	(2 Wdgs.)	31‡	100	20‡	200	5‡	1 A	3‡	2 A	.3			
H-168†	TF4S04AJ	68‡	100	52‡	200	20‡	1 A	14‡	2 A	.8		750	AJ
*	(2 Wdgs.)	17‡	200	13‡	400	5‡	2 A	3.5‡	4 A	.2			
H-170†	TF4S04GB	180‡	125	140‡	250	25‡	1.25A	11‡	2.5A	.6		1000	GB
*	(2 Wdgs.)	45‡	250	35‡	500	6.2‡	2.5 A	2.7‡	5 A	.15			
H-171†	TF4S04JA	9‡	.75A	5‡	1.5A	2.2‡	7.5 A	1.6‡	15 A	.03		1000	JA
*	(2 Wdgs.)	2.25‡	1.25A	1.25‡	3 A	.55‡	15 A	.4‡	30 A	.0075			
H-172†	TF4S04HA	70‡	.25A	65‡	.4A	20‡	2 A	9‡	4 A	.22		1000	HA
*	(2 Wdgs.)	17.5‡	.5 A	16‡	.8A	5‡	4 A	2.25‡	8 A	.055			
H-173†	TF4S04KA	80‡	.5 A	72‡	.8A	16.5‡	4 A	8.2‡	8 A	.15		1000	KA
*	(2 Wdgs.)	20‡	1 A	18‡	1.6A	4.1‡	8 A	2.1‡	16 A	.038			
H-174†	TF4S04MB	50‡	.65A	45‡	1.3A	10‡	6.5 A	6.5‡	13 A	.08		1000	MB
*	(2 Wdgs.)	12.5‡	1.3 A	11‡	2.6A	2.5‡	13 A	1.6‡	26 A	.02			

MOLDED

Type No.	MIL Part No.	Inductance - Henries @ ma DC	DCR Ohms	Test Volts	L	W	H	Mtg. Dim. and Studs	Wgt. Lbs.
H-105	M27/149-01	2.5 @ 25 ma, 2 @ 35 ma, 1.5 @ 45 ma	225	1000	1¼	15/16	15/16	9/16 x 7/8 two #4-40 Taps, Diag.	.1
H-106	M27/159-01	2.25 @ 60 ma, 1.75 @ 80 ma, 125 @ 100 ma	110	1000	1⅝	1⅝	1⅜	1⅝ x 15/16 1/8 Dia. 4 holes	.28
H-107	M27/160-01	2 @ 120 ma, 1.5 @ 160 ma, 1 @ 200 ma	55	2500	2⅛	1¾	1 55/64	1¾ x 1 11/32 5/32 Dia. 4 holes	.9
H-108	M27/179-01	2 @ 220 ma, 1.5 @ 270 ma, 1 @ 325 ma	35	2500	2⅞	2½	2 17/32	2 3/16 x 2 1/16 5/32 x 7/32 4 slots	1.7
H-109† (2 wdgs)*	TF5S04ZZ	.2 @ 125 ma, .025 @ 1.25A, .011 @ 2.5A .055 @ 250 ma, .00625 @ 2.5A, .0027 @ 5A	.6 .15	750	2⅞	2½	2 17/32	2 3/16 x 2 1/16 5/32 x 7/32 4 slots	1.7

† Split winding in series. * Split winding in parallel. ‡ Rated in millihenries. ¶ Terminals opposite mounting.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

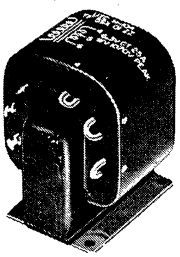
400 Hz Transformers

PACKAGING Hermetically sealed. DO-T's and MET's metal encased. H-101 group — molded.

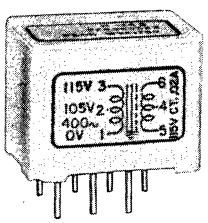
APPLICATION Transistor/filament and isolation.
SHIELDING All isolation transformers electrostatically shielded.

MIL SPECS To complete MIL-T-27D Specs. DO-T's: Grade 5, Class R. MET's: Grade 4, Class S. Molded units: Grade 5, Class S.

Molded Types, Grade 5



H-101 thru H-104



H-118
H-148
H-149

Primary: 105/115 Volts 380-1000 Hz
Secondary: 6.3 VCT 2500V RMS Test

Type No.	MIL-Type	Sec. Amp.	L In.	W In.	H In.	Mtg. Dim.	Wt. Lbs.
H-101	TF5S03ZZ	3.5	1 25/32	1 21/32	2	1 1/8 x 1 5/32	.3
H-102	M27/202-01	5.5	1 3/4	2	2 1/4	1 1/8 x 1 9/32	.44
H-103	M27/158-01	10	2 5/16	2 1/8	2 1/2	1 11/16 x 1 13/32	.8
H-104	M27/201-01	25	2 7/8	2 1/2	3 1/32	2 3/16 x 1 17/32	1.5

H-101 thru H-104 mounted by 4 holes .157D

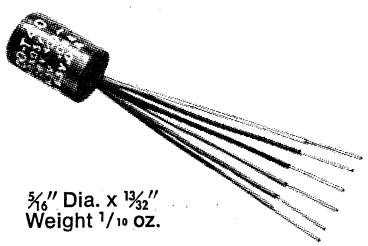
500V RMS TEST

Type No.	H-118	H-148‡	H-149
Application	Supply	Isolation	Supply
Primary	105/115V 380-1000 Hz	105/115V 400 Hz	28V 380-1000 Hz
Secondary	6.3V CT — .3A	115V CT-.02A	1) 6.3V-.08A 2) 6.3V-.08A 12.6V-.08A* 6.3V-.16A†
MIL-Type	TF5S03ZZ	TF5S03ZZ	TF5S03ZZ
Case Type (See pgs. 19 & 22)	SO-#P	SO-#P	SSO-#P

* Series Connected. † Parallel Connected. ‡ **ELECTROSTATICALLY SHIELDED.**

Metal Encased Types, Grade 5 DO-T400™ Series

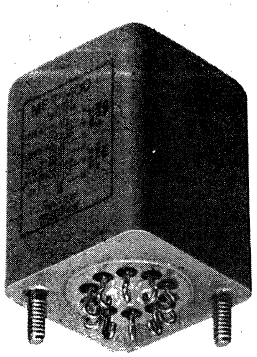
MIL TYPE TF5R03ZZ



5/16" Dia. x 13/32"
Weight 1/10 oz.

Type No.	Application	Primary	Secondary	Rated Heat Rise
DO-T400	Isolation transformer	28V, 400 Hz	6.3V @ 60 mA	40°C
DO-T410	Isolation transformer	28V, 400 Hz	(2 secs.) 6.3V @ 30 mA, 6.3V @ 30 mA	40°C
DO-T415	Isolation transformer	28V, 400 Hz	(2 secs.) 12.6V @ 15 mA, 12.6V @ 15 mA	40°C
DO-T420	Electrostatically shielded isolation transformer	28V, 400 Hz	28V @ 10 mA	40°C
DO-T430	3-watt autotransformer	28V, 400 Hz	12.6V - 0 - 12.6V @ 120 mA	40°C
DO-T440	3/4-watt autotransformer	28V, 400 Hz	6.3V - 0 - 6.3V @ 60 mA	40°C
DO-TSH DO-TSH2	Drawn Hipermalloy shields provide 20 to 40 dB shielding, each. See Catalog page 7 for dimensions			

MET™ Series

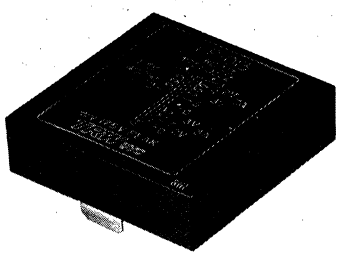


Type No.	MIL Type	Pri. Volt	Sec. Volts	Amps. (MIL)	Amps (Industrial)	Sec. Test Volts RMS	MIL Case
MET-400‡	TF4S03AH 380-1000 Hz 105/115/125V		115 CT 115 CT 230* 115†	.06 .06 .06 .12	**.072** **.072** **.072** **.144**	1000	AH
MET-405‡	TF4S03EA 380-1000 Hz 105/115/125V		115 CT 115 CT 230* 115†	0.2 0.2 0.2 0.4	**.24** **.24** **.24** **.48**	1000	EA
MET-410	TF4S03YY 115V, 400 Hz		6.3	0.6	**.75**	500	RC-25 (Pg. 12)
MET-420	TF4S03AH 380-1000 Hz 105/115/125V		6.3 CT	2	**2.5**	1500	AH
MET-430¶	M27/180-01 400 Hz 57.5, 99.6, 115V		12.6 CT 12.6	2 2	**2.5** **2.5**	1500	FA

* Series Connected. † Parallel Connected. ‡ **ELECTROSTATICALLY SHIELDED.**
¶ Two MET-430's Scott connected provide 26 volt two phase from 115 V. three phase 400 Hz input.

400 Hz Power Transformers
Low Profile MIL-T-27 Grade 5 Class S

FP Series



APPLICATION Offering significant cost and size advantages over competitive low-voltage, high-current toroids, FP Series 400 Hz power transformers are wide applicability types which will fit many modern circuit needs.

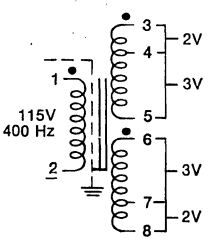
RATINGS Three power levels are available: 10, 20 and 30 watts. Within each power rating, three different winding and secondary tap arrangements are provided to cover a total voltage range from 2 to 30 volts. Since performance specifications are based on maximum-voltage, full-winding use, slight power derating is required when employing lower voltage taps, to keep current density normal.

CONSTRUCTION FP transformers feature a semi-toroidal, hum-bucking, self-shielding construction. Integral electrostatic shields are terminated in two unique mounting tabs. The units are of a low-profile design — .62 inches high — to fit "sandwich board" shallow drawer requirements. "PC" terminal types on all units.

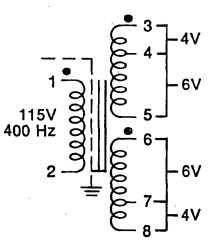
MIL SPECS To complete MIL-T-27D specifications. MIL Type No. TF5SO3ZZ.

SCHEMATICS

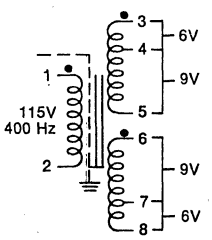
FP-011
FP-012
FP-013

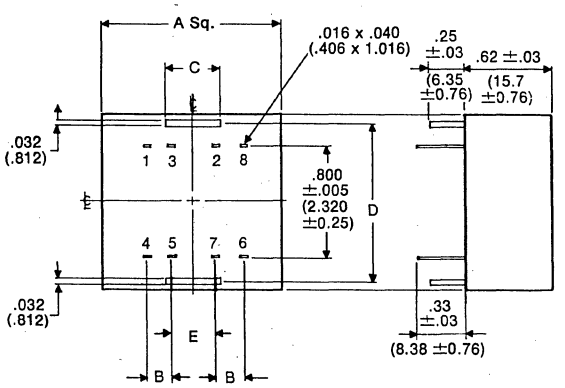


FP-021
FP-022
FP-023



FP-031
FP-032
FP-033





SPECIFICATIONS

Type No.	Power Rating (Watts)	Primary Voltage (Volts)	Secondary Voltages (Volts)	Weight Lb. (Gms.)
FP-011	10	115	2, 3, 4, 5, 6, 7, 8, 10	.125 (56.7)
FP-021	10	115	4, 6, 8, 10, 12, 14, 16, 20	.125 (56.7)
FP-031	10	115	6, 9, 12, 15, 18, 21, 24, 30	.125 (56.7)
FP-012	20	115	2, 3, 4, 5, 6, 7, 8, 10	.25 (114)
FP-022	20	115	4, 6, 8, 10, 12, 14, 16, 20	.25 (114)
FP-032	20	115	6, 9, 12, 15, 18, 21, 24, 30	.25 (114)
FP-013	30	115	2, 3, 4, 5, 6, 7, 8, 10	.38 (172)
FP-023	30	115	4, 6, 8, 10, 12, 14, 16, 20	.38 (172)
FP-033	30	115	6, 9, 12, 15, 18, 21, 24, 30	.38 (172)

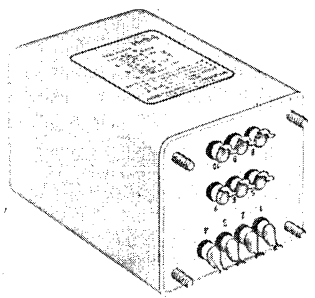
DIMENSIONS

Type No.	Case Width "A" ±.03 in. (±.76mm)	Case Height ±.03 in. (±.76mm)	Terminal Spacing "B" ±.005 in. (±.12mm)	Tab Width "C" ±.02 in. (±.50mm)	Tab Spacing "D" ±.01 in. (±.25mm)	A ±.03 in. (±0.76mm)	B ±.005 in. (±0.12mm)	C ±.02 in. (±0.50mm)	D ±.010 in. (±0.25mm)	E ±.005 in. (±0.12mm)
FP-011	1.24 sq. (31.49)	.62 (15.7)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	1.24 (31.49)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	.300 (7.62)
FP-021	1.24 sq. (31.49)	.62 (15.7)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	1.24 (31.49)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	.300 (7.62)
FP-031	1.24 sq. (31.49)	.62 (15.7)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	1.24 (31.49)	.200 (5.08)	.38 (9.65)	1.128 (28.65)	.300 (7.62)
FP-012	1.75 sq. (44.45)	.62 (15.7)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	1.75 (44.45)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	.350 (8.89)
FP-022	1.75 sq. (44.45)	.62 (15.7)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	1.75 (44.45)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	.350 (8.89)
FP-032	1.75 sq. (44.45)	.62 (15.7)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	1.75 (44.45)	.400 (10.16)	.38 (9.65)	1.625 (41.27)	.350 (8.89)
FP-013	2.25 sq. (57.15)	.62 (15.7)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	2.25 (57.15)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	.400 (10.16)
FP-023	2.25 sq. (57.15)	.62 (15.7)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	2.25 (57.15)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	.400 (10.16)
FP-033	2.25 sq. (57.15)	.62 (15.7)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	2.25 (57.15)	.600 (15.24)	.50 (12.7)	2.132 (54.15)	.400 (10.16)

Supply and Ultrashielded Transformers

ALL HERMETICALLY SEALED, all to complete MIL-T-27D Specs.

Transistor/Filament Supply Transformers

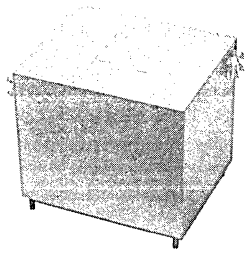


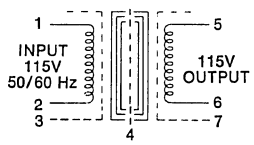
Primary: 105/115/210/220 volts, 50/60 Hz, except H-119, H-130, H-137, H-138, (115 V) and H-131 (115/220 V). All units designed for 50/60 Hz also suited for 400/1000 Hz service.

MIL-T-27D RATINGS IN REGULAR TYPE, **INDUSTRIAL RATINGS IN BOLD TYPE.**

Type No.	MIL Type	Sec. Volts	Amps (MIL)	Amps (Indust.)	Sec. Test Volts RMS	MIL Case
H-124	TF4S03FB	5	3	**3.8**	2000	FB
H-125	M27/151-01	5	10	**12**	10000	KB
H-119	TF4S03AH	6.3 CT	.3	**.38**	1500	AH
H-130	TF4S03AJ	6.3 CT	.6	**.75**	1500	AJ
H-131	M27/153-01	6.3 CT	2	**2.5**	2500	FB
H-132	TF4S03JA	6.3 CT 6.3 CT	6 6	**7** **7**	2500	JA
H-133	TF4S03HB	6.3 CT	7	**8**	2500	HB
H-134	TF4S03HA	6.3 CT	10	**12**	2500	HA
H-135	TF4S03JB	10 CT	10	**13**	2500	JB
H-137	TF4S03EB	6.3 6.3	.6 .6	**.75** **.75**	1500	EB
H-138	TF4S03GA	12.6 12.6	2 2	**2.5** **2.5**	1500	GA

HIT™ Series Ultrashielded Power-Line Isolation Transformers





SIMULATES BATTERY OPERATION FOR CRITICAL CIRCUITS REQUIRING EXTREME ISOLATION FOR POWER LINE.

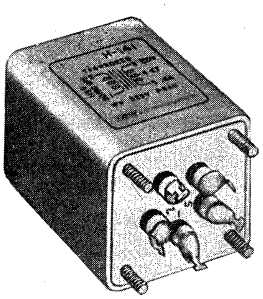
The effective capacity coupling between primary and secondary windings is less than 0.1 pf. Individually terminated shields allow maximum circuit design flexibility to further reduce this minute capacitance. Input and output terminals are on opposite sides of housing for excellent line/load isolation.

MIL-T-27D RATINGS IN REGULAR TYPE, **INDUSTRIAL RATINGS IN BOLD TYPE.**

Primary 115 V 50/60 Hz, Secondary 115 V.

Type No.	Power Watts	Power Watts	Max. Case Size	Mounting Dim. and Studs	Wt. Lbs.	MIL Part No.
HIT-1	50	**60**	4 1/32 x 4 1/32 x 3 1/32 h	3 3/8 x 3 3/8 10-32 x 1/2 long	5 1/2	M27/235-02
HIT-15	120	**150**	5 11/32 x 5 x 3 1/2 h	4 5/8 x 4 5/16 10-32 x 1/2 long	13	M27/235-03
HIT-2	160	**200**	5 17/32 x 5 17/32 x 4 17/32 h	4 13/16 x 4 13/16 10-32 x 1/2 long	15 1/2	M27/235-04
HIT-3	400	**480**	8 x 6 17/32 x 5 17/32 h	7 1/16 x 5 5/8 5/16-18 x 13/16 long	35	M27/235-01
HIT-4	1000	**1200**	9 x 7 1/2 x 7 1/2 h	8 x 6 1/2 5/16-18 x 15/16 long	60	M27/235-05

Transistor Supply Transformers

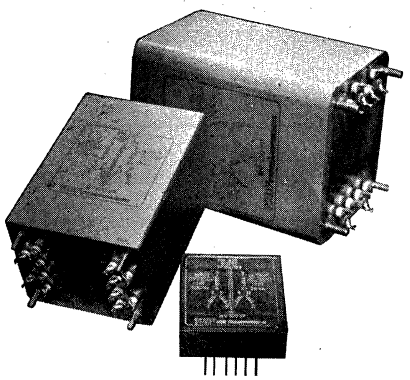


Primary 115 V 50/60 Hz (tapped on H-143 thru H-146 for dual secondary voltages). DC ratings are approximate, based on silicon bridge rectifier (except H-141, H-142 also shown F.W.C.T.). Choke input DCV is based on 10% voltage drop in choke. Condenser value, C, is in 1000 mfd. H-141, H-142, H-147 listing under "Secs in parallel" is single winding.

Type No.	MIL Part No.	Sec. V RMS	Sec. A RMS	Sec. in Parallel					Sec. in Series					MIL Case
				Choke DCV	Input DCA	Cond. DCV	Input DCA	C	Choke DCV	Input DCA	Cond. DCV	Input DCA	C	
H-141	M27/154-01 Full wave CT	20 CT	.3	16.5 8	.3 .43	26 12	.2 .3	.2 .5						EB
H-142	M27/155-01 Full wave CT	20 CT	.6	16.5 9	.6 .85	26 13	.4 .6	.4 1						EA
H-143	TF4S03HA	17/21.5 17/21.5	1.5 1.5	14/17.5	3	18.5/25	2	1	28/35	1.5	43/56	1	.5	HA
H-144	TF4S03LA	17/21.5 17/21.5	4 4	14/17.5	8	18.5/25	5	2	28/35	4	43/56	2.5	1	LA
H-145	TF4S03YY	17/21.5 17/21.5	9 9	14/17.5	18	18.5/25	12	6	28/35	9	43/56	6	4	RC-175*
H-146	TF4S03YY	34/43 34/43	4.5 4.5	28/35	9	43/56	6	4	56/70	4.5	85/110	3	1	RC-175*
H-147	TF4S03KA	10	20	8.2	20	10	13	12						KA

* See Catalog page 32 for dimensions.

PH and PV Universal Three-Phase Transformers



PH Series three-phase transformers are electrostatically shielded isolation transformers constructed to MIL-T-27 specifications.

Two Grade 4 metal-cased PH units are intended for 50/60-Hz, 120/208-volt Wye or 120-volt Delta inputs. One is rated at 65 watts, the other at 360 watts.

A 25-watt, molded Grade 5 PH unit is designed for 400-Hz, 115/200-volt Wye or 115-volt Delta inputs. All PH Series primaries and secondaries can be connected in either Wye or Delta.

PV Series three-phase transformers are identically packaged and suggested for similar inputs, but feature windings arranged and tapped to provide low-voltage, high-current inputs for full-wave bridge circuits.

Two Grade 4 metal-cased PV units for 50/60-Hz inputs provide 3.1 to 48 volts DC in 27 different voltage combinations, at currents ranging from 1.25 to 12.5 amps DC.

A Grade 5 molded PV transformer for 400-Hz use has the same voltage capabilities, but yields bridge circuit currents from 0.5 to 0.87 amp DC.

PV SPECIFICATIONS

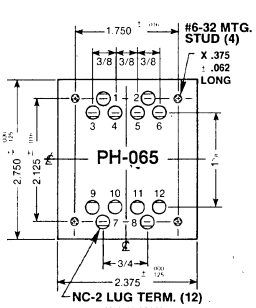
Type No.	Max. DC Rectified Current	
	Delta	Wye
PV-100	2.15 A	1.25 A
PV-105	12.5 A	7.2 A
PV-400	0.87 A	0.5 A

PH SPECIFICATIONS

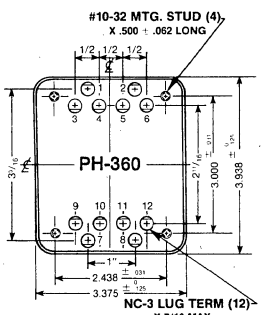
Type No.	Application	AC Input	Nominal AC Output
PH-065	Isolation	120 V, 50/60 Hz Delta	120 V @ 0.31 A/line
		208 V, 50/60 Hz Wye	208 V @ 0.18 A/line
PH-360	Isolation	120 V, 50/60 Hz Delta	120 V @ 1.73 A/line
		208 V, 50/60 Hz Wye	208 V @ 1.00 A/line
PH-425	Isolation	115 V, 400 Hz Delta	115 V @ 0.13 A/line
		200 V, 400 Hz Wye	200 V @ 0.07 A/line

Type No.	Application	AC Input	Nominal DC Output in 3-Phase Full-Wave Bridge Rectifier Circuit*					
			Secondary					
			Full Delta	⅓ Delta	⅔ Delta	Full Wye	⅓ Wye	⅔ Wye
PV-100 and PV-105	Full-Wave Bridge Circuit	208 V, 50/60 Hz Delta	28 V	9.3 V	18.7 V	48 V or ±24 V	16 V or ±8 V	32 V or ±16 V
		120 V, 50/60 Hz L-N Wye 208 V, 50/60 Hz L-L Wye 120 V, 50/60 Hz Delta	16.2 V	5.4 V	10.8 V	28 V or ±14 V	9.3 V or ±4.65 V	18.6 V or ±9.3 V
		120 V, 50/60 Hz L-L Wye	9.36 V	3.1 V	6.2 V	16.2 V or ±8.1 V	5.4 V or ±2.7 V	10.8 V or ±5.4 V
PV-400	Full-Wave Bridge Circuit	200 V, 400 Hz Delta	28 V	9.3 V	18.7 V	48 V or ±24 V	16 V or ±8 V	32 V or ±16 V
		115 V, 400 Hz L-N Wye 200 V, 400 Hz L-L Wye 115 V, 400 Hz Delta	16.2 V	5.4 V	10.8 V	28 V or ±14 V	9.3 V or ±4.65 V	18.6 V or ±9.3 V
		115 V, 400 Hz L-L Wye	9.36 V	3.1 V	6.2 V	16.2 V or ±8.1 V	5.4 V or ±2.7 V	10.8 V or ±5.4 V

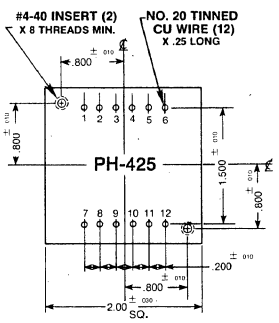
* Diode drops neglected.



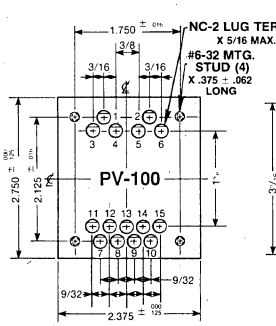
CASE HEIGHT = 3.812 + .000, - .188



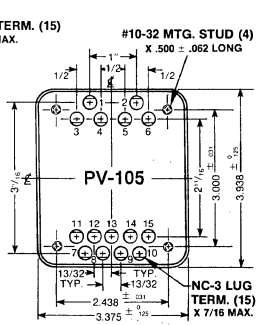
CASE HEIGHT = 5.250 + .000, - .188



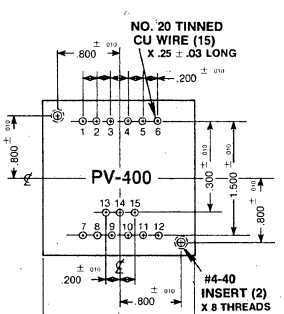
CASE HEIGHT = .75 ± .03



CASE HEIGHT = 3.812 + .000, - .188

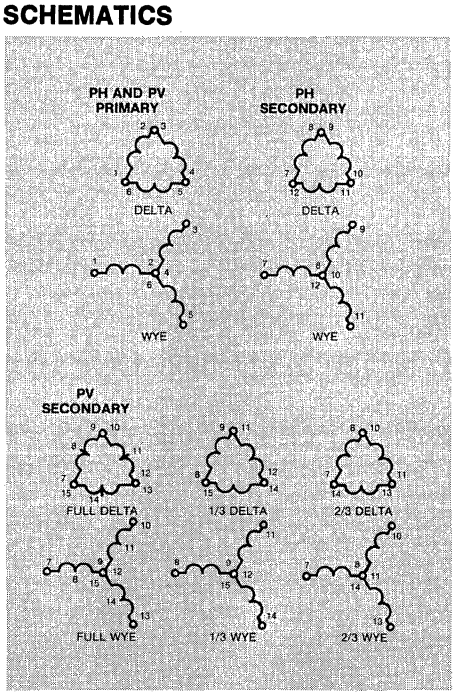


CASE HEIGHT = 5.250 + .000, - .188

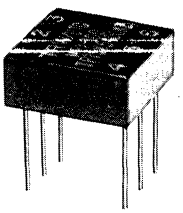


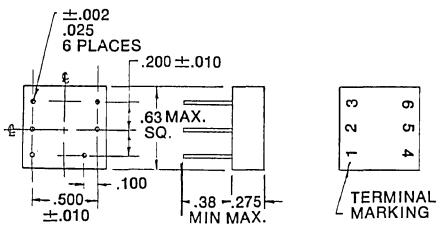
CASE HEIGHT = .75 ± .03

SCHEMATICS



Multiplex Data Bus MIL Std. 1553B Pulse Transformers





Type No.	Application	Ratio*
MPX-100	Isolation Transformer	1 CT: 1 CT
MPX-200	Coupling Transformer	1.41 CT: 1 CT
MPX-300	Coupling Transformer	1.25 CT: 1 CT

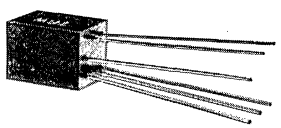
* Other ratios available on special order.

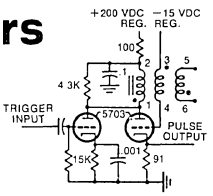
MIL SPECS MPX pulse transformers fully meet MIL STD 1553B Command/Response Multiplex Data Bus requirements. They also meet MIL-T-21038D Pulse Transformer Specs. MIL Type No. TP7SX( ) KZ.

PERFORMANCE MPX pulse transformers feature a high efficiency design for minimum losses. Common mode rejection ratio is greater than 45 db at 1 MHz. Input impedance is greater than 3000 ohms over the band from 75 KHz to 1 MHz at 1V rms. This series possesses exceptional waveform integrity: Rise time and fall time is less than 100 nanoseconds. Overshoot and ringing is less than ±1V peak. Droop is less than 20%.

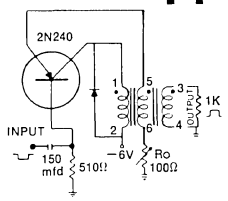
CONSTRUCTION All windings are centertapped for greater circuit application flexibility. The series is packaged in a printed circuit style configuration, with a low profile configuration of 0.275 inches maximum height.
Dielectric withstanding voltage is tested at 100 Vrms.

Plug-in Precision Miniature Wide Application Pulse Transformers





TEST CIRCUIT FOR PCH-45 TO PCH-57



TEST CIRCUIT FOR PCH-60 TO PCH-68

PCH pulse transformers are plug-in versions of our MIL-T-21038 line of pulse transformers H45 to H57 and H60 to H68.

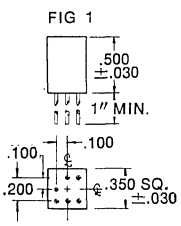
PACKAGING Hermetically sealed. Epoxy cased.

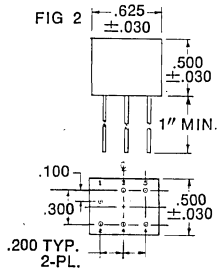
CONSTRUCTION Designed to be used on PC boards with 0.1″ pin spacings. The pins are in a non-symmetrical pattern to provide foolproof insertion.

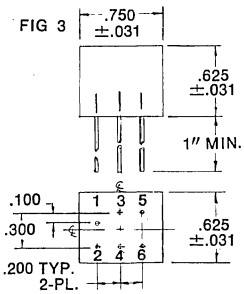
MIL SPECS Meet MIL-T-21038D Specs. All units are Grade 7, Class S, Life X.

APPLICATIONS Transistor blocking oscillators, SCR drivers, coupling and isolation. The PCH-45 through PCH-57 also can be used in transistor circuits.

NOTE The units are individually adjusted in the circuit shown for each group. Parameters are checked to give the required pulse widths.





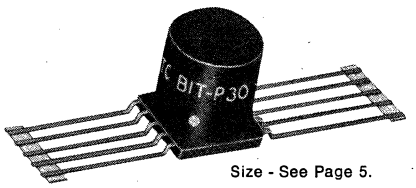


Type No.	Approx. DCR, Ohms 1-2	3-4	5-6	Blocking Oscillator Pulse: P Width μSec.	Rise Time	% Over Shoot	Droop %	% Back Swing	Coupling Circuit Characteristics: P Width μ Sec.	Volt Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in/out,* ohms	Frequency Response within 2 db†	Size
RATIO 1:1:1 MIL TYPE DESIGNATION TP7SX1110KZ																	
PCH-45	3	3.5	4	.05	.022	0	20	10	.05	17	.01	20	0	35	250	260 kHz-34 MHz	Fig. 1
PCH-46	5.5	6.5	7	.10	.024	0	25	10	.10	19	.01	30	10	50	250	220 kHz-34 MHz	Fig. 1
PCH-47	3.7	4.0	4	.20	.026	0	25	8	.20	18	.01	30	15	65	500	260 kHz-93 MHz	Fig. 2
PCH-48	5.5	5.8	6	.50	.03	0	20	5	.50	20	.01	30	20	65	500	85 kHz-73 MHz	Fig. 2
PCH-49	8	8.5	9	1	.04	0	20	10	1	24	.02	15	15	65	500	50 kHz-62.5 MHz	Fig. 2
PCH-50	20	21	22	2	.05	0	20	10	2	27	.05	10	15	35	500	24.5 kHz-49 MHz	Fig. 2
PCH-51	28	31	33	3	.10	1	20	8	3	26	.07	10	10	35	500	12.6 kHz-5.65 MHz	Fig. 2
PCH-52	36	41	44	5	.13	1	25	8	5	23	.15	10	10	45	1000	13 kHz-3.465 MHz	Fig. 2
PCH-53	37	44	49	7	.28	0	25	8	7	24	.20	10	10	50	1000	9.5 kHz-6.3 MHz	Fig. 3
PCH-54	50	58	67	10	.30	0	20	8	10	24	.25	10	10	50	1000	7.1 kHz-1.35 MHz	Fig. 3
PCH-55	78	96	112	16	.75	0	20	10	16	23	.40	5	15	20	1000	1.65 kHz-3.05 MHz	Fig. 3
PCH-56	93	116	138	20	1.25	0	25	10	20	23	.6	5	10	10	1000	2.15 kHz-285 kHz	Fig. 3
PCH-57	104	135	165	25	2.0	0	30	10	25	24	1.5	5	10	10	1000	1.7 kHz-315 kHz	Fig. 3
RATIO: 4:4:1 MIL TYPE DESIGNATION TP7SX4410KZ																	
PCH-60	.124	.14	.05	.05	.016	0	0	30	.05	9.3	.012	0	0	20	50	550 kHz-43 MHz	Fig. 1
PCH-61	.41	.48	.19	.1	.016	0	0	30	.1	8.2	.021	0	0	15	50	95 kHz-17 MHz	Fig. 1
PCH-62	.78	.94	.33	.2	.022	0	0	18	.2	7.4	.034	0	5	12	100	60 kHz-14.5 MHz	Fig. 1
PCH-63	1.86	2.26	.70	.5	.027	2	10	20	.5	7.5	.045	0	20	25	100	22 kHz-3.7 MHz	Fig. 1
PCH-64	3.73	4.4	1.33	1	.033	0	12	25	1	7	.078	0	15	23	100	12 kHz-2.3 MHz	Fig. 1
PCH-65	6.2	7.3	2.22	2	.066	0	15	25	2	6.6	.14	0	10	20	100	8.5 kHz-1.675 MHz	Fig. 1
PCH-66	10.2	12	3.6	3	.087	0	18	30	3	6.8	.17	0	10	20	100	3.9 kHz-950 kHz	Fig. 1
PCH-67	14.5	17.5	5.14	5	.097	0	23	28	5	7.9	.2	0	18	28	200	3.6 kHz-840 kHz	Fig. 1
PCH-68	42.3	52.1	14.8	10	.14	0	15	28	10	6.5	.4	0	15	30	200	1.1 kHz-400 kHz	Fig. 1

* Input winding terminals 1-2; output winding terminals 3-4; terminals 5-6 open.
† Per coupling circuit Z in/out, 1 V input.

TRW INDUCTIVE PRODUCTS DIVISION, 150 Varick Street, New York, NY 10013, Telephone: (212) 255-3500, TWX: 710-581-2722

BIT-P™
High Performance Pulse Transformers



Size - See Page 5.

PACKAGING

Size reduction without loss of performance is achieved by major reduction of air gaps in the magnetic circuit. Core permeability closely approaches the theoretical maximum for material and structure.

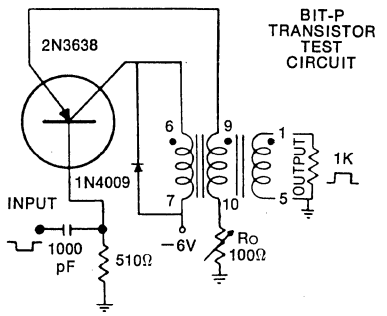
Materials, dimensions, and surface finish are identical with IC Flat Pack standards. Removable support protects terminal alignment prior to final assembly. This insulated support allows testing in conventional jigs.

FLEXIBILITY

Stock units are designed for the standard blocking oscillator circuit shown as well as for coupling application. By interconnecting windings, a variety of primary to secondary ratios may be obtained.

NOTES

- **PULSE WIDTH** .05 μsec-100 μsec
- **DIELECTRIC STRENGTH** tested @ 200 VRMS
- **MIL SPECS** To complete MIL-T-21038D Metal encased, ruggedized Grade 6, Class R, Life X.
- **SHIELDED** All units electromagnetically self-shielded
- **LEAD MATERIAL** Ribbon-style, solderable to MIL-STD 1276C.

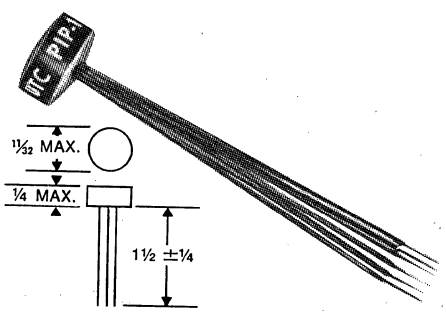


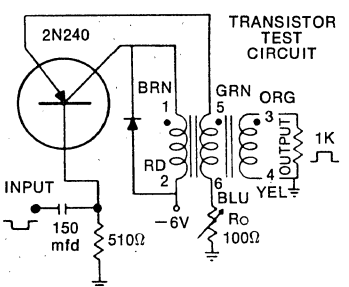
RATIO 4:4:1 MIL TYPE DESIGNATION TP6RX4410CZ

	Approx. DCR, Ohms			Block Oscillator Pulse					Coupling Circuit Characteristics						
Type No.	1 & 5	6 & 7	9 & 10	P Width μSec.	Rise Time	% Over Shoot	Droop %	% Back Swing	P Width μSec.	Volt Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp.* in/out
BIT-P21	.32	.29	.28	.05	.01	0	0	35	.05	0.2	.01	0	0	20	50
BIT-P22	.33	.32	.29	.1	.012	0	0	25	.1	0.5	.015	0	0	20	50
BIT-P23	.38	.37	.3	.2	.02	0	0	15	.2	1.2	.02	0	0	20	100
BIT-P24	.5	.48	.32	.5	.023	0	5	15	.5	1.5	.022	0	5	25	100
BIT-P25	.62	.57	.35	1	.03	0	10	14	1	1.5	.025	0	20	28	100
BIT-P26	.7	.64	.4	2	.035	0	12	15	2	1.5	.028	0	15	23	100
BIT-P27	.85	.76	.48	3	.04	0	13	15	3	1.5	.032	0	18	28	100
BIT-P28	.96	.86	.52	5	.045	0	15	14	5	2	.035	0	20	20	200
BIT-P29	1.4	1.1	.57	10	.065	0	15	10	10	2	.05	0	25	25	200
BIT-P30	2.1	1.7	.8	15	.07	0	15	13	15	2	.06	0	27	18	200
BIT-P31	2.7	2.1	.97	25	.08	0	15	13	25	3	.1	0	30	30	500
BIT-P32	20	15	6	50	.2	0	10	5	50	3	.3	0	22	20	500
BIT-P33	42	32	12	100	.35	0	11	13	100	6	.4	0	15	18	500

* Input winding terminals 1 & 5, output winding terminals 6 & 7, terminals 9 & 10 open.

Precision Miniature Wide Application Pulse Transformers





PACKAGING

Hermetically sealed. DO-T family construction. See Catalog page 6.

MIL SPECS

To complete MIL-T-21038D Specs. Grade 6, Class R, Life X.

APPLICATION

Transistor. D.W.V. Test = 100V.

NOTE

All individually adjusted to parameters shown and checked in test circuit to give required pulse width.

RATIO 4:4:1 MIL TYPE DESIGNATION TP6RX4410CZ

		Approx. DCR, Ohms			Blocking Oscillator Pulse					Coupling Circuit Characteristics							
Type No.	Military Part No.	1-Brn 2-Rd	3-Org 4-Yel	5-Grn 6-Blu	P Width μ Sec.	Rise Time	% Over Shoot	Droop %	% Back Swing	P Width μ Sec.	Volt Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in/out,* Ohms	Frequency Response Within 2 db†
PIP-1	——	.21	.23	.13	.05	.02	0	0	37	.05	9	.018	0	0	12	50	150 kHz-29 MHz
PIP-2	——	.47	.56	.22	.1	.025	0	0	25	.1	8	.02	0	0	5	50	100 kHz-17 MHz
PIP-3	——	1.01	1.25	.37	.2	.030	2	0	15	.2	7	.035	0	0	5	100	16 kHz-9.5 MHz
PIP-4	——	1.5	1.85	.54	.5	.05	0	0	15	.5	7	.06	0	0	0	100	7 kHz-3.25 MHz
PIP-5	——	2.45	3.1	.9	1	.08	0	0	14	1	6.8	.15	0	0	5	100	7.5 kHz-2.25 MHz
PIP-6	——	3.0	3.7	1.1	2	.10	0	0	15	2	6.6	.18	0	2	10	100	2.2 kHz-1.32 MHz
PIP-7	——	4.9	6.05	1.8	3	.20	0	0	14	3	6.8	.20	0	2	10	100	1.7 kHz-1.5 MHz
PIP-8	——	8.0	9.7	2.9	5	.30	0	0	3	5	7.9	.22	0	13	25	200	1.8 kHz-1.45 MHz
PIP-9	M21038/6	13.1	15.9	4.7	10	.35	0	5	12	10	6.5	.4	0	15	20	200	1.5 kHz-1.14 MHz

RATIO 5:3:1 MIL TYPE DESIGNATION TP6RX5310CZ

PIP-10	——	.55	.41	.15	.1	.01	0	0	20	.1	8	.01	0	0	5	140/50	170 kHz-32 MHz
PIP-11	——	2.9	2.2	8.2	1	.02	4	4	6	1	6.6	.05	0	6	12	280/100	12.5 kHz-3.25 MHz
PIP-12	M21038/7	9.4	7.1	2.6	5	.05	0	12	12	5	8	.09	2	12	25	560/200	15 kHz-4 MHz
PIP-SH	——	Drawn Hipermalloy shield and cover for PIP's provides 20 to 30 db shielding .281″ h x .359″ dia., ⅛″ hole in cover.															

* Input winding leads Brn-Rd (1-2); output winding leads Org-Yel (3-4); leads Grn-Blu (5-6) open.
† Per coupling circuit Z in/out, 1 V input.

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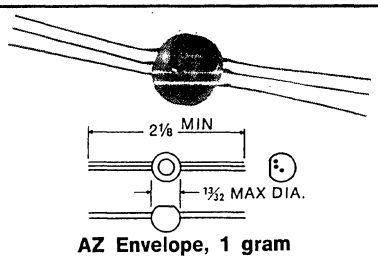
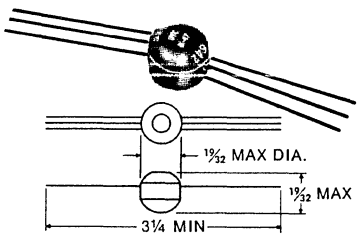
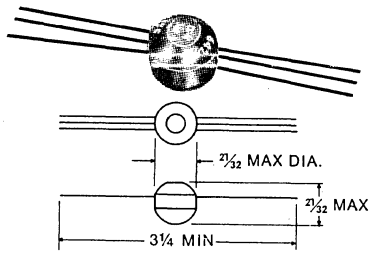
Precision Miniature Wide Application Pulse Transformers



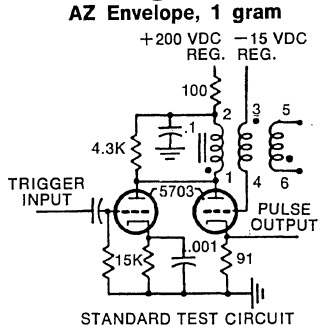
AZ Envelope, 1 gram



AC Envelope, 4 grams



AN Envelope, 6 grams



STANDARD TEST CIRCUIT

PACKAGING Hermetically sealed. Vacuum molded.

SERVICE −70°C to +130°C.

MIL SPECS To complete MIL-T-21038D Specs. Grade 7, Class S, Life X.

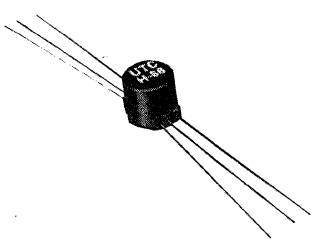
APPLICATION Tube, SCR and transistor Test Voltage 1250 V RMS.

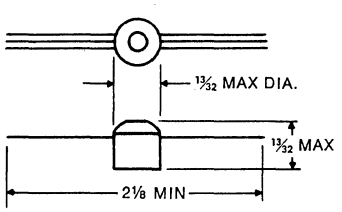
NOTE All individually adjusted to parameters shown and checked in test circuit to given required pulse width.

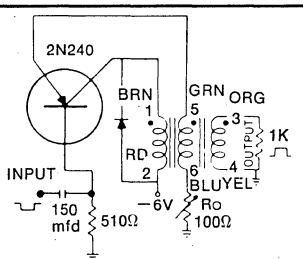
RATIO 1:1:1 MIL TYPE DESIGNATION TP7SX1110(††)

Type No.	Military Part No.	Approx. DCR, Ohms 1-2	3-4	5-6	Blocking Oscillator Pulse P Width μSec.	Rise Time	% Over Shoot	Droop %	% Back Swing	Coupling Circuit Characteristics P Width μSec.	Volt Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in/out,* ohms	Frequency Response within 2 db†	†† Style & Env.
H-45	M21038/8-001	3	3.5	4	.05	.022	0	20	10	.05	17	.01	20	0	35	250	260 kHz-34 MHz	AZ
H-46	M21038/8-002	5.5	6.5	7	.10	.024	0	25	10	.10	19	.01	30	10	50	250	220 kHz-34 MHz	AZ
H-47	M21038/9-001	3.7	4.0	4	.20	.026	0	25	8	.20	18	.01	30	15	65	500	260 kHz-93 MHz	AC
H-48	M21038/9-002	5.5	5.8	6	.50	.03	0	20	5	.50	20	.01	30	20	65	500	85 kHz-73 MHz	AC
H-49	M21038/9-003	8	8.5	9	1	.04	0	20	10	1	24	.02	15	15	65	500	50 kHz-62.5 MHz	AC
H-50	M21038/9-004	20	21	22	2	.05	0	20	10	2	27	.05	10	15	35	500	24.5 kHz-49 MHz	AC
H-51	M21038/9-005	28	31	33	3	.10	1	20	8	3	26	.07	10	10	35	500	12.6 kHz-5.65 MHz	AC
H-52	M21038/9-006	36	41	44	5	.13	1	25	8	5	23	.15	10	10	45	1000	13 kHz-3.465 MHz	AC
H-53	——	37	44	49	7	.28	0	25	8	7	24	.20	10	10	50	1000	9.5 kHz-6.3 MHz	AN
H-54	M21038/10-001	50	58	67	10	.30	0	20	8	10	24	.25	10	10	50	1000	7.1 kHz-1.35 MHz	AN
H-55	M21038/10-002	78	96	112	16	.75	0	20	10	16	23	.40	5	15	20	1000	1.65 kHz-3.05 MHz	AN
H-56	——	93	116	138	20	1.25	0	25	10	20	23	.6	5	10	10	1000	2.15 kHz-285 kHz	AN
H-57	M21038/10-003	104	135	165	25	2.0	0	30	10	25	24	1.5	5	10	10	1000	1.7 kHz-315 kHz	AN

* Input winding terminals 1-2; output winding terminals 3-4; terminals 5-6 open.
† Per coupling circuit Z in/out, 1 V input.







TRANSISTOR TEST CIRCUIT

RATIO 4:4:1 MIL TYPE DESIGNATION TP7SX4410AZ DWV TEST = 100 VRMS

Type No.	Military Part No.	Approx. DCR, Ohms 1-2	3-4	5-6	Blocking Oscillator Pulse P Width μ Sec.	Rise Time	% Over Shoot	Droop %	% Back Swing	Coupling Circuit Characteristics P Width μ Sec.	Volt Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in/out,* ohms	Frequency Response within 2 db†
H-60	——	.124	.14	.05	.05	.016	0	0	30	.05	9.3	.012	0	0	20	50	550 kHz-43 MHz
H-61	——	.41	.48	.19	.1	.016	0	0	30	.1	8.2	.021	0	0	15	50	95 kHz-17 MHz
H-62	——	.78	.94	.33	.2	.022	0	0	18	.2	7.4	.034	0	5	12	100	60 kH-14.5 MHz
H-63	——	1.86	2.26	.70	.5	.027	2	10	20	.5	7.5	.045	0	20	25	100	22 kHz-3.7 MHz
H-64	——	3.73	4.4	1.33	1	.033	0	12	25	1	7	.078	0	15	23	100	12 kHz-2.3 MHz
H-65	——	6.2	7.3	2.22	2	.066	0	15	25	2	6.6	.14	0	10	20	100	8.5 kHz-1.675 MHz
H-66	——	10.2	12	3.6	3	.087	0	18	30	3	6.8	.17	0	10	20	100	3.9 kHz-950 kHz
H-67	——	14.5	17.5	5.14	5	.097	0	23	28	5	7.9	.2	0	18	28	200	3.6 kHz-840 kHz
H-68	M21038/11	42.3	52.1	14.8	10	.14	0	15	28	10	6.5	.4	0	15	30	200	1.1 kHz-400 kHz

* Input winding terminals 1-2; output winding terminals 3-4; terminals 5-6 open.
† Per coupling circuit Z in/out, 1 V input.

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COMMONLY USED ELECTRICAL/ELECTRONIC ABBREVIATIONS AND ACRONYMS

A

AC alternating current
A/D analog to digital
ADC analog to digital converter
ADP automatic data processing
AF audio frequency
AFC automatic frequency control
ALGOL algorithmic language
AM amplitude modulation
AND a logical operator
AQL acceptable quality level
ASCII American national standard code for information interchange
AWG American wire guage

B

BALUN balanced to unbalanced
BASIC beginners' all-purpose symbolic instruction code
BCD binary-coded decimal
BNC baby "N" connector
BUS basic utility system

C

CAD computer aided design
CAM computer aided manufacture
CATV cable television or community antenna television
CERMET ceramic metal element
Comm. communications
CMOS complementary metal-oxide semiconductor
CPS characters per second
CPU central processing unit

D

D/A digital to analog
DAC digital to analog converter
DC direct curent
DIL dual in-line
DIP dual in-line package
DPM digital panel meter
DTL diode transistor logic

E

EDP electronic data processing
EBCDIC extended binary coded decimal interchange code
EEPROM electrically erasable PROM
EMC electromagnetic compatibility
EMI electromagnetic interference
EPROM electrically programmable ROM
ESR equivalent series resistance

F

FEP fluorinated ethylene propylene Copolymar, 200° Teflon
FET field-effect transistor
FM frequency modulation
FORTRAN formula translator

G

GaAsFET gallium arsenide field effect transistor
GPIB general purpose interface bus

H

HF high frequency (3 to 30 MHz)
HIPOT test, measurement and diagnostic equipment
HLL high level language
HV high voltage
Hz Hertz

I

IC integrated circuit
IF intermediate frequency
IO input/output (devices)
IR insulation resistance (or) infrared

J

JFET junction field effect transistor
JMOS junction metal oxide semiconductor

K

kHz kilohertz (10^3 hertz)
KSR keyboard send receive

L

LC inductance capacitance
LCD liquid crystal display
LED light-emitting diode
LF low frequency (30 to 300 kHz)
LSI large scale integration
LVDT linear velocity displacement transformer

M

MATV master antenna television
μF microforad
MHz megahertz
MOS metal oxide semiconductor
MOSFET metal oxide semiconductor field effect transistor
MOV metal oxide varistor
MPU microprocessor unit
MSI medium scale integration

N

NBS National Bureau of Standards
NIM nuclear instrumentation module
NOR not OR

O

OEM original equipment manufacturer
OR a logical operator

P

pF picofarad
PC printed circuit
PCB printed circuit board
PIN positive-intrinsic-negative (transistor)
PLA programmable logic array
PPI plan position indicator
PROM programmable read only memory
PUT programmable unijunction transistor

Q

QAM quadrature amplitude modulation
Q (meter) quality-factor meter

R

RAM random access memory
RC resistance-capacitance
RFI radio frequency interference
RMS root mean square
ROM read only memory
RF radio frequency
RFC radio-frequency choke
RFI radio-frequency interference
RTD resistance-temperature detector
RTL resistor transistor logic
RTV room temperature vulcanizing
RW read/write

S

SAS silicon asymmetrical switch
SBC single board (micro) computer
SBS silicon bilateral switch
SCR silicon-controlled rectifier
SIP single in-line package
SSI small scale integration
SSR solid state relay
STL Schottky transistor logic

T

TC temperature coefficient
TCXO temperature compensated crystal oscillator
TFE tetrafluoride ethylene propylene Copolymer, 250° Teflon
TTL transistor-transistor logic
TTY teletypewriter

U

UHF ultra high frequency (300 MHz to 3 GHz)
UL Underwriters Laboratory
UPS uninterruptible power supply

V

VAC volts (of) alternating current
VAR volt-ampere reactive
VCR video cassette recorder
VDC volts (of) direct current
VHF very high frequency
VHSIC very high speed integrated circuit
VLF very low frequency (3 to 30 kHz)
VLSI very large scale integration
VRM voice recognition module
VTVM vacuum tube volt meter
VU volume unit
VSWR voltage standing wave ratio

W

WPS word processing software

Y

YIG yttrium iron garnet